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# A GENERAL COMPUTER PROGRAM FOR THE DETERMINATION OF RADIANT-INTERCHANGE CONFIGURATION AND FORM FACTORS - CONFAC I

October 1965

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# FOREWORD

This report documents significant modifications to CONFAC I and CONFAC II, which are digital computer programs used to determine geometric configuration and form factors. These factors are essential to thermal and luminous radiant interchange analyses. This effort, sponsored by the NASA Houston Manned Spacecraft Center under Contract NAS9-4133, was directed by R. Brown and R. Durkee of the Thermal Systems Branch and represents the completion of the second stage in the development of a general form factor computer program.

The original Air Force documentation of CONFAC I and CONFAC II has been revised accordingly; this report is issued in two volumes, identified as SID 65-1043-1 and SID 65-1043-2.

NORTH AMERICAN AVIATION, INC. SPACE and INFORMATION SYSTEMS DIVISION

## TECHNICAL REPORT INDEX/ABSTRACT

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**ABSTRACT**

A simple numerical method is derived for the determination of the geometric radiant-interchange factors used in radiant heat transfer and illumination. A FORTRAN IV digital computer program utilizing this method is developed which provides a rapid and accurate means of computation of configuration and form factors. The source of flux may be any general plane polygon, and the receiver may be any general plane or nonplanar polygon.

Form factors are computed rapidly—averaging less than two seconds on the IBM 7094 for simple plane surfaces. Simplicity of data entry, flexibility of application, and economy of operation are principal features of this program. Sample problems illustrating these important aspects are provided.

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# PREFACE

The FORTRAN IV Computer Program described here is a modified version of the first configuration factor program developed by North American Aviation as part of the Air Force Thermal and Atmospheric Control Study (Reference 5). The original CONFAC I computer program has been extensively modified since it was first issued, primarily as a result of the development of CONFAC II, which extended capabilities of the basic program into solid geometry. Because of the larger space requirements of CONFAC II, storage space for surface data is extremely limited. Hence, although CONFAC II computes factors between plane surfaces in the same manner as CONFAC I and is practically as rapid, CONFAC I has been principally used for such purposes. When larger computer memory becomes available, the CONFAC I version will probably no longer be needed.

Because CONFAC I is different in program structure but basically identical to CONFAC II in analytical procedure, material relating to analysis is practically identical in both volumes of this report. Also, the sample problems illustrating the use of CONFAC I are very similar to those of CONFAC II. The presentation of data and output are slightly different because of the limited capabilities of CONFAC I.

## CONFAC I MODIFICATIONS

The principal modifications to CONFAC I consist of the following:

1. The program has been converted from IBM FORTRAN II to IBM FORTRAN IV.

2. An automatic factor request generator has been incorporated. A single pseudo-factor request named GROUPRUN may now be used to compute a combinational sequence of factors between surfaces entered in data.

3. Modifications in data entry have also been made to permit compression of numerical data by use of FORTRAN IV NAMELIST, and to allow printout of card images of data prior to data processing, making possible rapid scanning for errors and data modifications.

4. The pseudo-transformation command "9R" has been incorporated to effect a 180° reversal of a surface orientation vector. The need for a transformation data entry or another surface data entry is eliminated.

5. Data entry of transformation data has been modified to permit use of the CONFAC II data entry format. Compatibility with the original CONFAC I transformation data format has been maintained.

6. Formating and execution of the factor request has been changed to permit automatic repetition of output mode and/or mapping increment specifications.

# CONTENTS


| Section | | Page |
|---|---|---|
| | INTRODUCTION | 1 |
| I | ANALYTICAL PROCEDURES | 3 |
| | Configuration and Form Factor | 3 |
| | Coordinate Transformation | 12 |
| II | COMPUTER PROGRAM CONTENTS | 15 |
| | Program Description | 15 |
| | General Rules and Restrictions | 21 |
| III | INPUT DATA | 23 |
| | Data Specifications and Specific Restrictions | 23 |
| | Data Dimension Restrictions | 25 |
| | Program Control | 25 |
| | Format | 25 |
| IV | PROGRAM OUTPUT | 35 |
| V | REFERENCES | 37 |
| | APPENDIX A. SAMPLE PROBLEMS | 39 |
| | Sample Problem Group A | 39 |
| | Sample Problem Group B | 85 |
| | APPENDIX B. PROGRAM DECK SETUP, LISTINGS, AND MAPS | 119 |

# ILLUSTRATIONS


| Figure | | Page |
|---|---|---|
| 1 | Nusselt Geometrical Relationships | 4 |
| 2 | Geometry of Configuration Factor Computation | 10 |
| 3 | Surface Coordinate Transformation | 14 |
| 4 | DOICU Surface Analysis | 17 |
| 5 | Surface 1 Mapping Procedure | 19 |
| 6 | Program Control Card Format | 26 |
| 7 | Class 1 and 2 Surface Input Data Format | 28 |
| 8 | Class 9 Transformation Data Input Data Format | 29 |
| 9 | Class 1, 2, and 9 Data Entry Format, Namelist Mode | 32 |
| 10 | Factor Request Input Data Format | 33 |
| 11 | Sample Problems Geometry Group A | 40 |
| 12 | Group A Sample Problems Input Data Code Sheets | 43 |
| 13 | Group A Sample Problems Program Results | 50 |
| 14 | Sample Problems Geometry Group B | 86 |
| 15 | Group B Sample Problems Input Data Code Sheets | 88 |
| 16 | Group B Sample Problems Program Results | 92 |
| 17 | Program Deck Setup | 120 |
| 18 | MAIN Program Listing | 121 |
| 19 | MAIN Program Core Storage Map | 132 |
| 20 | Subroutine UNIVEC Listing | 136 |
| 21 | Subroutine UNIVEC Core Storage Map | 137 |
| 22 | Subroutine SELEK Listing | 139 |
| 23 | Subroutine SELEK Core Storage Map | 140 |
| 24 | Subroutine TXFRM Listing | 142 |
| 25 | Subroutine TXFRM Core Storage Map | 147 |
| 26 | Subroutine DOICU Listing | 149 |
| 27 | Subroutine DOICU Core Storage Map | 154 |
| 28 | Subroutine MAP Listing | 156 |
| 29 | Subroutine MAP Core Storage Map | 160 |
| 30 | Subroutine FACTOR Listing | 162 |
| 31 | Subroutine FACTOR Core Storage Map | 166 |
| 32 | Variable Formats | 168 |

# TABLES


| Table | | Page |
|---|---|---|
| 1 | Comparison of Configuration and Form Factors Computed by CONFAC I to Those Given in Reference I . . . . . | 2 |

## NOMENCLATURE

| | |
|---|---|
| A | **Area** |
| e | **Exchange coefficient** |
| c | **Configuration factor (italicized)** |
| f | **Form factor (italicized)** |
| h, k, l | **Translation components** |
| i, j, k | **Unit vectors along the X-, Y-, Z-axis, respectively** |
| 0 | **Center of unit sphere, origin of coordinate system** |
| R | **Radius of sphere** |
| S | **Distance between two areas** |
| X, Y, Z or x, y, z | Spatial coordinates of a point relative to X, Y, Z axis |
| $\alpha, \beta, \gamma$ | Direction angles of a line relative to X, Y, Z axis respectively |
| $\gamma$ | Angle between Z axis and vector normal to plane |
| $\theta$ | Angle between two vectors |
| $\pi$ | Numerical constant = 3.14159 + |
| $\omega$ | Solid angle |
| Subscripts | |
| A, B, C | Points on an area |
| s | Sector |
| $\Delta A$ | Finite incremental area |

| | |
|---|---|
| dA | Differential area |
| dA-A | From a differential area to an area |
| 1,2, | Areas 1,2, |
| 12 | Area 1 to area 2 |
| $\epsilon$ | Elliptical |

## INTRODUCTION

The geometric form factor, $f_{12}$, is defined as the fraction of radiant energy emanating from finite surface $A_1$ and intercepted by another surface $A_2$.

$$f_{12} = \frac{\text{Flux received by finite surface } A_2}{\text{Flux emitted by finite surface } A_1} \tag{1}$$

The geometric configuration factor, $c_{12}$, is defined in a similar manner, except that the emitting surface is infinitesimal (sometimes designated as the plane point configuration factor),

$$c_{12} = \frac{\text{Flux received by finite surface, } A_2}{\text{Flux emitted by infinitesimal surface } dA_1} \tag{2}$$

The subscripts denote the direction of flow of net flux; $c_{12}$ and $f_{12}$ pertain respectively to the configuration and form factor from surface $A_1$ to surface $A_2$. It is assumed that each surface is isothermal and radiates diffusely, i.e., follows Lambert's cosine distribution law.

The "closed-form" determination of the configuration or form factor by classical integration techniques is impossible or impractical in most situations. Experimental techniques and devices have been reported in the literature (Reference 1), and probably the most useful is Pleijel's globoscope (Reference 4). Experimental techniques produce only the configuration factor, however. Nonetheless, they are useful for many applications where only one or a few configuration factors are required and nominal accuracy is sufficient.

However, if a large number of form factors are required in a short period of time, experimental techniques are not practical. This report presents a numerical method and a computer program which permits rapid and accurate computation of configuration and form factors between plane surfaces, and plane or nonplanar surfaces. The source (surface 1) may be any general plane polygon; the receiver (surface 2) may be any arbitrarily oriented general plane or nonplanar polygon. Form factors (which nominally are derived from 625 configuration factors) are computed rapidly, averaging less than 2 seconds by IBM 7094 time for simple plane surfaces. Table 1 compares solutions obtained by CONFAC I to those given in Reference 1.

Table 1. Comparison of Configuration and Form Factors Computed by CONFAC I to Those Given in Reference 1

| Configuration | Reference 1 | Computer (Trapezodial Rule) | |
|---|---|---|---|
| | | 24 x 24 grid | 60 x 60 grid |
| P-1, X = 1, Y = 1 | 0.13853 | 0.138532 | 0.138532 |
| X = 0.1, Y = 0.1 | 0.00314 | 0.003141 | 0.003141 |
| X = 1, Y = 4 | 0.17525 | 0.175270 | 0.175270 |
| X = 0.1, Y = 0.4 | 0.01147 | 0.011471 | 0.011471 |
| X = 1, Y = ∞* | 0.17678 | 0.176777 | 0.176777 |
| X = 0.1, Y = ∞* | 0.02488 | 0.024876 | 0.024876 |
| P-2, Ø = 30°, L = 0, N = 1 | 0.4665 | 0.466506 | 0.466506 |
| Ø = 30°, L = 1, N = 1 | 0.1759 | 0.175923 | 0.175923 |
| Ø = 30°, L = 0, N = 4 | 0.4665 | 0.466506 | 0.466506 |
| Ø = 30°, L = 4, N = 4 | 0.0964 | 0.096447 | 0.096447 |
| Ø = 120°, L = 0, N = 1 | 0.125 | 0.125000 | 0.125000 |
| Ø = 120°, L = 1, N = 1 | 0.0236 | 0.023554 | 0.023554 |
| Ø = 120°, L = 0, N = 4 | 0.125 | 0.125000 | 0.125000 |
| Ø = 120°, L = 4, N = 4 | 0.0077 | 0.007683 | 0.007683 |
| A-1, X = 1, Y = 1 | 0.19982 | 0.19972 | 0.19981 |
| X = 0.1, Y = 0.1 | 0.00316 | 0.00316 | 0.00316 |
| X = 1, Y = 4 | 0.34596 | 0.34559 | 0.34590 |
| X = 0.1, Y = 0.4 | 0.01207 | 0.01207 | 0.01207 |
| X = 1, Y = ∞* | 0.41421 | 0.40549 | 0.41075 |
| X = 0.1, Y = ∞* | 0.04988 | 0.04884 | 0.04946 |
| A-2, Ø = 30°, L = 1, N = 1 | 0.6202+ | 0.61769 | 0.61878 |
| Ø = 30°, L = 4, N = 4 | 0.3961+ | 0.39431 | 0.39450 |
| Ø = 120°, L = 1, N = 1 | 0.0870+ | 0.08665 | 0.08662 |
| Ø = 120°, L = 4, N = 4 | 0.0433+ | 0.04272 | 0.04235 |

*$10^8$ was assumed to approximate ∞ for computer run

+These values were obtained by numerical integration across surface $A_1$, according to Reference 1

# SECTION I. ANALYTICAL PROCEDURES

## CONFIGURATION AND FORM FACTOR

The general equation that must be solved in the determination of the radiant-interchange form factor is (see Figure 1)

$$f_{12} = \frac{1}{A_1} \iint_{A_1} \iint_{A_2} \frac{\cos \theta_1 \cos \theta_2 \, dA_2 dA_1}{\pi S^2} \tag{1}$$

The following part of the integrand is the factor from the elemental surface $dA_1$ to the total surface $A_2$, referred to as the configuration factor or plane point factor, $c_{12}$:

$$c_{12} = \iint_{A_2} \frac{\cos \theta_1 \cos \theta_2}{\pi S^2} \, dA_2 \tag{2}$$

Therefore,

$$f_{12} = \frac{1}{A_1} \iint_{A_1} c_{12} \, dA_1 \tag{3}$$

A very simple geometric interpretation of Equation 2 is given by Nusselt. The principal value of the Nusselt concept is that the computational procedure is simplified and made more accurate by the fact that no mathematical or numerical integration is required to compute the configuration factor. However, the Nusselt method yields only the configuration factor from the elemental area $dA_1$; one must still integrate all such factors over surface $A_1$ to yield the form factor $f_{12}$ as given in Equation 3.

The Nusselt concept utilizes a hemisphere of radius R constructed over the incremental plane area $dA_1$, as shown in Figure 1. Every point defining the boundary of surface $A_2$ is projected radially to the hemisphere surface and then vertically downward to the plane of $dA_1$, the equatorial plane of the hemisphere. The locus of all points thus projected encloses an area, $A''_2$, on the hemisphere base. This area $A''_2$, divided by the area of the base, is the configuration factor from $dA_1$ to $A_2$.

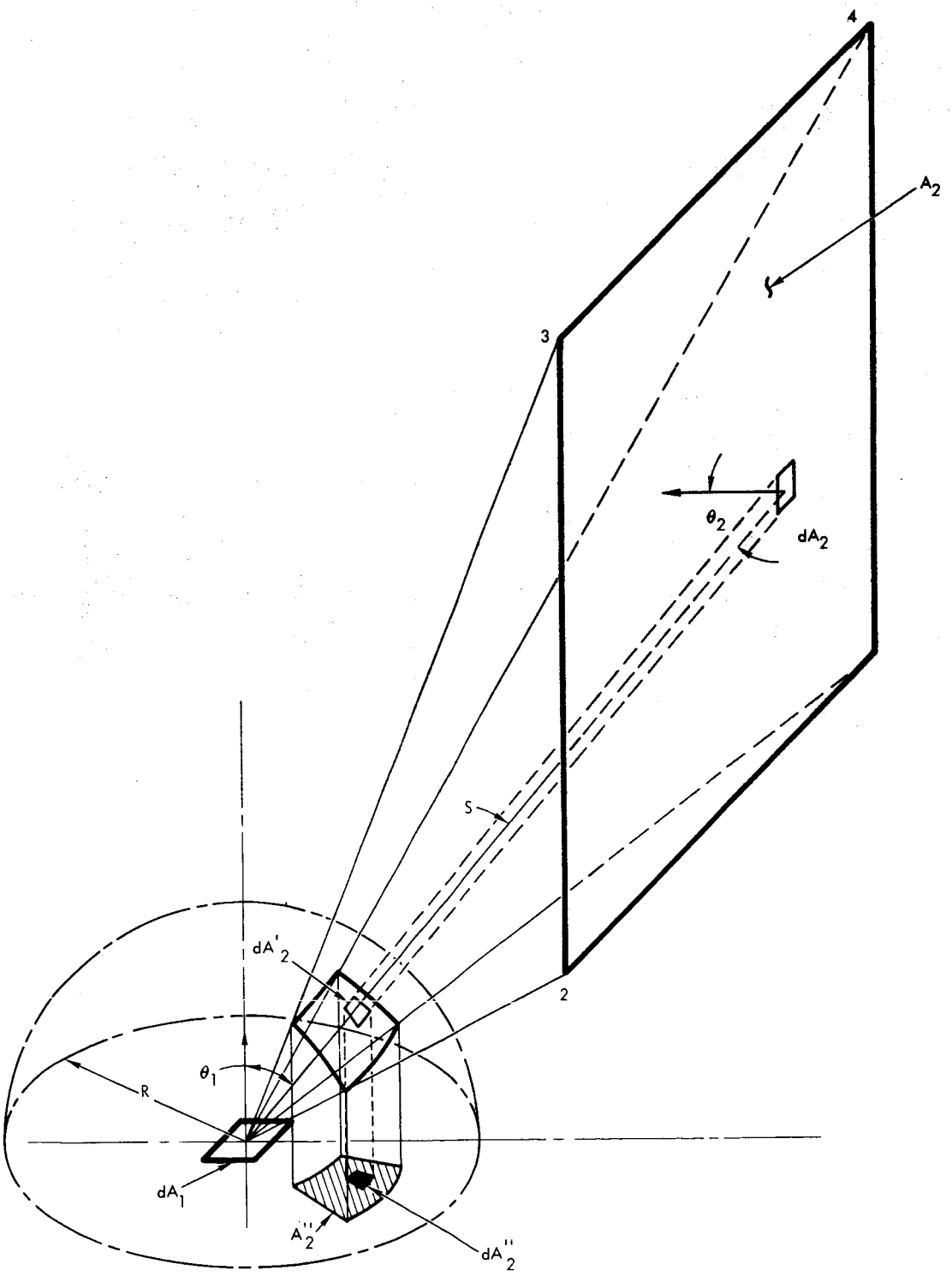



Figure 1. Nusselt Geometrical Relationships

The validity of this conclusion can be demonstrated as follows. Note that the elemental area $dA_2$ is described in surface $A_2$ by the elemental solid angle $d\omega_1$, or

$$d\omega_1 = \frac{\cos \theta_2 \, dA_2}{S^2} \tag{4}$$

Similarly, on the sphere having radius R,

$$d\omega_1 = \frac{dA_2'}{R^2} \tag{5}$$

Because $dA_2''$ is the projection of $dA_2$ on the hemisphere base,

$$dA_2' = \frac{dA_2''}{\cos \theta_1} \tag{6}$$

Inserting Equation 6 in Equation 5,

$$d\omega_1 = \frac{dA_2''}{R^2 \cos \theta_1} \tag{7}$$

The right side of Equation 4 appears explicitly in Equation 1 and, because Equation 7 is identical to Equation 4, Equation 2 becomes

$$c_{12} = \iint_{A_2} \frac{\cos \theta_1}{\pi} \left( \frac{dA_2''}{R^2 \cos \theta_1} \right) = \iint_{A_2} \frac{dA_2''}{\pi R^2} = \frac{A_2''}{\pi R^2}$$

For a sphere of unit radius (unit sphere),

$$c_{12} = \frac{A_2''}{\pi} \tag{8}$$

which completes the proof of Nusselt's method. By inserting Equation 8 in Equation 3, the original equation becomes greatly simplified; only one area integration is now required.

$$f_{12} = \frac{1}{A_1} \iint_{A_1} \frac{A_2''}{\pi} \, dA_1 \tag{9}$$

The computer program described herein solves Equation 9 numerically by successive algebraic evaluation of $A_2''$ at preselected points on surface $A_1$, with subsequent numerical integration to yield $f_{12}$, or

$$f_{12} = \frac{1}{A_1} \sum\sum_{A_1} \frac{A_2''}{\pi} \Delta A_1 \tag{10}$$

It should be emphasized that area $A_2''$ is, in fact, formed by the doubly projected silhouette of surface $A_2$ as it appears from $dA_1$.

The element $dA_1$ is assumed to be oriented in the xy plane and at the origin of the coordinate system of surface $A_2$. The area $A_2''$ can be found from the line integral where $y_1 = F(x_1)$ is the locus of the boundary of $A_2''$,

$$A_2'' = \frac{1}{2} \int_C (x_1 \, dy_1 - y_1 \, dx_1) \tag{11}$$

Let $z = F(x, y)$ be the locus of the silhouette of $A_2$, and S the distance from $dA_1$ to the point $(x, y, z)$ on the silhouette of $A_2$.

$$S = \sqrt{x^2 + y^2 + z^2}$$

From similar triangles,

$$x_1 = \frac{x}{S}, \quad dx_1 = \frac{1}{S} dx + x \, d\left(\frac{1}{S}\right)$$

$$y_1 = \frac{y}{S}, \quad dy_1 = \frac{1}{S} dy + y \, d\left(\frac{1}{S}\right)$$

Inserting in Equation 11

$$A_2'' = \frac{1}{2} \int_C \frac{x\,dy - y\,dx}{S^2} \tag{12}$$

Equation 12 can be transposed to finite difference form by replacing the differentials with increments for numerical evaluation. Because of the problems of increment size control, it appears desirable to solve Equation 12 for a finite line segment in space and to allow the analyst to control accuracy of configuration factor computation by suitable selection of line segments describing surface 2. If the surface is actually a polygon or polyhedra, the

simulation is perfect; if the surface boundary is curved, like a disk, for example, the validity of the result is a function of the number of line segments used.

However, a much simpler and more easily understood geometric derivation, using the unit sphere, yields the result in superior computational form. Referring to Figure 2, note that the radial projection of line segment AB on the hemisphere surface forms the circular arc A'B'. Projection of A'B' to the base plane produces the elliptical arc A"B", forming the elliptical section A"OB" with the origin.

If all line segments describing surface 2 are similarly projected, the area $A_2''$ will be formed by a closed series of elliptical arcs. Surface $A_2$ does not have to be a plane. Actually, the area $A_2''$ results from the geometry of a silhouette; any surface or object projecting an identical silhouette in the same spatial position on the hemisphere surface will produce the same area $A_2''$ and the same point factor.

Inspection reveals that the magnitude of area $A_2''$ can be determined by computing the area of each elliptical sector, properly signed, followed by an algebraic summation.

In Figure 2, the area of elliptical sector $A_\epsilon$ is the projected area of circular sector $A_S$. If the angle between the plane of the circular sector A'OB' and the xy plane is $\gamma$, then

$$\cos \gamma = \frac{A_\epsilon}{A_S} \tag{13}$$

The area $A_S$ is computed from the usual polar equation, with $\theta$ in radians,

$$A_S = \frac{1}{2} R^2 \theta$$

For the unit radius sphere,

$$A_S = \frac{\theta}{2} \tag{14}$$

Substituting Equation 14 in Equation 13, and solving for $A_\epsilon$,

$$A_\epsilon = \frac{\theta}{2} \cos \gamma \tag{15}$$

For a polygon of N sides, the net area $A_2''$ is found by algebraic summation of all computed $A_\epsilon$.

$$A_2'' = \frac{1}{2}\left|\sum_{n=1}^{N} \theta_n \cos \gamma_n\right| \tag{16}$$

Substituting in Equation 8, we have

$$c_{12} = \frac{1}{2\pi}\left|\sum_{n=1}^{N} \theta_n \cos \gamma_n\right| \tag{17}$$

A general analytical derivation of this equation is given in Reference 3, and is reported to have been originally developed by Omoto in 1924.

The absolute value notation will be explained later. The use of vector algebra greatly facilitates the computation of $\theta$ and cos $\gamma$. Taking, for example, directed line segments of $\vec{OA}$ and $\vec{OB}$, the vector dot product is

$$\vec{OA}\cdot\vec{OB} = x_A x_B + y_A y_B + z_A z_B \tag{18}$$

The cross product $\vec{OA} \times \vec{OB}$ in determinant form is

$$\vec{OA} \times \vec{OB} = \begin{vmatrix} i & j & k \\ x_A & y_A & z_A \\ x_B & y_B & z_B \end{vmatrix}$$

which, upon expansion, becomes the normal vector $\vec{V}_N$,

$$\vec{V}_N = \vec{OA} \times \vec{OB} = (y_A z_B - z_A y_B)i + (x_B z_A - z_B x_A)j + (z_A y_B - x_B y_A)k \tag{19}$$

where i, j, and k are mutually orthogonal unit base vectors directed along the principal axes.

$\vec{V}_N$ is equal in magnitude to twice the area of the triangle AOB and is oriented normal to the plane of AOB so that the three vectors form a right-handed system. The magnitude is computed by the Pythagorean theorem,

$$\left|\vec{V}_N\right| = \sqrt{(y_A z_B - z_A y_B)^2 + (x_B z_A - x_A z_B)^2 + (x_A y_B - x_B y_A)^2} \tag{20}$$

The angle $\theta$ may be evaluated from either the dot or the cross product by use of inverse functions, specifically

$$\theta = \cos^{-1}\left[\frac{\vec{OA}\cdot\vec{OB}}{OA\,|\,|\vec{OB}}\right] \text{ or } \sin^{-1}\left[\frac{|\vec{V_N}|}{\vec{OA}\,|\,|\vec{OB}}\right]$$

However, an overall economy of computation results from the use of the arctan function,

$$\theta = \tan^{-1}\left[\frac{|\vec{V_N}|}{\vec{OA}\cdot\vec{OB}}\right] \tag{21}$$

As noted earlier, the angle $\gamma$ is defined as the angle between the plane of AOB and the xy plane. It is also the angle between the vector $\vec{V}_N$ and the z axis; cos $\gamma$ is therefore the direction cosine of $\vec{V}_N$ with respect to the z axis. Using the z component in Equation 19,

$$\cos\gamma = \frac{x_A y_B - x_B y_A}{|\vec{V_N}|} \tag{22}$$

If the numerator and denominator are both divided by 2,

$$\cos\gamma = \frac{\frac{x_A y_B - x_B y_A}{2}}{\left|\frac{\vec{V_N}}{2}\right|}$$

This shows that cos $\gamma$ is also equal to the ratio of the signed projected area of triangle AOB on the xy plane and the plane area of triangle AOB.

In the right-handed system shown, cos $\gamma$ is positive when the order of computation of the vectors in the cross product causes the normal vector $\vec{V}_N$ to point in the direction of the + z axis ($0 < \gamma < 90$). The order in which one proceeds from point to point on the boundary of surface 2 will sign each elliptical sector accordingly; however, because the sectors are summed algebraically, the same absolute magnitude will result regardless of order. Because the point factor is always a positive number, the order is computationally unimportant. Nevertheless, the program requires that data be entered in counterclockwise order for other reasons. This will be discussed in more detail later.

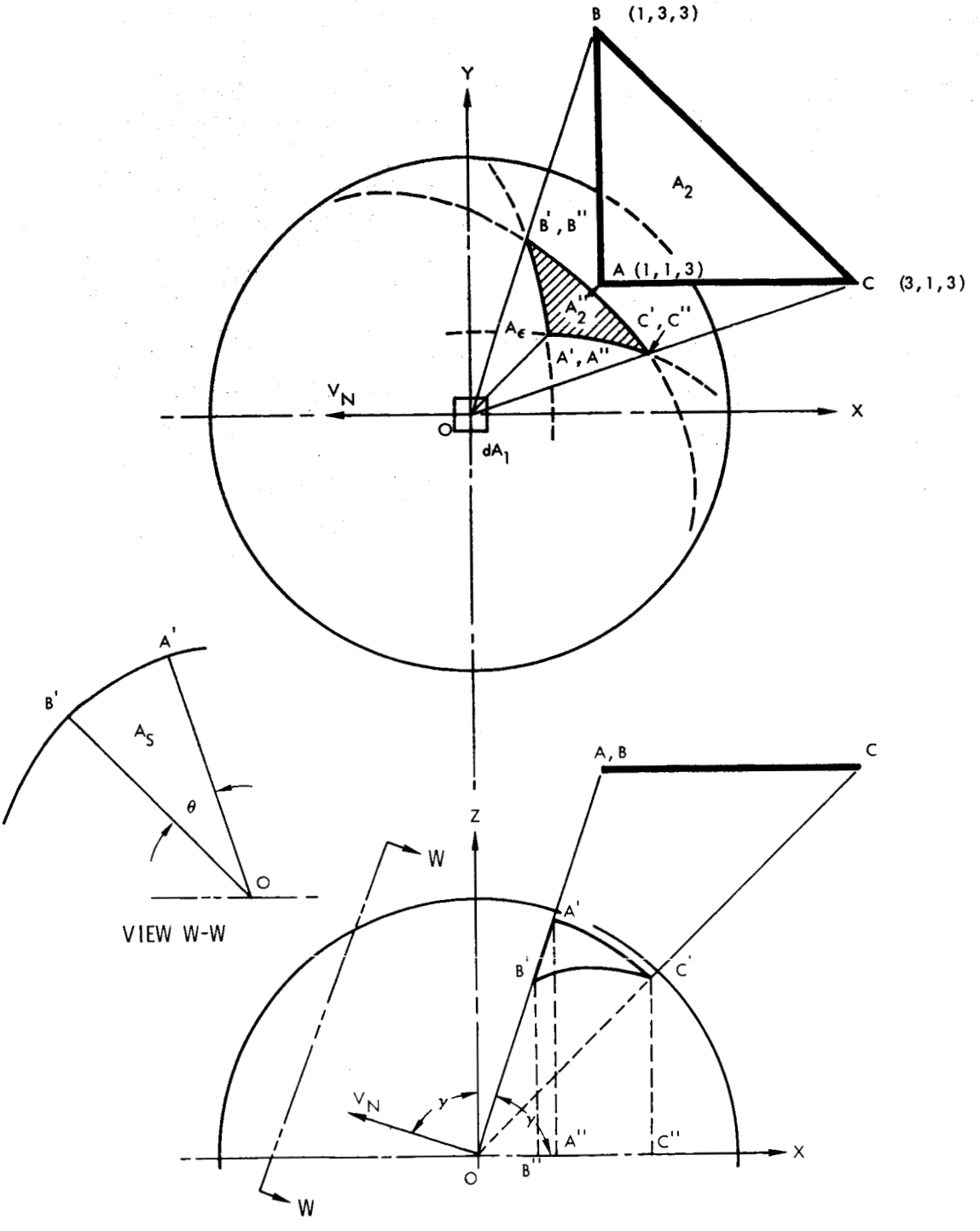



Figure 2. Geometry of Configuration Factor Computation

The relative ease with which the point factor can be computed is best illustrated by an example. Using the triangle shown in Figure 2, and starting with line segment AB, from Equation 18.

$$\vec{OA} \cdot \vec{OB} = 1 + 3 + 9 = 13$$

From Equation 20

$$\left|\vec{V}_{AB}\right| = \left|\vec{OA} \times \vec{OB}\right| = \sqrt{(-6)^2 + 0 + (2)^2} = \sqrt{40}$$

From Equation 21

$$\theta_{AB} = \tan^{-1}\left[\frac{\sqrt{40}}{13}\right] \cong 0.453$$

From Equation 22

$$\cos \gamma_{AB} = \frac{2}{\sqrt{40}} = 0.316$$

Moving to BC,

$$\vec{OB} \cdot \vec{OC} = 3 + 3 + 9 = 15$$

$$\left|\vec{V}_{BC}\right| = \sqrt{6^2 + 6^2 + (-8)^2} = \sqrt{136}$$

$$\theta_{BC} = \tan^{-1}\left[\frac{\sqrt{136}}{15}\right] \cong 0.661$$

$$\cos \gamma_{BC} = \frac{-8}{\sqrt{136}} = -0.686$$

Finally, line segment $\vec{CA}$,

$$\vec{OC} \cdot \vec{OA} = 3 + 1 + 9 = 13$$

$$\vec{V}_{VA} = \sqrt{0 + 6^2 + (-2)^2} = \sqrt{40}$$

$$\theta_{CA} = \tan^{-1}\left(\sqrt{\frac{40}{13}}\right) \cong 0.453$$

$$\cos \gamma_{CA} = \frac{2}{\sqrt{40}} = 0.316$$

The configuration factor is, therefore, from Equation 17,

$$c_{12} = \frac{1}{2\pi}\left| 2(0.453)\,(0.316) + (0.661)\,(-0.686) \right|$$

$$= \frac{1}{2\pi}\left| -0.167 \right|$$

$$c_{12} = 0.0266$$

**Note the repetitive nature of the computation. Thus, all surfaces represented by straight line segments in space can be analyzed in the simple, direct manner shown.**

## COORDINATE TRANSFORMATION

The task of computing factors, even when simple "closed-form" solutions are available, is often laborious because the surfaces under consideration appear in difficult, skewed relative positions. A significant part of this effort has been eliminated by the program through the possibility of general coordinate transformation (translation and/or rotation). Surface data may be entered for each surface using an individually convenient local origin. The surfaces may then be linked together by transforming one or both surfaces to a convenient third origin that is common to both surfaces.

Actually, two different types of coordinate transformation are used by the program. The transformation discussed in the prior paragraph is termed a "primary" transformation, and is under control of the user through transformation data entry. The second type of transformation is termed an "auxiliary" transformation, and is under internal program control only. An auxiliary transformation transforms the surface coordinates of both surfaces into a new coordinate system formed so that the xy plane of the coordinate system lies in the reference plane of one of the surfaces. The reference plane of a surface is the plane formed by the first, second and last point describing that surface. The origin of an auxiliary coordinate system is located at point 1 in the particular surface controlling the transformation.

The x-axis is directed along the line segment formed by points 1 and 2. The surface unit orientation vector becomes the z-axis; the y-axis is computed orthogonal to the x- and z-axes, thus locating the xy plane in the control surface reference plane.

The auxiliary transformation actually serves two purposes. First, it is utilized by Subroutine DOICU to facilitate reconstruction of the "seen" part of surfaces that are not entirely seen by the other surface. Second, the program requires that prior to computation of the configuration factors, surface 1 must appear in the xy plane of the final coordinate system along with surface 2 in its proper relative position. This is necessary to enable Subroutine MAP to select points on surface 1 from which factors to surface 2 may be directly computed, or from which silhouettes of surface 2 may be generated and factors computed.

For example, suppose Figure 3 represents the surfaces of various items of equipment appearing in a compartment. The unprimed coordinate system shown may be conveniently chosen at a corner or axis of symmetry, possibly as shown on a mechanical drawing. This system may not be convenient for data entry of the disk, however. The primed coordinate system with the origin at the center of the disk is the more logical choice in this case. The disk data can then be transformed from the primed to the unprimed system by a primary transformation. The plate coordinates can be easily entered from the unprimed system. Now, suppose we desire the form factor from the disk to the plate. If the data are entered as discussed above (including the transformation data), the program will primary transform disk coordinates to the unprimed system. Since the disk is bisected by the plate, an auxiliary transformation of all coordinates, both disk and plate, will be made from the unprimed to the quad-primed system. That portion of the disk appearing above the active side of the plate will be determined, and an auxiliary transformation of the plate and truncated disk will be made to the double primed coordinate system, i.e., the reference plane of the disk. The disk is now in a position for mapping, and the plate coordinates are proper for obtaining the configuration factors. A similar manipulation of surface data would be made to obtain the form factors to the sides of the cube.

The transformation technique utilized for a primary transformation differs from the customary method whereby old coordinates plus translation data and direction cosines or Euler angles are supplied, from which a new set of coordinates are derived. The program requires the coordinates of any three points (not in a line) measured from the new origin. These data are then used to derive direction cosines and translation terms, by which the old coordinates are then transformed to the new origin.

The reader may find it easier to visualize transformation in terms of the movement of the surfaces instead of the origins. In the case of the disk, again referring to Figure 3, we may say we generated the disk with its center at the origin of the unprimed system and in its xy plane, and then moved the surface to the position indicated by the primed system. This viewpoint appears more realistic when motion is simulated by transforming a surface along a particular path.

The mathematical treatment of primary and auxiliary transformation is presented in Appendix C of Volume II.

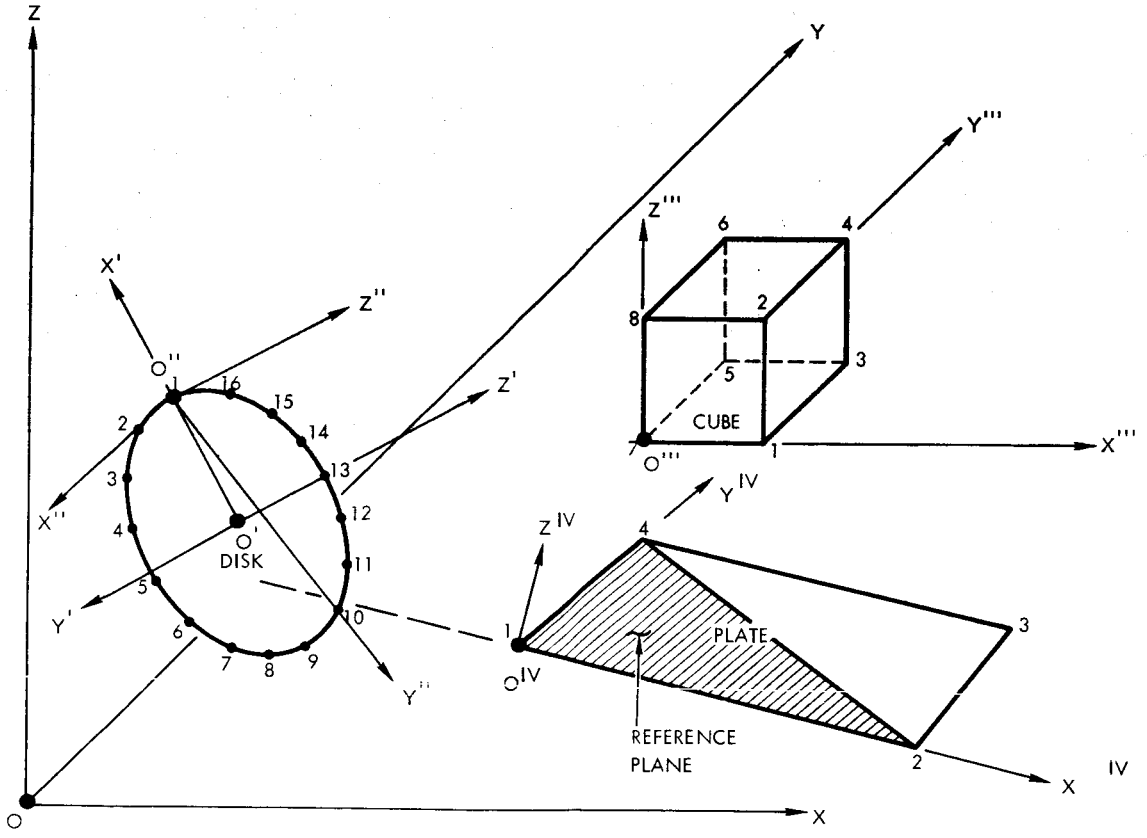



Figure 3. Surface Coordinate Transformation

# SECTION II. COMPUTER PROGRAM CONTENTS

## PROGRAM DESCRIPTION

The program is written in IBM 7094 FORTRAN IV source language. The source deck consists of the main program and subroutines UNIVEC, SELEK, DATA, TXFRM, DOICU, MAP, and FACTOR. Algebraic routines required from library tape are SQRT (square root), ARCTAN (inverse tangent trigonometric function). FORTRAN logical tapes 5 and 6 are used in the NAA computing system "NAASYS" for input/output. In addition, logical tape 3 is used by CONFAC when card image printout of data is desired. IBM-IBSYS facilities utilizing different tape numbers may easily alter tape assignments by using a $NAME control card. The source programs are presently dimensioned so that a 32 K core size is required.

### Main Program

The main program reads title cards, surface data and transformation data name cards and factor requests from input tape 5. If a card image printout is desired, each card image is printed on output tape 6 and auxiliary tape 3. After reading is terminated by an END card, tape 3 is then used as the input tape.

When a factor request card is detected, the main program directs flow as required to subroutines TXFRM, DOICU, MAP and FACTOR. Program results are output by the main program.

### Subroutine UNIVEC

This subroutine computes the components of a unit orientation vector normal to the reference plane formed by the first, second and last point in surface data classes 1, 3, 4 and plane 6. The cross product of vectors 1-2 and 1-last is computed and normalized. The vector is formed normal to point 1, and is located on the active side of the surface, thus orienting the surface.

It also computes a new fourth point normal to the new three points submitted in transformation data and an old fourth point normal to the old three points in the surface data to be transformed.

Subroutine SELEK

This subroutine selects, according to the name of the data given in the factor request, the location of the data bearing the same name in the surface and transformation data arrays.

Subroutine TXFRM

The first section performs the auxiliary transformation. This transformation is used to reconstruct a surface which is bisected by the second surface. It also tests surface 1 to determine if the reference plane is substantially in the xy plane of its coordinate system. If it is not, an auxiliary transformation is effected to move the surfaces to fulfill this requirement prior to computation of factors.

This subroutine also performs a primary transformation as indicated by factor requests and transformation data. This transformation, if indicated for a surface, is accomplished prior to entry to subroutine DOICU so that tests of the surface "view" of each other occur in their transformed position(s).

The pseudo-transformation "9R" is accomplished in this subroutine. This operation merely reverses the order of data entry and orientation vector of plane surfaces as indicated in the factor request. The original surface data is not disturbed by any transformation; temporary storage is utilized.

Subroutine DOICU

The function of this subroutine is conveyed literally by its name DO-I-C-U. Given surfaces A1 and A2 with the "active" side of each surface identified by the surface orientation unit vector, the question is asked: Is all, part, or none of surface A1 "seen" by A2? Conversely, does A2 see all, none, or part of A1? This is accomplished by computing the vector dot product formed by the unit vector in one surface with the vector formed by point 1 in the first surface and each point in the other surface (see Figure 4). The sign of the dot product indicates whether the angle between the vectors is less or greater than $90^{\circ}$, which reveals the position of the point relative to the plane of the viewing surface. In Figure 4(a) the dot products from surface A1 to A2 are all positive and, conversely, all are positive from A2 to A1; A1 sees all of A2; A2 sees all of A1. However, in Figure 4(b) all dot products from A2 to A1 are positive, but from A1 to A2 they are all negative. Hence, in general if all dot products from one surface to another are negative, then the surfaces do not see each other, even though the converse products may be positive. There is also the trivial case where all products are zero, in which case the surfaces are in the same plane, and obviously cannot see each other.

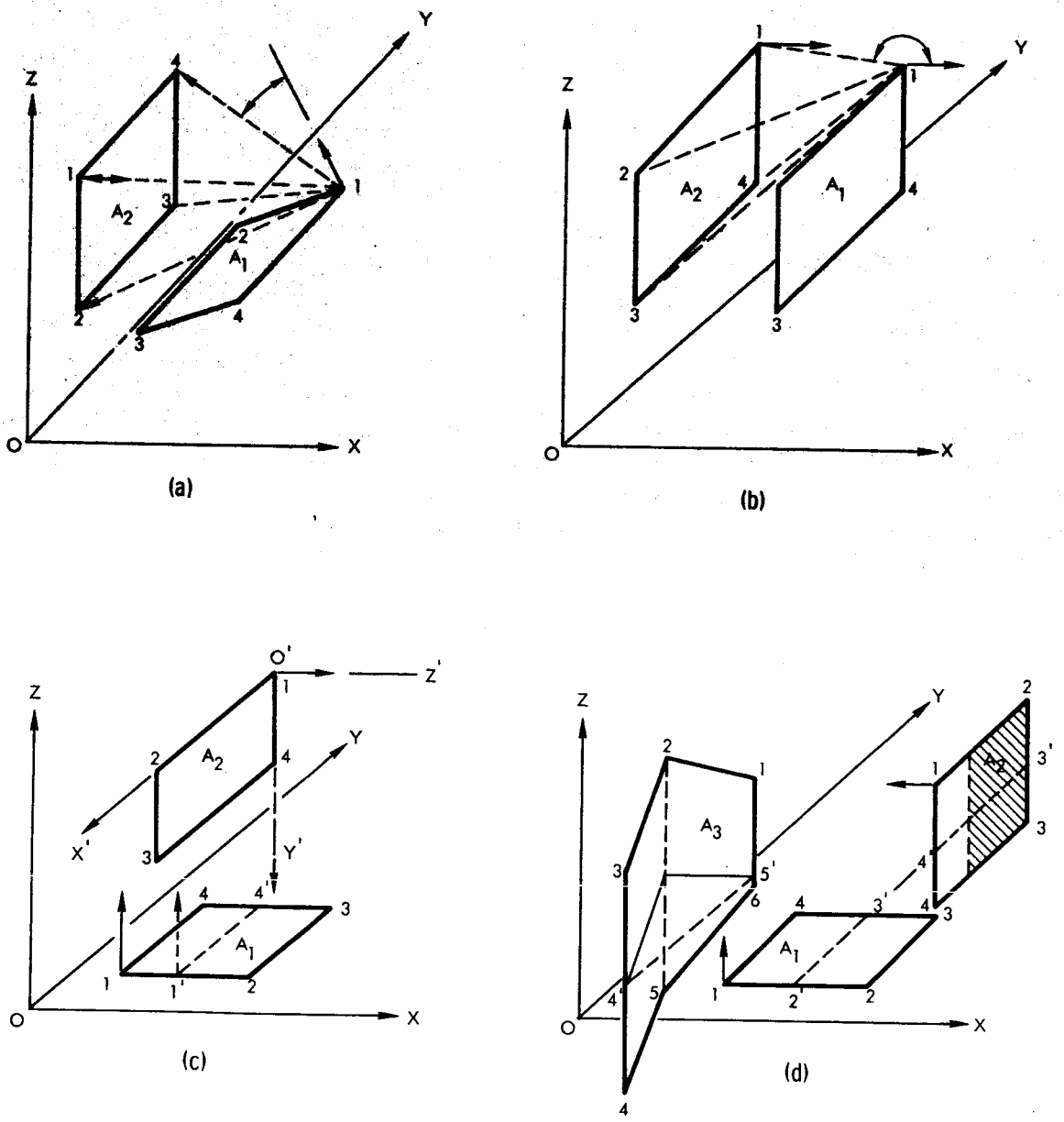



Figure 4. DOICU Surface Analysis

Figure 4 (c) shows a surface A2 bisecting surface A1. In this case, some of the dot products from A2 and A1 are positive and some negative. In Figure 4 (d) both A1 and A2 are bisected. Nonplanar surface A3 was added to show how it would be bisected by A1. Surface A3 has no orientation vector and thus no test is made of the view from this surface. The vertical dashed line in A2 represents how the plane 1-2-5-6 in A3 might bisect A2. DOICU will not detect this condition. If the configuration factor, $c_{23}$, were required, DOICU would properly bisect A3. However, if the factor to the concave side only is desired, an error would result because part of A2 sees the convex side of A3. This represents one of the limitations of CONFAC I that is carried over to CONFAC II.

If a surface is bisected, DOICU reconstructs the surface data to exclude the area not seen by the other surface. If point 1 in the original surface is removed as a result, a new orientation vector is created over the new point 1 as shown in Figure 4 (c). Notice that in reconstructing A3 (Figure 4 (d)), DOICU created the new array 1, 2, 3, 4', 5'. This "surface" is identical to the actual surface seen by A1 insofar as factor computation from A1 is concerned.

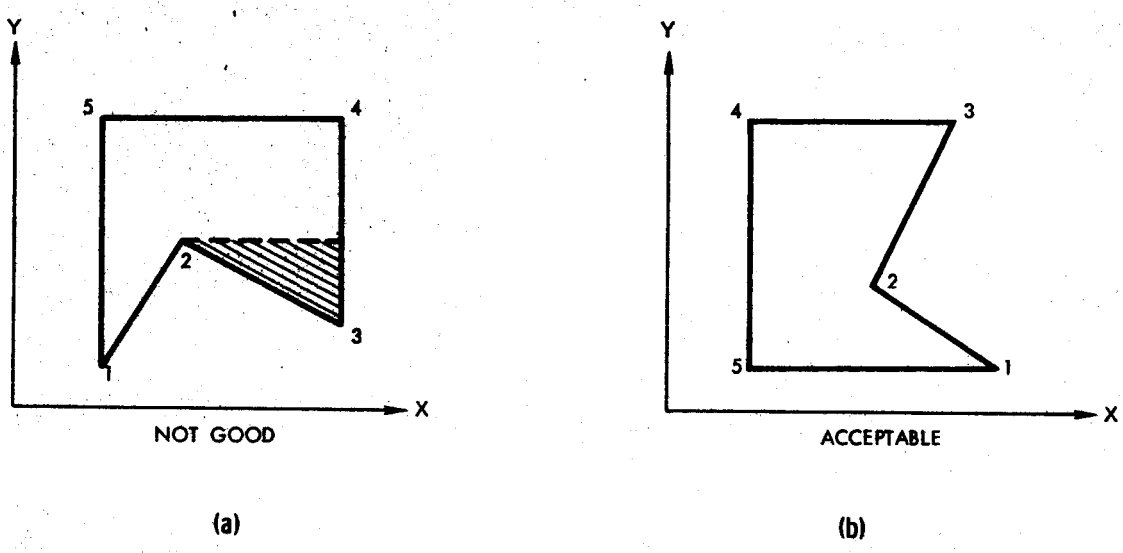
The bisection of a surface is done in a simple manner, with the aid of the auxiliary transformation capability. For example, in Figure 4 (c) the coordinates of both surfaces are transformed so that A2 lies in the xy plane of the auxiliary (primed) coordinate system. Each point in A1 is tested, in numerical order, until a change in the sign of the z-coordinate occurs. The coordinates of the new points where the transition line segment crosses the x'y' plane ($z' = 0$) are obtained by computing x and y intercepts of traces projected on the x'z' and y'z' principal planes.

Subroutine MAP

The double integral in Equation (9) and its numerical counterpart in Equation (10) mathematically represent the volume under a surface defined by the configuration factor $c_{12} = f(x, y)$. Subroutine MAP decides the location $(x, y)$ from which each factor to surface 2 will be computed.

It is assumed that surface 1 is a plane surface throughout. The program insures only that the reference plane of surface 1 is in the xy plane of the final coordinate system. MAP will use the x, y coordinates of all points, and assumes a value of 0 for all z coordinates. This procedure cannot properly map a nonplanar surface.

Subroutine MAP determines the maximum y coordinate and the minimum y coordinate from among the points defining surface 1 (Figure 5). The total



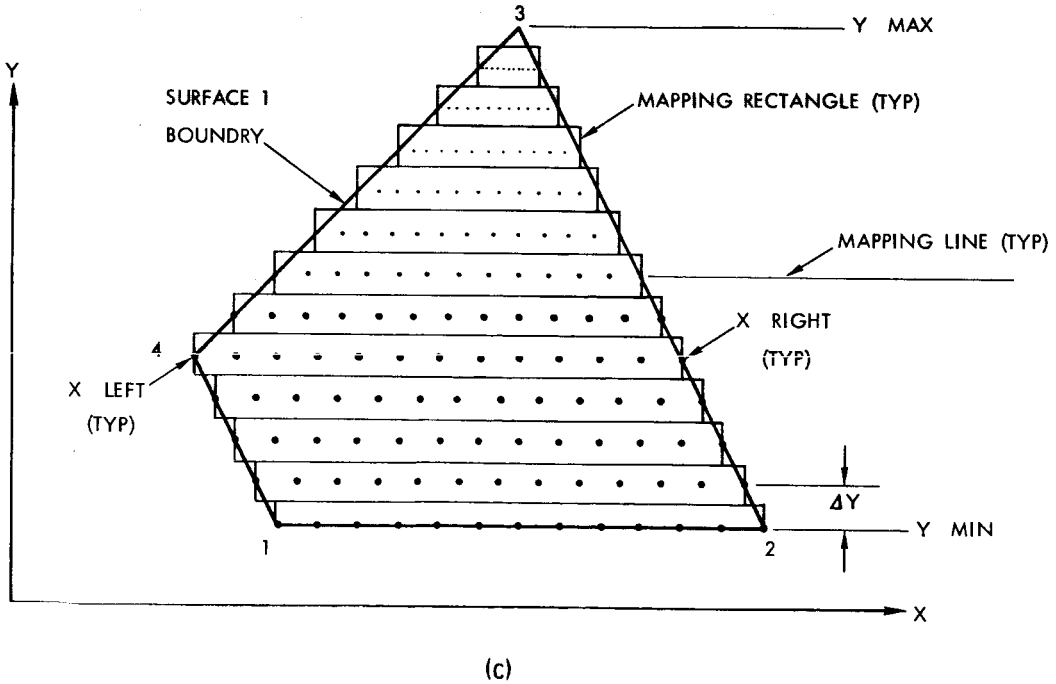




Figure 5. Surface 1 Mapping Procedure

vertical distance between $y_{max}$ and $y_{min}$ is divided into equal vertical increments, as specified by the run instructions. Then, horizontal lines are scribed across (parallel to the x-axis) the surface at each vertical increment position, including $y_{max}$ and $y_{min}$. The point at which a horizontal line intersects the left (toward the negative x-direction) boundary of surface 1 is termed "x-left" and the intersection on the right, "x-right." Each horizontal line segment thus created is termed a "mapping line". Each mapping line segment is also divided into an equal number of increments as specified by the factor request. All mapping lines are divided into the same number of increments, not necessarily the same size of increment. Obviously, if surface 1 converges to a point instead of a line at $y_{max}$ or $y_{min}$, the horizontal increment is 0. A configuration factor is computed at each increment point along a mapping line, including x-left and x-right, which means the number of factors per line is one greater than the number of increments.

The number of increments is automatically set to 24 horizontal and 24 vertical by a title card, but can be separately specified by input data to 6, 18, 24, 30, 36, 42, 48, 54, or 60. The details are discussed in Section IV.

A typical example of surface 1 mapping using a standard (24 x 24) increment is shown in Figure 5 (c). The mapping area is also computed by subroutine MAP; it is the sum of the rectangular areas formed by each mapping line. A measure of form factor accuracy is the degree with which the mapping area approximates the actual surface area.

Figure 5 (a) illustrates a surface 1 orientation that cannot be satisfactorily mapped; the crosshatched area will be ignored. The program does not allow more than one left and one right intersection between a mapping line and the surface boundary; the program will detect this condition and print a diagnostic warning. This restriction may be avoided by rotating the surface in Figure 5(b).

Subroutine FACTOR

This subroutine computes configuration factors from each point on surface 1 selected by MAP to surface 2. The exchange coefficient is computed by numerical integration of configuration factors across surface 1, from which the form factor is finally derived as the area-weighted mean of all configuration factors.

Factors are computed for each point along each mapping line, moving from x-left to x-right, by translating the origin of the surface 2 coordinate system in x. The analysis and equations are organized for minimum computational time; constants at each loop level are computed once prior to loop entry. Because the usual output desired is only the form factor, configuration

factors per se are not computed unless a detailed output is requested. A numerical integration of computed point function with respect to x is performed before proceeding to the next line. After all horizontal integrations are completed, these products are integrated with respect to y, and divided by the mapping area computed in subroutine MAP.

A standard 24 x 24 grid results in 625 configuration factors to be computed. The question naturally arises as to whether this many configuration factors are actually required. If the configuration factor changes very little across surface 1, then it is probably too many; but if there are sharp changes in the factor, and third place accuracy is desired, then it is probably sufficient. Contrary to expectations, a more sophisticated integration rule such as Simpson's or Weddle's is not as accurate as the trapezoidal rule for standard increments if the factor function slope changes rapidly. Weddle's Rule was initially used, which explains why the program increment control is in groups of six. If the factor varies smoothly, a 6 x 6 Weddle Rule integration (49 factors) is probably as accurate as the standard 625 factors presently used by the trapezoidal rule. The time saved is appreciable when running many factors. If desired, Weddle's Rule may be inserted in the source deck and compiled with no other changes required.

The form factor computed by the above is from that part of surface 1 which "sees" surface 2. If surface 1 is bisected, then the computed factor must be reduced in proportion to the area reduction. This is required because all of surface 1 entered in data is considered to be involved in radiant-interchange with surface 2.

## GENERAL RULES AND RESTRICTIONS

The following general rules and restrictions must be observed for normal program operation:

1. All data must be derived from right-handed rectangular coordinate systems.

2. Points 1, 2 and the last point in plane surface input data (class 1) must not form a straight line in space.

3. The active side of a plane or nonplanar surface is established by entering the boundary points in counterclockwise order, as they appear when facing the active side.

4. If the factor to a class 2 (nonplanar) surface is required, only the active surfaces should be seen from any point on surface 1, and they must also be seen from every point on surface 1.

5. Detailed restrictions and limitations upon input data are given in Section III.

# SECTION III. INPUT DATA

## DATA SPECIFICATIONS AND SPECIFIC RESTRICTIONS

Input data consists of title cards, surface data, transformation data and factor request data. Title cards are discussed under Program Control.

Data type is classified by the use of the integers 1, 2, or 9 placed in column 1 of the data name card, followed by a 1 to 5 FORTRAN character name to provide data identity within each class. The classes of data are described below.

### Surface and Transformation Data

#### Class 1 - Plane Polygon

The x, y, and z coordinates of each point defining the surface boundary are required. Only one side of a single plane surface can be made active for a particular factor computation, i.e., may interchange radiant flux with another surface. The active side is established in the following manner: face or look at the desired active side, and select any point on the surface boundary as point number one. Proceeding in a counterclockwise direction about the boundary of the surface, select the remaining points in sequence. If this rule is followed, the surface will always be on the left when moving along the boundary. The active side may be reversed in a factor request by use of the "9R" pseudo-transformation.

The x, y, and z coordinates of each point are entered on the data cards in the above sequence, and each point is numbered internally according to its position in the data.

It is assumed that a class 1 surface is a plane surface. An internal check is made to verify this; a warning is printed if it is not substantially plane. If a substantially nonplanar surface is classed as a plane surface, serious errors in mapping could result if it is used as surface 1, or wrong factors could be computed if it is used as surface 2. See item 4 of General Rules and Restrictions, Section II.

#### Class 2 - Nonplanar Surface

Two or more plane surfaces, not in the same plane, adjoining or connected, and entered as one package are termed a nonplanar surface.

A class 2 surface can be used as a surface 2 if the side of each facet selected as the active side, and only those sides, are seen from every point on the active side of surface 1. The counterclockwise order of data entry to establish the active side is also required as in class 1, but no orientation vector is generated.

Class 9 - Transformation Data

Transformation data consists of the coordinates of three points in a surface, not in a straight line, derived from the "new" position of a surface that has been moved in its coordinate system. One may, with equal validity, interpret the transformation to mean that the origin of the coordinate system is being moved to a different position, and the data are the coordinates of each point taken from the new origin. The three points selected need not be chosen or entered in any particular order, nor must the same points be used if more than one different primary transformation of the same surface is desired. The pseudo-transformation name "9R" is not entered in data, but only in factor requests.

Factor Requests

Factor requests specify, for each factor desired, the following:

1. The name of surface 1 data

2. The name of surface 2 data

3. The names of surface 1 and/or surface 2 transformation data

4. Whether a standard (minimum) or detailed printout mode is desired. The code "D" signifies that a detailed printout is desired. The code "N" signifies that a standard printout is desired. The code "blank" is a command to use the printout mode used for the prior factor request with the following exception. The program is initialized to the standard "N" mode before the first factor request is processed and by a title card.

5. The horizontal and/or vertical divisions to be used in mapping surface 1. The major divisions that can be used are 6, 12, 18, 24, 30, 36, 42, 48, 54 and 60, but these are specified in the factor request by the integers 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10. The presence of a blank field is interpreted in a similar manner as the output mode specification.

## DATA DIMENSION RESTRICTIONS

1. There is a maximum of 30 boundary points (90 coordinates) for each surface entered as class 1 or 2, and a maximum of 80 surface data entries.

2. The total number of class 9 data must not exceed 30.

3. The total number of factor requests must not exceed 200 for each set of data, except for the GROUPRUN mode.

## PROGRAM CONTROL

The program deck setup is shown in Figure 17. Note the presence of the title card immediately following the $DATA and Variable Format. A title card must have a "T" or an "I" in column 1. The title card serves three purposes. Columns 2-72 may contain run identification data such as job title, user name, date, etc. Second, the presence of this card is a command to reinitialize data storage locations so that new data may be read into storage. This means, however that the old data is no longer available for factor computations unless reentered as new input data. Third, the "I" control character in column 1 signifies that a card image (columns 1-80) printout of all data up to and including the END card is desired, prior to data processing. If an image printout is not desired, a "T" must appear in column 1.

### FORMAT

All data may be entered on NAA FORTRAN Fixed 10 Decimal Data sheets. Each line represents 12 card columns with six lines per card, making a total of 72 card columns available for data entry. Columns 73-80 are used for card identification and/or numerical sequencing for sorting purposes.

#### Title Card

A title card is characterized by an alphabetical "T" or an "I" placed in column 1. Columns 2-72 are available for job identification, as shown on Figure 6.

#### Surface and Transformation Data

All surface and transformation data are preceded by a name card uniquely identifying the data. A name consists of six FORTRAN characters

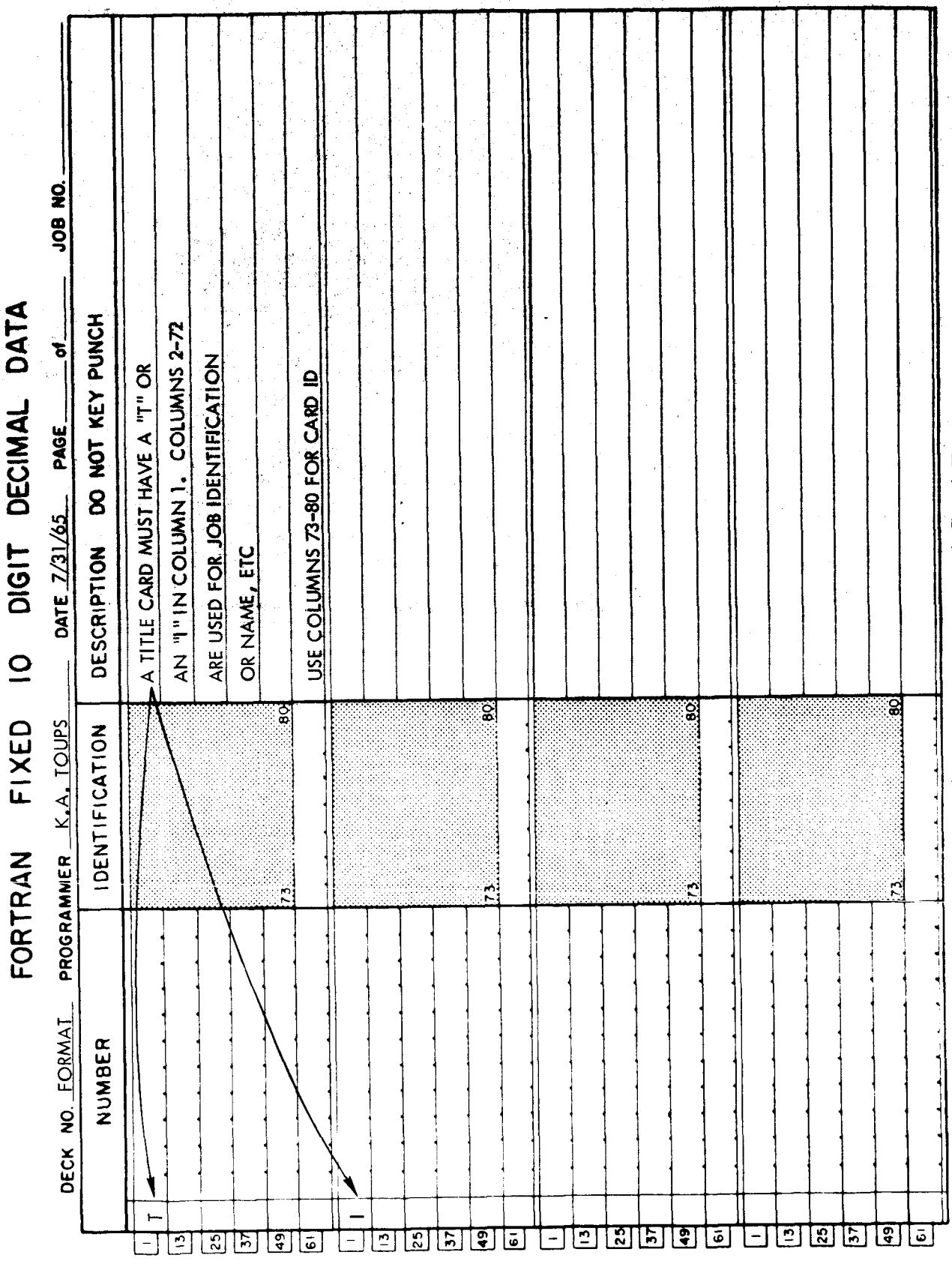



Figure 6. Program Control Card Format

(a computer "word") and always occupies the first six columns of the name card. The data class, the integers 1, 2, or 9, which is part of the name, must always be placed in column 1. The remainder of the name occupies columns 2-6, and it is important to note that a blank space is considered a character and a part of the name. For example, the name 1S1 is not the same as 1_S1 or 1___S1.

The next word on the name card, columns 7-12 must be left blank. Decimal input data may be entered in one of two modes. The first mode utilizes fixed input formating; data must be entered into specified fields on the card. This is the original and only mode used by FORTRAN II CONFAC I. However, FORTRAN IV features a powerful "free style" data entry technique called NAMELIST, which is discussed later. This mode of data entry permits consecutive entry of decimal data separated by commas. In most cases, the number of cards required to enter data using name is drastically reduced.

The data identified by the name card must follow the name card. There are two different formats which must be adhered to in entering data.

Class 1 and 2

The number of points to be entered describing the surface appears on the first line, Figure 7, followed by the x, y, and z coordinates of each point in sequence. The order in which the points are selected in the surface is explained in detail in Section III.

Class 9

The first point to be transformed in entered on the first line, followed by the x, y, and z coordinates of the "new" position of the point as shown in Figure 8. The second point to be transformed immediately follows on the fifth line followed by the x coordinate of the new position of the second point, thus completing the first card. The y and z coordinates of the new position of the second point are entered on the first two lines of the second card, followed by the number of the third point to be transformed and its new x, y, and z coordinates.

All of the numbers entered in the above data may be entered as fixed or floating point numbers. If a decimal point is given (fractional numbers must have decimal points given), the floating number may be located anywhere in the field (line); if no decimal point is given, the number must be located to the extreme right of the field (no blanks to the right of the number). The foregoing applies as well to NAMELIST data entries, except that the field is defined as the space between two commas (Figure 8).

# FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. FORMAT PROGRAMMER K.A. TOUPS DATE 7/31/65 PAGE ____ of ____ JOB NO. ____

| | NUMBER | IDENTIFICATION | DESCRIPTION DO NOT KEY PUNCH |
|---|---|---|---|
| 1 | N X X X X X | | NAME OF CLASS 1 OR 2 SURFACE, COLS 1-6 |
| 13 | | | CLASS 1 - PLANE POLYGON, USE "1" IN COL. 1 |
| 25 | | | CLASS 2 - NONPLANAR POLYGON, USE "2" IN COL. 1 |
| 37 | | | IMPORTANT: COLS. 7-18 MUST BE BLANK! |
| 49 | | 73 80 | USE COLS. 19-72 FOR ADDITIONAL DESCRIPTION |
| 61 | | | USE COLS. 73-80 FOR CARD ID, ALL CARDS |
| 1 | N P | | NO. OF POINTS DEFINING THE SURFACE |
| 13 | X 1 | | |
| 25 | Y 1 | | COORDINATES OF FIRST BOUNDARY POINT |
| 37 | Z 1 | | |
| 49 | X 2 | 73 80 | |
| 61 | Y 2 | | COORDINATES OF SECOND BOUNDARY POINT |
| 1 | Z 2 | | |
| 13 | X 3 | | |
| 25 | Y 3 | | 3RD |
| 37 | Z 3 | | |
| 49 | | 73 80 | |
| 61 | | | ETC. |
| 1 | | | |
| 13 | | | NOTE: 1) ALL DATA MUST USE DECIMAL POINT, EXCEPT |
| 25 | | | INTEGERS WHICH MAY BE ENTERED TO |
| 37 | | | EXTREME RIGHT OF FIELD |
| 49 | | 73 80 | 2) DATA MUST BE DERIVED FROM RIGHT-HANDED |
| 61 | | | RECTANGULAR COORDINATE SYSTEM |

Figure 7. Class 1 and 2 Surface Input Data Format





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# FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. FORMAT PROGRAMMER K.A. TOUPS DATE 7/31/65 PAGE ____ of ____ JOB NO. ____

| | NUMBER | IDENTIFICATION | DESCRIPTION DO NOT KEY PUNCH |
|---|---|---|---|
| 1 | 9 X X X X X | | NAME OF CLASS 9 DATA, COLS 1-6 |
| 13 | | | USE "9" IN COL. 1 FOR TRANSFORMATION |
| 25 | | | DATA |
| 37 | | | IMPORTANT: COLS. 7-18 MUST BE BLANK! |
| 49 | | 73 80 | USE COLS. 19-72 FOR ADDITIONAL DESCRIPTION |
| 61 | | | USE COLS. 73-80 FOR CARD ID, ALL CARDS. |
| 1 | N 1 | | FIRST POINT TO BE TRANSFORMED |
| 13 | X 1 | | |
| 25 | Y 1 | | COORDINATES OF FIRST POINT FROM |
| 37 | Z 1 | | "NEW" ORIGIN |
| 49 | N 2 | 73 80 | SECOND POINT TO BE TRANSFORMED |
| 61 | X 2 | | |
| 1 | Y 2 | | COORDINATES OF SECOND POINT FROM "NEW" ORIGIN |
| 13 | Z 2 | | |
| 25 | N 3 | | THIRD POINT, ETC |
| 37 | X 3 | | |
| 49 | Y 3 | 73 80 | COORDINATES, ETC |
| 61 | Z 3 | | |
| 1 | | | |
| 13 | | | NOTE: 1) ALL DATA MUST USE DECIMAL POINT EXCEPT |
| 25 | | | INTEGERS WHICH MAY BE ENTERED TO EXTREME |
| 37 | | | RIGHT OF FIELD |
| 49 | | 73 80 | 2) DATA MUST BE DERIVED FROM A RIGHT-HANDED |
| 61 | | | RECTANGULAR COORDINATE SYSTEM |

Figure 8. Class 9 Transformation Data Input Data Format



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Because of present data management restrictions, the full flexibility of NAMELIST cannot be realized. One cannot, for example, modify surface data already entered by selective specification of the subscripts of the points to be changed in the array. Data already entered cannot be changed except by complete reentry after reinitialization with the title card. If reentry is attempted without reinitialization, the program will not process the data properly.

The use of the NAMELIST mode of data entry is commanded by the presence of any nonblank character in the third word (columns 13 - 18) of the name card. If the third word is blank, then the standard fixed-format mode described as before will be used. The remaining words (columns 19 - 72) may be used for data identification as shown in Figure 9.

The first column of each card used for a NAMELIST data entry must be left blank. The embedded blanks in the first word must appear identically as shown in the various formats illustrating data entry. No data or alphabetic characters may appear in the card sequence area (columns 73 - 80). Commas are used to separate items of data; there must be no embedded blanks in the item, but blanks may precede or follow each comma. Data may be continued on as many cards as required, but a data item cannot be entered partly on one card and partly on the next. A comma or a dollar sign must follow the last item on a card; the comma is used if data to be continued, the dollar sign if not.

Factor Requests

Six FORTRAN words comprise a set of factor requests; two sets may be entered on one card as shown in Figure 10. The first set starts at column 1 and the second set starts at column 37. Two words (12 columns) comprise one line on the data sheet. The name of the surface 1 data is entered in the first word (columns 1 - 6) precisely as it appears in the first word of the surface data name card. The name of the surface 2 data is entered in the second word (columns 8 - 12) precisely as it appears in the first word of the surface data name card. If a primary transformation of surface 1 is desired, the desired transformation data name is entered in columns 13 - 18, otherwise, it is left blank. If a primary transformation of surface 2 is desired, the name of the transformation data is entered in the fourth word, columns 19 - 24. If a standard output is desired, the character "N" is entered instead of "D." If a blank is entered in both locations, the mode of output will be the same as the last factor request. The horizontal mapping division integer is entered in column 30 or 29 and 30. Similarly, the vertical mapping division interger is entered in column 36 or 35 and 36. If columns 29 and 30 are left blank, the horizontal mapping division used will be the same as the last factor request. If columns 35 and 36 are left blank, the vertical mapping division will be the same as the last factor request. The above format is repeated in the same manner, starting from column 37 on the fourth line, for the second set of factor requests on the card. A maximum of 200 factor

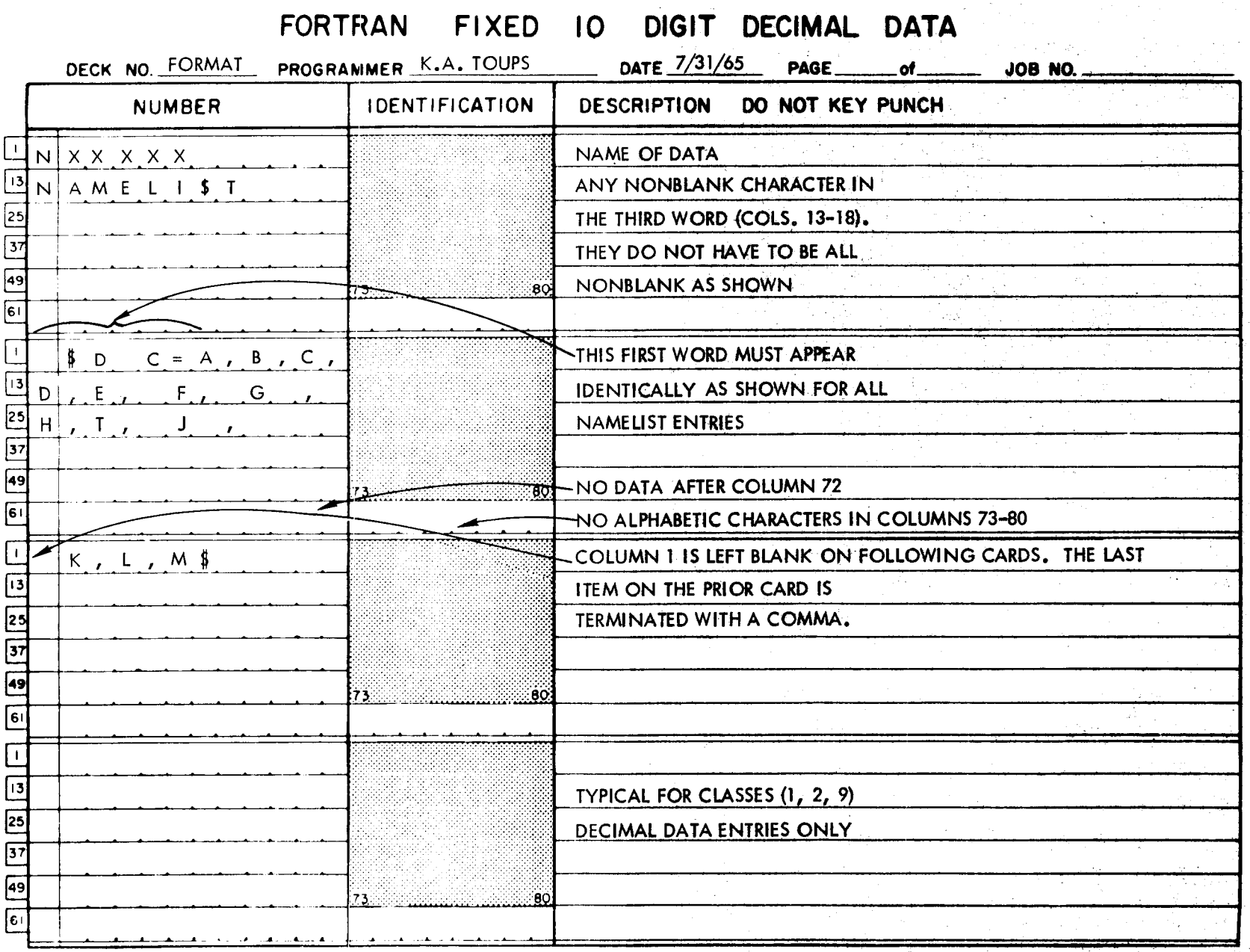



Figure 9. Class 1, 2, and 9 Data Entry Format, Namelist Mode





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# FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. FORMAT PROGRAMMER K.A. TOUPS DATE 7/31/65 PAGE ____ of ____ JOB NO. ____

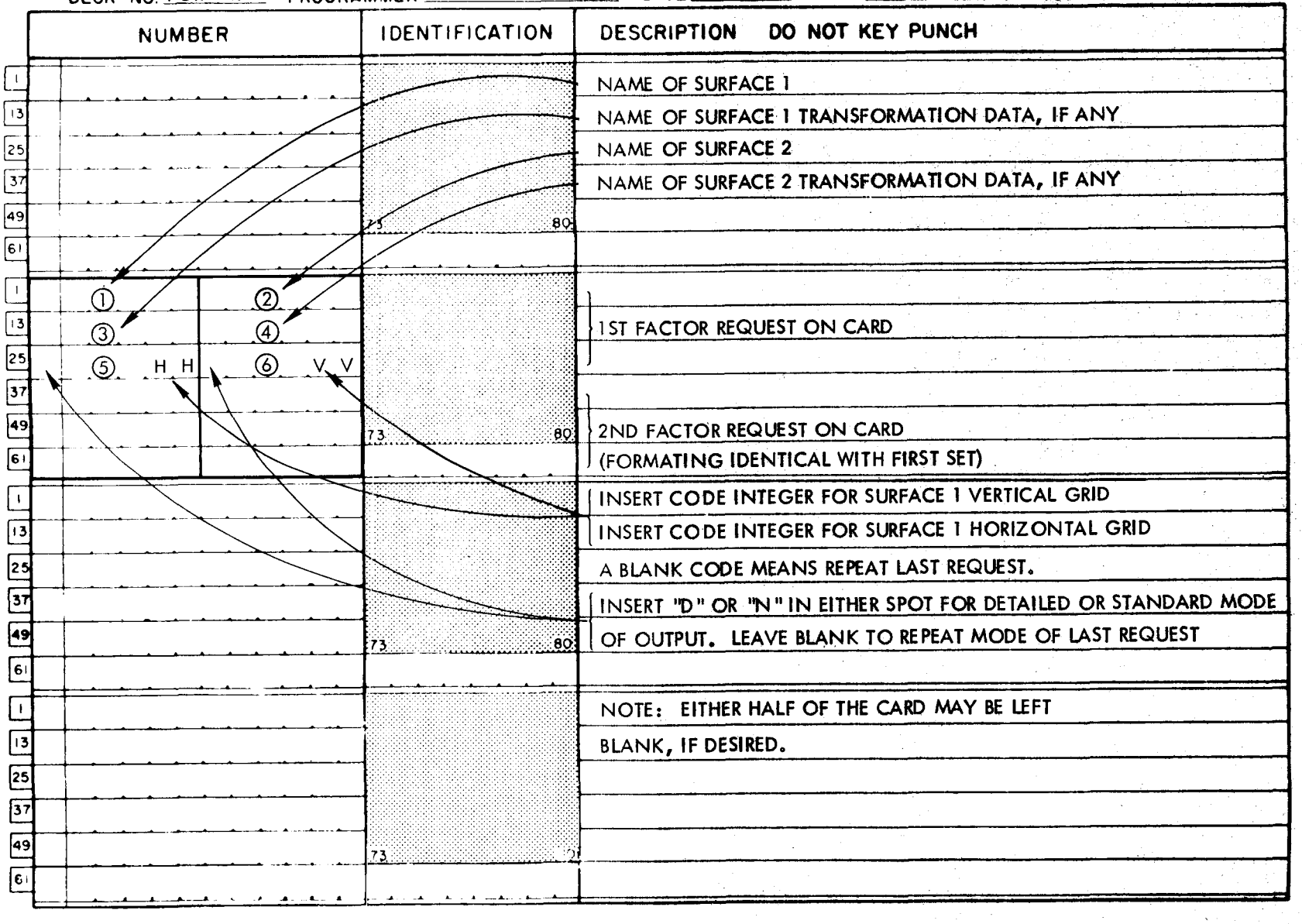



Figure 10. Factor Request Input Data Format

requests may be entered. (See Data Dimension Restrictions for limitations on number of factor requests). The only requirement is, of course, that the data called for has been loaded in under the names used.

END Card

Factor request data must be terminated by an END card. This card consists of the entry of the word END starting in Column 1. This card signals the end of the data package consisting of the title card, surface and transformation data and factor requests. Any number of such data packages may follow.

## SECTION IV. PROGRAM OUTPUT

Input data is processed and printed out for programmer verification prior to use in factor computations. The orientation vector head end is also printed out for all plane surfaces, so that the "active" side used by the program is clearly shown. Factor requests data are also printed out. If an "I" was placed in column 1 of the title card, an image of each card will be printed.

A standard "minimum" output consists of the following:

1. Run number
2. Factor request data
3. The computed form factors from surface 1 to surface 2
4. The surface 1 mapping area
5. The exchange coefficient (fA product)
6. The total area of surface 1
7. If surface 1 is bisected, the area seen by surface 2
8. The total area of surface 2
9. If surface 2 is bisected, the area seen by surface 1
10. The form factor from surface 2 to surface 1, if surface 2 area is known.

If a detailed output is requested, the minimum output plus the following is printed:

1. The final coordinates of surface 1 and surface 2 prior to computation of configuration factors.
2. The x-left and x-right coordinates for each y division of surface 1 mapping, including horizontal and vertical divisions used.

3. Each configuration factor computed. The output is given in groups of factors easily identified because the last factor in a group occupies a line by itself. Each group contains the configuration factors computed on a mapping line. The first factor in the group is that computed at x-left and the last factor in the group is that computed at x-right. The first group represents the first mapping line, the second group the second mapping line, etc.

## SECTION V. REFERENCES

1. Hamilton, D. C. and W. R. Morgan. Radiant-Interchange Configuration Factors. National Advisory Committee for Aeronautics. NACA TN-2836 (1952).

2. Sokolnikoff, I. D. and R. M. Redheffer. Mathematics of Physics and Modern Engineering. New York: McGraw-Hill Book Company, Inc. (1958).

3. Moon, Parry. The Scientific Basis of Illuminating Engineering. New York: Dover Publications, Inc. (1961), pp. 312-318.

4. O'Brien, P. F. "Pleijel's Globoscope for Lighting Design, "Illuminating Engineering, Vol. LVIII, No. 3 (3 March 1963).

5. Toups, Kempton A. A General Computer Program for the Determination of Radiant-Interchange Configuration Factors. NAA S&ID, SID 62-393, ASD Technical Note ASD-TN-61-101 (DDC No. 403027) (March 1963).

6. Toups, Kempton A. "CONFAC II, A General Computer Program for the Determination of Radiant-Interchange Configuration and Form Factors" NAA, SID 63-1397, Air Force FDL-TDR-64-43 (DDC ) January 1964.

# APPENDIX A. SAMPLE PROBLEMS

A number of sample problems have been devised to illustrate the capabilities and limitations of CONFAC I.

The surface configurations upon which the sample problems are based are shown in accompanying illustrations. Each illustration is conveniently grouped separately with the problem description pertaining to the surfaces shown in the illustration, along with the input data sheets, factor request data program output, and a short discussion.

## SAMPLE PROBLEM GROUP A

The geometry of this group is shown in Figure 11. The data sheets are shown in Figure 12 and the results are presented in Figure 13. The standard and namelist modes of data entry are demonstrated. Note the card image printout produced by the "I" card.

### Problem 1A

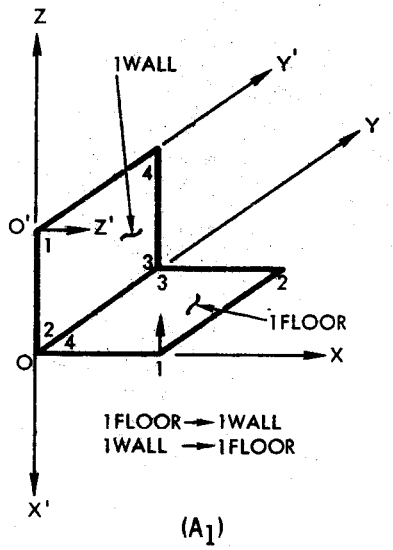
In Figure 11 (A1), the factor between the floor of a cubical room (1FLOOR) and an adjacent wall (1WALL) is computed, using standard horizontal and vertical mapping divisions (24 x 24) on surface 1. A detailed output is requested and standard data input mode is used.

Note that because no primary or auxiliary transformation occurred, the final coordinate system is the same as the input data (unprimed) coordinate system. The first mapping line starts at the origin and extends to point 1 in 1FLOOR.

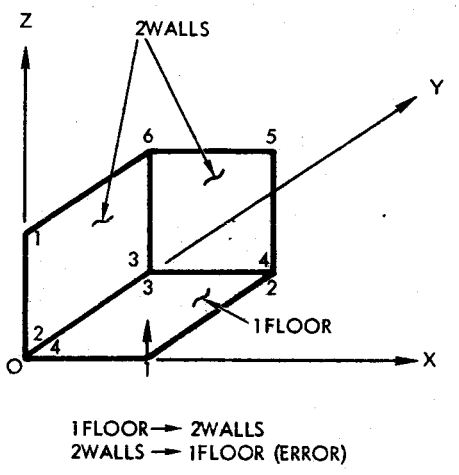
### Problem 2A

In Figure 11 (A1), any plane surface may be used as surface 1 providing it has been properly entered in data prior to the factor request. To demonstrate, the wall (1WALL) now acts as surface 1, and the factor to the floor (1FLOOR) is requested.

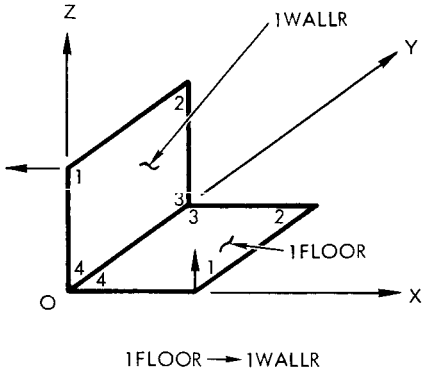
Note that surface 1WALL is not in the xy plane of its input (unprimed) coordinate system. The program, therefore, had to perform an auxiliary transformation of both surfaces to the primed system shown, prior to factor computation, to get surface 1 in the xy plane.



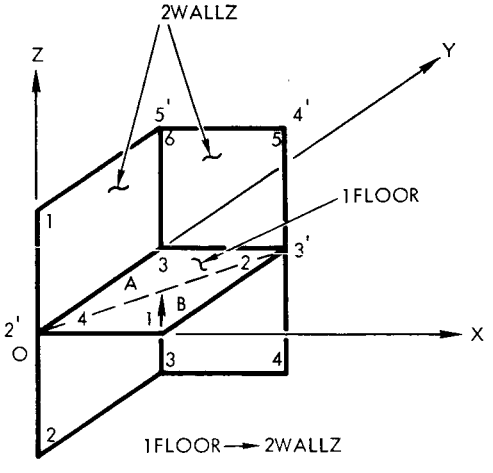

(A1)




(A2)




(A3)




(A4)

Figure 11. Sample Problems Geometry Group A

Problem 3A

**In Figure 11 (A2), the factor from the floor (1FLOOR) to two adjacent walls taken together (2WALLS) is requested. This is a valid request because the boundary data describing 2WALLS form a valid silhouette of 2WALLS from any point on 1FLOOR. The factor should be twice that to one wall alone.**

Problem 4A

**The program cannot validly compute the factor from a nonplanar surface. A class 2 surface is assumed nonplanar. The factor from 2WALLS to 1FLOOR is requested in order to elicit the diagnostic, warning the user that this is a nonplanar surface.**

Problem 5A

**In Figure 11 (A3), the necessity for proper order in data entry is emphasized. The wall data are deliberately entered in a clockwise direction (1WALLR) looking at the active surface, instead of counterclockwise. Hence, the orientation vector points in the wrong direction. The factor from 1FLOOR to 1WALLR is requested in order to elicit the diagnostic which** alerts the user to a possible error.

Problem 6A

In Figure 11 (A4), CONFAC I illustrates the capability of bisecting a nonplanar (class 2) surface. The factor from 1FLOOR to 2WALLZ is requested to demonstrate this capability.

Subroutine DOICU bisected 2WALLZ at the xy plane, and reconstructed the surface by eliminating points 2, 3, and 4, as shown, and creating new points 2', 3', 4' and 5'. The dashed line 2' 3' divides surface 1 (1FLOOR) into triangular parts, designated A and B. The view of the reconstructed 2WALLZ from anywhere in area B reflects a valid silhouette in the proper counterclockwise order. When reconstructed 2 WALLZ is viewed from area A, the points still form a valid silhouette, but the order is reversed. This means the computed configuration factor will be to the hemispherical space not occupied by 2WALLZ, and will be negative. So, subroutine FACTOR subtracts this factor from 1.0 to yield the correct factor to 2WALLZ.

Problem 7A

The use of the pseudo-transform "9R" is demonstrated by applying it to the 1WALLR data to cause the orientation of the surface to be reversed prior to factor computation. A standard output is requested.

Problem 8A

1FLOOR and 1WALL data are reentered along with the coordinates of the back-wall entered as 1BKWAL. Then a GROUPRUN factor request is entered in order to demonstrate the automatic generation of factor requests by this command. A combinational series of factor requests is computed in the following manner. Factor requests from the first surface entered in data to all of the remaining surfaces are created. Then, factor requests from the second surface entered to all of the remaining surfaces are created. This procedure is repeated to the limit of surfaces entered.

GROUPRUN must be set up as a separate task; i.e., title card, surface data, GROUPRUN card, and the END card.

# FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. GROUP A PROGRAMMER K.A. TOUPS DATE 7/31/65 PAGE 1 of 11 JOB NO. 2699-40

| | NUMBER | IDENTIFICATION | DESCRIPTION DO NOT KEY PUNCH |
|---|---|---|---|
| 1 | INAA CONFAC | | SEE FIGURE 6 FOR FORMATING |
| 13 | I REPORT $A | | |
| 25 | MPLE PROBLEM | | |
| 37 | $ GROUP A | | |
| 49 | K.A.TOUP$,7/ | 73 80 | |
| 61 | 31/65 | 101 | |
| 1 | 1FLOOR | | |
| 13 | | | |
| 25 | 1X1 SQUARE | | |
| 37 | | | |
| 49 | | 73 80 | |
| 61 | | 102 | |
| 1 | 4.0 | | $TANDARD DATA ENTRY MODE |
| 13 | 1.0 | | SEE FIGURE 7 FOR FORMATING |
| 25 | 0.0 | | |
| 37 | 0.0 | | |
| 49 | 1.0 | 73 80 | |
| 61 | 1.0 | 103 | |
| 1 | 0.0 | | |
| 13 | 0.0 | | |
| 25 | 1.0 | | |
| 37 | 0.0 | | |
| 49 | 0.0 | 73 80 | |
| 61 | 0.0 | 104 | |

Figure 12. Group A Sample Problems Input Data Code Sheets (Sheet 1 of 7)





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# FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. GROUP A PROGRAMMER K.A. TOUPS DATE 7/31/65 PAGE 2 of 11 JOB NO. 2699-40

| | NUMBER | IDENTIFICATION | DESCRIPTION DO NOT KEY PUNCH |
|---|---|---|---|
| 1 | 0 . 0 | | |
| 13 | | | |
| 25 | | | |
| 37 | | | |
| 49 | | 73 80 | |
| 61 | | 1 0 5 | |
| 1 | 1 W A L L | | |
| 13 | N A M E L I $ T | | |
| 25 | 1 X 1 $ Q U A R E T | | |
| 37 | Φ U C H I N G 1 F L Φ | | |
| 49 | Φ R | 73 80 | |
| 61 | | 1 0 6 | |
| 1 | $ D C = 4 , 0 , 0 , | | NAMELIST DATA ENTRY MODE |
| 13 | 1 , 0 , 0 , 0 , 0 , 1 , | | SEE FIGURE 9 FOR FORMATING |
| 25 | 0 , 0 , 1 , 1 $ | | |
| 37 | | | |
| 49 | | 73 80 | |
| 61 | | 1 0 7 | |
| 1 | 1 W A L L R | | |
| 13 | N | | |
| 25 | $ A M E A $ 1 W A L | | |
| 37 | L B U T Φ R D E R | | |
| 49 | Φ F E N T R Y R E V | 73 80 | |
| 61 | E R $ E D | 1 0 8 | |

Figure 12. Group A Sample Problems Input Data Code Sheets (Sheet 2 of 7)





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# FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. GROUP A PROGRAMMER K.A. TOUPS DATE 7/31/65 PAGE 3 of 11 JOB NO. 2699-40

| | NUMBER | IDENTIFICATION | DESCRIPTION DO NOT KEY PUNCH |
|---|---|---|---|
| 1 | $D C=4,0,0, | | |
| 13 | 1,0,1,1,0,1, | | |
| 25 | 0,0,0,0$ | | |
| 37 | | | |
| 49 | | 73 80 | |
| 61 | | 109 | |
| 1 | 2WALL$ | | |
| 13 | N | | |
| 25 | $IDE AND BAC | | |
| 37 | K WALL ENTER | | |
| 49 | ED A$ ΦNE $U | 73 80 | |
| 61 | RFACE | 110 | |
| 1 | $D C=6,0,0, | | |
| 13 | 1,0,0,0,0,1, | | |
| 25 | 0,1,1,0,1,1, | | |
| 37 | 1,0,1,1$ | | |
| 49 | | 73 80 | |
| 61 | | 111 | |
| 1 | 2WALLZ | | |
| 13 | N | | |
| 25 | 2WALL$ EXTEN | | |
| 37 | DED BELΦW $U | | |
| 49 | RFACE ΦF 1FL | 73 80 | |
| 61 | ΦΦR | 112 | |

Figure 12. Group A Sample Problems Input Data Code Sheets (Sheet 3 of 7)





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# FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. GROUP A PROGRAMMER K.A. TOUPS DATE 7/31/65 PAGE 4 of 11 JOB NO. 2699-40

| | NUMBER | IDENTIFICATION | DESCRIPTION DO NOT KEY PUNCH |
|---|---|---|---|
| 1 | $D C=6,0,0, | | |
| 13 | 1 ,0,0,-1,0,1 | | |
| 25 | ,-1,1,1,-1,1 | | |
| 37 | ,1,1,0,1,1$ | | |
| 49 | | 73 80 | |
| 61 | | 113 | |
| 1 | 1 FLΦΦR 1WALL | | PROBLEM 1A |
| 13 | | | |
| 25 | D | | |
| 37 | 1 WALL 1 FLΦΦR | | PROBLEM 2A |
| 49 | | 73 80 | |
| 61 | | 114 | |
| 1 | 1 FLΦΦR 2WALL$ | | PROBLEM 3A |
| 13 | | | |
| 25 | | | |
| 37 | 2 WALL$1 FLΦΦR | | PROBLEM 4A |
| 49 | | 73 80 | |
| 61 | | 115 | |
| 1 | 1 FLΦΦR 1WALLR | | PROBLEM 5A |
| 13 | | | |
| 25 | | | |
| 37 | 1 FLΦΦR 2WALL≠ | | PROBLEM 6A |
| 49 | | 73 80 | |
| 61 | | 116 | |

Figure 12. Group A Sample Problems Input Data Code Sheets (Sheet 4 of 7)





NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

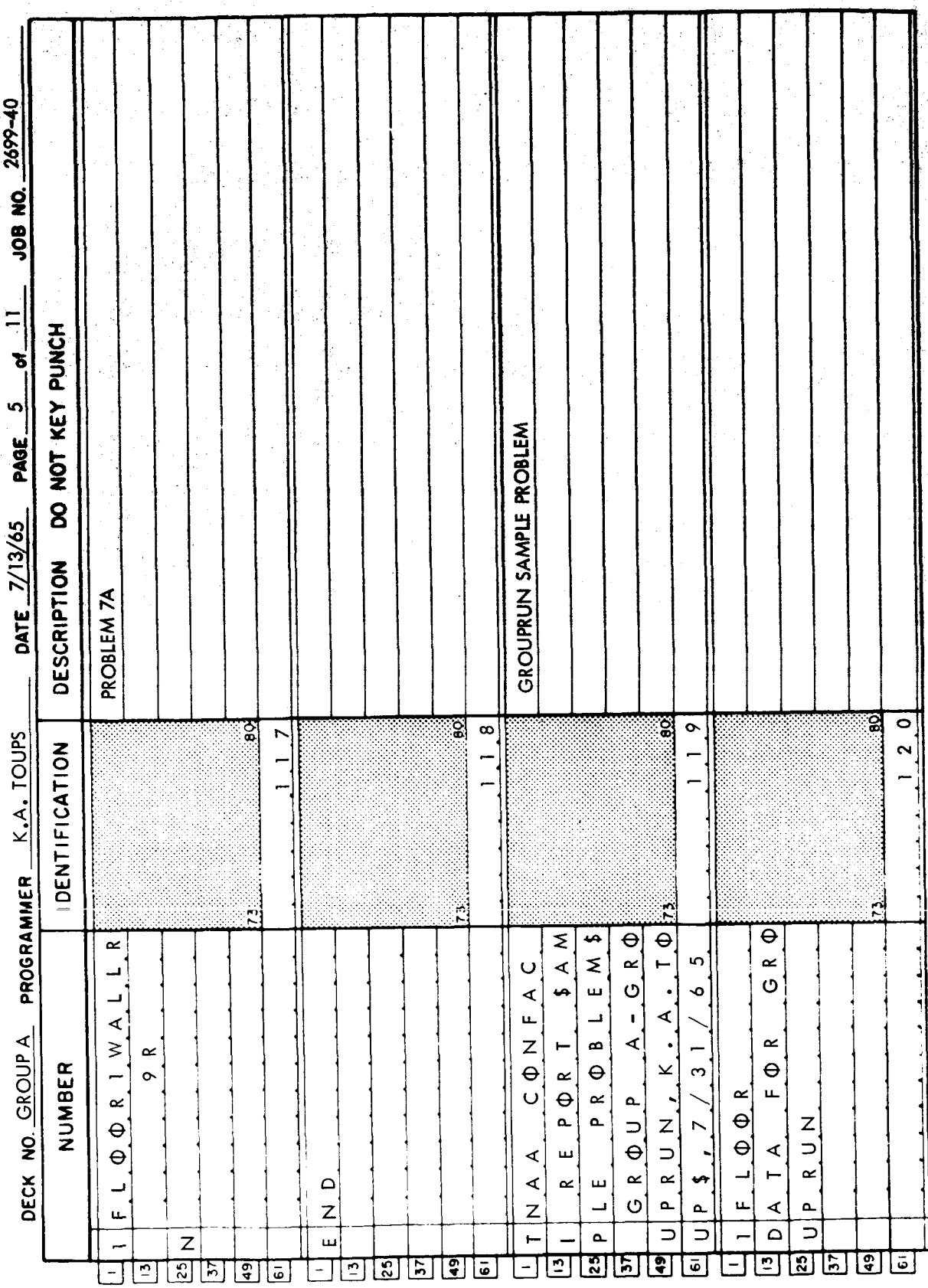



Figure 12. Group A Sample Problems Input Data Code Sheets (Sheet 5 of 7)

# FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. GROUP A PROGRAMMER K.A. TOUPS DATE 7/31/65 PAGE 6 of 11 JOB NO. 2699-40

| | NUMBER | IDENTIFICATION | DESCRIPTION DO NOT KEY PUNCH |
|---|---|---|---|
| 1 | $ D C = 4 , 1 , 0 , | 73 80 | |
| 13 | 0 , 1 , 1 , 0 , 0 , 1 , | | |
| 25 | 0 , 0 , 0 , 0 $ | | |
| 37 | | | |
| 49 | | | |
| 61 | | 1 2 1 | |
| 1 | 1 W A L L | 73 80 | |
| 13 | D A T A F Φ R G R Φ | | |
| 25 | U P R U N | | |
| 37 | | | |
| 49 | | | |
| 61 | | 1 2 2 | |
| 1 | $ D C = 4 , 0 , 0 , | 73 80 | |
| 13 | 1 , 0 , 0 , 0 , 0 , 1 , | | |
| 25 | 0 , 0 , 1 , 1 $ | | |
| 37 | | | |
| 49 | | | |
| 61 | | 1 2 3 | |
| 1 | 1 B K W A L | 73 80 | |
| 13 | D A T A F Φ R G R Φ | | |
| 25 | U P R U N | | |
| 37 | | | |
| 49 | | | |
| 61 | | 1 2 4 | |

Figure 12. Group A Sample Problems Input Data Code Sheets (Sheet 6 of 7)

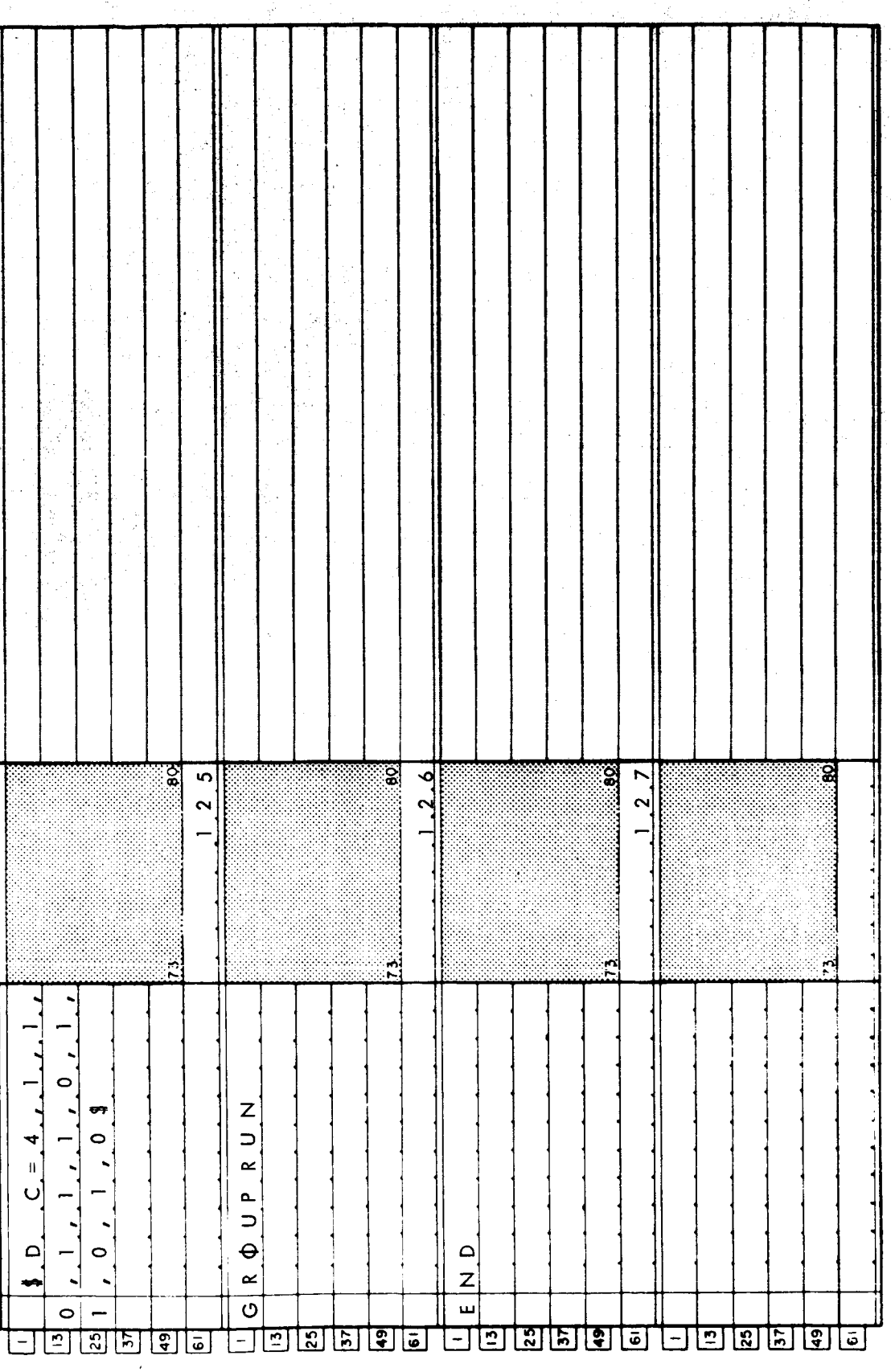



Figure 12. Group A Sample Problems Input Data Code Sheets (Sheet 7 of 7)

```
INAA CONFAC I  REPORT SAMPLE PROBLEMS GROUP A   K.A.TOUPS,7/31/65        C0000101
1FLOOR                    1X1 SQUARE                                    C0000102
4.0          1.0          0.0          0.0          1.0          1.0     C0000103
0.0          0.0          1.0          0.0          0.0          0.0     C0000104
0.0                                                                      C0000105
1WALL        NAMELIST     1X1 SQUARE TOUCHING 1FLOOR                    C0000106
 $D C=4,0,0,1,0,0,0,0,1,0,0,1,1$                                         00000107
1WALLR       N            SAME AS 1WALL BUT ORDER OF ENTRY REVERSED     C0000108
 $D C=4,0,0,1,0,1,1,0,1,0,0,0,0$                                         C0000109
2WALLS       N            SIDE AND BACK WALL ENTERED AS ONE SURFACE     CC000110
 $D C=6,0,0,1,0,0,0,0,1,0,1,1,0,1,1,1,0,1,1$                             00000111
2WALLZ       N            2WALLS EXTENDED BELOW SURFACE OF 1FLOOR       C0000112
 $D C=6,0,0,1,0,0,-1,0,1,-1,1,1,-1,1,1,1,0,1,1$                          00000113
1FLOOR1WALL               D            1WALL 1FLOOR                     00000114
1FLOOR2WALLS                           2WALLS1FLOOR                     CC000115
1FLOOR1WALLR                           1FLOOR2WALLZ                     00000116
1FLOOR1WALLR       9R     N                                             C0000117
END                                                                      C0000118
```

Figure 13. Group A Sample Problems Program Results (Sheet 1 of 35)

NAA SPACE AND INFORMATION SYSTEMS DIVISION
CONFIGURATION FACTOR PROGRAM

CONFAC I

NAA CONFAC I REPORT SAMPLE PROBLEMS GROUP A K.A.TOUPS,7/31/65

I N P U T D A T A

SURFACE AND TRANSFORMATION DATA

THE FIRST DATA SET ARE THE ORIGINAL INPUT DATA
THE SET IMMEDIATELY FOLLOWING ARE THE ORIGINAL DATA REFERENCED TO THE PLANE FORMED BY THE
1,2 AND LAST DATA POINTS, IF THE ORIGINAL DATA WERE NOT SUBSTANTIALLY IN THE XY PLANE OF ITS CS

DATA NAME *1FLOOR *

| POINT | X | Y | Z | POINT | X | Y | Z |
|---|---|---|---|---|---|---|---|
| | 0.10CCC00E 01 | -0.CC00000E-38 | 0.1000000E 01 | (INTERNALLY GENERATED ORIENTATION VECTOR) | | | |
| 1 | 0.10CCC00E 01 | 0.CC00000E-38 | 0.0000000E-38 | 2 | 0.1000000E 01 | 0.100C000E 01 | 0.0000000E-38 |
| 3 | C.CCCCC00E-38 | 0.1000000E 01 | 0.0000000E-38 | 4 | 0.CCCC000E-38 | 0.C00C000E-38 | 0.0000000E-38 |
| 1 | C.10CC000E 01 | 0.C000000E-38 | 0.0000000E-38 | 2 | 0.10C0C00E 01 | 0.1000000E 01 | 0.0000000E-38 |
| 3 | 0.C0CC000E-38 | 0.1C00000E 01 | 0.0000000E-38 | 4 | 0.C0C0C00E-38 | 0.000C000E-38 | 0.0000000E-38 |

DATA NAME *1WALL *

| POINT | X | Y | Z | POINT | X | Y | Z |
|---|---|---|---|---|---|---|---|
| | 0.1000C00E 01 | -0.0C00000E-38 | 0.1000000E 01 | (INTERNALLY GENERATED ORIENTATION VECTOR) | | | |
| 1 | 0.C00C000E-38 | 0.0CC0000E-38 | 0.1000000E 01 | 2 | 0.0000000E-38 | 0.0000000E-38 | 0.0000000E-38 |
| 3 | 0.C00C000E-38 | 0.1C00000E 01 | 0.0000000E-38 | 4 | 0.00C0000E-38 | 0.100C000E 01 | 0.1000000E 01 |
| 1 | C.C000000E-38 | 0.CC00000E-38 | 0.0000000E-38 | 2 | 0.1C00000E 01 | 0.C000000E-38 | 0.0000000E-38 |
| 3 | 0.10000000E 01 | 0.1CC0000E 01 | 0.0000000E-38 | 4 | 0.00C0000E-38 | 0.1000000E 01 | 0.0000000E-38 |

DATA NAME *1WALLR *

| POINT | X | Y | Z | POINT | X | Y | Z |
|---|---|---|---|---|---|---|---|
| | -C.10CC000E 01 | 0.0000000E-38 | 0.1000000E 01 | (INTERNALLY GENERATED ORIENTATION VECTOR) | | | |
| 1 | C.CCCC00E-38 | 0.CC00000E-38 | 0.1000000E 01 | 2 | 0.00C0C00E-38 | 0.100C00E 01 | 0.1000000E 01 |
| 3 | 0.CCCC00E-38 | 0.1C00000E 01 | 0.0000000E-38 | 4 | 0.C0C0C00E-38 | 0.000C000E-38 | 0.0000000E-38 |
| 1 | C.C00C000E-38 | 0.0C00000E-38 | 0.0000000E-38 | 2 | 0.1CCCC00E 01 | 0.000C000E-38 | 0.0000000E-38 |
| 3 | 0.10CCC00E 01 | 0.1C00000E 01 | 0.0000000E-38 | 4 | 0.0000C00E-38 | 0.100C000E 01 | 0.0000000E-38 |

Figure 13. Group A Sample Problems Program Results (Sheet 2 of 35)

DATA NAME *2WALLS *

| POINT | X | Y | Z | POINT | X | Y | Z |
|---|---|---|---|---|---|---|---|
| | 0.10CCC00E 01 | -0.CCCC000E-38 | 0.1000000E 01 | (INTERNALLY GENERATED ORIENTATION VECTOR) | | | |
| 1 | C.CCCCC00E-38 | 0.CC000000E-38 | 0.1000000E 01 | 2 | 0.00C0C00E-38 | 0.000C000E-38 | 0.0000000E-38 |
| 3 | C.CCCCC00E-38 | 0.1C000000E 01 | 0.0000000E-38 | 4 | 0.1CC0C00E 01 | 0.100C000E 01 | 0.0000000E-38 |
| 5 | C.10CC000E 01 | 0.1C000000E 01 | 0.1000000E 01 | 6 | 0.00C0C00E-38 | 0.1000000E 01 | 0.1000000E 01 |
| 1 | C.CC00C00E-38 | 0.0C000000E-38 | 0.0000000E-38 | 2 | 0.1CC0000E 01 | 0.000C000E-38 | 0.0000000E-38 |
| 3 | 0.10CC000E 01 | 0.1CC0000E 01 | 0.00C0000E-38 | 4 | 0.1CC0C00E 01 | 0.1000000E 01 | 0.1000000E 01 |
| 5 | C.CCCC000E-38 | 0.1C00000E 01 | 0.1000000E 01 | 6 | 0.CC00C00E-38 | 0.1000000E 01 | 0.0000000E-38 |

DATA NAME *2WALLZ *

| POINT | X | Y | Z | POINT | X | Y | Z |
|---|---|---|---|---|---|---|---|
| | 0.10CC000E 01 | -0.C000000E-38 | 0.1000000E 01 | (INTERNALLY GENERATED ORIENTATION VECTOR) | | | |
| 1 | 0.C00C00E-38 | 0.CC00000E-38 | 0.10C0000E 01 | 2 | 0.C0C0C00E-38 | 0.0000000E-38 | -0.1000000E 01 |
| 3 | C.CCCCC00E-38 | 0.1C00000E 01 | -0.1000000E 01 | 4 | 0.10C0000E 01 | 0.1000000E 01 | -0.1000000E 01 |
| 5 | C.10CCC00E 01 | 0.1C00000E 01 | 0.1000000E 01 | 6 | 0.C0CCC00E-38 | 0.100C000E 01 | 0.1000000E 01 |
| 1 | 0.C00C000E-38 | 0.CC00000E-38 | 0.0000000E-38 | 2 | C.2CC0C00E 01 | 0.0000000E-38 | 0.0000000E-38 |
| 3 | C.2CCCC00E 01 | 0.1C00000E 01 | 0.00C0000E-38 | 4 | 0.20C0C00E 01 | 0.100C000E 01 | 0.1000000E 01 |
| 5 | C.C00C000E-38 | 0.1C00000E 01 | 0.1000000E 01 | 6 | 0.CCC0C00E-38 | 0.10C0000E 01 | 0.0000000E-38 |

RUN DATA-

| RUN NO | SURF 1 | SURF 2 | SURF1 TXFRM | SURF2 TXFRM | HORZ INCR | VERT INCR | |
|---|---|---|---|---|---|---|---|
| 1 | *1FL00R*1WALL * | | * | *D | * | * | |
| 2 | *1WALL *1FL00R* | | * | * | * | * | |
| 3 | *1FL00R*2WALLS* | | * | * | * | * | |
| 4 | *2WALLS*1FL00R* | | * | * | * | * | |
| 5 | *1FL00R*1WALLR* | | * | * | * | * | |
| 6 | *1FL00R*2WALLZ* | | * | * | * | * | |
| 7 | *1FL00R*1WALLR* | | *9R | *N | * | * | |

Figure 13. Group A Sample Problems Program Results (Sheet 3 of 35)

```
                NAA CONFAC I  REPORT SAMPLE PROBLEMS GROUP A   K.A.TOUPS,7/31/65

RUN NO.   1   DATA USED FOR THIS RUN- *1FLOOR*1WALL *
                                      *      *      *
                                      *D     *      *

THE FORM FACTOR FROM SURFACE *1FLOOR      * TO SURFACE *1WALL       * = 0.19996

THE EXCHANGE COEFFICIENT (FA) =   0.19996E 00 SQ UNITS

                  THE MAPPING AREA = 0.1000000E 01 SQ UNITS

THE AREA OF SURFACE *1FLOOR       * = 0.1000000E 01 SQ UNITS.

THE AREA OF SURFACE *1WALL        * = 0.1000000E 01 SQ UNITS.

THE FORM FACTOR FROM SURFACE *1WALL       * TO SURFACE *1FLOOR      * = 0.19996

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-

    DATA NAME *1FLOOR      *

POINT       X              Y              Z           POINT      X              Y              Z
       0.10CCCOOE 01 -0.CC00000E-38  0.1000000E 01 (INTERNALLY GENERATED ORIENTATION VECTOR)
   1   0.10C0C00E 01  0.CC00000E-38  0.0000000E-38       2   0.10C0C00E 01  0.1C00000E 01  0.0000000E-38
   3   0.C0CC000E-38  0.1C00000E 01  0.0000000E-38       4   0.CCC0C00E-38  0.C00C000E-38  0.0000000E-38

    DATA NAME *1WALL       *

POINT       X              Y              Z           POINT      X              Y              Z
       0.10CC000E 01 -0.CC00000E-38  0.1000000E 01 (INTERNALLY GENERATED ORIENTATION VECTOR)
   1   0.CCCCC00E-38  0.CC00000E-38  0.1000000E 01       2   0.0000000E-38  0.C000000E-38  0.0000000E-38
   3   0.C0CCC00E-38  0.1C00000E 01  0.0000000E-38       4   0.00C0C00E-38  0.1C0C000E 01  0.1000000E 01

COORDINATES OF POINTS ON BOUNDARY OF SURF    *1FLOOR      * FOR EACH Y INTERVAL

      X-LEFT          X-RIGHT           Y                    X-LEFT          X-RIGHT           Y

 0.CCCOCC0E-38  0.1000000E 01  0.0000000E-38          0.0000000E-38  0.1000000E 01  0.4166667E-01
 0.CCCOCC0E-38  0.1CC0000E 01  0.8333333E-01          0.0000000E-38  0.1000000E 01  0.1250000E 00
 0.CC000000E-38  0.1C00000E 01  0.1666667E 00          0.0000000E-38  0.100C000E 01  0.2083333E 00
```

Figure 13. Group A Sample Problems Program Results (Sheet 4 of 35)





NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
0.CCCCCCOE-38  0.1CCOCOOE 01  0.25C0000E 00      C.CCCOCOOE-38  0.1COCOOOE 01  0.2916667E 00
0.OCCCCCOE-38  0.1CCOCOOE 01  0.3333333E 00      0.CCOOOOOE-38  0.1OOCOOOE 01  0.3750000E 00
0.OCCOCOOE-38  0.1CCOCOOE 01  0.4166667E 00      0.CCOOOOOE-38  0.1OOOOOOE 01  0.4583333E 00
0.OCOOOOOE-38  0.1OOOOOOE 01  0.5000000E 00      0.COCOOOOE-38  0.1OOOCOOE 01  0.5416666E 00
0.CCCCOCOE-38  0.1CCCCOOE 01  0.5833333E 00      0.0000000E-38  0.1OOOCOOE 01  0.6250000E 00
0.CCCOCCOE-38  0.1CCCCOOE 01  0.6666666E 00      0.COCOCCOE-38  0.1OCCOOOE 01  0.7083333E 00
0.CCCOCCOE-38  0.1OOOOOOE 01  0.75C0000E 00      0.COOCCOOE-38  0.1OOOOOOE 01  0.7916666E 00
C.COOCCCOE-38  0.1CCOOOOE 01  0.8333333E 00      C.COCOOOOE-38  0.1OOOOOOE 01  0.8750000E 00
0.CCCOCCOE-38  0.1CCOCOOE 01  0.9166666E 00      0.COOOOOOE-38  0.1OOCOOOE 01  0.9583333E 00
0.CCCCOCOE-38  0.1COOCOOE 01  0.1000000E 01
```

NO. OF HORIZONTAL INCREMENTS= 24  NO. OF VERTICAL INCREMENTS= 24

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

```
0.25CCCCOE CO   0.2381714E 00   0.2264098E 00   0.2147805E 00   0.2033451E 00   0.1921608E 00
0.1812784E 00   0.1707421E 00   0.1605884E 00   0.1508463E 00   0.1415374E 00   0.1326757E 00
0.1242689E CO   0.1163187E 00   0.1088213E 00   0.1017688E 00   0.9514960E-01   0.8894909E-01
0.8315061E-01   0.7773592E-01   0.7268577E-01   0.6798038E-01   0.6359979E-01   0.5952420E-01
0.5573420E-01
0.5CCOOCOE 00   0.3627489E 00   0.2993618E 00   0.2647417E 00   0.2406955E 00   0.2215649E 00
0.2051995E 00   0.1906369E 00   0.1773929E 00   0.1652008E 00   0.1539019E 00   0.1433944E 00
0.1336074E 00   0.1244870E 00   0.1159894E 00   0.1080764E CO   0.1007129E 00   0.9386608E-01
0.8750442E-01   0.8159761E-01   0.7611643E-01   0.7103273E-01   0.6631951E-01   0.6195098E-01
0.5790261E-01
0.5CCOCOOE 00   0.4135154E 00   0.3496923E 00   0.3058146E 00   0.2737868E 00   0.2486091E 00
0.2276612E 00   0.2095478E 00   0.1934858E 00   0.1790103E 00   0.1658296E CO   0.1537498E 00
0.1426349E 00   0.1323835E 00   0.1229162E 00   0.1141671E 00   0.1060798E 00   0.9860413E-01
0.9169456E-01   0.8530921E-01   0.7940921E-01   0.7395828E-01   0.6892256E-01   0.6427036E-01
0.5997213E-01
0.5CCCOOOE 00   0.4356356E 00   0.3801883E 00   0.3358659E 00   0.3006194E 00   0.2718642E 00
0.2476720E 00   0.2267755E 00   0.2083611E 00   0.1918990E 00   0.1770340E CO   0.1635191E 00
0.1511751E CO   0.1398664E 00   0.1294859E 00   0.1199457E 00   0.1111711E 00   0.1030969E 00
0.9566517E-01   0.888234CE-01   0.8252385E-01   0.7672266E-01   0.7137946E-01   0.6645701E-01
0.6192094E-01
0.5CCCOCOE 00   0.4473657E 00   0.3990101E 00   0.3570122E 00   0.3213185E CO   0.2909358E 00
0.2647653E 00   0.2419023E 00   0.2216715E 00   0.2035842E 00   0.1872861E CO   0.1725157E 00
0.1590750E 00   0.1468093E 00   0.1355937E 00   0.1253244E 00   0.1159130E 00   0.1072821E 00
0.9936325E-01   0.9209504E-01   0.8542179E-01   0.7929282E-01   0.7366185E-01   0.6848651E-01
```

Figure 13. Group A Sample Problems Program Results (Sheet 5 of 35)

```
0.6372759E-01
0.5CCCCCCE CO   0.4544209E 00   0.4112148E 00   0.3718966E 00   0.3369377E 00   0.3061129E 00
0.2789097E 00   0.2547786E 00   0.2332360E 00   0.2138885E 00   0.1964244E 00   0.1805977E 00
0.1662118E 00   0.1531066E 00   0.1411489E 00   0.1302257E 00   0.1202389E 00   0.1111026E 00
0.10274C0E 00   0.9508227E-01   0.8806704E-01   0.8163780E-01   0.7574306E-01   0.7033587E-01
0.6537341E-01
0.5CCCCC0E 00   0.4590002E 00   0.4194697E 00   0.3824940E 00   0.3486228E 00   0.3179568E 00
0.2903267E 00   0.2654469E 00   0.2430097E 00   0.2227285E 00   0.2043526E 00   0.1876684E 00
0.1724943E 00   0.1586752E 00   0.1460774E 00   0.1345840E 00   0.1240917E 00   0.1145086E 00
0.1057520E 00   0.9774738E-01   0.9042696E-01   0.8372935E-01   0.7759864E-01   0.7198393E-01
0.6683890E-01
0.5CCCCCCE 00   0.4621056E 00   0.4252060E 00   0.3901042E 00   0.3573098E C0   0.3270483E 00
0.2993339E 00   0.2740546E 00   0.2510376E 00   0.2300914E 00   0.2110276E 00   0.1936706E 00
0.1778607E 00   0.1634541E 00   0.1503215E 00   0.1383464E 00   0.1274235E 00   0.1174576E 00
0.1083618E 00   0.1000575E 00   0.9247279E-01   0.8554240E-01   0.7920679E-01   0.7341175E-01
0.6810803E-01
0.5CCCCCCE 00   0.4642507E 00   0.4292292E 00   0.3955579E 00   0.3636870E 00   0.3338817E 00
0.3062500E 00   0.2807856E 00   0.2574107E 00   0.2360083E 00   0.2164437E 00   0.1985776E 00
0.1822734E 00   0.1674011E 00   0.1538385E 00   0.1414719E 00   0.1301962E 00   0.1199146E 00
0.1105380E 00   0.1019848E 00   0.9418001E-01   0.8705545E-01   0.8054869E-01   0.7460294E-01
0.6916649E-01
0.5CCCCC0E 00   0.4657200E 00   0.4320121E 00   0.3993846E 00   0.3682363E C0   0.3388398E 00
0.3113485E 00   0.2858183E 00   0.2622336E 00   0.2405309E C0   0.2206169E 00   0.2023829E 00
0.1857127E 00   0.1704894E 00   0.1565984E 00   0.1439300E 00   0.1323804E 00   0.1218524E 00
0.1122557E 00   0.1035067E 00   0.9552856E-01   0.8825074E-01   0.8160876E-01   0.7554381E-01
0.7CC0237E-01
0.5C000C0E 00   0.4666782E 00   0.4338384E 00   0.4019193E 00   0.3712832E 00   0.3421993E 00
0.3148421E 00   0.2893C24E 00   0.2656025E 00   0.2437138E 00   0.2235724E 00   0.2050913E 00
0.1881704E 00   0.1727031E 00   0.1585815E 00   0.1456994E 00   0.1339547E 00   0.1232505E 00
0.1134958E 00   0.1046060E 00   0.9650285E-01   0.8911442E-01   0.8237474E-01   0.7622362E-01
0.706C623E-01
0.5CCC0C0E 00   0.4672204E 00   0.4348755E 00   0.4033667E 00   0.3730350E 00   0.3441448E 00
0.31688C0E 00   0.2913482E 00   0.2675923E 00   0.2456034E 00   0.2253343E 00   0.2067115E 00
0.1896446E 00   0.1740338E 00   0.1597756E 00   0.1467662E 00   0.1349046E 00   0.1240948E 00
0.1142451E 00   0.1052704E 00   0.9709184E-01   0.8963658E-01   0.8283786E-01   0.7663463E-01
0.7097129E-01
0.5C0C0C0E 00   0.4673959E 00   0.4352119E 00   0.4038375E 00   0.3736066E 00   0.3447819E 00
0.3175496E 00   0.2920227E 00   0.2682502E 00   0.2462298E 00   0.2259196E 00   0.2072507E 00
0.1901359E 00   0.1744778E 00   0.1601743E 00   0.1471226E 00   0.1352224E 00   0.1243771E 00
0.1144957E 00   0.1054927E 00   0.9728890E-01   0.8981130E-01   0.8299282E-01   0.7677215E-01
0.7109344E-01
0.5CC00C0E 00   0.4672204E 00   0.4348755E 00   0.4033667E 00   0.3730350E 00   0.3441448E 00
0.31688C0E 00   0.2913482E 00   0.2675923E 00   0.2456034E 00   0.2253343E 00   0.2067115E 00
```

Figure 13. Group A Sample Problems Program Results (Sheet 6 of 35)

```
0.1896446E 00   0.1740338E 00   0.1597756E 00   0.1467662E 00   0.1349048E 00   0.1240948E 00
0.1142451E 00   0.1052704E 00   0.9709184E-01   0.8963658E-01   0.8283786E-01   0.7663463E-01
0.7097129E-01
0.5CCCCCCE 00   0.4666782E 00   0.4338384E 00   0.4019193E 00   0.3712832E 00   0.3421993E 00
0.3148421E 00   0.2893024E 00   0.2656025E 00   0.2437138E 00   0.2235724E 00   0.2050913E 00
0.1881704E 00   0.1727031E 00   0.1585815E 00   0.1456994E 00   0.1339547E 00   0.1232505E 00
0.1134958E 00   0.1046060E 00   0.9650286E-01   0.8911442E-01   0.8237474E-01   0.7622363E-01
0.7060623E-01
0.5CCCCCCE 00   0.4657200E 00   0.4320121E 00   0.3993846E 00   0.3682363E 00   0.3388398E 00
0.3113485E 00   0.2858183E 00   0.2622336E 00   0.2405309E 00   0.2206169E 00   0.2023829E 00
0.1857127E 00   0.1704894E 00   0.1565984E 00   0.1439300E 00   0.1323804E 00   0.1218524E 00
0.1122557E 00   0.1035067E 00   0.9552856E-01   0.8825074E-01   0.8160876E-01   0.7554381E-01
0.7CCC236E-01
0.5CCCCCCE 00   0.4642507E 00   0.4292292E 00   0.3955579E 00   0.3636870E 00   0.3338817E 00
0.3062500E 00   0.2807856E 00   0.2574107E 00   0.2360083E 00   0.2164437E 00   0.1985776E 00
0.1822734E 00   0.1674011E 00   0.1538385E 00   0.1414719E 00   0.1301962E 00   0.1199146E 00
0.1105380E 00   0.1019848E 00   0.9418002E-01   0.8705545E-01   0.8054869E-01   0.7460294E-01
0.6916649E-01
0.5CCCCCCE 00   0.4621056E 00   0.4252061E 00   0.3901042E 00   0.3573098E 00   0.3270483E 00
0.2993339E 00   0.2740546E 00   0.2510376E 00   0.2300914E 00   0.2110276E 00   0.1936706E 00
0.1778607E 00   0.1634541E 00   0.1503215E 00   0.1383464E 00   0.1274235E 00   0.1174576E 00
0.1083618E 00   0.1000575E 00   0.9247279E-01   0.8554241E-01   0.7920679E-01   0.7341175E-01
0.6810803E-01
0.5CCCCCCE 00   0.4590CC2E 00   0.4194697E 00   0.3824940E 00   0.3486228E 00   0.3179568E 00
0.2903267E 00   0.2654470E 00   0.2430097E 00   0.2227285E 00   0.2043526E 00   0.1876684E 00
0.1724943E 00   0.1586752E 00   0.1460774E 00   0.1345840E 00   0.1240917E 00   0.1145086E 00
0.1057521E 00   0.9774738E-01   0.9042696E-01   0.8372935E-01   0.7759864E-01   0.7198393E-01
0.6683890E-01
0.5CCCCCCE 00   0.4544209E 00   0.4112148E 00   0.3718967E 00   0.3369377E 00   0.3061129E 00
0.2789097E 00   0.2547786E 00   0.2332360E 00   0.2138885E 00   0.1964244E 00   0.1805977E 00
0.1662118E 00   0.1531066E 00   0.1411489E 00   0.1302257E 00   0.1202389E 00   0.1111026E 00
0.1027400E 00   0.9508227E-01   0.8806705E-01   0.8163781E-01   0.7574306E-01   0.7033587E-01
0.6537342E-01
0.5CCCCCCE 00   0.4473657E 00   0.3990101E 00   0.3570122E 00   0.3213185E 00   0.2909358E 00
0.2647653E 00   0.2419023E 00   0.2216715E 00   0.2035842E 00   0.1872861E 00   0.1725157E 00
0.1590750E 00   0.1468093E 00   0.1355937E 00   0.1253244E 00   0.1159130E 00   0.1072821E 00
0.9936326E-01   0.9209505E-01   0.8542179E-01   0.7929283E-01   0.7366185E-01   0.6848651E-01
0.6372799E-01
0.5CCCCCCE 00   0.4356356E 00   0.3801883E 00   0.3358659E 00   0.3006195E 00   0.2718643E 00
0.2476720E 00   0.2267756E 00   0.2083612E 00   0.1918990E 00   0.1770340E 00   0.1635191E 00
0.1511751E 00   0.1398664E 00   0.1294859E 00   0.1199457E 00   0.1111711E 00   0.1030970E 00
0.9566518E-01   0.8882341E-01   0.8252385E-01   0.7672266E-01   0.7137946E-01   0.6645701E-01
0.6192094E-01
```

Figure 13. Group A Sample Problems Program Results (Sheet 7 of 35)

```
0.5C00000E 00   0.4135154E 00   0.3496924E 00   0.3058146E 00   0.2737868E 00   0.2486091E 00
0.2276612E 00   0.2095478E 00   0.1934858E 00   0.1790103E 00   0.1658296E 00   0.1537498E 00
0.1426349E 00   0.1323835E 00   0.1229162E 00   0.1141671E 00   0.1060798E 00   0.9860413E-01
0.9169456E-01   0.8530921E-01   0.7940921E-01   0.7395829E-01   0.6892256E-01   0.6427036E-01
0.5997213E-01
0.5C00CC0E 00   0.3627490E 00   0.2993619E 00   0.2647418E 00   0.2406956E 00   0.2215649E 00
0.2051995E 00   0.1906369E 00   0.1773929E 00   0.1652008E 00   0.1539019E 00   0.1433945E 00
0.1336074E 00   0.1244870E 00   0.1159894E 00   0.1080764E 00   0.1007129E 00   0.9386609E-01
0.8750442E-01   0.8159762E-01   0.7611643E-01   0.7103273E-01   0.6631951E-01   0.6195098E-01
0.5790261E-01
0.2500000E 00   0.2381714E 00   0.2264098E 00   0.2147805E 00   0.2033451E 00   0.1921608E 00
0.1812784E 00   0.1707421E 00   0.1605884E 00   0.1508463E 00   0.1415374E 00   0.1326757E 00
0.1242689E 00   0.1163187E 00   0.1088213E 00   0.1017688E 00   0.9514960E-01   0.8894909E-01
0.8315061E-01   0.7773592E-01   0.7268577E-01   0.6798038E-01   0.6359979E-01   0.5952420E-01
0.5573420E-01
```

Figure 13. Group A Sample Problems Program Results (Sheet 8 of 35)

```
                NAA CONFAC I  REPORT SAMPLE PROBLEMS GROUP A   K.A.TOUPS,7/31/65

RUN NO.   2   DATA USED FOR THIS RUN- *1WALL *1FLOOR*
                                      *      *      *
                                      *      *      *

THE FORM FACTOR FROM SURFACE *1WALL       * TO SURFACE *1FLOOR      * = 0.19996

THE EXCHANGE COEFFICIENT (FA) =   0.19996E 00 SQ UNITS

                  THE MAPPING AREA = 0.1000000E 01 SQ UNITS

THE AREA OF SURFACE *1WALL        * = 0.1000000E 01 SQ UNITS.

THE AREA OF SURFACE *1FLOOR       * = 0.1000000E 01 SQ UNITS.

THE FORM FACTOR FROM SURFACE *1FLOOR      * TO SURFACE *1WALL       * = 0.19996

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-

    DATA NAME *1WALL      *

POINT       X              Y              Z           POINT      X              Y              Z
        0.0000000E-38  0.0000000E-38  0.1000000E 01 (INTERNALLY GENERATED ORIENTATION VECTOR)
   1    0.0000000E-38  0.0000000E-38  0.0000000E-38       2    0.1000000E 01  0.0000000E-38  0.0000000E-38
   3    0.1000000E 01  0.1000000E 01  0.0000000E-38       4    0.0000000E-38  0.1000000E 01  0.0000000E-38

    DATA NAME *1FLOOR     *

POINT       X              Y              Z           POINT      X              Y              Z
        0.0000000E-38  0.0000000E-38  0.1000000E 01 (INTERNALLY GENERATED ORIENTATION VECTOR)
   1    0.1000000E 01  0.0000000E-38  0.1000000E 01       2    0.1000000E 01  0.1000000E 01  0.1000000E 01
   3    0.1000000E 01  0.1000000E 01  0.0000000E-38       4    0.1000000E 01  0.0000000E-38  0.0000000E-38

COORDINATES OF POINTS ON BOUNDARY OF SURF    *1WALL       * FOR EACH Y INTERVAL

      X-LEFT         X-RIGHT          Y                    X-LEFT         X-RIGHT          Y

 0.0000000E-38  0.1000000E 01  0.0000000E-38          0.0000000E-38  0.1000000E 01  0.4166667E-01
 0.0000000E-38  0.1000000E 01  0.8333333E-01          0.0000000E-38  0.1000000E 01  0.1250000E 00
 0.0000000E-38  0.1000000E 01  0.1666667E 00          0.0000000E-38  0.1000000E 01  0.2083333E 00
```

Figure 13. Group A Sample Problems Program Results (Sheet 9 of 35)

| | | |
|---|---|---|
| 0.0C0CCC0E-38 | 0.10C0000E 01 | 0.2500000E 00 |
| 0.0CC00C0E-38 | 0.1C00000E 01 | 0.3333333E 00 |
| 0.0CC00C0E-38 | 0.1000000E 01 | 0.4166667E 00 |
| 0.0C0C0C0E-38 | 0.10C0000E 01 | 0.5000000E 00 |
| 0.CC000C0E-38 | 0.1CC0000E 01 | 0.5833333E 00 |
| 0.CCCC000E-38 | 0.1C00000E 01 | 0.6666666E 00 |
| 0.CCCC0C0E-38 | 0.1CC0000E 01 | 0.7500000E 00 |
| 0.000C000E-38 | 0.1C00C00E 01 | 0.8333333E 00 |
| 0.0C000C0E-38 | 0.1C00000E 01 | 0.9166666E 00 |
| 0.CC00CC0E-38 | 0.10C0000E 01 | 0.1000000E 01 |

| | | |
|---|---|---|
| 0.C000000E-38 | 0.1000000E 01 | 0.2916667E 00 |
| 0.0000000E-38 | 0.1000000E 01 | 0.3750000E 00 |
| 0.C000000E-38 | 0.1000000E 01 | 0.4583333E 00 |
| 0.0000000E-38 | 0.1000000E 01 | 0.5416666E 00 |
| 0.0000000E-38 | 0.1000000E 01 | 0.6250000E 00 |
| 0.C000000E-38 | C.1000000E 01 | 0.7083333E 00 |
| 0.0000000E-38 | 0.1000000E 01 | 0.7916666E 00 |
| 0.0000000E-38 | 0.1000000E 01 | 0.8750000E 00 |
| 0.00C0000E-38 | 0.1000000E 01 | 0.9583333E 00 |

NO. OF HORIZONTAL INCREMENTS= 24 NO. OF VERTICAL INCREMENTS= 24

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

| | | | | | |
|---|---|---|---|---|---|
| 0.5573420E-01 | 0.5952419E-01 | 0.6359978E-01 | 0.6798038E-01 | 0.7268577E-01 | 0.7773592E-01 |
| 0.8315061E-01 | 0.8894909E-01 | 0.9514960E-01 | 0.1017688E 00 | 0.1088213E 00 | 0.1163187E 00 |
| 0.1242689E 00 | 0.1326757E 00 | 0.1415374E 00 | 0.1508464E 00 | 0.1605884E 00 | 0.1707421E 00 |
| 0.1812784E 00 | 0.1921608E 00 | 0.2033451E 00 | 0.2147805E 00 | 0.2264099E 00 | 0.2381714E 00 |
| 0.25CCC00E 00 | | | | | |
| 0.5790261E-01 | 0.6195098E-01 | 0.6631951E-01 | 0.7103273E-01 | 0.7611643E-01 | 0.8159761E-01 |
| 0.8750442E-01 | 0.9386608E-01 | 0.1007129E 00 | 0.1080764E 00 | 0.1159894E 00 | 0.1244870E 00 |
| 0.1336074E 00 | 0.1433945E 00 | 0.1539019E 00 | 0.1652008E 00 | 0.1773929E 00 | 0.1906369E 00 |
| 0.2051995E 00 | 0.2215649E 00 | 0.2406956E 00 | 0.2647418E 00 | 0.2993619E 00 | 0.3627491E 00 |
| 0.5CC0CC0E 00 | | | | | |
| 0.5997213E-01 | 0.6427035E-01 | 0.6892255E-01 | 0.7395828E-01 | 0.7940920E-01 | 0.8530920E-01 |
| 0.9169455E-01 | 0.9860413E-01 | 0.1060798E 00 | 0.1141671E 00 | 0.1229162E 00 | 0.1323835E 00 |
| 0.1426349E 00 | 0.1537498E 00 | 0.1658296E 00 | 0.1790103E 00 | 0.1934858E 00 | 0.2095478E 00 |
| 0.2276612E 00 | 0.2486091E 00 | 0.2737868E 00 | 0.3058146E 00 | 0.3496924E 00 | 0.4135155E 00 |
| 0.50C00C0E 00 | | | | | |
| 0.6192094E-01 | 0.66457C0E-01 | 0.7137946E-01 | 0.7672266E-01 | 0.8252385E-01 | 0.8882340E-01 |
| 0.9566517E-01 | 0.1030969E 00 | 0.1111711E 00 | 0.1199457E 00 | 0.1294859E 00 | 0.1398664E 00 |
| 0.1511751E 00 | 0.1635191E 00 | 0.1770340E 00 | 0.1918990E 00 | 0.2083612E 00 | 0.2267756E 00 |
| 0.2476720E 00 | 0.2718643E 00 | 0.3006195E 00 | 0.3358659E 00 | 0.3801883E 00 | 0.4356357E 00 |
| 0.5C000C0E 00 | | | | | |
| 0.6372799E-01 | 0.6848651E-01 | 0.7366185E-01 | 0.7929282E-01 | 0.8542179E-01 | 0.9209504E-01 |
| 0.9936325E-01 | 0.1072821E 00 | 0.1159130E 00 | 0.1253244E 00 | 0.1355937E 00 | 0.1468093E 00 |
| 0.1590750E 00 | 0.1725157E 00 | 0.1872861E 00 | 0.2035842E 00 | 0.2216715E 00 | 0.2419023E 00 |
| 0.2647653E 00 | 0.2909358E 00 | 0.3213185E 00 | 0.3570122E 00 | 0.3990102E 00 | 0.4473658E 00 |

Figure 13. Group A Sample Problems Program Results (Sheet 10 of 35)

```
0.5CCCCCCE CO
0.6537341E-01   0.7033587E-01   0.7574306E-01   0.8163780E-01   0.8806704E-01   0.9508226E-01
0.10274C0E 00   0.1111026E 00   0.1202389E 00   0.1302257E 00   0.1411489E 00   0.1531066E 00
0.1662118E 00   0.1805977E 00   0.1964244E 00   0.2138885E 00   0.2332360E 00   0.2547786E 00
0.2789097E 00   0.3061129E 00   0.3369377E 00   0.3718967E 00   0.4112149E 00   0.4544210E 00
0.5CCCCCCE 00
0.6683890E-01   0.7198393E-01   0.7759863E-01   0.8372935E-01   0.9042696E-01   0.9774737E-01
0.1057520E 00   0.1145086E 00   0.1240917E 00   0.1345840E 00   0.1460774E 00   0.1586752E 00
0.1724943E 00   0.1876684E 00   0.2043526E 00   0.2227285E 00   0.2430098E 00   0.2654470E 00
0.2903267E CO   0.3179569E 00   0.3486228E 00   0.3824940E 00   0.4194698E 00   0.459C003E 00
0.5CCCCCCE 00
0.6810803E-01   0.7341175E-01   0.7920678E-01   0.8554240E-01   0.9247279E-01   0.1000575E 00
0.1083618E 00   0.1174576E 00   0.1274235E 00   0.1383464E 00   0.1503215E 00   0.1634541E 00
0.1778607E 00   0.1936706E 00   0.2110276E 00   0.2300914E 00   0.2510376E 00   0.2740546E 00
0.2993340E 00   0.3270483E 00   0.3573098E 00   0.3901042E 00   0.4252061E 00   0.4621057E 00
0.5CCCCCCE 00
0.6916649E-01   0.7460293E-01   0.8054869E-01   0.8705544E-01   0.9418001E-01   0.1019848E 00
0.1105380E CO   0.1199146E 00   0.1301962E 00   0.1414719E 00   0.1538385E 00   0.1674011E 00
0.1822734E 00   0.1985776E 00   0.2164437E 00   0.2360083E 00   0.2574107E 00   0.2807856E 00
0.3062500E CO   0.3338818E 00   0.3636870E 00   0.3955580E 00   0.4292293E 00   0.4642507E 00
0.5CCCCCCE 00
0.7CCC237E-01   0.7554381E-01   0.8160876E-01   0.8825073E-01   0.9552856E-01   0.1035067E 00
0.1122557E 00   0.1218524E 00   0.1323804E 00   0.1439300E 00   0.1565984E 00   0.1704894E 00
0.1857127E 00   0.2023829E 00   0.2206170E 00   0.2405309E 00   0.2622337E 00   0.2858183E 00
0.3113485E 00   0.3388399E 00   0.3682364E 00   0.3993847E 00   0.4320122E 00   0.4657200E 00
0.5CCCCCCE CO
0.7060623E-01   0.7622362E-01   0.8237474E-01   0.8911441E-01   0.9650285E-01   0.1046060E 00
0.1134958E 00   0.1232505E 00   0.1339547E 00   0.1456994E 00   0.1585815E 00   0.1727031E 00
0.1881704E 00   0.2050914E 00   0.2235724E 00   0.2437139E CO   0.2656C25E 00   0.2893C24E 00
0.3148422E 00   0.3421993E 00   0.3712832E 00   0.4019193E 00   0.4338385E 00   0.4666783E 00
0.5CCCCCCE 00
0.7097129E-01   0.7663462E-01   0.8283785E-01   0.8963658E-01   0.9709184E-01   0.1052704E 00
0.1142451E 00   0.1240948E 00   0.1349048E 00   0.1467662E 00   0.1597756E 00   0.1740339E 00
0.1896446E 00   0.2067116E 00   0.2253344E 00   0.2456034E 00   0.2675923E 00   0.2913482E 00
0.31688C0E 00   0.3441449E 00   0.3730350E 00   0.4033668E 00   0.4348755E 00   0.4672204E 00
0.5CCCCCCE 00
0.7109344E-01   0.7677214E-01   0.8299281E-01   0.8981129E-01   0.9728890E-01   0.1054927E 00
0.1144957E 00   0.1243771E 00   0.1352224E 00   0.1471226E 00   0.1601743E 00   0.1744778E 00
0.1901359E 00   0.2072507E 00   0.2259196E 00   0.2462298E 00   0.2682503E 00   0.2920227E 00
0.3175497E 00   0.3447820E 00   0.3736067E 00   0.4038376E 00   0.4352120E 00   0.4673960E 00
0.5CCCCCCE 00
0.7097129E-01   0.7663462E-01   0.8283785E-01   0.8963658E-01   0.9709184E-01   0.1052704E 00
0.1142451E 00   0.1240948E 00   0.1349048E 00   0.1467662E 00   0.1597756E CO   0.1740339E 00
```

Figure 13. Group A Sample Problems Program Results (Sheet 11 of 35)

| | | | | | |
|---|---|---|---|---|---|
| 0.1896446E 00 | 0.2067116E 00 | 0.2253344E 00 | 0.2456034E 00 | 0.2675923E 00 | 0.2913483E 00 |
| 0.3168800E 00 | 0.3441449E 00 | 0.3730350E 00 | 0.4033668E 00 | 0.4348755E 00 | 0.4672204E 00 |
| 0.5CCCCCCE CO | | | | | |
| 0.7060623E-01 | 0.7622362E-01 | 0.8237474E-01 | 0.8911441E-01 | 0.9650285E-01 | 0.1046060E 00 |
| 0.1134958E 00 | 0.1232505E 00 | 0.1339547E 00 | 0.1456994E 00 | 0.1585815E 00 | 0.1727031E 00 |
| 0.1881704E 00 | 0.2050914E 00 | 0.2235724E 00 | 0.2437139E 00 | 0.2656025E 00 | 0.2893024E 00 |
| 0.3148422E 00 | 0.3421993E 00 | 0.3712832E 00 | 0.4019193E 00 | 0.4338385E 00 | 0.4666783E 00 |
| 0.5CCCCCCE 00 | | | | | |
| 0.7000236E-01 | 0.7554381E-01 | 0.8160876E-01 | 0.8825073E-01 | 0.9552856E-01 | 0.1035067E 00 |
| 0.1122557E 00 | 0.1218524E 00 | 0.1323804E 00 | 0.1439300E 00 | 0.1565984E 00 | 0.1704894E 00 |
| 0.1857127E 00 | 0.2023829E 00 | 0.2206170E 00 | 0.2405309E 00 | 0.2622337E 00 | 0.2858183E 00 |
| 0.3113465E 00 | 0.3388399E 00 | 0.3682364E 00 | 0.3993847E 00 | 0.4320122E 00 | 0.4657200E 00 |
| 0.5CCCCCCE 00 | | | | | |
| 0.6916649E-01 | 0.7460293E-01 | 0.8054869E-01 | 0.8705545E-01 | 0.9418001E-01 | 0.1019848E 00 |
| 0.1105380E 00 | 0.1199145E 00 | 0.1301962E 00 | 0.1414719E 00 | 0.1538385E 00 | 0.1674011E 00 |
| 0.1822734E 00 | 0.1985775E 00 | 0.2164437E 00 | 0.2360083E 00 | 0.2574107E 00 | 0.2807856E 00 |
| 0.3062500E 00 | 0.3338818E 00 | 0.3636870E 00 | 0.3955580E 00 | 0.4292293E 00 | 0.4642507E 00 |
| 0.5CCCCCCE 00 | | | | | |
| 0.6810803E-01 | 0.7341175E-01 | 0.7920678E-01 | 0.8554240E-01 | 0.9247279E-01 | 0.1000575E 00 |
| 0.1083618E 00 | 0.1174576E 00 | 0.1274235E 00 | 0.1383464E 00 | 0.1503215E 00 | 0.1634541E 00 |
| 0.1778607E 00 | 0.1936706E 00 | 0.2110276E 00 | 0.2300914E 00 | 0.2510376E 00 | 0.2740546E 00 |
| 0.2993340E 00 | 0.3270483E 00 | 0.3573098E 00 | 0.3901042E 00 | 0.4252061E 00 | 0.4621057E 00 |
| 0.5CCCCCCE 00 | | | | | |
| 0.6683890E-01 | 0.7198393E-01 | 0.7759863E-01 | 0.8372935E-01 | 0.9042696E-01 | 0.9774738E-01 |
| 0.1057520E 00 | 0.1145086E 00 | 0.1240917E 00 | 0.1345840E 00 | 0.1460774E 00 | 0.1586752E 00 |
| 0.1724943E 00 | 0.1876684E 00 | 0.2043526E 00 | 0.2227285E 00 | 0.2430098E 00 | 0.2654470E 00 |
| 0.2903267E 00 | 0.3179569E 00 | 0.3486229E 00 | 0.3824940E 00 | 0.4194698E 00 | 0.4590003E 00 |
| 0.5CCCCCCE 00 | | | | | |
| 0.6537342E-01 | 0.7033587E-01 | 0.7574306E-01 | 0.8163780E-01 | 0.8806704E-01 | 0.9508227E-01 |
| 0.1027400E 00 | 0.1111026E 00 | 0.1202390E 00 | 0.1302257E 00 | 0.1411489E 00 | 0.1531066E 00 |
| 0.1662118E 00 | 0.1805977E 00 | 0.1964244E 00 | 0.2138885E 00 | 0.2332360E 00 | 0.2547786E 00 |
| 0.2789098E 00 | 0.3061129E 00 | 0.3369378E 00 | 0.3718967E 00 | 0.4112149E 00 | 0.4544210E 00 |
| 0.5CCCCCCE 00 | | | | | |
| 0.6372799E-01 | 0.6848651E-01 | 0.7366185E-01 | 0.7929282E-01 | 0.8542179E-01 | 0.9209504E-01 |
| 0.9936325E-01 | 0.1072821E 00 | 0.1159130E 00 | 0.1253244E 00 | 0.1355937E 00 | 0.1468093E 00 |
| 0.1590750E 00 | 0.1725157E 00 | 0.1872861E 00 | 0.2035843E 00 | 0.2216715E 00 | 0.2419023E 00 |
| 0.2647654E 00 | 0.2909358E 00 | 0.3213185E 00 | 0.3570123E 00 | 0.3990102E 00 | 0.4473658E 00 |
| 0.5CCCCCCE 00 | | | | | |
| 0.6192094E-01 | 0.6645700E-01 | 0.7137946E-01 | 0.7672266E-01 | 0.8252385E-01 | 0.8882341E-01 |
| 0.9566517E-01 | 0.1030970E 00 | 0.1111711E 00 | 0.1199457E 00 | 0.1294859E 00 | 0.1398664E 00 |
| 0.1511751E 00 | 0.1635191E 00 | 0.1770341E 00 | 0.1918991E 00 | 0.2083612E 00 | 0.2267756E 00 |
| 0.2476721E 00 | 0.2718643E 00 | 0.3006195E 00 | 0.3358659E 00 | 0.3801884E 00 | 0.4356357E 00 |
| 0.5CCCCCCE 00 | | | | | |

Figure 13. Group A Sample Problems Program Results (Sheet 12 of 35)

| | | | | | |
|---|---|---|---|---|---|
| 0.5997213E-01 | 0.6427035E-01 | 0.6892256E-01 | 0.7395828E-01 | 0.7940921E-01 | 0.8530921E-01 |
| 0.9169456E-01 | 0.9860413E-01 | 0.1060798E 00 | 0.1141671E 00 | 0.1229162E 00 | 0.1323835E 00 |
| 0.1426349E 00 | 0.1537498E 00 | 0.1658296E 00 | 0.1790103E 00 | 0.1934858E 00 | 0.2095478E 00 |
| 0.2276613E 00 | 0.2486091E 00 | 0.2737869E 00 | 0.3058147E 00 | 0.3496924E 00 | 0.4135156E 00 |
| 0.5CCCCCCE 00 | | | | | |
| 0.5790261E-01 | 0.6195098E-01 | 0.6631951E-01 | 0.7103273E-01 | 0.7611643E-01 | 0.8159761E-01 |
| 0.8750442E-01 | 0.9386609E-01 | 0.1007129E 00 | 0.1080764E 00 | 0.1159894E 00 | 0.1244870E 00 |
| 0.1336074E 00 | 0.1433945E 00 | 0.1539020E 00 | 0.1652008E 00 | 0.1773929E 00 | 0.1906369E 00 |
| 0.2051995E 00 | 0.2215649E 00 | 0.2406956E 00 | 0.2647418E 00 | 0.2993620E 00 | 0.3627492E 00 |
| 0.5CCCCCCE 00 | | | | | |
| 0.5573420E-01 | 0.5952419E-01 | 0.6359978E-01 | 0.6798038E-01 | 0.7268577E-01 | 0.7773592E-01 |
| 0.8315061E-01 | 0.8894909E-01 | 0.9514960E-01 | 0.1017688E 00 | 0.1088213E 00 | 0.1163187E 00 |
| 0.1242689E 00 | 0.1326757E 00 | 0.1415374E 00 | 0.1508464E 00 | 0.1605884E 00 | 0.1707421E 00 |
| 0.1812784E 00 | 0.1921608E 00 | 0.2033451E 00 | 0.2147805E 00 | 0.2264099E 00 | 0.2381714E 00 |
| 0.25CCCCCE 00 | | | | | |

Figure 13. Group A Sample Problems Program Results (Sheet 13 of 35)

```
                NAA CONFAC I  REPORT SAMPLE PROBLEMS GROUP A   K.A.TOUPS,7/31/65

RUN NO.   3   DATA USED FOR THIS RUN- *1FLOOR*2WALLS*
                                      *      *      *
                                      *      *      *

THE FORM FACTOR FROM SURFACE *1FLOOR      * TO SURFACE *2WALLS      * = 0.39992

THE EXCHANGE COEFFICIENT (FA) =   0.39992E 00 SQ UNITS

                THE MAPPING AREA = 0.1000000E 01 SQ UNITS

THE AREA OF SURFACE *1FLOOR      * = 0.1000000E 01 SQ UNITS.

THE AREA OF SURFACE *2WALLS      * = 0.1000000E 01 SQ UNITS.

THE FORM FACTOR FROM SURFACE *2WALLS      * TO SURFACE *1FLOOR      * = 0.39992
THIS SURFACE IS NONPLANAR-THE COMPUTED AREAS AND THE FACTOR FROM THIS SURFACE MAY BE INCORRECT.


WARNING-WARNING

AN INCORRECT FACTOR WILL RESULT IF
1) SURFACE 1 IS SUBSTANTIALLY NONPLANAR, OR
2) IF SURFACE 2 IS NONPLANAR, AND THE INPUT DATA DOES NOT DEFINE THE SILHOUETTE AS IT ACTUALLY
   APPEARS FROM ANY AND ALL POINTS ON THE ACTIVE SIDE OF SURFACE 1.

STUDY THE FINAL SURFACE COORDINATES BELOW.  NO LARGE NEGATIVE Z COORDINATES SHOULD APPEAR.


THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-

    DATA NAME *1FLOOR      *

POINT       X               Y               Z            POINT      X               Y               Z
       0.10CC000E 01 -0.CC00000E-38  0.1000000E 01 (INTERNALLY GENERATED ORIENTATION VECTOR)
   1   0.100CC00E 01  0.CCC0000E-38  0.0000000E-38       2   0.1000000E 01  0.1000000E 01  0.0000000E-38
   3   C.CCC0C00E-38  0.1C00000E 01  0.0000000E-38       4   0.CCC0000E-38  0.CC0CC00E-38  0.0000000E-38

    DATA NAME *2WALLS      *

POINT       X               Y               Z            POINT      X               Y               Z
```

Figure 13. Group A Sample Problems Program Results (Sheet 14 of 35)



NORTH AMERICAN AVIATION, INC.

SPACE and INFORMATION SYSTEMS DIVISION

```
      0.1000000E 01 -0.0000000E-38  0.1000000E 01 (INTERNALLY GENERATED ORIENTATION VECTOR)
  1   0.0000000E-38  0.0000000E-38  0.1000000E 01      2   0.0000000E-38  0.0000000E-38  0.0000000E-38
  3   0.0000000E-38  0.1000000E 01  0.0000000E-38      4   0.1000000E 01  0.1000000E 01  0.0000000E-38
  5   0.1000000E 01  0.1000000E 01  0.1000000E 01      6   0.0000000E-38  0.1000000E 01  0.1000000E 01

COORDINATES OF POINTS ON BOUNDARY OF SURF     *1FLOOR      * FOR EACH Y INTERVAL

      X-LEFT          X-RIGHT          Y                    X-LEFT          X-RIGHT          Y

 0.0000000E-38  0.1000000E 01  0.0000000E-38        0.0000000E-38  0.1000000E 01  0.4166667E-01
 0.0000000E-38  0.1000000E 01  0.8333333E-01        0.0000000E-38  0.1000000E 01  0.1250000E 00
 0.0000000E-38  0.1000000E 01  0.1666667E 00       0.0000000E-38  0.1000000E 01  0.2083333E 00
 0.0000000E-38  0.1000000E 01  0.2500000E 00       0.0000000E-38  0.1000000E 01  0.2916667E 00
 0.0000000E-38  0.1000000E 01  0.3333333E 00       0.0000000E-38  0.1000000E 01  0.3750000E 00
 0.0000000E-38  0.1000000E 01  0.4166667E 00       0.0000000E-38  0.1000000E 01  0.4583333E 00
 0.0000000E-38  0.1000000E 01  0.5000000E 00       0.0000000E-38  0.1000000E 01  0.5416666E 00
 0.0000000E-38  0.1000000E 01  0.5833333E 00       0.0000000E-38  0.1000000E 01  0.6250000E 00
 0.0000000E-38  0.1000000E 01  0.6666666E 00       0.0000000E-38  0.1000000E 01  0.7083333E 00
 0.0000000E-38  0.1000000E 01  0.7500000E 00       0.0000000E-38  0.1000000E 01  0.7916666E 00
 0.0000000E-38  0.1000000E 01  0.8333333E 00       0.0000000E-38  0.1000000E 01  0.8750000E 00
 0.0000000E-38  0.1000000E 01  0.9166666E 00       0.0000000E-38  0.1000000E 01  0.9583333E 00
 0.0000000E-38  0.1000000E 01  0.1000000E 01

NO. OF HORIZONTAL INCREMENTS= 24  NO. OF VERTICAL INCREMENTS= 24

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

 0.3057342E 00  0.2960740E 00  0.2863820E 00  0.2767014E 00  0.2670731E 00  0.2575342E 00
 0.2481173E 00  0.2388501E 00  0.2297549E 00  0.2208487E 00  0.2121436E 00  0.2036470E 00
 0.1953623E 00  0.1872899E 00  0.1794275E 00  0.1717712E 00  0.1643161E 00  0.1570571E 00
 0.1499895E 00  0.1431093E 00  0.1364138E 00  0.1299013E 00  0.1235719E 00  0.1174268E 00
 0.1114684E 00
 0.5595242E 00  0.4246699E 00  0.3636322E 00  0.3311987E 00  0.3091820E 00  0.2919007E 00
 0.2771834E 00  0.2640486E 00  0.2519958E 00  0.2407446E 00  0.2301255E 00  0.2200291E 00
 0.2103795E 00  0.2011216E 00  0.1922130E 00  0.1836202E 00  0.1753158E 00  0.1672778E 00
 0.1594883E 00  0.1519335E 00  0.1446029E 00  0.1374897E 00  0.1305899E 00  0.1239020E 00
 0.1174266E 00
 0.5635994E 00  0.4736549E 00  0.4186149E 00  0.3771940E 00  0.3474486E 00  0.3243521E 00
 0.3052594E 00  0.2887545E 00  0.2740344E 00  0.2606191E 00  0.2482043E 00  0.2365876E 00
```

Figure 13. Group A Sample Problems Program Results (Sheet 15 of 35)

0.2256277E 00 0.2152214E 00 0.2052909E 00 0.1957759E 00 0.1866285E 00 0.1778109E 00
0.1692932E 00 0.1610522E 00 0.1530710E 00 0.1453377E 00 0.1378451E 00 0.1305899E 00
0.1235719E 00
0.5679804E 00 0.5066683E 00 0.4541465E 00 0.4125885E 00 0.3799123E 00 0.3535020E 00
0.3314013E 00 0.3123179E 00 0.2954166E 00 0.2801497E 00 0.2661484E 00 0.2531557E 00
0.2409864E 00 0.2295030E 00 0.2186003E 00 0.2081965E 00 0.1982266E 00 0.1886393E 00
0.1793945E 00 0.1704612E 00 0.1618167E 00 0.1534453E 00 0.1453377E 00 0.1374897E 00
0.1299013E 00
0.5726858E 00 0.5234821E 00 0.4784193E 00 0.4395360E 00 0.4067403E 00 0.3790028E 00
0.3551923E 00 0.3343750E 00 0.3158515E 00 0.2991128E 00 0.2837889E 00 0.2696075E 00
0.2563639E 00 0.2439011E 00 0.2320965E 00 0.2208530E 00 0.2100930E 00 0.1997548E 00
0.1897902E 00 0.1801621E 00 0.1708436E 00 0.1618167E 00 0.1530710E 00 0.1446029E 00
0.1364138E 00
0.5777359E 00 0.5360185E 00 0.4965240E 00 0.4607200E 00 0.4290327E 00 0.4011951E 00
0.3766571E 00 0.3548360E 00 0.3352207E 00 0.3173952E 00 0.3010304E 00 0.2858681E 00
0.2717044E 00 0.2583769E 00 0.2457549E 00 0.2337323E 00 0.2222237E 00 0.2111601E 00
0.2004874E 00 0.1901645E 00 0.1801621E 00 0.1704612E 00 0.1610523E 00 0.1519335E 00
0.1431093E 00
0.5831506E 00 0.5465046E 00 0.5111643E 00 0.4781591E 00 0.4479860E 00 0.4206968E 00
0.3960787E 00 0.3738087E 00 0.3535477E 00 0.3349841E 00 0.3178484E 00 0.3019134E 00
0.2869859E 00 0.2729203E 00 0.2595732E 00 0.2468396E 00 0.2346297E 00 0.2228704E 00
0.2115041E 00 0.2004874E 00 0.1897902E 00 0.1793945E 00 0.1692932E 00 0.1594883E 00
0.1499895E 00
0.5889491E 00 0.5559717E 00 0.5238102E 00 0.4932011E 00 0.4645918E 00 0.4381509E 00
0.4138423E 00 0.3915121E 00 0.3709522E 00 0.3519438E 00 0.3342781E 00 0.3177654E 00
0.3022378E 00 0.2875489E 00 0.2735720E 00 0.2601988E 00 0.2473381E 00 0.2349151E 00
0.2228704E 00 0.2111601E 00 0.1997548E 00 0.1886393E 00 0.1778109E 00 0.1672778E 00
0.1570571E 00
0.5951496E 00 0.5649636E 00 0.5353090E 00 0.5067291E 00 0.4795999E 00 0.4541207E 00
0.4303417E 00 0.4082091E 00 0.3876069E 00 0.3683887E 00 0.3503984E 00 0.3334824E 00
0.3174958E 00 0.3023059E 00 0.2877932E 00 0.2738522E 00 0.2603924E 00 0.2473381E 00
0.2346297E 00 0.2222237E 00 0.2100930E 00 0.1982266E 00 0.1866285E 00 0.1753158E 00
0.1643161E 00
0.6017688E 00 0.5737963E 00 0.5461792E 00 0.5193303E 00 0.4935607E 00 0.4690655E 00
0.4459324E 00 0.4241647E 00 0.4037055E 00 0.3844608E 00 0.3663163E 00 0.3491491E 00
0.3328353E 00 0.3172556E 00 0.3022978E 00 0.2878600E 00 0.2738522E 00 0.2601988E 00
0.2468396E 00 0.2337323E 00 0.2208530E 00 0.2081965E 00 0.1957758E 00 0.1836202E 00
0.1717712E 00
0.6088213E 00 0.5826676E 00 0.5567546E 00 0.5314052E 00 0.5068769E 00 0.4833481E 00
0.4609195E 00 0.4396239E 00 0.4194409E 00 0.4003122E 00 0.3821539E 00 0.3648669E 00
0.3483446E 00 0.3324786E 00 0.3171629E 00 0.3022978E 00 0.2877932E 00 0.2735720E 00
0.2595732E 00 0.2457549E 00 0.2320965E 00 0.2186003E 00 0.2052909E 00 0.1922130E 00
0.1794275E 00

Figure 13. Group A Sample Problems Program Results (Sheet 16 of 35)

```
0.6163187E 00   0.5917073E 00   0.5672590E 00   0.5432331E 00   0.5198442E 00   0.4972514E 00
0.4755552E 00   0.4548023E 00   0.4349934E 00   0.4160927E 00   0.3980374E 00   0.3807454E 00
0.3641224E 00   0.3480677E 00   0.3324786E 00   0.3172556E 00   0.3023059E 00   0.2875489E 00
0.2729202E 00   0.2583769E 00   0.2439011E 00   0.2295029E 00   0.2152213E 00   0.2011216E 00
0.1872899E 00
0.6242689E 00   0.6010033E 00   0.5778468E 00   0.5550126E 00   0.5326816E 00   0.5109937E 00
0.4900439E 00   0.4698833E 00   0.4505236E 00   0.4319424E 00   0.4140900E 00   0.3968953E 00
0.3802718E 00   0.3641224E 00   0.3483447E 00   0.3328353E 00   0.3174958E 00   0.3022378E 00
0.2869899E 00   0.2717044E 00   0.2563639E 00   0.2409863E 00   0.2256277E 00   0.2103795E 00
0.1953623E 00
0.6326757E 00   0.6106148E 00   0.5886253E 00   0.5668858E 00   0.5455506E 00   0.5247425E 00
0.5045483E 00   0.4850188E 00   0.4661699E 00   0.4479863E 00   0.4304256E 00   0.4134231E 00
0.3968953E 00   0.3807454E 00   0.3648669E 00   0.3491491E 00   0.3334823E 00   0.3177654E 00
0.3019134E 00   0.2858681E 00   0.2696075E 00   0.2531556E 00   0.2365876E 00   0.2200290E 00
0.2036470E 00
0.6415373E 00   0.6205801E 00   0.5996680E 00   0.5789533E 00   0.5585693E 00   0.5386236E 00
0.5191947E 00   0.5003300E 00   0.4820461E 00   0.4643307E 00   0.4471448E 00   0.4304256E 00
0.4140900E 00   0.3980374E 00   0.3821539E 00   0.3663163E 00   0.3503984E 00   0.3342781E 00
0.3178484E 00   0.3010303E 00   0.2837889E 00   0.2661484E 00   0.2482043E 00   0.2301255E 00
0.2121436E 00
0.6508463E 00   0.6309207E 00   0.6110224E 00   0.5912836E 00   0.5718205E 00   0.5527283E 00
0.5340769E 00   0.5159097E 00   0.4982419E 00   0.4810617E 00   0.4643307E 00   0.4479862E 00
0.4319424E 00   0.4160927E 00   0.4003122E 00   0.3844608E 00   0.3683887E 00   0.3519438E 00
0.3349841E 00   0.3173951E 00   0.2991127E 00   0.2801497E 00   0.2606190E 00   0.2407445E 00
0.2208487E 00
0.6605884E 00   0.6416435E 00   0.6227150E 00   0.6039190E 00   0.5853584E 00   0.5671177E 00
0.5492597E 00   0.5318231E 00   0.5148214E 00   0.4982419E 00   0.4820461E 00   0.4661698E 00
0.4505236E 00   0.4349934E 00   0.4194409E 00   0.4037055E 00   0.3876069E 00   0.3709521E 00
0.3535477E 00   0.3352207E 00   0.3158515E 00   0.2954165E 00   0.2740344E 00   0.2519958E 00
0.2297549E 00
0.6707421E 00   0.6527425E 00   0.6347538E 00   0.6168797E 00   0.5992120E 00   0.5818268E 00
0.5647808E 00   0.5481091E 00   0.5318231E 00   0.5159097E 00   0.5003300E 00   0.4850188E 00
0.4698833E 00   0.4548023E 00   0.4396239E 00   0.4241647E 00   0.4082091E 00   0.3915121E 00
0.3738087E 00   0.3548360E 00   0.3343750E 00   0.3123179E 00   0.2887545E 00   0.2640486E 00
0.2388501E 00
0.6812784E 00   0.6641997E 00   0.6471309E 00   0.6301660E 00   0.6133881E 00   0.5968665E 00
0.5806533E 00   0.5647808E 00   0.5492597E 00   0.5340769E 00   0.5191947E 00   0.5045483E 00
0.4900438E 00   0.4755551E 00   0.4609195E 00   0.4459324E 00   0.4303416E 00   0.4138425E 00
0.3960787E 00   0.3766570E 00   0.3551922E 00   0.3314013E 00   0.3052598E 00   0.2771833E 00
0.2481173E 00
0.6921608E 00   0.6759857E 00   0.6598238E 00   0.6437608E 00   0.6278734E 00   0.6122257E 00
0.5968665E 00   0.5818268E 00   0.5671177E 00   0.5527283E 00   0.5386236E 00   0.5247425E 00
0.5109937E 00   0.4972513E 00   0.4833481E 00   0.4690654E 00   0.4541206E 00   0.4381509E 00
```

Figure 13. Group A Sample Problems Program Results (Sheet 17 of 35)

| | | | | | |
|---|---|---|---|---|---|
| 0.4206968E 00 | 0.4011951E 00 | 0.3790027E 00 | 0.3535020E 00 | 0.3243520E 00 | 0.2919C07E 00 |
| 0.2575342E 00 | | | | | |
| 0.7033451E 00 | 0.6880612E 00 | 0.6727969E 00 | 0.6576316E 00 | 0.6426369E 00 | 0.6278734E 00 |
| 0.6133881E 00 | 0.5992120E 00 | 0.5853584E 00 | 0.5718205E 00 | 0.5585693E 00 | 0.5455506E 00 |
| 0.5326816E 00 | 0.5198442E 00 | 0.5068768E 00 | 0.4935607E 00 | 0.4795599E 00 | 0.4645918E 00 |
| 0.4479860E 00 | 0.4290327E 00 | 0.4067402E 00 | 0.3799122E 00 | 0.3474485E 00 | 0.3091820E 00 |
| 0.2677731E 00 | | | | | |
| 0.7147804E 00 | 0.7003773E 00 | 0.6860028E 00 | 0.6717317E 00 | 0.6576316E 00 | 0.6437608E 00 |
| 0.6301660E 00 | 0.6168797E 00 | 0.6039190E 00 | 0.5912836E 00 | 0.5789533E 00 | 0.5668858E 00 |
| 0.5550126E 00 | 0.5432331E 00 | 0.5314052E 00 | 0.5193303E 00 | 0.5067290E 00 | 0.4932011E 00 |
| 0.4781591E 00 | 0.4607200E 00 | 0.4395360E 00 | 0.4125884E 00 | 0.3771939E 00 | 0.3311986E 00 |
| 0.2767014E 00 | | | | | |
| 0.7264098E 00 | 0.7128772E 00 | 0.6993846E 00 | 0.6860028E 00 | 0.6727969E 00 | 0.6598238E 00 |
| 0.6471309E 00 | 0.6347538E 00 | 0.6227150E 00 | 0.6110224E 00 | 0.5996679E 00 | 0.5886253E 00 |
| 0.5778468E 00 | 0.5672590E 00 | 0.5567545E 00 | 0.5461792E 00 | 0.5353090E 00 | 0.5238101E 00 |
| 0.5111642E 00 | 0.4965239E 00 | 0.4784192E 00 | 0.4541465E 00 | 0.4186147E 00 | 0.3636320E 00 |
| 0.2863820E 00 | | | | | |
| 0.7381714E 00 | 0.7254978E 00 | 0.7128772E 00 | 0.7003773E 00 | 0.6880612E 00 | 0.6759857E 00 |
| 0.6641996E 00 | 0.6527425E 00 | 0.6416435E 00 | 0.6309207E 00 | 0.6205801E 00 | 0.6106148E 00 |
| 0.6010033E 00 | 0.5917073E 00 | 0.5826676E 00 | 0.5737963E 00 | 0.5649635E 00 | 0.5559717E 00 |
| 0.5465046E 00 | 0.5360184E 00 | 0.5234821E 00 | 0.5066682E 00 | 0.4798348E 00 | 0.4246997E 00 |
| 0.2960740E 00 | | | | | |
| 0.5CCCCCCC 00 | 0.7381714E 00 | 0.7264098E 00 | 0.7147805E 00 | 0.7033451E 00 | 0.6921608E 00 |
| 0.6812784E 00 | 0.6707421E 00 | 0.6605884E 00 | 0.6508463E 00 | 0.6415374E 00 | 0.6326757E 00 |
| 0.6242689E 00 | 0.6163187E 00 | 0.6088213E 00 | 0.6017688E 00 | 0.5951496E 00 | 0.5889491E 00 |
| 0.5831506E 00 | 0.5777359E 00 | 0.5726858E 00 | 0.5679804E 00 | 0.5635998E 00 | 0.5595242E 00 |
| 0.3057342E 00 | | | | | |

Figure 13. Group A Sample Problems Program Results (Sheet 18 of 35)

```
RUN NO.   4   DATA USED FOR THIS RUN- *2WALLS*1FLOOR*
                                      *      *      *
                                      *      *      *

WARNING-EXAMINATION OF SURFACE 2WALLS INDICATES IT IS SUBSTANTIALLY NONPLANAR AND SHOULD NOT BE USED
AS SURFACE 1.

THE FORM FACTOR FROM SURFACE *2WALLS      * TO SURFACE *1FLOOR      * = 0.19996

THE EXCHANGE COEFFICIENT (FA) =   0.19996E 00 SQ UNITS

                  THE MAPPING AREA = 0.1000000E 01 SQ UNITS

THE AREA OF SURFACE *2WALLS      * = 0.1000000E 01 SQ UNITS.
THIS SURFACE IS NONPLANAR-THE COMPUTED AREAS AND THE FACTOR FROM THIS SURFACE MAY BE INCORRECT.

THE AREA OF SURFACE *1FLOOR      * = 0.1000000E 01 SQ UNITS.

THE FORM FACTOR FROM SURFACE *1FLOOR      * TO SURFACE *2WALLS      * = 0.19996

WARNING-WARNING

AN INCORRECT FACTOR WILL RESULT IF
1) SURFACE 1 IS SUBSTANTIALLY NONPLANAR, OR
2) IF SURFACE 2 IS NONPLANAR, AND THE INPUT DATA DOES NOT DEFINE THE SILHOUETTE AS IT ACTUALLY
   APPEARS FROM ANY AND ALL POINTS ON THE ACTIVE SIDE OF SURFACE 1.

STUDY THE FINAL SURFACE COORDINATES BELOW.  NO LARGE NEGATIVE Z COORDINATES SHOULD APPEAR.

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-

    DATA NAME *2WALLS      *

POINT       X              Y              Z              POINT       X              Y              Z
                                                         (INTERNALLY GENERATED ORIENTATION VECTOR)
      C.CCCCCCCE-38  0.CCCCCCCE-38  0.1000000E 01      2   0.10CCCCCE 01  0.CCCCCCCE-38  0.CCCCCCCE-38
  1   C.CCCCCCCE-38  0.CCCCCCCE-38  0.CCCCCCCE-38      4   0.1CCCCCCE 01  0.10CCCCCE 01  0.1000000E 01
  3   C.10CCCCCE 01  0.1CCCCCCE 01  0.CCCCCCCE-38
```

Figure 13. Group A Sample Problems Program Results (Sheet 19 of 35)





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```
    5    0.CCCCCCCE-38  0.1C000000E 01  0.1000000E 01        6    0.00C0C00E-38  0.1CC0000E 01  0.0000000E-38

     DATA NAME *1FLOOR      *

POINT        X              Y              Z          POINT      X              Y              Z
        0.CCCCCCCE-38  0.C000000E-38  0.1000000E 01 (INTERNALLY GENERATED ORIENTATION VECTOR)
    1   0.10CC000E 01  0.0CCC000E-38  0.1000000E 01        2   0.1000C00E 01  0.1000000E 01  0.1000000E 01
    3   0.1CCC000E 01  0.1C000000E 01  0.0000000E-38        4   0.1CC0000E 01  0.C000000E-38  0.0000000E-38

COORDINATES OF POINTS ON BOUNDARY OF SURF     *2WALLS       * FOR EACH Y INTERVAL

      X-LEFT          X-RIGHT          Y                      X-LEFT          X-RIGHT          Y

  0.0C000000E-38  0.1C000000E 01  0.0000000E-38          0.0000000E-38  0.1000000E 01  0.4166667E-01
  0.CCCCCCCCE-38  0.1C000000E 01  0.8333333E-01          0.0000000E-38  0.1000000E 01  0.1250000E 00
  0.CCCCCCCCE-38  0.1C000000E 01  0.1666667E 00          0.0000000E-38  0.1000000E 01  0.2083333E 00
  0.CCCCCCCCE-38  0.1CCC0000E 01  0.2500000E 00          0.CCC0000E-38  0.1000000E 01  0.2916667E 00
  0.0CCCCCCCE-38  0.1000000E 01  0.3333333E 00          0.0000000E-38  0.1000000E 01  0.3750000E 00
  0.CCCCCCCCE-38  0.1CCC0000E 01  0.4166667E 00          0.CCC0000E-38  0.1000000E 01  0.4583333E 00
  0.CCCCCCCCE-38  0.1CCC0000E 01  0.5000000E 00          0.CCC0000E-38  0.1000000E 01  0.5416666E 00
  0.CCCCCCCCE-38  0.1C000000E 01  0.5833333E 00          0.C000000E-38  0.1000000E 01  0.6250000E 00
  0.0C000CCCE-38  0.1CCCC00E 01  0.6666666E 00          0.0000000E-38  0.1000000E 01  0.7083333E 00
  0.CCCCCCCCE-38  0.1CCC0000E 01  0.7500000E 00          0.C000000E-38  0.1000C00E 01  0.7916666E 00
  0.CCCCCCCCE-38  0.1000000E 01  0.8333333E 00          0.0000000E-38  0.1000000E 01  0.8750000E 00
  0.CCCCCCCCE-38  0.1CCC0000E 01  0.9166666E 00          0.CCCCC00E-38  0.1000000E 01  0.9583333E 00
  0.CCCCCCCCE-38  0.1000000E 01  0.1000000E 01

NO. OF HORIZONTAL INCREMENTS= 24  NO. OF VERTICAL INCREMENTS= 24

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

  0.5573420E-01  0.5952419E-01  0.6359978E-01  0.6798038E-01  0.7268577E-01  0.7773592E-01
  0.8315061E-01  0.8894909E-01  0.9514960E-01  0.1017688E 00  0.1088213E 00  0.1163187E 00
  0.1242689E 00  0.1326757E 00  0.1415374E 00  0.1508464E 00  0.1605884E 00  0.1707421E 00
  0.1812784E 00  0.1921608E 00  0.2033451E 00  0.2147805E 00  0.2264099E 00  0.2381714E 00
  0.2500000E 00
  0.5790261E-01  0.6195098E-01  0.6631951E-01  0.7103273E-01  0.7611643E-01  0.8159761E-01
  0.8750442E-01  0.9386608E-01  0.1007129E 00  0.1080764E 00  0.1159894E 00  0.1244870E 00
  0.1336074E 00  0.1433945E 00  0.1539019E 00  0.1652008E 00  0.1773929E 00  0.1906369E 00
```

Figure 13. Group A Sample Problems Program Results (Sheet 20 of 35)

| | | | | | |
|---|---|---|---|---|---|
| 0.2051995E 00 | 0.2215649E 00 | 0.2406956E 00 | 0.2647418E 00 | 0.2993619E 00 | 0.3627491E 00 |
| 0.5C000C0E 00 | | | | | |
| 0.5997213E-01 | 0.6427035E-01 | 0.6892255E-01 | 0.7395828E-01 | 0.7940920E-01 | 0.8530920E-01 |
| 0.9169455E-01 | 0.9860413E-01 | 0.1060798E 00 | 0.1141671E 00 | 0.1229162E 00 | 0.1323835E 00 |
| 0.1426349E 00 | 0.1537498E 00 | 0.1658296E 00 | 0.1790103E 00 | 0.1934858E 00 | 0.2095478E 00 |
| 0.2276612E 00 | 0.2486091E 00 | 0.2737868E 00 | 0.3058146E 00 | 0.3496924E 00 | 0.4135155E 00 |
| 0.5CCCC0E 00 | | | | | |
| 0.6192094E-01 | 0.6645700E-01 | 0.7137946E-01 | 0.7672266E-01 | 0.8252385E-01 | 0.8882340E-01 |
| 0.9566517E-01 | 0.1030969E 00 | 0.1111711E 00 | 0.1199457E 00 | 0.1294859E 00 | 0.1398664E 00 |
| 0.1511751E 00 | 0.1635191E 00 | 0.1770340E 00 | 0.1918990E 00 | 0.2083612E 00 | 0.2267756E 00 |
| 0.2476720E 00 | 0.2718643E 00 | 0.3006195E 00 | 0.3358659E 00 | 0.3801883E 00 | 0.4356357E 00 |
| 0.5CCOC00E 00 | | | | | |
| 0.6372799E-01 | 0.6848651E-01 | 0.7366185E-01 | 0.7929282E-01 | 0.8542179E-01 | 0.9209504E-01 |
| 0.9936325E-01 | 0.1072821E 00 | 0.1159130E 00 | 0.1253244E 00 | 0.1355937E 00 | 0.1468093E 00 |
| 0.1590750E 00 | 0.1725157E 00 | 0.1872861E 00 | 0.2035842E 00 | 0.2216715E 00 | 0.2419023E 00 |
| 0.2647653E 00 | 0.2909358E 00 | 0.3213185E 00 | 0.3570122E 00 | 0.3990102E 00 | 0.4473658E 00 |
| 0.5C000C0E 00 | | | | | |
| 0.6537341E-01 | 0.7033587E-01 | 0.7574306E-01 | 0.8163780E-01 | 0.8806704E-01 | 0.9508226E-01 |
| 0.1027 4C0E 00 | 0.1111026E 00 | 0.1202389E 00 | 0.1302257E 00 | 0.1411489E 00 | 0.1531066E 00 |
| 0.1662118E 00 | 0.1805977E 00 | 0.1964244E 00 | 0.2138885E 00 | 0.2332360E C0 | 0.2547786E 00 |
| 0.2789097E 00 | 0.3061129E 00 | 0.3369377E 00 | 0.3718967E 00 | 0.4112149E 00 | 0.4544210E 00 |
| 0.5C00C00E 00 | | | | | |
| 0.6683890E-01 | 0.7198393E-01 | 0.7759863E-01 | 0.8372935E-01 | 0.9042696E-01 | 0.9774737E-01 |
| 0.1057520E 00 | 0.1145086E 00 | 0.1240917E 00 | 0.1345840E 00 | 0.1460774E 00 | 0.1586752E 00 |
| 0.1724943E 00 | 0.1876684E 00 | 0.2043526E 00 | 0.2227285E 00 | 0.2430098E 00 | 0.2654470E 00 |
| 0.2903267E 00 | 0.3179569E 00 | 0.3486228E 00 | 0.3824940E 00 | 0.4194698E 00 | 0.4590003E 00 |
| 0.5CCOC00E CO | | | | | |
| 0.6810803E-01 | 0.7341175E-01 | 0.7920678E-01 | 0.8554240E-01 | 0.9247279E-01 | 0.1000575E 00 |
| 0.1083618E 00 | 0.1174576E 00 | 0.1274235E 00 | 0.1383464E 00 | 0.1503215E 00 | 0.1634541E 00 |
| 0.1778607E 00 | 0.1936706E 00 | 0.2110276E 00 | 0.2300914E 00 | 0.2510376E 00 | 0.2740546E 00 |
| 0.2993340E 00 | 0.3270483E 00 | 0.3573098E 00 | 0.3901042E 00 | 0.4252061E 00 | 0.4621057E 00 |
| 0.5CCCC00E 00 | | | | | |
| 0.6916649E-01 | 0.7460293E-01 | 0.8054869E-01 | 0.8705544E-01 | 0.9418001E-01 | 0.1019848E 00 |
| 0.1105380E 00 | 0.1199146E 00 | 0.1301962E 00 | 0.1414719E 00 | 0.1538385E 00 | 0.1674011E 00 |
| 0.1822734E 00 | 0.1985776E 00 | 0.2164437E 00 | 0.2360083E 00 | 0.2574107E 00 | 0.2807856E 00 |
| 0.30625C0E 00 | 0.3338818E 00 | 0.3636870E 00 | 0.3955580E 00 | 0.4292293E 00 | 0.4642507E 00 |
| 0.5CCCC00E 00 | | | | | |
| 0.7000237E-01 | 0.7554381E-01 | 0.8160876E-01 | 0.8825073E-01 | 0.9552856E-01 | 0.1035067E 00 |
| 0.1122557E 00 | 0.1218524E 00 | 0.1323804E 00 | 0.1439300E 00 | 0.1565984E C0 | 0.1704894E 00 |
| 0.1857127E 00 | 0.2023829E 00 | 0.2206170E 00 | 0.2405309E 00 | 0.2622337E C0 | 0.2858183E 00 |
| 0.3113425E 00 | 0.3388399E 00 | 0.3682364E 00 | 0.3993847E 00 | 0.4320122E C0 | 0.4657200E 00 |
| 0.5C00C00E 00 | | | | | |
| 0.7060623E-01 | 0.7622362E-01 | 0.8237474E-01 | 0.8911441E-01 | 0.9650285E-01 | 0.1046060E 00 |

Figure 13. Group A Sample Problems Program Results (Sheet 21 of 35)

| | | | | | |
|---|---|---|---|---|---|
| 0.1134958E 00 | 0.1232505E 00 | 0.1339547E 00 | 0.1456994E 00 | 0.1585815E 00 | 0.1727031E 00 |
| 0.1881704E 00 | 0.2050914E 00 | 0.2235724E 00 | 0.2437139E 00 | 0.2656025E 00 | 0.2893024E 00 |
| 0.3148422E 00 | 0.3421993E 00 | 0.3712832E 00 | 0.4019193E 00 | 0.4338385E 00 | 0.4666783E 00 |
| 0.5CCCCC0E 00 | | | | | |
| 0.7097129E-01 | 0.7663462E-01 | 0.8283785E-01 | 0.8963658E-01 | 0.9709184E-01 | 0.1052704E 00 |
| 0.1142451E 00 | 0.1240948E 00 | 0.1349048E 00 | 0.1467662E 00 | 0.1597756E 00 | 0.1740339E 00 |
| 0.1896446E 00 | 0.2067116E 00 | 0.2253344E 00 | 0.2456034E 00 | 0.2675923E 00 | 0.2913482E 00 |
| 0.3168800E 00 | 0.3441449E 00 | 0.3730350E 00 | 0.4033668E 00 | 0.4348755E 00 | 0.4672204E 00 |
| 0.5CCCCC0E 00 | | | | | |
| 0.7109344E-01 | 0.7677214E-01 | 0.8299281E-01 | 0.8981129E-01 | 0.9728890E-01 | 0.1054927E 00 |
| 0.1144957E 00 | 0.1243771E 00 | 0.1352224E 00 | 0.1471226E 00 | 0.1601743E 00 | 0.1744778E 00 |
| 0.1901359E 00 | 0.2072507E 00 | 0.2259196E 00 | 0.2462298E 00 | 0.2682503E 00 | 0.2920227E 00 |
| 0.3175497E 00 | 0.3447820E 00 | 0.3736067E 00 | 0.4038376E 00 | 0.4352120E 00 | 0.4673960E 00 |
| 0.5CCCCC0E 00 | | | | | |
| 0.7097129E-01 | 0.7663462E-01 | 0.8283785E-01 | 0.8963658E-01 | 0.9709184E-01 | 0.1052704E 00 |
| 0.1142451E 00 | 0.1240948E 00 | 0.1349048E 00 | 0.1467662E 00 | 0.1597756E 00 | 0.1740339E 00 |
| 0.1896446E 00 | 0.2067116E 00 | 0.2253344E 00 | 0.2456034E 00 | 0.2675923E 00 | 0.2913483E 00 |
| 0.3168800E 00 | 0.3441449E 00 | 0.3730350E 00 | 0.4033668E 00 | 0.4348755E 00 | 0.4672204E 00 |
| 0.5CCCCC0E 00 | | | | | |
| 0.7060623E-01 | 0.7622362E-01 | 0.8237474E-01 | 0.8911441E-01 | 0.9650285E-01 | 0.1046060E 00 |
| 0.1134958E 00 | 0.1232505E 00 | 0.1339547E 00 | 0.1456994E 00 | 0.1585815E 00 | 0.1727031E 00 |
| 0.1881704E 00 | 0.2050914E 00 | 0.2235724E 00 | 0.2437139E 00 | 0.2656025E 00 | 0.2893024E 00 |
| 0.3148422E 00 | 0.3421993E 00 | 0.3712832E 00 | 0.4019193E 00 | 0.4338385E 00 | 0.4666783E 00 |
| 0.5CCCCC0E 00 | | | | | |
| 0.7000236E-01 | 0.7554381E-01 | 0.8160876E-01 | 0.8825073E-01 | 0.9552856E-01 | 0.1035067E 00 |
| 0.1122557E 00 | 0.1218524E 00 | 0.1323804E 00 | 0.1439300E 00 | 0.1565984E 00 | 0.1704894E 00 |
| 0.1857127E 00 | 0.2023829E 00 | 0.2206170E 00 | 0.2405309E 00 | 0.2622337E 00 | 0.2858183E 00 |
| 0.3113495E 00 | 0.3388399E 00 | 0.3682364E 00 | 0.3993847E 00 | 0.4320122E 00 | 0.4657200E 00 |
| 0.5CCCCC0E 00 | | | | | |
| 0.6916649E-01 | 0.7460293E-01 | 0.8054869E-01 | 0.8705545E-01 | 0.9418001E-01 | 0.1019848E 00 |
| 0.1105380E 00 | 0.1199146E 00 | 0.1301962E 00 | 0.1414719E 00 | 0.1538385E 00 | 0.1674011E 00 |
| 0.1822734E 00 | 0.1985776E 00 | 0.2164437E 00 | 0.2360083E 00 | 0.2574107E 00 | 0.2807856E 00 |
| 0.3062500E 00 | 0.3338818E 00 | 0.3636870E 00 | 0.3955580E 00 | 0.4292293E 00 | 0.4642507E 00 |
| 0.5CCCCC0E 00 | | | | | |
| 0.6810803E-01 | 0.7341175E-01 | 0.7920678E-01 | 0.8554240E-01 | 0.9247279E-01 | 0.1000575E 00 |
| 0.1083618E 00 | 0.1174576E 00 | 0.1274235E 00 | 0.1383464E 00 | 0.1503215E 00 | 0.1634541E 00 |
| 0.1778607E 00 | 0.1936706E 00 | 0.2110276E 00 | 0.2300914E 00 | 0.2510376E 00 | 0.2740546E 00 |
| 0.2993340E 00 | 0.3270483E 00 | 0.3573098E 00 | 0.3901042E 00 | 0.4252061E 00 | 0.4621057E 00 |
| 0.5CCCCC0E 00 | | | | | |
| 0.6683890E-01 | 0.7198393E-01 | 0.7759863E-01 | 0.8372935E-01 | 0.9042696E-01 | 0.9774738E-01 |
| 0.1057520E 00 | 0.1145086E 00 | 0.1240917E 00 | 0.1345840E 00 | 0.1460774E 00 | 0.1586752E 00 |
| 0.1724943E 00 | 0.1876684E 00 | 0.2043526E 00 | 0.2227285E 00 | 0.2430098E 00 | 0.2654470E 00 |
| 0.2903267E 00 | 0.3179569E 00 | 0.3486229E 00 | 0.3824940E 00 | 0.4194698E 00 | 0.4590003E 00 |

Figure 13. Group A Sample Problems Program Results (Sheet 22 of 35)

```
0.5CCCCC0E 00
0.6537342E-01  0.7033587E-01  0.7574306E-01  0.8163780E-01  0.8806704E-01  0.9508227E-01
0.1027400E 00  0.1111026E 00  0.1202390E 00  0.1302257E 00  0.1411489E 00  0.1531066E 00
0.1662118E 00  0.1805977E 00  0.1964244E 00  0.2138885E 00  0.2332360E 00  0.2547786E 00
0.2789098E 00  0.3061129E 00  0.3369378E 00  0.3718967E 00  0.4112149E 00  0.4544210E 00
0.5C000C0E 00
0.6372799E-01  0.6848651E-01  0.7366185E-01  0.7929282E-01  0.8542179E-01  0.9209504E-01
0.9936325E-01  0.1072821E 00  0.1159130E 00  0.1253244E 00  0.1355937E 00  0.1468093E 00
0.1590750E 00  0.1725157E 00  0.1872861E 00  0.2035843E 00  0.2216715E 00  0.2419023E 00
0.2647654E 00  0.2909358E 00  0.3213185E 00  0.3570123E 00  0.3990102E 00  0.4473658E 00
0.5C000C0E 00
0.6192094E-01  0.6645700E-01  0.7137946E-01  0.7672266E-01  0.8252385E-01  0.8882341E-01
0.9566517E-01  0.1030970E 00  0.1111711E 00  0.1199457E 00  0.1294859E 00  0.1398664E 00
0.1511751E 00  0.1635191E 00  0.1770341E 00  0.1918991E 00  0.2083612E 00  0.2267756E 00
0.2476721E 00  0.2718643E 00  0.3006195E 00  0.3358659E 00  0.3801884E 00  0.4356357E 00
0.5CCCC0C0E 00
0.5997213E-01  0.6427035E-01  0.6892256E-01  0.7395828E-01  0.7940921E-01  0.8530921E-01
0.9169456E-01  0.9860413E-01  0.1060798E 00  0.1141671E 00  0.1229162E 00  0.1323835E 00
0.1426349E 00  0.1537498E 00  0.1658296E 00  0.1790103E 00  0.1934858E 00  0.2095478E 00
0.2276613E 00  0.2486091E 00  0.2737869E 00  0.3058147E 00  0.3496924E 00  0.4135156E 00
0.5CCOC00E 00
0.5790261E-01  0.6195098E-01  0.6631951E-01  0.7103273E-01  0.7611643E-01  0.8159761E-01
0.8750442E-01  0.9386609E-01  0.1007129E 00  0.1080764E 00  0.1159894E 00  0.1244870E 00
0.1336074E 00  0.1433945E 00  0.1539020E 00  0.1652008E 00  0.1773929E 00  0.1906369E 00
0.2051995E 00  0.2215649E 00  0.2406956E 00  0.2647418E 00  0.2993620E 00  0.3627492E 00
0.5CC00C0E 00
0.5573420E-01  0.5952419E-01  0.6359978E-01  0.6798038E-01  0.7268577E-01  0.7773592E-01
0.8315C61E-01  0.8894909E-01  0.9514960E-01  0.1017688E 00  0.1088213E 00  0.1163187E 00
0.1242689E 00  0.1326757E 00  0.1415374E 00  0.1508464E 00  0.1605884E 00  0.1707421E 00
0.1812784E 00  0.1921608E 00  0.2033451E 00  0.2147805E 00  0.2264099E 00  0.2381714E 00
0.250CC00E 00
```

Figure 13. Group A Sample Problems Program Results (Sheet 23 of 35)

```
                NAA CONFAC I  REPORT SAMPLE PROBLEMS GROUP A   K.A.TOUPS,7/31/65

RUN NO.   5   DATA USED FOR THIS RUN- *1FLOOR*1WALLR*
                                      *      *      *
                                      *      *      *

NONE OF SURFACE *1FLOOR      * IS SEEN BY SURFACE *1WALLR      *

IF THE ABOVE RESULT IS UNEXPECTED, DO NOT BECOME ALARMED- IT HAPPENS TO THE BEST OF EM. JUST CHECK YOUR
DATA-ESPECIALLY BE SURE THAT YOU ENTERED ALL POINTS IN CC ORDER, AS THEY APPEAR WHEN FACING THE SURFACE.
```

Figure 13. Group A Sample Problems Program Results (Sheet 24 of 35)

```
                NAA CONFAC I  REPORT SAMPLE PROBLEMS GROUP A   K.A.TOUPS,7/31/65

RUN NO.   6   DATA USED FOR THIS RUN- *1FLOOR*2WALLZ*
                                      *      *      *
                                      *      *      *

THE FORM FACTOR FROM SURFACE *1FLOOR      * TO SURFACE *2WALLZ      * = 0.39992

THE EXCHANGE COEFFICIENT (FA) =   0.39992E 00 SQ UNITS

                THE MAPPING AREA = 0.1000000E 01 SQ UNITS

THE AREA OF SURFACE *1FLOOR      * = 0.1000000E 01 SQ UNITS.


ONLY A PART OF SURFACE *2WALLZ      *, COMPRISING  AN AREA OF 0.1000000E 01  SQ UNITS
SEES SURFACE *1FLOOR      *

THE AREA OF SURFACE *2WALLZ      * = 0.2000000E 01 SQ UNITS.

THE FORM FACTOR FROM SURFACE *2WALLZ      * TO SURFACE *1FLOOR      * = 0.19996
THIS SURFACE IS NONPLANAR-THE COMPUTED AREAS AND THE FACTOR FROM THIS SURFACE MAY BE INCORRECT.


WARNING-WARNING

AN INCORRECT FACTOR WILL RESULT IF
1) SURFACE 1 IS SUBSTANTIALLY NONPLANAR, OR
2) IF SURFACE 2 IS NONPLANAR, AND THE INPUT DATA DOES NOT DEFINE THE SILHOUETTE AS IT ACTUALLY
   APPEARS FROM ANY AND ALL POINTS ON THE ACTIVE SIDE OF SURFACE 1.

STUDY THE FINAL SURFACE COORDINATES BELOW.  NO LARGE NEGATIVE Z COORDINATES SHOULD APPEAR.


THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-

    DATA NAME *1FLOOR      *

POINT       X               Y               Z          POINT      X               Y               Z
       0.1000000E 01 -0.0000000E-38  0.1000000E 01 (INTERNALLY GENERATED ORIENTATION VECTOR)
   1   0.1000000E 01  0.0000000E-38  0.0000000E-38       2   0.1000000E 01  0.1000000E 01  0.0000000E-38
   3   0.0000000E-38  0.1000000E 01  0.0000000E-38       4   0.0000000E-38  0.0000000E-38  0.0000000E-38
```

Figure 13. Group A Sample Problems Program Results (Sheet 25 of 35)

DATA NAME *2*ALLZ •

| POINT | X | Y | Z | POINT | X | Y | Z |
|---|---|---|---|---|---|---|---|
| | 0.1000000E 01 | -0.0000000E-38 | 0.1000000E 01 | (INTERNALLY GENERATED ORIENTATION VECTOR) | | | |
| 1 | 0.0000000E-38 | 0.0000000E-38 | 0.1000000E 01 | 2 | 0.0000000E-38 | 0.0000000E-38 | 0.0000000E-38 |
| 3 | 0.1000000E 01 | 0.1000000E 01 | 0.0000000E-38 | 4 | 0.1000000E 01 | 0.1000000E 01 | 0.1000000E 01 |
| 5 | 0.0000000E-38 | 0.1000000E 01 | 0.1000000E 01 | | | | |

COORDINATES OF POINTS ON BOUNDARY OF SURF *1FLOOR * FOR EACH Y INTERVAL

| X-LEFT | X-RIGHT | Y | X-LEFT | X-RIGHT | Y |
|---|---|---|---|---|---|
| 0.0000000E-38 | 0.1000000E 01 | 0.0000000E-38 | 0.0000000E-38 | 0.1000000E 01 | 0.4166667E-01 |
| 0.0000000E-38 | 0.1000000E 01 | 0.8333333E-01 | 0.0000000E-38 | 0.1000000E 01 | 0.1250000E 00 |
| 0.0000000E-38 | 0.1000000E 01 | 0.1666667E 00 | 0.0000000E-38 | 0.1000000E 01 | 0.2083333E 00 |
| 0.0000000E-38 | 0.1000000E 01 | 0.2500000E 00 | 0.0000000E-38 | 0.1000000E 01 | 0.2916667E 00 |
| 0.0000000E-38 | 0.1000000E 01 | 0.3333333E 00 | 0.0000000E-38 | 0.1000000E 01 | 0.3750000E 00 |
| 0.0000000E-38 | 0.1000000E 01 | 0.4166667E 00 | 0.0000000E-38 | 0.1000000E 01 | 0.4583333E 00 |
| 0.0000000E-38 | 0.1000000E 01 | 0.5000000E 00 | 0.0000000E-38 | 0.1000000E 01 | 0.5416666E 00 |
| 0.0000000E-38 | 0.1000000E 01 | 0.5833333E 00 | 0.0000000E-38 | 0.1000000E 01 | 0.6250000E 00 |
| 0.0000000E-38 | 0.1000000E 01 | 0.6666666E 00 | 0.0000000E-38 | 0.1000000E 01 | 0.7083333E 00 |
| 0.0000000E-38 | 0.1000000E 01 | 0.7500000E 00 | 0.0000000E-38 | 0.1000000E 01 | 0.7916666E 00 |
| 0.0000000E-38 | 0.1000000E 01 | 0.8333333E 00 | 0.0000000E-38 | 0.1000000E 01 | 0.8750000E 00 |
| 0.0000000E-38 | 0.1000000E 01 | 0.9166666E 00 | 0.0000000E-38 | 0.1000000E 01 | 0.9583333E 00 |
| 0.0000000E-38 | 0.1000000E 01 | 0.1000000E 01 | | | |

NO. OF HORIZONTAL INCREMENTS= 24 NO. OF VERTICAL INCREMENTS= 24

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

| | | | | | |
|---|---|---|---|---|---|
| 0.1807342E 00 | 0.2960740E 00 | 0.2863820E 00 | 0.2767014E 00 | 0.2670731E 00 | 0.2575342E 00 |
| 0.2481173E 00 | 0.2388501E 00 | 0.2297549E 00 | 0.2208487E 00 | 0.2121436E 00 | 0.2036470E 00 |
| 0.1953624E 00 | 0.1872900E 00 | 0.1794275E 00 | 0.1717712E 00 | 0.1643161E 00 | 0.1570571E 00 |
| 0.1499895E 00 | 0.1431093E 00 | 0.1364138E 00 | 0.1299013E 00 | 0.1235719E 00 | 0.1174268E 00 |
| 0.1114684E 00 | | | | | |
| 0.5595242E 00 | 0.4246999E 00 | 0.3636322E 00 | 0.3311987E 00 | 0.3091820E 00 | 0.2919007E 00 |
| 0.2771834E 00 | 0.2640487E 00 | 0.2519958E 00 | 0.2407446E 00 | 0.2301256E 00 | 0.2200291E 00 |
| 0.2103795E 00 | 0.2011216E 00 | 0.1922131E 00 | 0.1836202E 00 | 0.1753159E 00 | 0.1672778E 00 |
| 0.1594884E 00 | 0.1519335E 00 | 0.1446029E 00 | 0.1374897E 00 | 0.1305899E 00 | 0.1239020E 00 |

Figure 13. Group A Sample Problems Program Results (Sheet 26 of 35)

```
0.1174268E 00
0.5635998E 00   0.4798349E 00   0.4186149E 00   0.3771940E 00   0.3474486E 00   0.3243521E 00
0.3052598E 00   0.2887546E 00   0.2740345E 00   0.2606191E 00   0.2482043E 00   0.2365877E 00
0.2256277E 00   0.2152214E 00   0.2052909E 00   0.1957759E 00   0.1866285E 00   0.1778109E 00
0.1692932E 00   0.1610523E 00   0.1530711E 00   0.1453377E 00   0.1378451E 00   0.1305899E 00
0.1235719E 00
0.5679804E 00   0.5066683E 00   0.4541465E 00   0.4125885E 00   0.3799123E 00   0.3535020E 00
0.3314013E 00   0.3123179E 00   0.2954166E 00   0.2801498E 00   0.2661484E 00   0.2531557E 00
0.2409864E 00   0.2295030E 00   0.2186003E 00   0.2081965E 00   0.1982266E 00   0.1886394E 00
0.1793945E 00   0.1704612E 00   0.1618167E 00   0.1534453E 00   0.1453377E 00   0.1374897E 00
0.1299013E 00
0.5726858E 00   0.5234821E 00   0.4784193E 00   0.4395360E 00   0.4067403E 00   0.3790028E 00
0.3551923E 00   0.3343750E 00   0.3158515E 00   0.2991128E 00   0.2837889E 00   0.2696075E 00
0.2563639E 00   0.2439011E 00   0.2320965E 00   0.2208530E 00   0.2100930E 00   0.1997549E 00
0.1897902E 00   0.1801621E 00   0.1708436E 00   0.1618167E 00   0.1530711E 00   0.1446029E 00
0.1364138E 00
0.5777359E 00   0.5360185E 00   0.4965240E 00   0.4607200E 00   0.4290327E 00   0.4011951E 00
0.3766571E 00   0.3548360E 00   0.3352207E 00   0.3173952E 00   0.3010304E 00   0.2858681E 00
0.2717045E 00   0.2583770E 00   0.2457549E 00   0.2337324E 00   0.2222237E 00   0.2111601E 00
0.2004874E 00   0.1901645E 00   0.1801621E 00   0.1704612E 00   0.1610523E 00   0.1519335E 00
0.1431093E 00
0.5831506E 00   0.5465046E 00   0.5111643E 00   0.4781591E 00   0.4479860E 00   0.4206968E 00
0.3960787E 00   0.3738087E 00   0.3535477E 00   0.3349841E 00   0.3178484E 00   0.3019134E 00
0.2869899E 00   0.2729203E 00   0.2595732E 00   0.2468397E 00   0.2346297E 00   0.2228704E 00
0.2115041E 00   0.2004874E 00   0.1897902E 00   0.1793945E 00   0.1692932E 00   0.1594883E 00
0.1499895E 00
0.5889491E 00   0.5559717E 00   0.5238102E 00   0.4932011E 00   0.4645918E 00   0.4381509E 00
0.4138425E 00   0.3915121E 00   0.3709522E 00   0.3519438E 00   0.3342781E 00   0.3177654E 00
0.3022378E 00   0.2875489E 00   0.2735720E 00   0.2601988E 00   0.2473381E 00   0.2349151E 00
0.2228704E 00   0.2111601E 00   0.1997549E 00   0.1886393E 00   0.1778109E 00   0.1672778E 00
0.1570571E 00
0.5951496E 00   0.5649635E 00   0.5353090E 00   0.5067290E 00   0.4795999E 00   0.4541207E 00
0.4303417E 00   0.4082091E 00   0.3876069E 00   0.3683887E 00   0.3503984E 00   0.3334824E 00
0.3174958E 00   0.3023059E 00   0.2877932E 00   0.2738522E 00   0.2603924E 00   0.2473381E 00
0.2346297E 00   0.2222237E 00   0.2100930E 00   0.1982266E 00   0.1866285E 00   0.1753159E 00
0.1643161E 00
0.6017688E 00   0.5737963E 00   0.5461792E 00   0.5193303E 00   0.4935607E 00   0.4690655E 00
0.4459324E 00   0.4241647E 00   0.4037055E 00   0.3844608E 00   0.3663163E 00   0.3491491E 00
0.3328353E 00   0.3172556E 00   0.3022978E 00   0.2878600E 00   0.2738522E 00   0.2601988E 00
0.2468396E 00   0.2337324E 00   0.2208530E 00   0.2081965E 00   0.1957759E 00   0.1836202E 00
0.1717712E 00
0.6088213E 00   0.5826676E 00   0.5567546E 00   0.5314052E 00   0.5068769E 00   0.4833481E 00
0.4609195E 00   0.4396239E 00   0.4194409E 00   0.4003122E 00   0.3821539E 00   0.3648669E 00
```

Figure 13. Group A Sample Problems Program Results (Sheet 27 of 35)

```
0.3483447E 00   0.3324787E 00   0.3171629E 00   0.3022978E 00   0.2877932E 00   0.2735720E 00
0.2595732E 00   0.2457549E 00   0.2320965E 00   0.2186C03E 00   0.2052909E C0   0.1922130E 00
0.1794275E 00
0.6163186E 00   0.5917073E 00   0.5672590E 00   0.5432331E 00   0.5198442E 00   0.4972514E 00
0.4755551E 00   0.4548023E 00   0.4349934E 00   0.4160927E 00   0.3980374E 00   0.3807454E 00
0.3641224E 00   0.3480677E 00   0.3324787E 00   0.3172556E 00   0.3023059E C0   0.2875489E 00
0.2729203E 00   0.2583769E 00   0.2439011E 00   0.2295030E 00   0.2152214E 00   0.2011216E 00
0.1872900E 00
0.6242699E 00   0.6010033E 00   0.5778468E 00   0.5550126E 00   0.5326816E 00   0.5109937E 00
0.4900439E 00   0.4698933E 00   0.4505236E 00   0.4319424E 00   0.4140900E C0   0.3968953E 00
0.3802718E 00   0.3641224E 00   0.3483447E 00   0.3328353E 00   0.3174958E 00   0.3022378E 00
0.2869899E 00   0.2717044E 00   0.2563639E 00   0.2409864E 00   0.2256277E 00   0.2103795E 00
0.1953624E 00
0.6326757E 00   0.6106148E 00   0.5886253E 00   0.5668858E 00   0.5455506E 00   0.5247425E 00
0.5045483E 00   0.4850188E 00   0.4661698E 00   0.4479862E 00   0.4304256E 00   0.4134230E 00
0.3968953E 00   0.3807454E 00   0.3648669E 00   0.3491491E 00   0.3334823E 00   0.3177654E 00
0.3019134E 00   0.2858681E 00   0.2696075E 00   0.2531557E 00   0.2365876E 00   0.2200291E 00
0.2036470E 00
0.6415373E 00   0.6205801E 00   0.5996680E 00   0.5789533E 00   0.5585693E 00   0.5386236E 00
0.5191947E 00   0.5003300E 00   0.4820461E 00   0.4643307E C0   0.4471448E 00   0.4304256E 00
0.4140900E 00   0.3980374E 00   0.3821539E 00   0.3663163E 00   0.3503984E 00   0.3342781E 00
0.3178484E 00   0.3010303E 00   0.2837889E 00   0.2661484E 00   0.2482043E 00   0.2301255E C0
0.2121436E 00
0.6508463E 00   0.6309207E 00   0.6110224E 00   0.5912836E 00   0.5718205E 00   0.5527282E 00
0.5340769E 00   0.5159097E 00   0.4982419E 00   0.4810617E 00   0.4643307E 00   0.4479862E 00
0.4319424E 00   0.4160927E 00   0.4003122E 00   0.3844608E 00   0.3683887E 00   0.3519438E 00
0.3349841E 00   0.3173951E 00   0.2991127E 00   0.2801497E 00   0.2606190E 00   0.2407446E 00
0.2208487E 00
0.6605884E 00   0.6416435E 00   0.6227150E 00   0.6039190E 00   0.5853584E 00   0.5671177E 00
0.5492597E 00   0.5318231E 00   0.5148214E 00   0.4982419E 00   0.4820461E 00   0.4661698E 00
0.4505236E 00   0.4349934E 00   0.4194409E 00   0.4037055E 00   0.3876069E C0   0.3709521E 00
0.3535477E 00   0.3352207E 00   0.3158515E 00   0.2954166E 00   0.2740344E 00   0.2519958E 00
0.2297549E 00
0.6707421E 00   0.6527425E 00   0.6347538E 00   0.6168797E 00   0.5992120E 00   0.5818268E 00
0.5647808E 00   0.5481091E 00   0.5318231E 00   0.5159097E C0   0.5003300E 00   0.4850188E 00
0.4698833E 00   0.4548023E 00   0.4396239E 00   0.4241647E 00   0.4082091E 00   0.3915121E 00
0.3738087E 00   0.3548360E 00   0.3343750E 00   0.3123179E 00   0.2887545E 00   0.2640486E 00
0.2388501E 00
0.6812784E 00   0.6641996E 00   0.6471309E 00   0.6301659E 00   0.6133881E 00   0.5968665E 00
0.5806533E 00   0.5647808E 00   0.5492597E 00   0.5340769E 00   0.5191947E 00   0.5045483E 00
0.4900438E 00   0.4755551E 00   0.4609195E 00   0.4459324E 00   0.4303416E 00   0.4138425E 00
0.3960787E 00   0.3766570E 00   0.3551922E 00   0.3314013E 00   0.3052598E C0   0.2771833E 00
0.2481173E 00
```

Figure 13. Group A Sample Problems Program Results (Sheet 28 of 35)

```
0.6921608E 00   0.6759857E 00   0.6598238E 00   0.6437608E 00   0.6278734E 00   0.6122257E 00
0.5968665E 00   0.5818268E 00   0.5671177E 00   0.5527282E 00   0.5386236E 00   0.5247425E 00
0.5109937E 00   0.4972513E 00   0.4833481E 00   0.4690654E 00   0.4541206E 00   0.4381509E 00
0.4206968E 00   0.4011951E 00   0.3790027E 00   0.3535020E 00   0.3243520E 00   0.2919007E 00
0.2575342E 00
0.7033451E 00   0.6880612E 00   0.6727969E 00   0.6576316E 00   0.6426369E 00   0.6278734E 00
0.6133881E 00   0.5992120E 00   0.5853584E 00   0.5718205E 00   0.5585693E 00   0.5455506E 00
0.5326816E 00   0.5198442E 00   0.5068768E 00   0.4935607E 00   0.4795999E 00   0.4645918E 00
0.4479860E 00   0.4290327E 00   0.4067402E 00   0.3799122E 00   0.3474485E 00   0.3091820E 00
0.2670731E 00
0.7147804E 00   0.7003773E 00   0.6860028E 00   0.6717317E 00   0.6576316E 00   0.6437608E 00
0.6301659E 00   0.6168797E 00   0.6039190E 00   0.5912836E 00   0.5789533E 00   0.5668858E 00
0.5550126E 00   0.5432331E 00   0.5314052E 00   0.5193303E 00   0.5067290E 00   0.4932011E 00
0.4781591E 00   0.4607200E 00   0.4395360E 00   0.4125884E 00   0.3771939E 00   0.3311986E 00
0.2767014E 00
0.7264098E 00   0.7128772E 00   0.6993846E 00   0.6860028E 00   0.6727969E 00   0.6598238E 00
0.6471309E 00   0.6347538E 00   0.6227150E 00   0.6110224E 00   0.5996679E 00   0.5886253E 00
0.5778468E 00   0.5672590E 00   0.5567545E 00   0.5461792E 00   0.5353090E 00   0.5238101E 00
0.5111642E 00   0.4965239E 00   0.4784192E 00   0.4541465E 00   0.4186147E 00   0.3636320E 00
0.2863820E 00
0.7381714E 00   0.7254978E 00   0.7128772E 00   0.7003773E 00   0.6880612E 00   0.6759857E 00
0.6641996E 00   0.6527425E 00   0.6416435E 00   0.6309207E 00   0.6205801E 00   0.6106148E 00
0.6010033E 00   0.5917073E 00   0.5826676E 00   0.5737963E 00   0.5649635E 00   0.5559717E 00
0.5465046E 00   0.5360184E 00   0.5234821E 00   0.5066682E 00   0.4798348E 00   0.4246997E 00
0.2960740E 00
0.7500000E 00   0.7381714E 00   0.7264098E 00   0.7147804E 00   0.7033451E 00   0.6921608E 00
0.6812784E 00   0.6707421E 00   0.6605884E 00   0.6508463E 00   0.6415373E 00   0.6326757E 00
0.6242689E 00   0.6163187E 00   0.6088213E 00   0.6017688E 00   0.5951496E 00   0.5889491E 00
0.5831506E 00   0.5777359E 00   0.5726858E 00   0.5679804E 00   0.5635998E 00   0.5595242E 00
0.1807342E 00
```

Figure 13. Group A Sample Problems Program Results (Sheet 29 of 35)

```
                NAA CONFAC I  REPORT SAMPLE PROBLEMS GROUP A   K.A.TOUPS,7/31/65

RUN NO.   7   DATA USED FOR THIS RUN- *1FLOOR*1WALLR*
                                      *      *9R    *
                                      *N     *      *

THE FORM FACTOR FROM SURFACE *1FLOOR      * TO SURFACE *1WALLR9R    * = 0.19996

THE EXCHANGE COEFFICIENT (FA) =   0.19996E 00 SQ UNITS

                  THE MAPPING AREA = 0.1000000E 01 SQ UNITS

THE AREA OF SURFACE *1FLOOR       * = 0.1000000E 01 SQ UNITS.

THE AREA OF SURFACE *1WALLR9R     * = 0.1000000E 01 SQ UNITS.

THE FORM FACTOR FROM SURFACE *1WALLR9R    * TO SURFACE *1FLOOR      * = 0.19996
```

Figure 13. Group A Sample Problems Program Results (Sheet 30 of 35)

NAA SPACE AND INFORMATION SYSTEMS DIVISION
CONFIGURATION FACTOR PROGRAM

CONFAC I

NAA CONFAC I REPORT SAMPLE PROBLEMS GROUP A-GROUPRUN,K.A.TOUPS,7/31/65

I N P U T  D A T A

SURFACE AND TRANSFORMATION DATA

THE FIRST DATA SET ARE THE ORIGINAL INPUT DATA
THE SET IMMEDIATELY FOLLOWING ARE THE ORIGINAL DATA REFERENCED TO THE PLANE FORMED BY THE
1,2 AND LAST DATA POINTS, IF THE ORIGINAL DATA WERE NOT SUBSTANTIALLY IN THE XY PLANE OF ITS CS

DATA NAME *1FLOOR *

| POINT | X | Y | Z | POINT | X | Y | Z |
|---|---|---|---|---|---|---|---|
| | 0.10CC000E 01 | -0.CCCCCCCE-38 | 0.1000000E 01 | (INTERNALLY GENERATED ORIENTATION VECTOR) | | | |
| 1 | 0.10CC000E 01 | 0.CCCCCCCE-38 | 0.0000000E-38 | 2 | 0.1CCCCCCE 01 | 0.1000000E 01 | 0.0000000E-38 |
| 3 | 0.CCCCCCCE-38 | 0.1CCCCCCE 01 | 0.0000000E-38 | 4 | 0.00CCCCCE-38 | 0.CCCCCCCE-38 | 0.0000000E-38 |
| 1 | 0.10CC000E 01 | 0.CCCCCCCE-38 | 0.0000000E-38 | 2 | 0.1CCCCCCE 01 | 0.10CCCCCE 01 | 0.0000000E-38 |
| 3 | 0.CCCCCCCE-38 | 0.1CCCCCCE 01 | 0.0000000E-38 | 4 | 0.0CCCCCCE-38 | 0.0000000E-38 | 0.0000000E-38 |

DATA NAME *1WALL *

| POINT | X | Y | Z | POINT | X | Y | Z |
|---|---|---|---|---|---|---|---|
| | 0.10CC000E 01 | -0.CCCCCCCE-38 | 0.1000000E 01 | (INTERNALLY GENERATED ORIENTATION VECTOR) | | | |
| 1 | 0.CCCC000E-38 | 0.CCCCCCCE-38 | 0.1000000E 01 | 2 | 0.0000000E-38 | 0.0000000E-38 | 0.0000000E-38 |
| 3 | 0.CCCCCCCE-38 | 0.1CCCCCCE 01 | 0.0000000E-38 | 4 | 0.00CCCCCE-38 | 0.1000000E 01 | 0.1000000E 01 |
| 1 | 0.CCCCCCCE-38 | 0.CCCCCCCE-38 | 0.0000000E-38 | 2 | 0.1CCCCCCE 01 | 0.CCCCCCCE-38 | 0.0000000E-38 |
| 3 | 0.10CCCCCE 01 | 0.1CCCCCCE 01 | 0.0000000E-38 | 4 | 0.CCCCCCCE-38 | 0.1CCCCCCE 01 | 0.0000000E-38 |

DATA NAME *1BKWAL *

| POINT | X | Y | Z | POINT | X | Y | Z |
|---|---|---|---|---|---|---|---|
| | 0.10CCCCCE 01 | -0.CCCCCCCE-38 | 0.0000000E-38 | (INTERNALLY GENERATED ORIENTATION VECTOR) | | | |
| 1 | 0.10CCCCCE 01 | 0.1CCCCCCE 01 | 0.0000000E-38 | 2 | 0.1CCCCCCE 01 | 0.10CCCCCE 01 | 0.1000000E 01 |
| 3 | 0.CCCCCCCE-38 | 0.1CCCCCCE 01 | 0.1000000E 01 | 4 | 0.00CCCCCE-38 | 0.10CCCCCE 01 | 0.0000000E-38 |
| 1 | 0.CCCCCCCE-38 | 0.CCCCCCCE-38 | 0.0000000E-38 | 2 | 0.1CCCCCCE 01 | 0.00CCCCCE-38 | 0.00CCCCCE-38 |
| 3 | 0.10CCCCCE 01 | 0.1CCCCCCE 01 | 0.0000000E-38 | 4 | 0.CCCCCCCE-38 | 0.1CCCCCCE 01 | 0.0000000E-38 |

Figure 13. Group A Sample Problems Program Results (Sheet 31 of 35)

```
RUN DATA-

 RUN   SURF   SURF   SURF1  SURF2   HORZ   VERT
 NO     1      2     TXFRM  TXFRM   INCR   INCR
  1 *1FLOOR*1WALL *      *      *      *
  2 *1FLOOR*1BKWAL*      *      *      *
  3 *1WALL *1BKWAL*      *      *      *
```

Figure 13. Group A Sample Problems Program Results (Sheet 32 of 35)

```
                NAA CONFAC I REPORT SAMPLE PROBLEMS GROUP A-GROUPRUN,K.A.TOUPS,7/31/65

RUN NO.   1   DATA USED FOR THIS RUN- *1FLOOR*1WALL *
                                      *      *      *
                                      *      *      *

THE FORM FACTOR FROM SURFACE *1FLOOR      * TO SURFACE *1WALL       * = 0.19996

THE EXCHANGE COEFFICIENT (FA) =   0.19996E 00 SQ UNITS

                THE MAPPING AREA = 0.1000000E 01 SQ UNITS

THE AREA OF SURFACE *1FLOOR       * = 0.1000000E 01 SQ UNITS.

THE AREA OF SURFACE *1WALL        * = 0.1000000E 01 SQ UNITS.

THE FORM FACTOR FROM SURFACE *1WALL       * TO SURFACE *1FLOOR      * = 0.19996
```

Figure 13. Group A Sample Problems Program Results (Sheet 33 of 35)

```
                NAA CONFAC I REPORT SAMPLE PROBLEMS GROUP A-GROUPRUN,K.A.TOUPS,7/31/65

RUN NO.   2   DATA USED FOR THIS RUN- *1FLOOR*1BKWAL*
                                      *      *      *
                                      *      *      *

THE FORM FACTOR FROM SURFACE *1FLOOR      * TO SURFACE *1BKWAL      * = 0.19996

THE EXCHANGE COEFFICIENT (FA) =   0.19996E 00 SQ UNITS

                THE MAPPING AREA = 0.1000000E 01 SQ UNITS

THE AREA OF SURFACE *1FLOOR       * = 0.1000000E 01 SQ UNITS.

THE AREA OF SURFACE *1BKWAL       * = 0.1000000E 01 SQ UNITS.

THE FORM FACTOR FROM SURFACE *1BKWAL      * TO SURFACE *1FLOOR      * = 0.19996
```

Figure 13. Group A Sample Problems Program Results (Sheet 34 of 35)

```
                NAA CONFAC I REPORT SAMPLE PROBLEMS GROUP A-GROUPRUN,K.A.TOUPS,7/31/65

RUN NO.    3    DATA USED FOR THIS RUN- *1WALL *1BKWAL*
                                        *      *      *
                                        *      *      *

THE FORM FACTOR FROM SURFACE *1WALL       * TO SURFACE *1BKWAL      * = 0.19996

THE EXCHANGE COEFFICIENT (FA) =   0.19996E 00 SQ UNITS

                  THE MAPPING AREA = 0.1000000E 01 SQ UNITS

THE AREA OF SURFACE *1WALL        * = 0.1000000E 01 SQ UNITS.

THE AREA OF SURFACE *1BKWAL       * = 0.1000000E 01 SQ UNITS.

THE FORM FACTOR FROM SURFACE *1BKWAL      * TO SURFACE *1WALL       * = 0.19996
```

Figure 13. Group A Sample Problems Program Results (Sheet 35 of 35)

## SAMPLE PROBLEM—GROUP B

The geometrical relationships used in this example are presented in Figure 14. The data sheets are shown in Figure 15 with results in Figure 16.

### Problem 1B

Double bisection of surfaces is demonstrated. The plane surface 1PLATI and 3DISK are entered as usual in the data.

The double bisection is easily seen in side view of 1PLATI and 3DISK. The results of the factor request from 1PLATI and 3DISK is shown in Run #1 output, indicating the areas in each surface seen by the other. The number of points defining 3DISK has been reduced to 7 and reorganized because of the bisection, as seen along the dotted line.

### Problem 2B

The converse factor, 3DISK to 1PLATI, is requested as Run #2. Because the disk is now surface 1, the final coordinate system in 3DISK is aligned so that the xy plane is the plane of the disk. Point 1' becomes the origin, and line segment 1'2' the X' axis. Note that the exchange coefficients (fA) are very nearly equal, as they should be because of the reciprocity theorem.

Notice that the factor from one surface to the other along the line of bisection is, in reality, zero, but the output is, in some cases, non-zero though quite small ($10^{-8}$ order of magnitude). This is caused by accumulated internal truncation error, and is not significant enough to warrant concern here.

### Problem 3B

The capability of coordinate transformation is illustrated. Run #3 requests the factor from 1PLAT1 to 3DISK transformed to the position shown by the transformation data 9TDISK. The program detected, after transforming 3DISK, that it bisected 1PLAT1. As the output shows, the part of 1PLAT1 actually mapped was the trapezoid indicated in the top view, and in the output final coordinate data.

### Problem 4B

It is quite feasible to manually input a surface, transform the surface to a different location, and then ask for the factor between the original

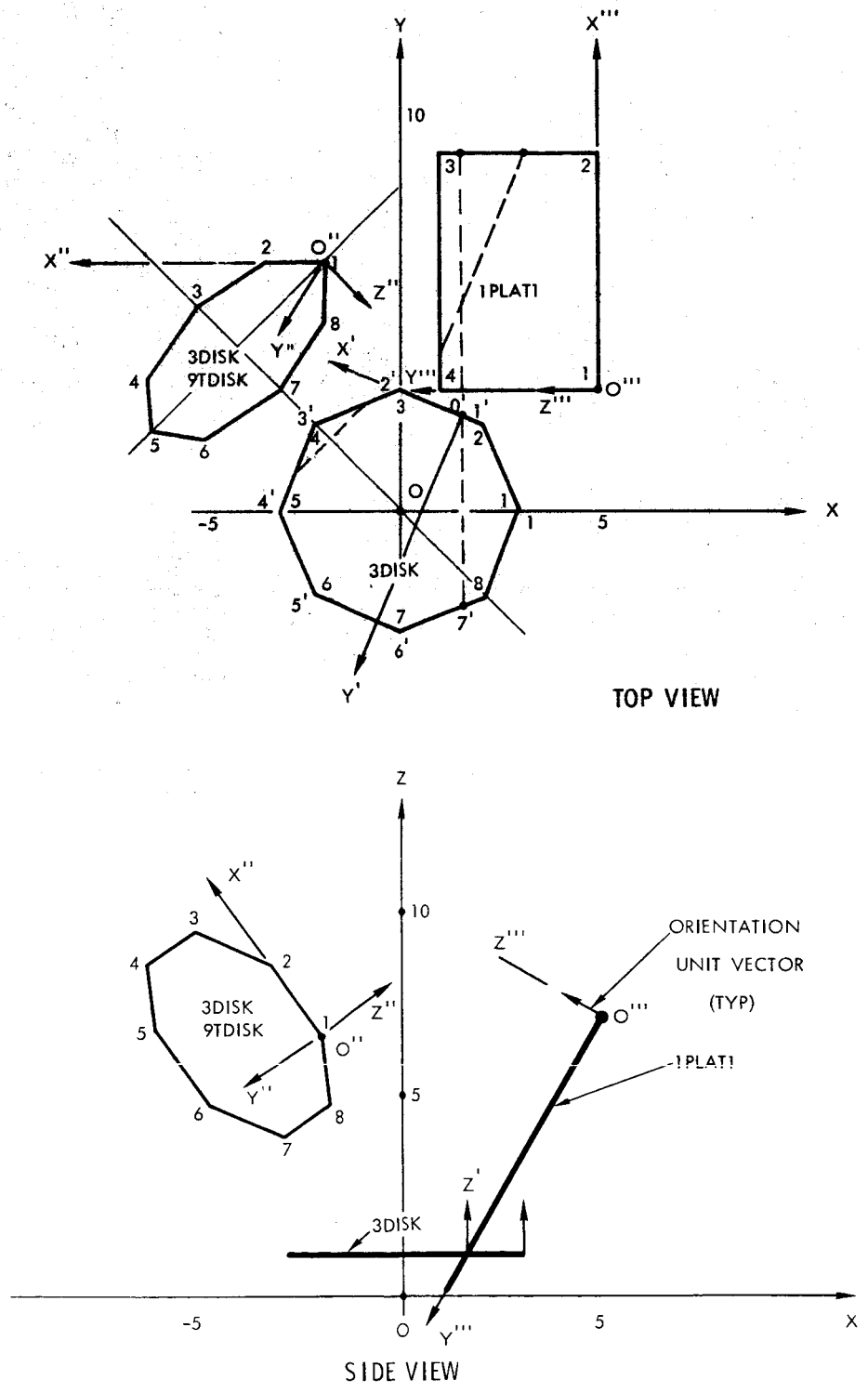



Figure 14. Sample Problems Geometry Group B

surface and the transformed surface. This is shown by Run #4, where 3DISK is used as surface 1, and 3DISK transformed by 9TDISK is used as surface 2. The output shows a bisection of 3DISK, removing the 4th boundary point, and therefore adding a point to the final 3DISK surface boundaries, making it 9 instead of 8.

Problem 5B

The factor from the transformed disk, 3DISK9TDISK, to 1PLAT1 is requested as Run #5, demonstrating program flexibility in that surface 1 is now transformed. The resulting exchange coefficient is very nearly equal to Run #3, as it should be.

# FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. GROUP B PROGRAMMER K.A. TOUPS DATE 7/31/65 PAGE 8 of 11 JOB NO. 2699-40

| | NUMBER | IDENTIFICATION | DESCRIPTION DO NOT KEY PUNCH |
|---|---|---|---|
| 1 | TNAA CONFAC | | |
| 13 | I REPORT $AM | | |
| 25 | PLE PROBLEM$ | | |
| 37 | GROUP B | | |
| 49 | K.A.TOUP$,7/ | 73 80 | |
| 61 | 31/65 | 201 | |
| 1 | PLAT1 | | |
| 3 | $KEWED RECTA | | |
| 25 | NGULAR PLATE | | |
| 37 | | | |
| 49 | | 73 80 | |
| 61 | | 202 | |
| 1 | $D C=4.0,5. | | |
| 13 | 0,3.0,7.,5,9 | | |
| 25 | ,7,1,9,0.,1, | | |
| 37 | 3,0$ | | |
| 49 | | 73 80 | |
| 61 | | 203 | |
| 1 | 3DI$K | | |
| 13 | OCTAGONAL PO | | |
| 25 | LYGON | | |
| 37 | | | |
| 49 | | 73 80 | |
| 61 | | 204 | |

Figure 15. Group B Sample Problems Input Data Code Sheets (Sheet 1 of 4)





NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

# FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. GROUP B PROGRAMMER K. A. TOUPS DATE 7/31/65 PAGE 9 of 11 JOB NO. 2699-40

| | NUMBER | IDENTIFICATION | DESCRIPTION DO NOT KEY PUNCH |
|---|---|---|---|
| 1 | $D C=8,3,0, | | |
| 13 | 1,2.12132,2. | | |
| 25 | 12132,1,0,3, | | |
| 37 | 1,-2.12132,2 | | |
| 49 | .12132,1,-3, | 73 80 | |
| 61 | 0,1, | 205 | |
| 1 | -2.12132,-2 | | |
| 13 | .12132,1,0,- | | |
| 25 | 3,1,2.12132, | | |
| 37 | -2.12132,1$ | | |
| 49 | | 73 80 | |
| 61 | | 206 | |
| 1 | 9TDI$K | | SEE FIGURE 8 FOR FORMATING |
| 13 | | | (THIS DATA COULD HAVE BEEN |
| 25 | MΦVE$ 3DI$K | | ENTERED IN NAMELIST MODE) |
| 37 | TΦ II QUADRA | | |
| 49 | NT | 73 80 | |
| 61 | | 207 | |
| 1 | 1.0 | | |
| 13 | -1.9393398 | | |
| 25 | 6.181906 | | |
| 37 | 6.598075 | | |
| 49 | 3.0 | 73 80 | |
| 61 | -5.12132048 | 208 | |

Figure 15. Group B Sample Problems Input Data Code Sheets (Sheet 2 of 4)





NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

# FORTRAN FIXED 10 DIGIT DECIMAL DATA

DECK NO. GROUP B PROGRAMMER K. A. TOUPS DATE 7/31/65 PAGE 10 of 11 JOB NO. 2699-40

| NUMBER | IDENTIFICATION (73–80) | DESCRIPTION DO NOT KEY PUNCH |
|---|---|---|
| 5.1213204 | | |
| 9.1961500 | | |
| 7.0 | | |
| -3.0 | | |
| 3.0 | | |
| 4.0 | 209 | |
| 1PLAT13DI$K | | PROBLEM 1B |
| | | |
| D | | |
| 3DI$K 1PLAT1 | | PROBLEM 2B |
| | | |
| | 210 | |
| 1PLAT13DI$K | | PROBLEM 3B |
| 9TDI$K | | |
| | | |
| 3DI$K 3DI$K | | PROBLEM 4B |
| 9TDI$K | | |
| | 211 | |
| 3DI$K 1PLAT1 | | PROBLEM 5B |
| 9TDI$K | | |
| | | |
| | | |
| | | |
| | 212 | |

Figure 15. Group B Sample Problems Input Data Code Sheets (Sheet 3 of 4)





NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

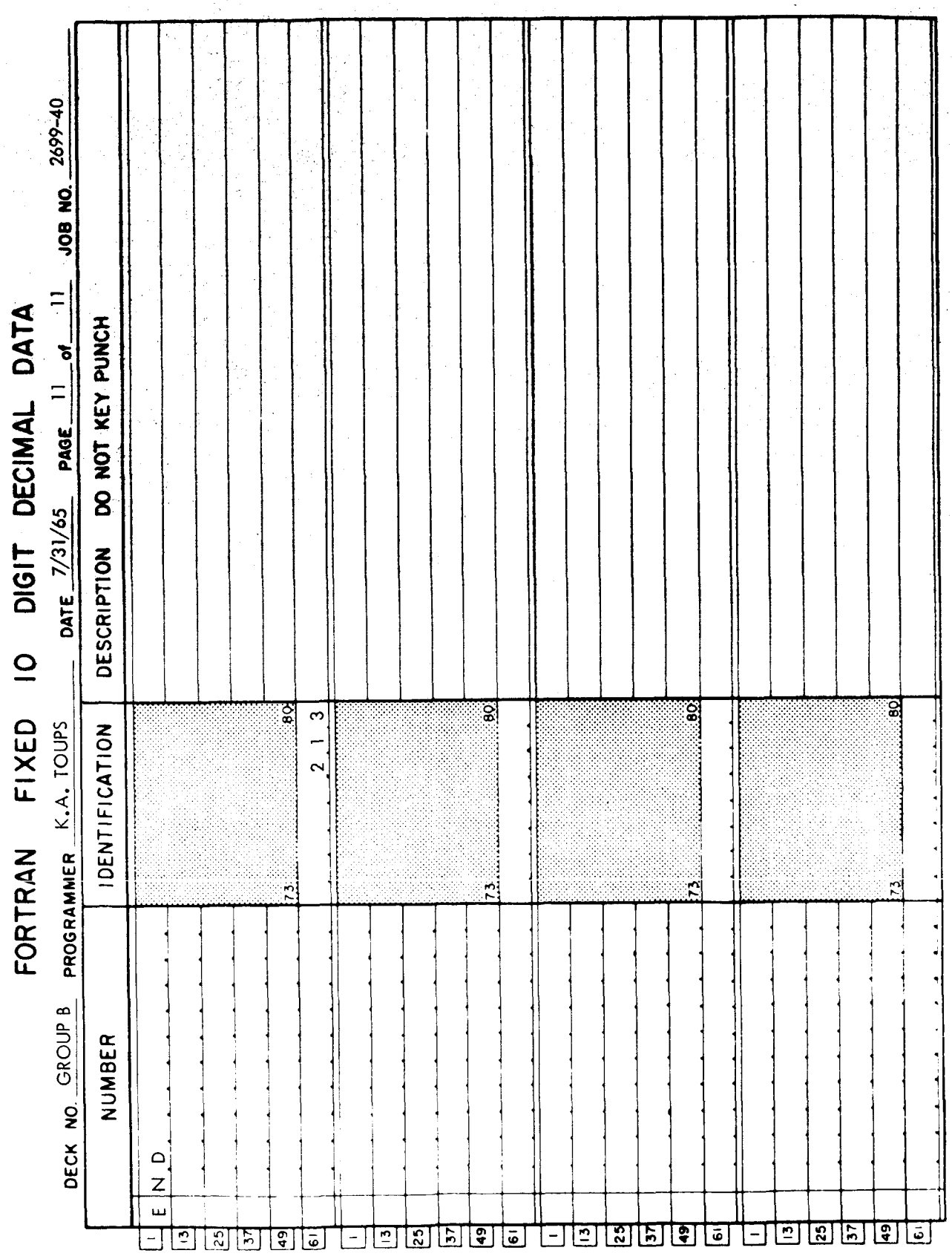



Figure 15. Group B Sample Problems Input Data Code Sheets (Sheet 4 of 4)

```
NAA SPACE AND INFORMATION SYSTEMS DIVISION
CONFIGURATION FACTOR PROGRAM

CONFAC I

NAA CONFAC I REPORT SAMPLE PROBLEMS GROUP B     K.A.TOUPS,7/31/65

I N P U T  D A T A

SURFACE AND TRANSFORMATION DATA

THE FIRST DATA SET ARE THE ORIGINAL INPUT DATA
THE SET IMMEDIATELY FOLLOWING ARE THE ORIGINAL DATA REFERENCED TO THE PLANE FORMED BY THE
1,2 AND LAST DATA POINTS, IF THE ORIGINAL DATA WERE NOT SUBSTANTIALLY IN THE XY PLANE OF ITS CS

     DATA NAME *1PLAT1       *

POINT        X                Y                Z           POINT      X                Y                Z
                0.4131757E 01    0.3000000E 01    0.7496139E 01 (INTERNALLY GENERATED ORIENTATION VECTOR)
    1           0.5000000E 01    0.3000000E 01    0.7000000E 01      2    0.5000000E 01    0.9000000E 01    0.7000000E 01
    3           0.1000000E 01    0.9000000E 01    0.0000000E-38      4    0.1000000E 01    0.3000000E 01    0.0000000E-38
    1           0.0000000E-38    0.0000000E-38    0.0000000E-38      2    0.6000000E 01    0.0000000E-38    0.0000000E-38
    3           0.6000000E 01    0.8062258E 01    0.0000000E-38      4    0.0000000E-38    0.8062258E 01    0.0000000E-38

WARNING-THE FOLLOWING DATA IS ASSUMED TO BE CLASS 1 OR 2. THIS VERSION OF CONFAC
DOES NOT ACCEPT CLASS 3-8 DATA.

     DATA NAME *3DISK        *

POINT        X                Y                Z           POINT      X                Y                Z
                0.3000000E 01   -0.0000000E-38    0.2000000E 01 (INTERNALLY GENERATED ORIENTATION VECTOR)
    1           0.3000000E 01    0.0000000E-38    0.1000000E 01      2    0.2121320E 01    0.2121320E 01    0.1000000E 01
    3           0.0000000E-38    0.3000000E 01    0.1000000E 01      4   -0.2121320E 01    0.2121320E 01    0.1000000E 01
    5          -0.3000000E 01    0.0000000E-38    0.1000000E 01      6   -0.2121320E 01   -0.2121320E 01    0.1000000E 01
    7           0.0000000E-38   -0.3000000E 01    0.1000000E 01      8    0.2121320E 01   -0.2121320E 01    0.1000000E 01
    1           0.0000000E-38    0.0000000E-38    0.0000000E-38      2    0.2296100E 01    0.0000000E-38    0.0000000E-38
    3           0.3919689E 01    0.1623588E 01    0.0000000E-38      4    0.3919689E 01    0.3919688E 01    0.0000000E-38
    5           0.2296102E 01    0.5543277E 01    0.0000000E-38      6    0.0000000E-38    0.5543277E 01    0.0000000E-38
    7          -0.1623588E 01    0.3919689E 01    0.0000000E-38      8   -0.1623588E 01    0.1623589E 01    0.0000000E-38

DATA NAME- *1PLAT2       *
```

Figure 16. Group B Sample Problems Program Results (Sheet 1 of 27)

| POINT | X | Y | Z |
|---|---|---|---|
| 1 | -0.1939340E 01 | 0.6181906E 01 | 0.6598075E 01 |
| 7 | -0.3000000E 01 | 0.3000000E 01 | 0.4000000E 01 |

| POINT | X | Y | Z |
|---|---|---|---|
| 3 | -0.5121320E 01 | 0.5121320E 01 | 0.9196150E 01 |

RUN DATA-

| RUN NO | SURF 1 | SURF 2 | SURF1 TXFRM | SURF2 TXFRM | HORZ INCR | VERT INCR |
|---|---|---|---|---|---|---|
| 1 | *1PLAT1* | *3DISK * | * | * | *D * | * |
| 2 | *3DISK * | *1PLAT1* | * | * | * | * |
| 3 | *1PLAT1* | *3DISK * | * | *9TDISK* | * | * |
| 4 | *3DISK * | *3DISK * | * | *9TDISK* | * | * |
| 5 | *3DISK * | *1PLAT1* | *9TDISK* | * | * | * |

Figure 16. Group B Sample Problems Program Results (Sheet 2 of 27)

```
                NAA CONFAC I REPORT SAMPLE PROBLEMS GROUP B     K.A.TOUPS,7/31/65

RUN NO.    1    DATA USED FOR THIS RUN- *1PLAT1*3DISK *
                                        *      *      *
                                        *D     *      *

THE FORM FACTOR FROM SURFACE *1PLAT1       * TO SURFACE *3DISK        * = 0.00954

THE EXCHANGE COEFFICIENT (FA) =   0.46132E 00 SQ UNITS

                THE MAPPING AREA = 0.4146303E 02 SQ UNITS


ONLY A PART OF SURFACE *1PLAT1       *, COMPRISING  AN AREA OF 0.4146304E 02  SQ UNITS
SEES SURFACE *3DISK        *

THE AREA OF SURFACE *1PLAT1       * = 0.4837355E 02 SQ UNITS.


ONLY A PART OF SURFACE *3DISK        *, COMPRISING  AN AREA OF 0.2113364E 02  SQ UNITS
SEES SURFACE *1PLAT1       *

THE AREA OF SURFACE *3DISK        * = 0.2545584E 02 SQ UNITS.

THE FORM FACTOR FROM SURFACE *3DISK        * TO SURFACE *1PLAT1       * = 0.01812


THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-

    DATA NAME *1PLAT1       *

POINT        X              Y              Z           POINT       X              Y              Z
       0.0000000E-38  0.0000000E-38  0.9999999E 00 (INTERNALLY GENERATED ORIENTATION VECTOR)
   1   0.0000000E-38  0.0000000E-38  0.0000000E-38       2   0.6000000E 01  0.0000000E-38  0.0000000E-38
   3   0.6000000E 01  0.6910506E 01  0.0000000E-38       4   0.0000000E-38  0.6910506E 01  0.0000000E-38

    DATA NAME *3DISK        *

POINT        X              Y              Z           POINT       X              Y              Z
      -0.6509073E 00  0.6042263E 01  0.4961389E 00 (INTERNALLY GENERATED ORIENTATION VECTOR)
   1  -0.6509073E 00  0.6910506E 01  0.0000000E-38       2   0.0000000E-38  0.7690153E 01  0.1364382E 01
   3  -0.8786500E 00  0.8742823E 01  0.3206203E 01       4  -0.3000000E 01  0.9178570E 01  0.3969111E 01
```

Figure 16. Group B Sample Problems Program Results (Sheet 3 of 27)

```
 5  -0.5121321E 01   0.8742622E 01   0.3206203E 01        6  -0.6000000E 01   0.7690153E 01   0.1364382E 01
 7  -0.5349093E 01   0.6910506E 01   0.0000000E-38

COORDINATES OF POINTS ON BOUNDARY OF SURF     *1PLAT1       * FOR EACH Y INTERVAL

      X-LEFT          X-RIGHT           Y                      X-LEFT          X-RIGHT           Y

  0.0C00000E-38   0.6000000E 01   0.0000000E-38        0.C000000E-38   0.600C000E 01   0.2879378E 00
  0.0CC0000E-38   0.6000000E 01   0.5758755E 00        0.C000000E-38   0.6000000E 01   0.8638133E 00
  0.0CCC000E-38   0.6000000E 01   0.1151751E 01        0.C000000E-38   0.600C000E 01   0.1439689E 01
  0.0CCC000E-38   0.6000000E 01   0.1727627E 01        0.C000000E-38   0.600C000E 01   0.2015564E 01
  0.0CCC000E-38   0.6000000E 01   0.2303502E 01        0.C000000E-38   0.600C000E 01   0.2591440E 01
  0.0000000E-38   0.6000000E 01   0.2879378E 01        0.0000000E-38   0.6000000E 01   0.3167315E 01
  0.C0C0000E-38   0.6000000E 01   0.3455253E 01        0.C000000E-38   0.6000000E 01   0.3743191E 01
  0.0C00000E-38   0.6000000E 01   0.4031129E 01        0.C000000E-38   0.6000000E 01   0.4319066E 01
  0.0CCC000E-38   0.6000000E 01   0.4607004E 01        0.CCC0000E-38   0.6000000E 01   0.4894942E 01
  0.0CC0000E-38   0.6000000E 01   0.5182880E 01        0.0000000E-38   0.6000000E 01   0.5470817E 01
  0.0CC0000E-38   0.6000000E 01   0.5758755E 01        0.C000000E-38   0.600C000E 01   0.6046693E 01
  0.0CC00C0E-38   0.6000000E 01   0.6334631E 01        0.C000000E-38   0.6000000E 01   0.6622568E 01
  0.0CCC000E-38   0.6000000E 01   0.6910506E 01

NO. OF HORIZONTAL INCREMENTS= 24  NO. OF VERTICAL INCREMENTS= 24


THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

  0.1059386E-01   0.1024097E-01   0.9877512E-02   0.9506419E-02   0.9130516E-02   0.8752481E-02
  0.8374790E-02   0.7999689E-02   0.7629243E-02   0.7265235E-02   0.6909214E-02   0.6562509E-02
  0.6226191E-02   0.5901133E-02   0.5587987E-02   0.5287227E-02   0.4999154E-02   0.4723921E-02
  0.4461552E-02   0.4211956E-02   0.3974934E-02   0.3750227E-02   0.3537516E-02   0.3336408E-02
  0.3146496E-02
  0.1145887E-01   0.1105646E-01   0.1064296E-01   0.1022180E-01   0.9796291E-02   0.9369558E-02
  0.8944458E-02   0.8523566E-02   0.8109182E-02   0.7703332E-02   0.7307714E-02   0.6923743E-02
  0.6552554E-02   0.6195036E-02   0.5851821E-02   0.5523321E-02   0.5209774E-02   0.4911230E-02
  0.4627609E-02   0.4358700E-02   0.4104188E-02   0.3863679E-02   0.3636733E-02   0.3422837E-02
  0.3221470E-02
  0.1241370E-01   0.1195360E-01   0.1148192E-01   0.1100278E-01   0.1052006E-01   0.1003737E-01
  0.9558030E-02   0.9084977E-02   0.8620832E-02   0.8167813E-02   0.7727793E-02   0.7302273E-02
  0.6892438E-02   0.6499145E-02   0.6122981E-02   0.5764288E-02   0.5423171E-02   0.5099564E-02
  0.4793244E-02   0.4503835E-02   0.4230865E-02   0.3973811E-02   0.3732057E-02   0.3504944E-02
```

Figure 16. Group B Sample Problems Program Results (Sheet 4 of 27)



NORTH AMERICAN AVIATION, INC.

SPACE and INFORMATION SYSTEMS DIVISION

| | | | | | |
|---|---|---|---|---|---|
| 0.3291799E-02 | | | | | |
| 0.1346930E-01 | 0.1294174E-01 | 0.1240229E-01 | 0.1185584E-01 | 0.1130695E-01 | 0.1075984E-01 |
| 0.1021839E-01 | 0.9685834E-02 | 0.9165241E-02 | 0.8659043E-02 | 0.8169245E-02 | 0.7697429E-02 |
| 0.7244786E-02 | 0.6812139E-02 | 0.6399975E-02 | 0.6008496E-02 | 0.5637654E-02 | 0.5287207E-02 |
| 0.4956736E-02 | 0.4645684E-02 | 0.4353382E-02 | 0.4079099E-02 | 0.3822034E-02 | 0.3581364E-02 |
| 0.3356239E-02 | | | | | |
| 0.1463810E-01 | 0.1403141E-01 | 0.1341276E-01 | 0.1278794E-01 | 0.1216236E-01 | 0.1154093E-01 |
| 0.1092811E-01 | 0.1032774E-01 | 0.9743113E-02 | 0.9176928E-02 | 0.8631346E-02 | 0.8108002E-02 |
| 0.7608055E-02 | 0.7132200E-02 | 0.6680795E-02 | 0.6253843E-02 | 0.5851096E-02 | 0.5472042E-02 |
| 0.5116040E-02 | 0.4782266E-02 | 0.4469831E-02 | 0.4177750E-02 | 0.3905002E-02 | 0.3650564E-02 |
| 0.3413370E-02 | | | | | |
| 0.1593416E-01 | 0.1523437E-01 | 0.1452285E-01 | 0.1380654E-01 | 0.1309184E-01 | 0.1238453E-01 |
| 0.1168972E-01 | 0.1101183E-01 | 0.1035450E-01 | 0.9720701E-02 | 0.9112683E-02 | 0.8532077E-02 |
| 0.7979942E-02 | 0.7456815E-02 | 0.6962808E-02 | 0.6497662E-02 | 0.6060816E-02 | 0.5651472E-02 |
| 0.5268644E-02 | 0.4911223E-02 | 0.4577998E-02 | 0.4267714E-02 | 0.3979066E-02 | 0.3710788E-02 |
| 0.3461591E-02 | | | | | |
| 0.1737341E-01 | 0.1656366E-01 | 0.1574294E-01 | 0.1491953E-01 | 0.1410102E-01 | 0.1329423E-01 |
| 0.1250507E-01 | 0.1173854E-01 | 0.1099870E-01 | 0.1028871E-01 | 0.9610907E-02 | 0.8966815E-02 |
| 0.8357306E-02 | 0.7782647E-02 | 0.7242614E-02 | 0.6736563E-02 | 0.6263547E-02 | 0.5822344E-02 |
| 0.5411586E-02 | 0.5029773E-02 | 0.4675318E-02 | 0.4346624E-02 | 0.4042074E-02 | 0.3760088E-02 |
| 0.3499135E-02 | | | | | |
| 0.1897387E-01 | 0.1803380E-01 | 0.1708419E-01 | 0.1613499E-01 | 0.1519529E-01 | 0.1427308E-01 |
| 0.1337520E-01 | 0.1250729E-01 | 0.1167383E-01 | 0.1087813E-01 | 0.1012247E-01 | 0.9408216E-02 |
| 0.8735886E-02 | 0.8105336E-02 | 0.7515876E-02 | 0.6966342E-02 | 0.6455249E-02 | 0.5980881E-02 |
| 0.5541355E-02 | 0.5134684E-02 | 0.4758831E-02 | 0.4411796E-02 | 0.4091594E-02 | 0.3796301E-02 |
| 0.3524067E-02 | | | | | |
| 0.2075583E-01 | 0.1966069E-01 | 0.1855842E-01 | 0.1746107E-01 | 0.1637950E-01 | 0.1532312E-01 |
| 0.1429985E-01 | 0.1331600E-01 | 0.1237640E-01 | 0.1148446E-01 | 0.1064225E-01 | 0.9850762E-02 |
| 0.9110025E-02 | 0.8419281E-02 | 0.7777158E-02 | 0.7181822E-02 | 0.6631100E-02 | 0.6122610E-02 |
| 0.5653837E-02 | 0.5222203E-02 | 0.4825175E-02 | 0.4460224E-02 | 0.4124941E-02 | 0.3817016E-02 |
| 0.3534272E-02 | | | | | |
| 0.2274213E-01 | 0.2146168E-01 | 0.2017788E-01 | 0.1890544E-01 | 0.1765737E-01 | 0.1644480E-01 |
| 0.1527682E-01 | 0.1416045E-01 | 0.1310077E-01 | 0.1210108E-01 | 0.1116307E-01 | 0.1028709E-01 |
| 0.9472394E-02 | 0.8717370E-02 | 0.8019723E-02 | 0.7376707E-02 | 0.6785291E-02 | 0.6242237E-02 |
| 0.5744259E-02 | 0.5288096E-02 | 0.4870541E-02 | 0.4488536E-02 | 0.4139158E-02 | 0.3819669E-02 |
| 0.3527490E-02 | | | | | |
| 0.2495825E-01 | 0.2345529E-01 | 0.2195475E-01 | 0.2047465E-01 | 0.1903072E-01 | 0.1763608E-01 |
| 0.1630110E-01 | 0.1503345E-01 | 0.1383830E-01 | 0.1271854E-01 | 0.1167514E-01 | 0.1070744E-01 |
| 0.9813570E-02 | 0.8990683E-02 | 0.8235280E-02 | 0.7543435E-02 | 0.6910973E-02 | 0.6333631E-02 |
| 0.5807181E-02 | 0.5327533E-02 | 0.4890724E-02 | 0.4493054E-02 | 0.4131046E-02 | 0.3801451E-02 |
| 0.3501308E-02 | | | | | |
| 0.2743236E-01 | 0.2566082E-01 | 0.2390030E-01 | 0.2217307E-01 | 0.2049820E-01 | 0.1889112E-01 |
| 0.1736357E-01 | 0.1592370E-01 | 0.1457640E-01 | 0.1332370E-01 | 0.1216533E-01 | 0.1109914E-01 |

Figure 16. Group B Sample Problems Program Results (Sheet 5 of 27)

| | | | | | |
|---|---|---|---|---|---|
| 0.1012161E-01 | 0.9228209E-02 | 0.8413828E-02 | 0.7672997E-02 | 0.7000148E-02 | 0.6389751E-02 |
| 0.5836450E-02 | 0.5335153E-02 | 0.4881084E-02 | 0.4469793E-02 | 0.4097169E-02 | 0.3759458E-02 |
| 0.3453236E-02 | | | | | |
| 0.3019508E-01 | 0.2809745E-01 | 0.2602353E-01 | 0.2400110E-01 | 0.2205335E-01 | 0.2019839E-01 |
| 0.1844924E-01 | 0.1681413E-01 | 0.1529708E-01 | 0.1389858E-01 | 0.1261633E-01 | 0.1144594E-01 |
| 0.1038157E-01 | 0.9416463E-02 | 0.8543354E-02 | 0.7754837E-02 | 0.7043612E-02 | 0.6402618E-02 |
| 0.5825188E-02 | 0.5305105E-02 | 0.4836630E-02 | 0.4414503E-02 | 0.4033943E-02 | 0.3690645E-02 |
| 0.3380712E-02 | | | | | |
| 0.3327883E-01 | 0.3078258E-01 | 0.2832876E-01 | 0.2595241E-01 | 0.2368177E-01 | 0.2153789E-01 |
| 0.1953471E-01 | 0.1767980E-01 | 0.1597530E-01 | 0.1441902E-01 | 0.1300556E-01 | 0.1172727E-01 |
| 0.1057508E-01 | 0.9539231E-02 | 0.8609729E-02 | 0.7776774E-02 | 0.7030937E-02 | 0.6363387E-02 |
| 0.5765930E-02 | 0.5231094E-02 | 0.4752074E-02 | 0.4322766E-02 | 0.3937697E-02 | 0.3591954E-02 |
| 0.3281213E-02 | | | | | |
| 0.3671609E-01 | 0.3372868E-01 | 0.3081164E-01 | 0.2800948E-01 | 0.2535664E-01 | 0.2287701E-01 |
| 0.2058465E-01 | 0.1848501E-01 | 0.1657668E-01 | 0.1485308E-01 | 0.1330411E-01 | 0.1191746E-01 |
| 0.1067975E-01 | 0.9577262E-02 | 0.8596594E-02 | 0.7724988E-02 | 0.6950552E-02 | 0.6262401E-02 |
| 0.5650665E-02 | 0.5106485E-02 | 0.4621977E-02 | 0.4190122E-02 | 0.3804751E-02 | 0.3460399E-02 |
| 0.3152278E-02 | | | | | |
| 0.4053586E-01 | 0.3693769E-01 | 0.3345215E-01 | 0.3013632E-01 | 0.2703178E-01 | 0.2416459E-01 |
| 0.2154689E-01 | 0.1917950E-01 | 0.1705472E-01 | 0.1515904E-01 | 0.1347543E-01 | 0.1198511E-01 |
| 0.1066894E-01 | 0.9508235E-02 | 0.8485386E-02 | 0.7584178E-02 | 0.6789912E-02 | 0.6089436E-02 |
| 0.5471081E-02 | 0.4924571E-02 | 0.4440890E-02 | 0.4012187E-02 | 0.3631594E-02 | 0.3293144E-02 |
| 0.2991659E-02 | | | | | |
| 0.4475620E-01 | 0.4039032E-01 | 0.3620258E-01 | 0.3226653E-01 | 0.2863112E-01 | 0.2532207E-01 |
| 0.2234569E-01 | 0.1969364E-01 | 0.1734763E-01 | 0.1528351E-01 | 0.1347431E-01 | 0.1189255E-01 |
| 0.1051166E-01 | 0.9306879E-02 | 0.8255675E-02 | 0.7337925E-02 | 0.6535884E-02 | 0.5834019E-02 |
| 0.5218865E-02 | 0.4678751E-02 | 0.4203635E-02 | 0.3784868E-02 | 0.3415018E-02 | 0.3087693E-02 |
| 0.2797404E-02 | | | | | |
| 0.4936860E-01 | 0.4402564E-01 | 0.3896590E-01 | 0.3428336E-01 | 0.3003200E-01 | 0.2623095E-01 |
| 0.2287288E-01 | 0.1993267E-01 | 0.1737490E-01 | 0.1515962E-01 | 0.1324620E-01 | 0.1159585E-01 |
| 0.1017292E-01 | 0.8945532E-02 | 0.7885731E-02 | 0.6969247E-02 | 0.6175241E-02 | 0.5485910E-02 |
| 0.4886099E-02 | 0.4362945E-02 | 0.3905531E-02 | 0.3504604E-02 | 0.3152323E-02 | 0.2842014E-02 |
| 0.2568001E-02 | | | | | |
| 0.5430407E-01 | 0.4770079E-01 | 0.4155645E-01 | 0.3598642E-01 | 0.3103996E-01 | 0.2671527E-01 |
| 0.2297685E-01 | 0.1977050E-01 | 0.1703436E-01 | 0.1470619E-01 | 0.1272752E-01 | 0.1104573E-01 |
| 0.9614829E-02 | 0.8395288E-02 | 0.7353596E-02 | 0.6461541E-02 | 0.5695493E-02 | 0.5035737E-02 |
| 0.4465798E-02 | 0.3971967E-02 | 0.3542770E-02 | 0.3168631E-02 | 0.2841524E-02 | 0.2554703E-02 |
| 0.2302494E-02 | | | | | |
| 0.5935640E-01 | 0.5110827E-01 | 0.4362728E-01 | 0.3703649E-01 | 0.3135156E-01 | 0.2651930E-01 |
| 0.2245085E-01 | 0.1904488E-01 | 0.1620135E-01 | 0.1382889E-01 | 0.1184767E-01 | 0.1018985E-01 |
| 0.8798833E-02 | 0.7627891E-02 | 0.6638685E-02 | 0.5799880E-02 | 0.5085899E-02 | 0.4475827E-02 |
| 0.3952560E-02 | 0.3502065E-02 | 0.3112809E-02 | 0.2775274E-02 | 0.2481583E-02 | 0.2225187E-02 |
| 0.2000634E-02 | | | | | |

Figure 16. Group B Sample Problems Program Results (Sheet 6 of 27)

| | | | | | |
|---|---|---|---|---|---|
| 0.6399732E-01 | 0.5360085E-01 | 0.4453607E-01 | 0.3686799E-01 | 0.3050483E-01 | 0.2528390E-01 |
| 0.2102488E-01 | 0.1755737E-01 | 0.1473235E-01 | 0.1242512E-01 | 0.1053395E-01 | 0.8977024E-02 |
| 0.7689144E-02 | 0.6618479E-02 | 0.5723888E-02 | 0.4972657E-02 | 0.4338702E-02 | 0.3801149E-02 |
| 0.3343233E-02 | 0.2951421E-02 | 0.2614738E-02 | 0.2324247E-02 | 0.2072632E-02 | 0.1853873E-02 |
| 0.1663000E-02 | | | | | |
| 0.6689904E-01 | 0.5381547E-01 | 0.4311003E-01 | 0.3456715E-01 | 0.2782881E-01 | 0.2253424E-01 |
| 0.1837074E-01 | 0.1508468E-01 | 0.1247711E-01 | 0.1039467E-01 | 0.8720069E-02 | 0.7363853E-02 |
| 0.6257709E-02 | 0.5349307E-02 | 0.4598318E-02 | 0.3973521E-02 | 0.3450553E-02 | 0.3010314E-02 |
| 0.2637693E-02 | 0.2320689E-02 | 0.2049683E-02 | 0.1816936E-02 | 0.1616179E-02 | 0.1442295E-02 |
| 0.1291099E-02 | | | | | |
| 0.6462938E-01 | 0.4890991E-01 | 0.3730367E-01 | 0.2876138E-01 | 0.2243616E-01 | 0.1770874E-01 |
| 0.1413776E-01 | 0.1141015E-01 | 0.9303223E-02 | 0.7657755E-02 | 0.6359033E-02 | 0.5323666E-02 |
| 0.4490432E-02 | 0.3813937E-02 | 0.3260163E-02 | 0.2803372E-02 | 0.2423884E-02 | 0.2106524E-02 |
| 0.1839467E-02 | 0.1613440E-02 | 0.1421104E-02 | 0.1256607E-02 | 0.1115243E-02 | 0.9932160E-03 |
| 0.8874380E-03 | | | | | |
| 0.4830580E-01 | 0.3344455E-01 | 0.2400332E-01 | 0.1770986E-01 | 0.1336349E-01 | 0.1027887E-01 |
| 0.8039943E-02 | 0.6382828E-02 | 0.5134811E-02 | 0.4180040E-02 | 0.3439162E-02 | 0.2856817E-02 |
| 0.2393722E-02 | 0.2021509E-02 | 0.1719456E-02 | 0.1472159E-02 | 0.1268049E-02 | 0.1098326E-02 |
| 0.9562212E-03 | 0.8364913E-03 | 0.7350092E-03 | 0.6485272E-03 | 0.5744449E-03 | 0.5106864E-03 |
| 0.4555599E-03 | | | | | |
| 0.COOCCCOE-38 | 0.6077208E-08 | 0.2964492E-08 | 0.3853839E-08 | 0.8893475E-09 | 0.3260941E-08 |
| 0.COOCCOOE-38 | 0.COOCCOOE-38 | 0.8893475E-09 | 0.OOCCOOOE-38 | 0.2075144E-08 | 0.0000C00E-38 |
| 0.OCOOCCOE-38 | 0.COOCCOOE-38 | 0.1334021E-08 | 0.1778695E-08 | 0.1482246E-08 | 0.1482246E-09 |
| 0.0000C00E-38 | 0.COOCCOOE-38 | 0.0000000E-38 | 0.0000000E-38 | 0.0000C00E-38 | 0.0000000E-38 |
| 0.CCCCCCOE-38 | | | | | |

Figure 16. Group B Sample Problems Program Results (Sheet 7 of 27)

```
                NAA CONFAC I REPORT SAMPLE PROBLEMS GROUP B    K.A.TOUPS,7/31/65

RUN NO.   2   DATA USED FOR THIS RUN- *3DISK *1PLAT1*
                                      *      *      *
                                      *      *      *

THE FORM FACTOR FROM SURFACE *3DISK       * TO SURFACE *1PLAT1       * = 0.01815

THE EXCHANGE COEFFICIENT (FA) =   0.46198E 00 SQ UNITS

                THE MAPPING AREA = 0.2112591E 02 SQ UNITS


ONLY A PART OF SURFACE *3DISK       *, COMPRISING  AN AREA OF 0.2113364E 02  SQ UNITS
SEES SURFACE *1PLAT1      *

THE AREA OF SURFACE *3DISK       * = 0.2545584E 02 SQ UNITS.


ONLY A PART OF SURFACE *1PLAT1      *, COMPRISING  AN AREA OF 0.4146304E 02  SQ UNITS
SEES SURFACE *3DISK       *

THE AREA OF SURFACE *1PLAT1      * = 0.4837355E 02 SQ UNITS.

THE FORM FACTOR FROM SURFACE *1PLAT1      * TO SURFACE *3DISK       * = 0.00955


THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-

    DATA NAME *3DISK       *

POINT       X               Y               Z              POINT       X               Y               Z
        0.0000000E-38  0.0000000E-38  0.1000000E 01 (INTERNALLY GENERATED ORIENTATION VECTOR)
   1    0.0000000E-38  0.0000000E-38  0.0000000E-38       2   0.1700902E 01  0.0000000E-38  0.0000000E-38
   3    0.3324490E 01  0.1623589E 01  0.0000000E-38       4   0.3324490E 01  0.3919689E 01  0.0000000E-38
   5    0.1700901E 01  0.5543277E 01  0.0000000E-38       6  -0.5951993E 00  0.5543277E 01  0.0000000E-38
   7   -0.1797918E 01  0.4340557E 01  0.0000000E-38

    DATA NAME *1PLAT1      *

POINT       X               Y               Z              POINT       X               Y               Z
      -0.2116343E 01 -0.1581156E 01  0.6496139E 01 (INTERNALLY GENERATED ORIENTATION VECTOR)
```

Figure 16. Group B Sample Problems Program Results (Sheet 8 of 27)





NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
   1  -0.2918495E 01 -0.1913418E 01  0.6000000E 01      2  -0.6223935E 00 -0.7456695E 01  0.6000000E 01
   3   0.2545193E 01 -0.6144637E 01  0.0000000E-38      4   0.2490916E 00 -0.6013600E 00  0.0000000E-38

COORDINATES OF POINTS ON BOUNDARY OF SURF     *3DISK        * FOR EACH Y INTERVAL

      X-LEFT          X-RIGHT           Y                    X-LEFT          X-RIGHT           Y

 0.0000000E-38  0.1700902E 01  0.0000000E-38          -0.9567089E-01  0.1931872E 01  0.2309699E 00
-0.1913418E 00  0.2162842E 01  0.4619397E 00          -0.2870127E 00  0.2393811E 01  0.6929096E 00
-0.3826836E 00  0.2624781E 01  0.9238794E 00          -0.4783545E 00  0.2855751E 01  0.1154849E 01
-0.5740254E 00  0.3086720E 01  0.1385819E 01          -0.6696963E 00  0.3317690E 01  0.1616789E 01
-0.7653672E 00  0.3324490E 01  0.1847759E 01          -0.8610380E 00  0.3324490E 01  0.2078729E 01
-0.9567089E 00  0.3324490E 01  0.2309699E 01          -0.1052380E 01  0.3324490E 01  0.2540668E 01
-0.1148051E 01  0.3324490E 01  0.2771638E 01          -0.1243722E 01  0.3324490E 01  0.3002608E 01
-0.1339392E 01  0.3324490E 01  0.3233578E 01          -0.1435063E 01  0.3324490E 01  0.3464548E 01
-0.1530734E 01  0.3324490E 01  0.3695518E 01          -0.1626405E 01  0.3317692E 01  0.3926488E 01
-0.1722076E 01  0.3086722E 01  0.4157457E 01          -0.1750048E 01  0.2855752E 01  0.4388427E 01
-0.1519078E 01  0.2624781E 01  0.4619397E 01          -0.1288109E 01  0.2393811E 01  0.4850367E 01
-0.1057139E 01  0.2162841E 01  0.5081337E 01          -0.8261692E 00  0.1931871E 01  0.5312307E 01
-0.5951993E 00  0.1700901E 01  0.5543277E 01

NO. OF HORIZONTAL INCREMENTS= 24  NO. OF VERTICAL INCREMENTS= 24

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

 0.0000000E-38  0.1011853E-01  0.2005936E-01  0.2957022E-01  0.3842509E-01  0.4645350E-01
 0.5355683E-01  0.5970703E-01  0.6493753E-01  0.6931487E-01  0.7292914E-01  0.7587532E-01
 0.7824512E-01  0.8012215E-01  0.8158000E-01  0.8268202E-01  0.8348207E-01  0.8402561E-01
 0.8435085E-01  0.8448095E-01  0.8446994E-01  0.8431364E-01  0.8404035E-01  0.8366646E-01
 0.8320594E-01
 0.1185797E-08  0.8153679E-02  0.1620880E-01  0.2400303E-01  0.3138343E-01  0.3822173E-01
 0.4442570E-01  0.4994391E-01  0.5476370E-01  0.5890408E-01  0.6240644E-01  0.6532535E-01
 0.6772116E-01  0.6965454E-01  0.7118316E-01  0.7235984E-01  0.7323180E-01  0.7384059E-01
 0.7422241E-01  0.7440[illegible]E-01  0.7442606E-01  0.7429817E-01  0.7404490E-01  0.7368352E-01
 0.7322832E-01
 0.2371593E-08  0.6932356E-02  0.1380240E-01  0.2048837E-01  0.2687288E-01  0.3285275E-01
 0.3834708E-01  0.4330211E-01  0.4769191E-01  0.5151558E-01  0.5479225E-01  0.5755505E-01
 0.5984566E-01  0.6173936E-01  0.6319226E-01  0.6433845E-01  0.6518901E-01  0.6578126E-01
 0.6614822E-01  0.6633[illegible]E-01  0.6632345E-01  0.6617972E-01  0.6590941E-01  0.6552985E-01
```

Figure 16. Group B Sample Problems Program Results (Sheet 9 of 27)

```
C.6505618E-01
0.CCCCCC0E-38  0.6066821E-02  0.1209266E-01  0.1797825E-01  0.2362666E-01  0.2895042E-01
0.3387777E-01  0.3835691E-01  0.4235750E-01  0.4586969E-01  0.4890109E-01  0.5147267E-01
0.5361457E-01  0.5536225E-01  0.5675337E-01  0.5782561E-01  0.5861509E-01  0.5915554E-01
0.5947779E-01  0.5960964E-01  0.5957593E-01  0.5939869E-01  0.5909737E-01  0.5868910E-01
0.5818892E-01
0.3557390E-08  0.5403147E-02  0.1077991E-01  0.1604524E-01  0.2111538E-01  0.2591349E-01
0.3037473E-01  0.3445000E-01  0.3810769E-01  0.4133353E-01  0.4412862E-01  0.4650654E-01
0.4849000E-01  0.5010765E-01  0.5139126E-01  0.5237367E-01  0.5308718E-01  0.5356253E-01
0.5382836E-01  0.5391085E-01  0.5383368E-01  0.5361806E-01  0.5328288E-01  0.5284491E-01
0.5231894E-01
0.2371593E-08  0.4867715E-02  0.9720065E-02  0.1448180E-01  0.1907836E-01  0.2344059E-01
0.2750896E-01  0.3123703E-01  0.3459312E-01  0.3756065E-01  0.4013682E-01  0.4233041E-01
0.4415913E-01  0.4564676E-01  0.4682079E-01  0.4771038E-01  0.4834479E-01  0.4875240E-01
0.4895994E-01  0.4899220E-01  0.4887176E-01  0.4861906E-01  0.4825240E-01  0.4778809E-01
0.4724064E-01
0.3557390E-08  0.4420660E-02  0.8834775E-02  0.1317432E-01  0.1737159E-01  0.2136323E-01
0.2509398E-01  0.2851973E-01  0.3160930E-01  0.3434486E-01  0.3672117E-01  0.3874379E-01
0.4042681E-01  0.4179052E-01  0.4285915E-01  0.4365898E-01  0.4421688E-01  0.4455924E-01
0.4471121E-01  0.4469634E-01  0.4453623E-01  0.4425056E-01  0.4385704E-01  0.4337154E-01
0.4280816E-01
0.2371593E-08  0.4038317E-02  0.8077417E-02  0.1205489E-01  0.1590838E-01  0.1957910E-01
0.2301531E-01  0.2617499E-01  0.2902762E-01  0.3155481E-01  0.3374968E-01  0.3561552E-01
0.3716381E-01  0.3841218E-01  0.3938232E-01  0.4009823E-01  0.4058482E-01  0.4086682E-01
0.4096804E-01  0.4091090E-01  0.4071614E-01  0.4040269E-01  0.3998771E-01  0.3948656E-01
0.3891298E-01
0.0CC0C00E-38  0.3512399E-02  0.7033766E-02  0.1051489E-01  0.1390614E-01  0.1715996E-01
0.2023328E-01  0.2308955E-01  0.2570034E-01  0.2804607E-01  0.3011601E-01  0.3190773E-01
0.3342587E-01  0.3468085E-01  0.3568732E-01  0.3646285E-01  0.3702664E-01  0.3739862E-01
0.3759860E-01  0.3764581E-01  0.3755843E-01  0.3735348E-01  0.3704662E-01  0.3665211E-01
0.3618290E-01
0.3557390E-08  0.3076316E-02  0.6166941E-02  0.9232368E-02  0.1223250E-01  0.1512837E-01
0.1788395E-01  0.2046769E-01  0.2285377E-01  0.2502294E-01  0.2696275E-01  0.2866735E-01
0.3013687E-01  0.3137660E-01  0.3239588E-01  0.3320714E-01  0.3382483E-01  0.3426467E-01
0.3454286E-01  0.3467556E-01  0.3467850E-01  0.3456664E-01  0.3435409E-01  0.3405387E-01
0.3367797E-01
0.0C00C00E-38  0.2714047E-02  0.5445832E-02  0.8163060E-02  0.1083275E-01  0.1342255E-01
0.1590200E-01  0.1824383E-01  0.2042490E-01  0.2242699E-01  0.2423713E-01  0.2584763E-01
0.2725581E-01  0.2846342E-01  0.2947596E-01  0.3030191E-01  0.3095198E-01  0.3143837E-01
0.3177416E-01  0.3197280E-01  0.3204771E-01  0.3201195E-01  0.3187801E-01  0.3165769E-01
0.3136196E-01
0.1185797E-08  0.2409347E-02  0.4838602E-02  0.7260943E-02  0.9648861E-02  0.1197513E-01
0.1421381E-01  0.1634120E-01  0.1833667E-01  0.2018332E-01  0.2186833E-01  0.2338316E-01
```

Figure 16. Group B Sample Problems Program Results (Sheet 10 of 27)

```
0.2472337E-01  0.2588834E-01  0.2688081E-01  0.2770631E-01  0.2837256E-01  0.2888892E-01
0.2926584E-01  0.2951443E-01  0.2964601E-01  0.2967188E-01  0.2960304E-01  0.2945002E-01
0.2922280E-01
0.1185797E-08  0.2150391E-02  0.4321987E-02  0.6492228E-02  0.8637885E-02  0.1073581E-01
0.1276369E-01  0.1470087E-01  0.1652894E-01  0.1823241E-01  0.1979898E-01  0.2121980E-01
0.2248941E-01  0.2360564E-01  0.2456925E-01  0.2538356E-01  0.2605398E-01  0.2658757E-01
0.2699262E-01  0.2727818E-01  0.2745378E-01  0.2752912E-01  0.2751380E-01  0.2741719E-01
0.2724827E-01
0.1185797E-08  0.1928354E-02  0.3878600E-02  0.5831566E-02  0.7767416E-02  0.9666293E-02
0.1150887E-01  0.1327701E-01  0.1495433E-01  0.1652667E-01  0.1798242E-01  0.1931278E-01
0.2051177E-01  0.2157618E-01  0.2250539E-01  0.2330108E-01  0.2396687E-01  0.2450801E-01
0.2493095E-01  0.2524308E-01  0.2545233E-01  0.2556698E-01  0.2559538E-01  0.2554580E-01
0.2542629E-01
0.1185797E-08  0.1736513E-02  0.3495177E-02  0.5259537E-02  0.7012530E-02  0.8736947E-02
0.1041595E-01  0.1203355E-01  0.1357511E-01  0.1502773E-01  0.1638056E-01  0.1762505E-01
0.1875499E-01  0.1976656E-01  0.2065816E-01  0.2143025E-01  0.2208508E-01  0.2262645E-01
0.2305935E-01  0.2338972E-01  0.2362415E-01  0.2376968E-01  0.2383353E-01  0.2382297E-01
0.2374519E-01
0.2371593E-08  0.1569657E-02  0.3161412E-02  0.4761041E-02  0.6353737E-02  0.7924498E-02
0.9458544E-02  0.1094173E-01  0.1236093E-01  0.1370440E-01  0.1496209E-01  0.1612577E-01
0.1718926E-01  0.1814832E-01  0.1900073E-01  0.1974603E-01  0.2038545E-01  0.2092162E-01
0.2135833E-01  0.2170033E-01  0.2195309E-01  0.2212252E-01  0.2221488E-01  0.2223654E-01
0.2219386E-01
0.1778695E-08  0.1423675E-02  0.2869187E-02  0.4324139E-02  0.5775603E-02  0.7210414E-02
0.8615530E-02  0.9978368E-02  0.1128715E-01  0.1253118E-01  0.1370114E-01  0.1478925E-01
0.1578940E-01  0.1669721E-01  0.1750997E-01  0.1822663E-01  0.1884759E-01  0.1937456E-01
0.1981038E-01  0.2015881E-01  0.2042433E-01  0.2061194E-01  0.2072700E-01  0.2077509E-01
0.2076185E-01
0.1778695E-08  0.1243501E-02  0.2608375E-02  0.3933795E-02  0.5258461E-02  0.6570803E-02
0.7859297E-02  0.9112752E-02  0.1032059E-01  0.1147312E-01  0.1256172E-01  0.1357908E-01
0.1451928E-01  0.1537789E-01  0.1615190E-01  0.1683977E-01  0.1744129E-01  0.1795740E-01
0.1839015E-01  0.1874244E-01  0.1901788E-01  0.1922067E-01  0.1935536E-01  0.1942678E-01
0.1943990E-01
0.2964492E-08  0.1125651E-02  0.2270661E-02  0.3426778E-02  0.4585366E-02  0.5737536E-02
0.6874352E-02  0.7987023E-02  0.9067103E-02  0.1010667E-01  0.1109850E-01  0.1203619E-01
0.1291433E-01  0.1372845E-01  0.1447522E-01  0.1515234E-01  0.1575853E-01  0.1629349E-01
0.1675779E-01  0.1715281E-01  0.1748059E-01  0.1774373E-01  0.1794529E-01  0.1808867E-01
0.1817752E-01
0.3389600E-03  0.1312967E-02  0.2301837E-02  0.3299427E-02  0.4299321E-02  0.5294939E-02
0.6279649E-02  0.7246876E-02  0.8190278E-02  0.9103819E-02  0.9981872E-02  0.1081937E-01
0.1161182E-01  0.1235542E-01  0.1304707E-01  0.1368439E-01  0.1426574E-01  0.1479016E-01
0.1525737E-01  0.1566772E-01  0.1602207E-01  0.1632181E-01  0.1656871E-01  0.1676492E-01
0.1691283E-01
```

Figure 16. Group B Sample Problems Program Results (Sheet 11 of 27)

```
0.1806363E-02  0.2613830E-02  0.3425920E-02  0.4238626E-02  0.5047865E-02  0.5849538E-02
0.6639578E-02  0.7414013E-02  0.8169043E-02  0.8901036E-02  0.9606660E-02  0.1028285E-01
0.1092687E-01  0.1153636E-01  0.1210935E-01  0.1264421E-01  0.1313975E-01  0.1359516E-01
0.1400996E-01  0.1438406E-01  0.1471771E-01  0.1501140E-01  0.1526593E-01  0.1548234E-01
0.1566185E-01
0.3015926E-02  0.3670365E-02  0.4323966E-02  0.4974274E-02  0.5618837E-02  0.6255229E-02
0.6881065E-02  0.7494047E-02  0.8091967E-02  0.8672741E-02  0.9234442E-02  0.9775277E-02
0.1029363E-01  0.1078809E-01  0.1125743E-01  0.1170061E-01  0.1211682E-01  0.1250540E-01
0.1286594E-01  0.1319820E-01  0.1350210E-01  0.1377776E-01  0.1402543E-01  0.1424553E-01
0.1443860E-01
0.3996476E-02  0.4514204E-02  0.5028752E-02  0.5538716E-02  0.6042712E-02  0.6539381E-02
0.7027409E-02  0.7505522E-02  0.7972500E-02  0.8427203E-02  0.8868552E-02  0.9295546E-02
0.9707288E-02  0.1010294E-01  0.1048179E-01  0.1084321E-01  0.1118666E-01  0.1151169E-01
0.1181800E-01  0.1210531E-01  0.1237350E-01  0.1262248E-01  0.1285229E-01  0.1306301E-01
0.1325484E-01
0.4776646E-02  0.5175039E-02  0.5569779E-02  0.5960126E-02  0.6345350E-02  0.6724750E-02
0.7097637E-02  0.7463349E-02  0.7821269E-02  0.8170797E-02  0.8511365E-02  0.8842448E-02
0.9163563E-02  0.9474264E-02  0.9774149E-02  0.1006285E-01  0.1034005E-01  0.1060549E-01
0.1085892E-01  0.1110016E-01  0.1132908E-01  0.1154556E-01  0.1174955E-01  0.1194102E-01
0.1212000E-01
0.5383753E-02  0.5680032E-02  0.5973157E-02  0.6262784E-02  0.6548564E-02  0.6830170E-02
0.7107264E-02  0.7379536E-02  0.7646704E-02  0.7908456E-02  0.8164542E-02  0.8414701E-02
0.8658635E-02  0.8896272E-02  0.9127269E-02  0.9351473E-02  0.9568715E-02  0.9778839E-02
0.9982711E-02  0.1017721E-01  0.1036523E-01  0.1054571E-01  0.1071854E-01  0.1088371E-01
0.1104117E-01
```

Figure 16. Group B Sample Problems Program Results (Sheet 12 of 27)

RUN NO. 3 DATA USED FOR THIS RUN- *1PLAT1*3DISK *
*9TDISK*

THE FORM FACTOR FROM SURFACE *1PLAT1 * TO SURFACE *3DISK 9TDISK* = 0.02579

THE EXCHANGE COEFFICIENT (FA) = 0.12475E 01 SQ UNITS

THE MAPPING AREA = 0.3686757E 02 SQ UNITS

ONLY A PART OF SURFACE *1PLAT1 *, COMPRISING AN AREA OF 0.3686695E 02 SQ UNITS
SEES SURFACE *3DISK 9TDISK*

THE AREA OF SURFACE *1PLAT1 * = 0.4837355E 02 SQ UNITS.

THE AREA OF SURFACE *3DISK 9TDISK* = 0.2545584E 02 SQ UNITS.

THE FORM FACTOR FROM SURFACE *3DISK 9TDISK* TO SURFACE *1PLAT1 * = 0.04901

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-

DATA NAME *1PLAT1 *

| POINT | X | Y | Z | POINT | X | Y | Z |
|---|---|---|---|---|---|---|---|
| | 0.0000000E-38 | 0.0000000E-38 | 0.1000000E 01 | (INTERNALLY GENERATED ORIENTATION VECTOR) | | | |
| 1 | 0.0000000E-38 | 0.0000000E-38 | 0.0000000E-38 | 2 | 0.6000000E 01 | 0.0000000E-38 | 0.0000000E-38 |
| 3 | 0.6000000E 01 | 0.3692172E 01 | 0.0000000E-38 | 4 | 0.7339294E 00 | 0.8062257E 01 | 0.0000000E-38 |
| 5 | 0.0000000E-38 | 0.8062257E 01 | 0.0000000E-38 | | | | |

DATA NAME *3DISK 9TDISK*

| POINT | X | Y | Z | POINT | X | Y | Z |
|---|---|---|---|---|---|---|---|
| | 0.2569569E 01 | 0.3053873E 01 | 0.5542002E 01 | (INTERNALLY GENERATED ORIENTATION VECTOR) | | | |
| 1 | 0.3181952E 01 | 0.3791811E 01 | 0.5825612E 01 | 2 | 0.3310640E 01 | 0.2877123E 01 | 0.7927720E 01 |
| 3 | 0.2121321E 01 | 0.3114788E 01 | 0.9877363E 01 | 4 | 0.3106812E 00 | 0.4365587E 01 | 0.1053247E 02 |
| 5 | -0.1061631E 01 | 0.5896817E 01 | 0.9509280E 01 | 6 | -0.1189319E 01 | 0.6811506E 01 | 0.7407171E 01 |
| 7 | 0.0000000E-38 | 0.5573840E 01 | 0.5457529E 01 | 8 | 0.1810640E 01 | 0.5323042E 01 | 0.4802426E 01 |

Figure 16. Group B Sample Problems Program Results (Sheet 13 of 27)

COORDINATES OF POINTS ON BOUNDARY OF SURF *1PLAT1 * FOR EACH Y INTERVAL

| X-LEFT | X-RIGHT | Y | X-LEFT | X-RIGHT | Y |
|---|---|---|---|---|---|
| 0.CCC0000E-38 | 0.6000C00E 01 | 0.0000000E-38 | 0.C000000E-38 | 0.600C000E 01 | 0.3359274E 00 |
| 0.COC0000E-38 | 0.6CC0000E 01 | 0.6718547E 00 | 0.C000000E-38 | 0.6000000E 01 | 0.1007782E 01 |
| 0.CCC0000E-38 | 0.60C0000E 01 | 0.1343709E 01 | 0.0000000E-38 | 0.6C00000E 01 | 0.1679637E 01 |
| 0.0CCCCC0E-38 | 0.6CC0000E 01 | 0.2015564E 01 | 0.C000000E-38 | 0.600CC00E 01 | 0.2351492E 01 |
| 0.0CCC000E-38 | 0.6CC0000E 01 | 0.2687419E 01 | 0.C000000E-38 | 0.6000000E 01 | 0.3023346E 01 |
| 0.0C000000E-38 | 0.6C00000E 01 | 0.3359274E 01 | 0.C0C0000E-38 | 0.6000000E 01 | 0.3695201E 01 |
| 0.0CC00C0E-38 | 0.5591548E 01 | 0.4031128E 01 | 0.C000000E-38 | 0.5186746E 01 | 0.4367056E 01 |
| 0.CC000000E-38 | 0.4781945E 01 | 0.4702983E 01 | 0.0000000E-38 | 0.4377143E 01 | 0.5038911E 01 |
| 0.CCCC0C0E-38 | 0.3972342E 01 | 0.5374838E 01 | 0.C0C0000E-38 | 0.3567540E 01 | 0.5710765E 01 |
| C.0C000C0E-38 | 0.3162739E 01 | 0.6046693E 01 | 0.0000000E-38 | 0.2757937E 01 | 0.6382620E 01 |
| 0.0CC0000E-38 | 0.2353136E 01 | 0.6718547E 01 | 0.C000000E-38 | 0.1948334E 01 | 0.7054475E 01 |
| C.0CC0000E-38 | 0.1543533E 01 | 0.7390402E 01 | 0.C0C0000E-38 | 0.1138731E 01 | 0.7726329E 01 |
| 0.CC0C000E-38 | 0.7339294E 00 | 0.8062257E 01 | | | |

NO. OF HORIZONTAL INCREMENTS= 24 NO. OF VERTICAL INCREMENTS= 24

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

| | | | | | |
|---|---|---|---|---|---|
| 0.5559730E-01 | 0.5516923E-01 | 0.5456245E-01 | 0.5377687E-01 | 0.5281479E-01 | 0.5168101E-01 |
| 0.5038280E-01 | 0.4892988E-01 | 0.4733424E-01 | 0.4560994E-01 | 0.4377279E-01 | 0.4184003E-01 |
| 0.3982991E-01 | 0.3776127E-01 | 0.3565309E-01 | 0.3352408E-01 | 0.3139227E-01 | 0.2927464E-01 |
| 0.2718688E-01 | 0.2514306E-01 | 0.2315556E-01 | 0.2123492E-01 | 0.1938983E-01 | 0.1762712E-01 |
| 0.1595192E-01 | | | | | |
| 0.5791987E-01 | 0.5745707E-01 | 0.5679932E-01 | 0.5594647E-01 | 0.5490110E-01 | 0.5366862E-01 |
| 0.5225732E-01 | 0.5067823E-01 | 0.4894501E-01 | 0.4707363E-01 | 0.4508205E-01 | 0.4298980E-01 |
| 0.4081751E-01 | 0.3858636E-01 | 0.3631762E-01 | 0.3403213E-01 | 0.3174984E-01 | 0.2948938E-01 |
| 0.2726780E-01 | 0.2510025E-01 | 0.2299984E-01 | 0.2097757E-01 | 0.1904229E-01 | 0.1720078E-01 |
| 0.1545787E-01 | | | | | |
| 0.6012254E-01 | 0.5961957E-01 | 0.5890469E-01 | 0.5797771E-01 | 0.5684157E-01 | 0.5550243E-01 |
| 0.5396973E-01 | 0.5225600E-01 | 0.5037678E-01 | 0.4835019E-01 | 0.4619658E-01 | 0.4393803E-01 |
| 0.4159772E-01 | 0.3919941E-01 | 0.3676679E-01 | 0.3432294E-01 | 0.3188977E-01 | 0.2948761E-01 |
| 0.2713480E-01 | 0.2484749E-01 | 0.2263940E-01 | 0.2052185E-01 | 0.1850369E-01 | 0.1659146E-01 |
| 0.1478951E-01 | | | | | |
| 0.6215271E-01 | 0.6160299E-01 | 0.6082387E-01 | 0.5981519E-01 | 0.5858033E-01 | 0.5712636E-01 |
| 0.5546401E-01 | 0.5360756E-01 | 0.5157463E-01 | 0.4938577E-01 | 0.4706396E-01 | 0.4463400E-01 |

Figure 16. Group B Sample Problems Program Results (Sheet 14 of 27)





NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
0.4212191E-01  0.3955414E-01  0.3695695E-01  0.3435569E-01  0.3177429E-01  0.2923466E-01
0.2675640E-01  0.2435647E-01  0.2204909E-01  0.1984564E-01  0.1775480E-01  0.1578265E-01
0.1393287E-01
0.6395136E-01  0.6334711E-01  0.6249567E-01  0.6139702E-01  0.6005513E-01  0.5847811E-01
0.5667823E-01  0.5467173E-01  0.5247858E-01  0.5012196E-01  0.4762773E-01  0.4502368E-01
0.4233877E-01  0.3960230E-01  0.3684315E-01  0.3408897E-01  0.3136560E-01  0.2869646E-01
0.2610222E-01  0.2360047E-01  0.2120564E-01  0.1892902E-01  0.1677882E-01  0.1476043E-01
0.1287665E-01
0.6545395E-01  0.6478606E-01  0.6385324E-01  0.6265576E-01  0.6119835E-01  0.5949037E-01
0.5754583E-01  0.5538319E-01  0.5302500E-01  0.5049736E-01  0.4782919E-01  0.4505145E-01
0.4219617E-01  0.3929555E-01  0.3638107E-01  0.3348262E-01  0.3062780E-01  0.2784134E-01
0.2514473E-01  0.2255593E-01  0.2008931E-01  0.1775574E-01  0.1556271E-01  0.1351467E-01
0.1161331E-01
0.6659183E-01  0.6584992E-01  0.6482583E-01  0.6352029E-01  0.6193899E-01  0.6009279E-01
0.5799770E-01  0.5567464E-01  0.5314900E-01  0.5045000E-01  0.4760982E-01  0.4466265E-01
0.4164368E-01  0.3858798E-01  0.3552951E-01  0.3250021E-01  0.2952920E-01  0.2664226E-01
0.2386134E-01  0.2120444E-01  0.1868555E-01  0.1631477E-01  0.1409861E-01  0.1204028E-01
0.1014014E-01
0.6729454E-01  0.6646708E-01  0.6534120E-01  0.6391832E-01  0.6220533E-01  0.6021486E-01
0.5796519E-01  0.5547995E-01  0.5278759E-01  0.4992059E-01  0.4691452E-01  0.4380685E-01
0.4063584E-01  0.3743927E-01  0.3425339E-01  0.3111188E-01  0.2804505E-01  0.2507929E-01
0.2223667E-01  0.1953479E-01  0.1698688E-01  0.1460195E-01  0.1238519E-01  0.1033836E-01
0.8460277E-02
0.6749279E-01  0.6656746E-01  0.6532908E-01  0.6378C00E-01  0.6192867E-01  0.5978975E-01
0.5738405E-01  0.5473813E-01  0.5188368E-01  0.4885657E-01  0.4569570E-01  0.4244176E-01
0.3913590E-01  0.3581834E-01  0.3252723E-01  0.2929758E-01  0.2616042E-01  0.2314230E-01
0.2026489E-01  0.1754500E-01  0.1499466E-01  0.1262146E-01  0.1042898E-01  0.8417288E-02
0.6583508E-02
0.6712249E-01  0.6608667E-01  0.6472542E-01  0.6304242E-01  0.6104796E-01  0.5875903E-01
0.5619922E-01  0.5339822E-01  0.5039102E-01  0.4721685E-01  0.4391786E-01  0.4053772E-01
0.3712009E-01  0.3370723E-01  0.3033869E-01  0.2705024E-01  0.2387311E-01  0.2083339E-01
0.1795191E-01  0.1524415E-01  0.1272059E-01  0.1038705E-01  0.8245260E-02  0.6293425E-02
0.4526865E-02
0.6612938E-01  0.6497087E-01  0.6347757E-01  0.6165485E-01  0.5951517E-01  0.5707815E-01
0.5437036E-01  0.5142468E-01  0.4827940E-01  0.4497695E-01  0.4156247E-01  0.3808217E-01
0.3458175E-01  0.3110490E-01  0.2769193E-01  0.2437875E-01  0.2119609E-01  0.1816904E-01
0.1531699E-01  0.1265370E-01  0.1018769E-01  0.7922762E-02  0.5858590E-02  0.3991419E-02
0.2314728E-02
0.6447420E-01  0.6318220E-01  0.6154980E-01  0.5958444E-01  0.5730108E-01  0.5472220E-01
0.5187745E-01  0.4880289E-01  0.4553994E-01  0.4213393E-01  0.3863248E-01  0.3508381E-01
0.3153497E-01  0.2803035E-01  0.2461028E-01  0.2131005E-01  0.1815922E-01  0.1518129E-01
0.1239369E-01  0.9808037E-02  0.7430612E-02  0.5262977E-02  0.3302674E-02  0.1543953E-02
0.9999785E-00
```

Figure 16. Group B Sample Problems Program Results (Sheet 15 of 27)

| | | | | | |
|---|---|---|---|---|---|
| 0.6213796E-01 | 0.6081271E-01 | 0.5919036E-01 | 0.5727830E-01 | 0.5508981E-01 | 0.5264402E-01 |
| 0.4996570E-01 | 0.4708467E-01 | 0.4403503E-01 | 0.4085415E-01 | 0.3758144E-01 | 0.3425716E-01 |
| 0.3092106E-01 | 0.2761120E-01 | 0.2436290E-01 | 0.2120782E-01 | 0.1817336E-01 | 0.1528222E-01 |
| 0.1255230E-01 | 0.9996732E-02 | 0.7624105E-02 | 0.5438868E-02 | 0.3441791E-02 | 0.1630494E-02 |
| 0.2371593E-08 | | | | | |
| 0.5912661E-01 | 0.5778069E-01 | 0.5618136E-01 | 0.5433578E-01 | 0.5225556E-01 | 0.4995676E-01 |
| 0.4745965E-01 | 0.4478836E-01 | 0.4197031E-01 | 0.3903548E-01 | 0.3601565E-01 | 0.3294342E-01 |
| 0.2985136E-01 | 0.2677107E-01 | 0.2373240E-01 | 0.2076275E-01 | 0.1788648E-01 | 0.1512456E-01 |
| 0.1249432E-01 | 0.1000938E-01 | 0.7679755E-02 | 0.5511989E-02 | 0.3509470E-02 | 0.1672768E-02 |
| 0.1334021E-08 | | | | | |
| 0.5547438E-01 | 0.5412568E-01 | 0.5256662E-01 | 0.5080390E-01 | 0.4884747E-01 | 0.4671048E-01 |
| 0.4440913E-01 | 0.4196242E-01 | 0.3939178E-01 | 0.3672054E-01 | 0.3397348E-01 | 0.3117616E-01 |
| 0.2835432E-01 | 0.2553324E-01 | 0.2273722E-01 | 0.1998899E-01 | 0.1730931E-01 | 0.1471660E-01 |
| 0.1222676E-01 | 0.9852954E-02 | 0.7605646E-02 | 0.5492619E-02 | 0.3519109E-02 | 0.1687986E-02 |
| 0.1334021E-08 | | | | | |
| 0.5124499E-01 | 0.4991528E-01 | 0.4841620E-01 | 0.4675375E-01 | 0.4493622E-01 | 0.4297409E-01 |
| 0.4087994E-01 | 0.3866828E-01 | 0.3635533E-01 | 0.3395866E-01 | 0.3149691E-01 | 0.2898939E-01 |
| 0.2645568E-01 | 0.2391522E-01 | 0.2138696E-01 | 0.1888894E-01 | 0.1643803E-01 | 0.1404962E-01 |
| 0.1173746E-01 | 0.9513455E-02 | 0.7387624E-02 | 0.5368062E-02 | 0.3460972E-02 | 0.1670727E-02 |
| 0.0000000E-38 | | | | | |
| 0.4653024E-01 | 0.4524408E-01 | 0.4382615E-01 | 0.4228160E-01 | 0.4061709E-01 | 0.3884067E-01 |
| 0.3696182E-01 | 0.3499123E-01 | 0.3294072E-01 | 0.3082307E-01 | 0.2865175E-01 | 0.2644079E-01 |
| 0.2420444E-01 | 0.2195702E-01 | 0.1971262E-01 | 0.1748491E-01 | 0.1528691E-01 | 0.1313077E-01 |
| 0.1102770E-01 | 0.8987736E-02 | 0.7019750E-02 | 0.5131324E-02 | 0.3328759E-02 | 0.1617062E-02 |
| 0.2223369E-08 | | | | | |
| 0.4144553E-01 | 0.4022868E-01 | 0.3891326E-01 | 0.3750345E-01 | 0.3600434E-01 | 0.3442191E-01 |
| 0.3276297E-01 | 0.3103512E-01 | 0.2924663E-01 | 0.2740638E-01 | 0.2552372E-01 | 0.2360836E-01 |
| 0.2167022E-01 | 0.1971934E-01 | 0.1776569E-01 | 0.1581907E-01 | 0.1388896E-01 | 0.1198443E-01 |
| 0.1011402E-01 | 0.8285640E-02 | 0.6506515E-02 | 0.4783113E-02 | 0.3121120E-02 | 0.1525398E-02 |
| -0.0000000E-38 | | | | | |
| 0.3612280E-01 | 0.3500040E-01 | 0.3380752E-01 | 0.3254733E-01 | 0.3122354E-01 | 0.2984036E-01 |
| 0.2840246E-01 | 0.2691498E-01 | 0.2538343E-01 | 0.2381370E-01 | 0.2221194E-01 | 0.2058455E-01 |
| 0.1893807E-01 | 0.1727916E-01 | 0.1561447E-01 | 0.1395062E-01 | 0.1229411E-01 | 0.1065125E-01 |
| 0.9028118E-02 | 0.7430481E-02 | 0.5863761E-02 | 0.4332980E-02 | 0.2842739E-02 | 0.1397186E-02 |
| 0.4446738E-09 | | | | | |
| 0.3070155E-01 | 0.2969620E-01 | 0.2864307E-01 | 0.2754440E-01 | 0.2640269E-01 | 0.2522074E-01 |
| 0.2400157E-01 | 0.2274845E-01 | 0.2146486E-01 | 0.2015446E-01 | 0.1882106E-01 | 0.1746864E-01 |
| 0.1610125E-01 | 0.1472300E-01 | 0.1333808E-01 | 0.1195065E-01 | 0.1056484E-01 | 0.9184741E-02 |
| 0.7814330E-02 | 0.6457480E-02 | 0.5117898E-02 | 0.3799127E-02 | 0.2504508E-02 | 0.1237167E-02 |
| 0.1037572E-08 | | | | | |
| 0.2531914E-01 | 0.2444931E-01 | 0.2354909E-01 | 0.2261994E-01 | 0.2166344E-01 | 0.2068128E-01 |
| 0.1967529E-01 | 0.1864739E-01 | 0.1759961E-01 | 0.1653408E-01 | 0.1545299E-01 | 0.1435862E-01 |
| 0.1325328E-01 | 0.1213936E-01 | 0.1101925E-01 | 0.9895356E-02 | 0.8770113E-02 | 0.7645922E-02 |

Figure 16. Group B Sample Problems Program Results (Sheet 16 of 27)

| | | | | | |
|---|---|---|---|---|---|
| 0.6525167E-02 | 0.5410194E-02 | 0.4303299E-02 | 0.3206715E-02 | 0.2122602E-02 | 0.1053036E-02 |
| 0.CCCCCCCE-38 | | | | | |
| 0.2010179E-01 | 0.1938059E-01 | 0.1864159E-01 | 0.1788563E-01 | 0.1711360E-01 | 0.1632643E-01 |
| 0.1552511E-01 | 0.1471067E-01 | 0.1388419E-01 | 0.1304677E-01 | 0.1219957E-01 | 0.1134377E-01 |
| 0.1048057E-01 | 0.9611190E-02 | 0.8736885E-02 | 0.7858910E-02 | 0.6978535E-02 | 0.6097024E-02 |
| 0.5215651E-02 | 0.4335679E-02 | 0.3458358E-02 | 0.2584926E-02 | 0.1716597E-02 | 0.8545656E-03 |
| 0.CCCCCCCE-38 | | | | | |
| 0.1515726E-01 | 0.1459193E-01 | 0.1401726E-01 | 0.1343369E-01 | 0.1284162E-01 | 0.1224152E-01 |
| 0.1163384E-01 | 0.1101906E-01 | 0.1039768E-01 | 0.9770207E-02 | 0.9137158E-02 | 0.8499066E-02 |
| 0.7856467E-02 | 0.7209922E-02 | 0.6559978E-02 | 0.5907210E-02 | 0.5252185E-02 | 0.4595480E-02 |
| 0.3937668E-02 | 0.3279334E-02 | 0.2621053E-02 | 0.1963409E-02 | 0.1306969E-02 | 0.6523106E-03 |
| 0.CCCCCCCE-38 | | | | | |
| 0.1057014E-01 | 0.1016207E-01 | 0.9749862E-02 | 0.9333671E-02 | 0.8913671E-02 | 0.8490029E-02 |
| 0.8062917E-02 | 0.7632519E-02 | 0.7199011E-02 | 0.6762583E-02 | 0.6323419E-02 | 0.5881715E-02 |
| 0.5437665E-02 | 0.4991468E-02 | 0.4543317E-02 | 0.4093423E-02 | 0.3641987E-02 | 0.3189213E-02 |
| 0.2735314E-02 | 0.2280495E-02 | 0.1824968E-02 | 0.1368942E-02 | 0.9126310E-03 | 0.4562450E-03 |
| 0.CCCCCCCE-38 | | | | | |
| 0.6399869E-02 | 0.6145166E-02 | 0.5889099E-02 | 0.5631709E-02 | 0.5373036E-02 | 0.5113127E-02 |
| 0.4852018E-02 | 0.4589762E-02 | 0.4326396E-02 | 0.4061967E-02 | 0.3796522E-02 | 0.3530108E-02 |
| 0.3262767E-02 | 0.2994546E-02 | 0.2725498E-02 | 0.2455665E-02 | 0.2185098E-02 | 0.1913845E-02 |
| 0.1641954E-02 | 0.1369475E-02 | 0.1096457E-02 | 0.8229511E-03 | 0.5490043E-03 | 0.2746697E-03 |
| 0.CCCCCCCE-38 | | | | | |

Figure 16. Group B Sample Problems Program Results (Sheet 17 of 27)

```
                NAA CONFAC I REPORT SAMPLE PROBLEMS GROUP B     K.A.TOUPS,7/31/65

RUN NO.   4   DATA USED FOR THIS RUN- *3DISK *3DISK *
                                      *      *9TDISK*
                                      *      *      *

THE FORM FACTOR FROM SURFACE *3DISK       * TO SURFACE *3DISK 9TDISK* = 0.01981

THE EXCHANGE COEFFICIENT (FA) =   0.50423E 00 SQ UNITS

                THE MAPPING AREA = 0.2487100E 02 SQ UNITS

ONLY A PART OF SURFACE *3DISK       *, COMPRISING  AN AREA OF 0.2487758E 02  SQ UNITS
SEES SURFACE *3DISK 9TDISK*

THE AREA OF SURFACE *3DISK       * = 0.2545584E 02 SQ UNITS.

THE AREA OF SURFACE *3DISK 9TDISK* = 0.2545584E 02 SQ UNITS.

THE FORM FACTOR FROM SURFACE *3DISK 9TDISK* TO SURFACE *3DISK       * = 0.01981


THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-

    DATA NAME *3DISK       *

POINT       X              Y              Z            POINT      X              Y              Z
        C.COOCOOOE-38  0.CCOOOOOE-38  0.9999999E 00 (INTERNALLY GENERATED ORIENTATION VECTOR)
   1    C.CCCCOOOE-38  0.COOOOOOE-38  0.0000000E-38      2   0.2296100E 01  0.000C000E-38  0.0000000E-38
   3    0.3919689E 01  0.1623587E 01  0.0000000E-38      4   0.3919689E 01  0.2640742E 01  0.0000000E-38
   5    C.3015416E 01  0.4823962E 01  0.0000000E-38      6   0.2296102E 01  0.5543276E 01  0.0000000E-38
   7    0.COOCCOOE-38  0.5543276E 01  0.0000000E-38      8  -0.1623587E 01  0.3919689E 01  0.0000000E-38
   9   -C.1623587E 01  0.1623589E 01  0.0000000E-38

    DATA NAME *3DISK 9TDISK*

POINT       X              Y              Z            POINT      X              Y              Z
        0.6801463E 01  0.1866198E 01  0.6098098E 01 (INTERNALLY GENERATED ORIENTATION VECTOR)
   1    C.7601572E 01  0.2197597E 01  0.5598098E 01      2   0.8245249E 01  0.3415293E 01  0.7435207E 01
   3    C.7839379E 01  0.5543275E 01  0.8196150E 01      4   0.6621715E 01  0.7335001E 01  0.7435175E 01
   5    C.5305547E 01  0.7740903E 01  0.5598052E 01      6   0.4661870E 01  0.6523207E 01  0.3760942E 01
```

Figure 16. Group B Sample Problems Program Results (Sheet 18 of 27)

7 C.5067740E 01 0.4395225E 01 0.3000000E 01 8 0.6285405E 01 0.2603499E 01 0.3760975E 01

COORDINATES OF POINTS ON BOUNDARY OF SURF *3DISK * FOR EACH Y INTERVAL

| X-LEFT | X-RIGHT | Y | X-LEFT | X-RIGHT | Y |
|---|---|---|---|---|---|
| 0.0000000E-38 | 0.2296100E 01 | 0.0000000E-38 | -0.2309696E 00 | 0.2527070E 01 | 0.2309698E 00 |
| -0.4619393E 00 | 0.2758040E 01 | 0.4619397E 00 | -0.6929090E 00 | 0.2989010E 01 | 0.6929095E 00 |
| -0.9238786E 00 | 0.3219981E 01 | 0.9238794E 00 | -0.1154848E 01 | 0.3450951E 01 | 0.1154849E 01 |
| -0.1385818E 01 | 0.3681921E 01 | 0.1385819E 01 | -0.1616788E 01 | 0.3912891E 01 | 0.1616789E 01 |
| -0.1623587E 01 | 0.3919689E 01 | 0.1847759E 01 | -0.1623587E 01 | 0.3919689E 01 | 0.2078729E 01 |
| -0.1623587E 01 | 0.3919689E 01 | 0.2309698E 01 | -0.1623587E 01 | 0.3919689E 01 | 0.2540668E 01 |
| -0.1623587E 01 | 0.3865473E 01 | 0.2771638E 01 | -0.1623587E 01 | 0.3769807E 01 | 0.3002608E 01 |
| -0.1623587E 01 | 0.3674141E 01 | 0.3233578E 01 | -0.1623587E 01 | 0.3578475E 01 | 0.3464548E 01 |
| -0.1623587E 01 | 0.3482809E 01 | 0.3695518E 01 | -0.1616789E 01 | 0.3387143E 01 | 0.3926487E 01 |
| -0.1385819E 01 | 0.3291477E 01 | 0.4157457E 01 | -0.1154849E 01 | 0.3195811E 01 | 0.4388427E 01 |
| -0.9238793E 00 | 0.3100145E 01 | 0.4619397E 01 | -0.6929095E 00 | 0.2989011E 01 | 0.4850367E 01 |
| -0.4619396E 00 | 0.2758041E 01 | 0.5081337E 01 | -0.2309698E 00 | 0.2527072E 01 | 0.5312306E 01 |
| 0.0000000E-38 | 0.2296102E 01 | 0.5543276E 01 | | | |

NO. OF HORIZONTAL INCREMENTS= 24 NO. OF VERTICAL INCREMENTS= 24

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

| | | | | | |
|---|---|---|---|---|---|
| 0.1922554E-01 | 0.1937650E-01 | 0.1952111E-01 | 0.1965881E-01 | 0.1978900E-01 | 0.1991103E-01 |
| 0.2002427E-01 | 0.2012802E-01 | 0.2022156E-01 | 0.2030414E-01 | 0.2037498E-01 | 0.2043327E-01 |
| 0.2047817E-01 | 0.2050880E-01 | 0.2052427E-01 | 0.2052363E-01 | 0.2050594E-01 | 0.2047020E-01 |
| 0.2041540E-01 | 0.2034051E-01 | 0.2024447E-01 | 0.2012621E-01 | 0.1998462E-01 | 0.1981863E-01 |
| 0.1962710E-01 | | | | | |
| 0.1937088E-01 | 0.1957992E-01 | 0.1978130E-01 | 0.1997407E-01 | 0.2015721E-01 | 0.2032964E-01 |
| 0.2049021E-01 | 0.2063768E-01 | 0.2077079E-01 | 0.2088817E-01 | 0.2098836E-01 | 0.2106988E-01 |
| 0.2113111E-01 | 0.2117041E-01 | 0.2118603E-01 | 0.2117617E-01 | 0.2113896E-01 | 0.2107244E-01 |
| 0.2097461E-01 | 0.2084343E-01 | 0.2067676E-01 | 0.2047248E-01 | 0.2022840E-01 | 0.1994233E-01 |
| 0.1961208E-01 | | | | | |
| 0.1942535E-01 | 0.1969848E-01 | 0.1996325E-01 | 0.2021821E-01 | 0.2046179E-01 | 0.2069230E-01 |
| 0.2090793E-01 | 0.2110670E-01 | 0.2128649E-01 | 0.2144506E-01 | 0.2157997E-01 | 0.2168866E-01 |
| 0.2176838E-01 | 0.2181622E-01 | 0.2182914E-01 | 0.2180391E-01 | 0.2173715E-01 | 0.2162536E-01 |
| 0.2146488E-01 | 0.2125195E-01 | 0.2098273E-01 | 0.2065327E-01 | 0.2025961E-01 | 0.1979777E-01 |
| 0.1926383E-01 | | | | | |

Figure 16. Group B Sample Problems Program Results (Sheet 19 of 27)

| | | | | | |
|---|---|---|---|---|---|
| 0.1939177E-01 | 0.1973321E-01 | 0.2006638E-01 | 0.2038925E-01 | 0.2069961E-01 | 0.2099502E-01 |
| 0.2127277E-01 | 0.2152991E-01 | 0.2176322E-01 | 0.2196921E-01 | 0.2214406E-01 | 0.2228367E-01 |
| 0.2238361E-01 | 0.2243915E-01 | 0.2244519E-01 | 0.2239638E-01 | 0.2228701E-01 | 0.2211111E-01 |
| 0.2186244E-01 | 0.2153456E-01 | 0.2112083E-01 | 0.2061453E-01 | 0.2000890E-01 | 0.1929726E-01 |
| 0.1847313E-01 | | | | | |
| 0.1927444E-01 | 0.1968652E-01 | 0.2009138E-01 | 0.2048638E-01 | 0.2086854E-01 | 0.2123452E-01 |
| 0.2158055E-01 | 0.2190248E-01 | 0.2219565E-01 | 0.2245491E-01 | 0.2267461E-01 | 0.2284853E-01 |
| 0.2296986E-01 | 0.2303121E-01 | 0.2302462E-01 | 0.2294149E-01 | 0.2277267E-01 | 0.2250847E-01 |
| 0.2213874E-01 | 0.2165291E-01 | 0.2104020E-01 | 0.2028965E-01 | 0.1939044E-01 | 0.1833204E-01 |
| 0.1710452E-01 | | | | | |
| 0.1907889E-01 | 0.1956212E-01 | 0.2004023E-01 | 0.2050993E-01 | 0.2096743E-01 | 0.2140837E-01 |
| 0.2182779E-01 | 0.2222003E-01 | 0.2257868E-01 | 0.2289653E-01 | 0.2316548E-01 | 0.2337651E-01 |
| 0.2351959E-01 | 0.2358368E-01 | 0.2355667E-01 | 0.2342540E-01 | 0.2317571E-01 | 0.2279247E-01 |
| 0.2225974E-01 | 0.2156096E-01 | 0.2067919E-01 | 0.1959750E-01 | 0.1829937E-01 | 0.1676925E-01 |
| 0.1499325E-01 | | | | | |
| 0.1881164E-01 | 0.1936482E-01 | 0.1991603E-01 | 0.2046135E-01 | 0.2099617E-01 | 0.2151507E-01 |
| 0.2201169E-01 | 0.2247868E-01 | 0.2290756E-01 | 0.2328852E-01 | 0.2361043E-01 | 0.2386062E-01 |
| 0.2402480E-01 | 0.2408697E-01 | 0.2402939E-01 | 0.2383249E-01 | 0.2347499E-01 | 0.2293401E-01 |
| 0.2218536E-01 | 0.2120387E-01 | 0.1996397E-01 | 0.1844050E-01 | 0.1660959E-01 | 0.1444996E-01 |
| 0.1194420E-01 | | | | | |
| 0.1847993E-01 | 0.1910030E-01 | 0.1972284E-01 | 0.2034312E-01 | 0.2095568E-01 | 0.2155401E-01 |
| 0.2213030E-01 | 0.2267528E-01 | 0.2317799E-01 | 0.2362565E-01 | 0.2400330E-01 | 0.2429371E-01 |
| 0.2447707E-01 | 0.2453085E-01 | 0.2442968E-01 | 0.2414527E-01 | 0.2364647E-01 | 0.2289962E-01 |
| 0.2186891E-01 | 0.2051724E-01 | 0.1880736E-01 | 0.1670339E-01 | 0.1417290E-01 | 0.1118934E-01 |
| 0.7734840E-02 | | | | | |
| 0.1870472E-01 | 0.1934308E-01 | 0.1998426E-01 | 0.2062361E-01 | 0.2125545E-01 | 0.2187291E-01 |
| 0.2246774E-01 | 0.2303009E-01 | 0.2354829E-01 | 0.2400856E-01 | 0.2439483E-01 | 0.2468840E-01 |
| 0.2486771E-01 | 0.2490808E-01 | 0.2478160E-01 | 0.2445696E-01 | 0.2389960E-01 | 0.2307185E-01 |
| 0.2193354E-01 | 0.2044284E-01 | 0.1855761E-01 | 0.1623716E-01 | 0.1344470E-01 | 0.1015022E-01 |
| 0.6333899E-02 | | | | | |
| 0.1891681E-01 | 0.1956966E-01 | 0.2022568E-01 | 0.2088006E-01 | 0.2152686E-01 | 0.2215887E-01 |
| 0.2276742E-01 | 0.2334209E-01 | 0.2387049E-01 | 0.2433796E-01 | 0.2472727E-01 | 0.2501834E-01 |
| 0.2518790E-01 | 0.2520919E-01 | 0.2505180E-01 | 0.2468149E-01 | 0.2406025E-01 | 0.2314650E-01 |
| 0.2189569E-01 | 0.2026125E-01 | 0.1819606E-01 | 0.1565456E-01 | 0.1259545E-01 | 0.8985162E-02 |
| 0.4801853E-02 | | | | | |
| 0.1909531E-01 | 0.1976024E-01 | 0.2042853E-01 | 0.2109516E-01 | 0.2175394E-01 | 0.2239729E-01 |
| 0.2301609E-01 | 0.2359935E-01 | 0.2413388E-01 | 0.2460413E-01 | 0.2499167E-01 | 0.2527496E-01 |
| 0.2542891E-01 | 0.2542463E-01 | 0.2522906E-01 | 0.2480489E-01 | 0.2411045E-01 | 0.2310006E-01 |
| 0.2172452E-01 | 0.1993224E-01 | 0.1767087E-01 | 0.1488968E-01 | 0.1154272E-01 | 0.7592855E-02 |
| 0.3016354E-02 | | | | | |
| 0.1923769E-01 | 0.1991202E-01 | 0.2058970E-01 | 0.2126545E-01 | 0.2193283E-01 | 0.2258390E-01 |
| 0.2320901E-01 | 0.2379657E-01 | 0.2433265E-01 | 0.2480066E-01 | 0.2518096E-01 | 0.2545048E-01 |
| 0.2558230E-01 | 0.2554521E-01 | 0.2530346E-01 | 0.2481650E-01 | 0.2403889E-01 | 0.2292061E-01 |

Figure 16. Group B Sample Problems Program Results (Sheet 20 of 27)

| | | | | | |
|---|---|---|---|---|---|
| 0.2140763E-01 | 0.1944312E-01 | 0.1696929E-01 | 0.1393008E-01 | 0.1027485E-01 | 0.5962923E-02 |
| 0.9690704E-03 | | | | | |
| 0.1934164E-01 | 0.2001573E-01 | 0.2069289E-01 | 0.2136780E-01 | 0.2203391E-01 | 0.2268319E-01 |
| 0.2330589E-01 | 0.2389021E-01 | 0.2442201E-01 | 0.2488441E-01 | 0.2525739E-01 | 0.2551737E-01 |
| 0.2563677E-01 | 0.2558355E-01 | 0.2532091E-01 | 0.2480688E-01 | 0.2399434E-01 | 0.2283111E-01 |
| 0.2126054E-01 | 0.1922264E-01 | 0.1665590E-01 | 0.1350005E-01 | 0.9699816E-02 | 0.5209749E-02 |
| 0.0000000E-38 | | | | | |
| 0.1940504E-01 | 0.2007050E-01 | 0.2073851E-01 | 0.2140381E-01 | 0.2205994E-01 | 0.2269901E-01 |
| 0.2331142E-01 | 0.2388559E-01 | 0.2440758E-01 | 0.2486084E-01 | 0.2522568E-01 | 0.2547892E-01 |
| 0.2559339E-01 | 0.2553750E-01 | 0.2527483E-01 | 0.2476382E-01 | 0.2395755E-01 | 0.2280381E-01 |
| 0.2124557E-01 | 0.1922188E-01 | 0.1666955E-01 | 0.1352560E-01 | 0.9730859E-02 | 0.5234541E-02 |
| 0.0000000E-38 | | | | | |
| 0.1942638E-01 | 0.2007954E-01 | 0.2073480E-01 | 0.2138666E-01 | 0.2202876E-01 | 0.2265332E-01 |
| 0.2325092E-01 | 0.2381018E-01 | 0.2431748E-01 | 0.2475656E-01 | 0.2510817E-01 | 0.2534960E-01 |
| 0.2545422E-01 | 0.2539107E-01 | 0.2512439E-01 | 0.2461325E-01 | 0.2381134E-01 | 0.2266693E-01 |
| 0.2112318E-01 | 0.1911890E-01 | 0.1659002E-01 | 0.1347180E-01 | 0.9702091E-02 | 0.5225716E-02 |
| 0.7967072E-09 | | | | | |
| 0.1940324E-01 | 0.2004136E-01 | 0.2068029E-01 | 0.2131493E-01 | 0.2193898E-01 | 0.2254480E-01 |
| 0.2312314E-01 | 0.2366287E-01 | 0.2415067E-01 | 0.2457067E-01 | 0.2490408E-01 | 0.2512876E-01 |
| 0.2521877E-01 | 0.2514391E-01 | 0.2486930E-01 | 0.2435496E-01 | 0.2355554E-01 | 0.2242025E-01 |
| 0.2089303E-01 | 0.1891318E-01 | 0.1641660E-01 | 0.1333773E-01 | 0.9612531E-02 | 0.5182533E-02 |
| 0.0000000E-38 | | | | | |
| 0.1933540E-01 | 0.1995487E-01 | 0.2057400E-01 | 0.2118773E-01 | 0.2178985E-01 | 0.2237284E-01 |
| 0.2292767E-01 | 0.2344343E-01 | 0.2390715E-01 | 0.2430340E-01 | 0.2461390E-01 | 0.2481718E-01 |
| 0.2488810E-01 | 0.2479737E-01 | 0.2451119E-01 | 0.2399080E-01 | 0.2319218E-01 | 0.2206591E-01 |
| 0.2055725E-01 | 0.1860670E-01 | 0.1615096E-01 | 0.1312463E-01 | 0.9462924E-02 | 0.5105244E-02 |
| 0.0000000E-38 | | | | | |
| 0.1924125E-01 | 0.1983813E-01 | 0.2043319E-01 | 0.2102141E-01 | 0.2159666E-01 | 0.2215159E-01 |
| 0.2267731E-01 | 0.2316324E-01 | 0.2359673E-01 | 0.2396283E-01 | 0.2424387E-01 | 0.2441914E-01 |
| 0.2446441E-01 | 0.2435153E-01 | 0.2404803E-01 | 0.2351667E-01 | 0.2271518E-01 | 0.2159604E-01 |
| 0.2010658E-01 | 0.1818925E-01 | 0.1578259E-01 | 0.1282261E-01 | 0.9245091E-02 | 0.4988843E-02 |
| 0.0000000E-38 | | | | | |
| 0.1972711E-01 | 0.2026854E-01 | 0.2080204E-01 | 0.2132238E-01 | 0.2182327E-01 | 0.2229730E-01 |
| 0.2273566E-01 | 0.2312800E-01 | 0.2346217E-01 | 0.2372400E-01 | 0.2389695E-01 | 0.2396187E-01 |
| 0.2389668E-01 | 0.2367600E-01 | 0.2327092E-01 | 0.2264861E-01 | 0.2177226E-01 | 0.2060082E-01 |
| 0.1908920E-01 | 0.1718853E-01 | 0.1484683E-01 | 0.1201012E-01 | 0.8624091E-02 | 0.4636442E-02 |
| 0.0000000E-38 | | | | | |
| 0.2012134E-01 | 0.2059725E-01 | 0.2105921E-01 | 0.2150188E-01 | 0.2191897E-01 | 0.2230312E-01 |
| 0.2264584E-01 | 0.2293720E-01 | 0.2316576E-01 | 0.2331834E-01 | 0.2337979E-01 | 0.2333277E-01 |
| 0.2315756E-01 | 0.2283177E-01 | 0.2233018E-01 | 0.2162454E-01 | 0.2068344E-01 | 0.1947227E-01 |
| 0.1795333E-01 | 0.1608607E-01 | 0.1382764E-01 | 0.1113366E-01 | 0.7959403E-02 | 0.4261495E-02 |
| 0.0000000E-38 | | | | | |
| 0.2039687E-01 | 0.2079734E-01 | 0.2117820E-01 | 0.2153410E-01 | 0.2185889E-01 | 0.2214555E-01 |

Figure 16. Group B Sample Problems Program Results (Sheet 21 of 27)

```
0.2238598E-01   0.2257093E-01   0.2268988E-01   0.2273087E-01   0.2268033E-01   0.2252296E-01
0.2224155E-01   0.2181687E-01   0.2122746E-01   0.2044956E-01   0.1945711E-01   0.1822166E-01
0.1671250E-01   0.1489692E-01   0.1274050E-01   0.1020777E-01   0.7263001E-02   0.3871290E-02
0.0000000E-38
0.2052245E-01   0.2083706E-01   0.2112720E-01   0.2138783E-01   0.2161318E-01   0.2179678E-01
0.2193128E-01   0.2200845E-01   0.2201899E-01   0.2195254E-01   0.2179750E-01   0.2154095E-01
0.2116857E-01   0.2066453E-01   0.2001143E-01   0.1919024E-01   0.1818027E-01   0.1695923E-01
0.1550327E-01   0.1378714E-01   0.1178450E-01   0.9468237E-02   0.6811005E-02   0.3785924E-02
0.3674290E-03
0.2046276E-01   0.2067692E-01   0.2086499E-01   0.2102288E-01   0.2114595E-01   0.2122913E-01
0.2126677E-01   0.2125262E-01   0.2117981E-01   0.2104074E-01   0.2082707E-01   0.2052970E-01
0.2013864E-01   0.1964303E-01   0.1903112E-01   0.1829018E-01   0.1740656E-01   0.1636565E-01
0.1515197E-01   0.1374918E-01   0.1214025E-01   0.1030754E-01   0.8233111E-02   0.5898918E-02
0.3287231E-02
0.2017862E-01   0.2029407E-01   0.2038391E-01   0.2044502E-01   0.2047399E-01   0.2046710E-01
0.2042032E-01   0.2032926E-01   0.2018914E-01   0.1999483E-01   0.1974074E-01   0.1942086E-01
0.1902874E-01   0.1855743E-01   0.1799952E-01   0.1734709E-01   0.1659173E-01   0.1572454E-01
0.1473614E-01   0.1361673E-01   0.1235607E-01   0.1094360E-01   0.9368462E-02   0.7619649E-02
0.5686109E-02
0.1962786E-01   0.1965249E-01   0.1965410E-01   0.1963057E-01   0.1957959E-01   0.1949870E-01
0.1938530E-01   0.1923659E-01   0.1904956E-01   0.1882104E-01   0.1854764E-01   0.1822576E-01
0.1785159E-01   0.1742110E-01   0.1693001E-01   0.1637386E-01   0.1574791E-01   0.1504724E-01
0.1426668E-01   0.1340086E-01   0.1244421E-01   0.1139100E-01   0.1023531E-01   0.8971142E-02
0.7592360E-02
```

Figure 16. Group B Sample Problems Program Results (Sheet 22 of 27)

RUN NO.  5  DATA USED FOR THIS RUN- *3DISK *1PLAT1*
*9TDISK*  *
*  *  *

THE FORM FACTOR FROM SURFACE *3DISK 9TDISK* TO SURFACE *1PLAT1  * = 0.04739

THE EXCHANGE COEFFICIENT (FA) =  0.12063E 01 SQ UNITS

THE MAPPING AREA = 0.2545277E 02 SQ UNITS

THE AREA OF SURFACE *3DISK 9TDISK* = 0.2545584E 02 SQ UNITS.

ONLY A PART OF SURFACE *1PLAT1  *, COMPRISING AN AREA OF 0.3686695E 02 SQ UNITS
SEES SURFACE *3DISK 9TDISK*

THE AREA OF SURFACE *1PLAT1  * = 0.4837355E 02 SQ UNITS.

THE FORM FACTOR FROM SURFACE *1PLAT1  * TO SURFACE *3DISK 9TDISK* = 0.02494

THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FACTOR COMPUTATION-

DATA NAME *3DISK 9TDISK*

| POINT | X | Y | Z | POINT | X | Y | Z |
|---|---|---|---|---|---|---|---|
| | 0.0000000E-38 | 0.0000000E-38 | 0.9999999E 00 | (INTERNALLY GENERATED ORIENTATION VECTOR) | | | |
| 1 | 0.0000000E-38 | 0.0000000E-38 | 0.0000000E-38 | 2 | 0.2296099E 01 | 0.0000000E-38 | 0.0000000E-38 |
| 3 | 0.3919688E 01 | 0.1623587E 01 | 0.0000000E-38 | 4 | 0.3919688E 01 | 0.3919686E 01 | 0.0000000E-38 |
| 5 | 0.2296101E 01 | 0.5543274E 01 | 0.0000000E-38 | 6 | 0.0000000E-38 | 0.5543274E 01 | 0.0000000E-38 |
| 7 | -0.1623587E 01 | 0.3919687E 01 | 0.0000000E-38 | 8 | -0.1623587E 01 | 0.1623588E 01 | 0.0000000E-38 |

DATA NAME *1PLAT1  *

| POINT | X | Y | Z | POINT | X | Y | Z |
|---|---|---|---|---|---|---|---|
| | -0.3085715E 01 | -0.9331905E 00 | 0.6115284E 01 | (INTERNALLY GENERATED ORIENTATION VECTOR) | | | |
| 1 | -0.4001227E 01 | -0.1218502E 01 | 0.6398893E 01 | 2 | -0.3664950E 01 | -0.5949933E 01 | 0.2724594E 01 |
| 3 | -0.5135786E 01 | -0.3938625E 01 | 0.0000000E-38 | 4 | -0.7171823E 01 | 0.2594651E 01 | 0.0000000E-38 |
| 5 | -0.7212958E 01 | 0.3173407E 01 | 0.4494460E 00 | | | | |

Figure 16. Group B Sample Problems Program Results (Sheet 23 of 27)





NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

COORDINATES OF POINTS ON BOUNDARY OF SURF *3DISK 9TDISK* FOR EACH Y INTERVAL

| X-LEFT | X-RIGHT | Y | X-LEFT | X-RIGHT | Y |
|---|---|---|---|---|---|
| 0.0CCCCC0E-38 | 0.2296099E 01 | 0.0000000E-38 | -0.2309696E 00 | 0.2527069E 01 | 0.2309698E 00 |
| -0.4619392E 00 | 0.2758039E 01 | 0.4619395E 00 | -0.6929088E 00 | 0.2989009E 01 | 0.6929093E 00 |
| -0.9238784E 00 | 0.3219979E 01 | 0.9238790E 00 | -0.1154848E 01 | 0.3450949E 01 | 0.1154849E 01 |
| -0.1385818E 01 | 0.3681919E 01 | 0.1385819E 01 | -0.1616787E 01 | 0.3912889E 01 | 0.1616788E 01 |
| -0.1623587E 01 | 0.3919688E 01 | 0.1847758E 01 | -0.1623587E 01 | 0.3919688E 01 | 0.2078728E 01 |
| -0.1623587E 01 | 0.3919688E 01 | 0.2309698E 01 | -0.1623587E 01 | 0.3919688E 01 | 0.2540667E 01 |
| -0.1623587E 01 | 0.3919688E 01 | 0.2771637E 01 | -0.1623587E 01 | 0.3919688E 01 | 0.3002607E 01 |
| -0.1623587E 01 | 0.3919688E 01 | 0.3233577E 01 | -0.1623587E 01 | 0.3919688E 01 | 0.3464546E 01 |
| -0.1623587E 01 | 0.3919688E 01 | 0.3695516E 01 | -0.1616789E 01 | 0.3912888E 01 | 0.3926486E 01 |
| -0.1385819E 01 | 0.3681918E 01 | 0.4157456E 01 | -0.1154849E 01 | 0.3450949E 01 | 0.4388425E 01 |
| -0.9238793E 00 | 0.3219979E 01 | 0.4619395E 01 | -0.6929096E 00 | 0.2989010E 01 | 0.4850365E 01 |
| -0.4619398E 00 | 0.2758040E 01 | 0.5081335E 01 | -0.2309701E 00 | 0.2527070E 01 | 0.5312304E 01 |
| 0.CCC0C00E-38 | 0.2296101E 01 | 0.5543274E 01 | | | |

NO. OF HORIZONTAL INCREMENTS= 24 NO. OF VERTICAL INCREMENTS= 24

THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR THIS RUN
LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.

| | | | | | |
|---|---|---|---|---|---|
| 0.9553546E-01 | 0.9262952E-01 | 0.8981871E-01 | 0.8710017E-01 | 0.8447107E-01 | 0.8192863E-01 |
| 0.7947013E-01 | 0.7709294E-01 | 0.7479444E-01 | 0.7257210E-01 | 0.7042346E-01 | 0.6834610E-01 |
| 0.6633765E-01 | 0.6439585E-01 | 0.6251846E-01 | 0.6070331E-01 | 0.5894830E-01 | 0.5725140E-01 |
| 0.5561061E-01 | 0.5402401E-01 | 0.5248976E-01 | 0.5100602E-01 | 0.4957107E-01 | 0.4818319E-01 |
| 0.4684074E-01 | | | | | |
| 0.9995047E-01 | 0.9635200E-01 | 0.9289114E-01 | 0.8956312E-01 | 0.8636325E-01 | 0.8328694E-01 |
| 0.8032972E-01 | 0.7748722E-01 | 0.7475518E-01 | 0.7212946E-01 | 0.6960604E-01 | 0.6718100E-01 |
| 0.6485055E-01 | 0.6261102E-01 | 0.6045884E-01 | 0.5839057E-01 | 0.5640287E-01 | 0.5449253E-01 |
| 0.5265645E-01 | 0.5089163E-01 | 0.4919518E-01 | 0.4756434E-01 | 0.4599642E-01 | 0.4448886E-01 |
| 0.4303917E-01 | | | | | |
| 0.1040432E 00 | 0.9974444E-01 | 0.9563196E-01 | 0.9169853E-01 | 0.8793707E-01 | 0.8434069E-01 |
| 0.8090265E-01 | 0.7761643E-01 | 0.7447567E-01 | 0.7147421E-01 | 0.6860609E-01 | 0.6586552E-01 |
| 0.6324693E-01 | 0.6074493E-01 | 0.5835432E-01 | 0.5607011E-01 | 0.5388748E-01 | 0.5180181E-01 |
| 0.4980867E-01 | 0.4790378E-01 | 0.4608307E-01 | 0.4434264E-01 | 0.4267875E-01 | 0.4108782E-01 |
| 0.3956642E-01 | | | | | |
| 0.1077306E 00 | 0.1027397E 00 | 0.9798841E-01 | 0.9346649E-01 | 0.8916399E-01 | 0.8507124E-01 |
| 0.8117883E-01 | 0.7747767E-01 | 0.7395894E-01 | 0.7061411E-01 | 0.6743493E-01 | 0.6441347E-01 |

Figure 16. Group B Sample Problems Program Results (Sheet 24 of 27)

```
0.6154208E-01  0.5881339E-01  0.5622035E-01  0.5375616E-01  0.5141436E-01  0.4918872E-01
0.4707332E-01  0.4506250E-01  0.4315086E-01  0.4133325E-01  0.3960479E-01  0.3796082E-01
0.3639693E-01
0.1109304E 00  0.1052727E 00  0.9991065E-01  0.9483058E-01  0.9001920E-01  0.8546370E-01
0.8115167E-01  0.7707117E-01  0.7321062E-01  0.6955889E-01  0.6610526E-01  0.6283939E-01
0.5975137E-01  0.5683172E-01  0.5407132E-01  0.5146150E-01  0.4899397E-01  0.4666082E-01
0.4445453E-01  0.4236797E-01  0.4039436E-01  0.3852728E-01  0.3676064E-01  0.3508869E-01
0.3350599E-01
0.1135627E 00  0.1072817E 00  0.1013529E 00  0.9575874E-01  0.9048225E-01  0.8550728E-01
0.8081826E-01  0.7640024E-01  0.7223880E-01  0.6832010E-01  0.6463083E-01  0.6115822E-01
0.5789C01E-01  0.5481451E-01  0.5192055E-01  0.4919746E-01  0.4663511E-01  0.4422389E-01
0.4195467E-01  0.3981881E-01  0.3780816E-01  0.3591501E-01  0.3413211E-01  0.3245262E-01
0.3087013E-01
0.1155519E 00  0.1087100E 00  0.1022746E 00  0.9622406E-01  0.9053759E-01  0.8519563E-01
0.8017950E-01  0.7547132E-01  0.7105393E-01  0.6691087E-01  0.6302633E-01  0.5938516E-01
0.5597286E-01  0.5277558E-01  0.4978011E-01  0.4697389E-01  0.4434500E-01  0.4188213E-01
0.3957460E-01  0.3741234E-01  0.3538585E-01  0.3348621E-01  0.3170504E-01  0.3003448E-01
0.2846718E-01
0.1168283E 00  0.1095069E 00  0.1026414E 00  0.9620556E-01  0.9017500E-01  0.8452702E-01
0.7924012E-01  0.7429385E-01  0.6966864E-01  0.6534571E-01  0.6130706E-01  0.5753542E-01
0.5401425E-01  0.5072776E-01  0.4766087E-01  0.4479926E-01  0.4212935E-01  0.3963828E-01
0.3731392E-01  0.3514485E-01  0.3312036E-01  0.3123037E-01  0.2946550E-01  0.2781694E-01
0.2627648E-01
0.1103920E 00  0.1036656E 00  0.9734243E-01  0.9140030E-01  0.8581877E-01  0.8057872E-01
0.7566202E-01  0.7105138E-01  0.6673019E-01  0.6268240E-01  0.5889260E-01  0.5534588E-01
0.5202792E-01  0.4892491E-01  0.4602369E-01  0.4331161E-01  0.4077666E-01  0.3840741E-01
0.3619302E-01  0.3412326E-01  0.3218844E-01  0.3037949E-01  0.2868786E-01  0.2710554E-01
0.2562504E-01
0.1038410E 00  0.9772156E-01  0.9195148E-01  0.8651302E-01  0.8138981E-01  0.7656642E-01
0.7202820E-01  0.6776103E-01  0.6375128E-01  0.5998567E-01  0.5645133E-01  0.5313573E-01
0.5002673E-01  0.4711259E-01  0.4438196E-01  0.4182395E-01  0.3942809E-01  0.3718440E-01
0.3508335E-01  0.3311589E-01  0.3127343E-01  0.2954788E-01  0.2793156E-01  0.2641728E-01
0.2499826E-01
0.9744103E-01  0.9190445E-01  0.8666592E-01  0.8171199E-01  0.7703023E-01  0.7260879E-01
0.6843629E-01  0.6450165E-01  0.6079401E-01  0.5730269E-01  0.5401721E-01  0.5092726E-01
0.4802276E-01  0.4529385E-01  0.4273094E-01  0.4032473E-01  0.3806625E-01  0.3594686E-01
0.3395826E-01  0.3209253E-01  0.3034213E-01  0.2869987E-01  0.2715894E-01  0.2571290E-01
0.2435569E-01
0.9122912E-01  0.8624738E-01  0.8151539E-01  0.7702390E-01  0.7276414E-01  0.6872764E-01
0.6490608E-01  0.6129118E-01  0.5787467E-01  0.5464827E-01  0.5160369E-01  0.4873268E-01
0.4602707E-01  0.4347873E-01  0.4107971E-01  0.3882221E-01  0.3669861E-01  0.3470154E-01
0.3282387E-01  0.3105872E-01  0.2939952E-01  0.2783997E-01  0.2637406E-01  0.2499609E-01
0.2370064E-01
```

Figure 16. Group B Sample Problems Program Results (Sheet 25 of 27)

| | | | | | |
|---|---|---|---|---|---|
| 0.8523670E-01 | 0.8077844E-01 | 0.7652526E-01 | 0.7247170E-01 | 0.6861239E-01 | 0.6494198E-01 |
| 0.6145490E-01 | 0.5814546E-01 | 0.5500773E-01 | 0.5203561E-01 | 0.4922283E-01 | 0.4656302E-01 |
| 0.4404972E-01 | 0.4167642E-01 | 0.3943666E-01 | 0.3732399E-01 | 0.3533209E-01 | 0.3345473E-01 |
| 0.3168587E-01 | 0.3001962E-01 | 0.2845031E-01 | 0.2697245E-01 | 0.2558080E-01 | 0.2427034E-01 |
| 0.2303628E-01 | | | | | |
| 0.7948922E-01 | 0.7552070E-01 | 0.7171648E-01 | 0.6807453E-01 | 0.6459256E-01 | 0.6126793E-01 |
| 0.5809761E-01 | 0.5507816E-01 | 0.5220578E-01 | 0.4947631E-01 | 0.4688532E-01 | 0.4442808E-01 |
| 0.4209971E-01 | 0.3989518E-01 | 0.3780934E-01 | 0.3583701E-01 | 0.3397303E-01 | 0.3221224E-01 |
| 0.3054958E-01 | 0.2898008E-01 | 0.2749889E-01 | 0.2610132E-01 | 0.2478281E-01 | 0.2353898E-01 |
| 0.2236565E-01 | | | | | |
| 0.7400627E-01 | 0.7049211E-01 | 0.6710562E-01 | 0.6384776E-01 | 0.6071891E-01 | 0.5771879E-01 |
| 0.5484656E-01 | 0.5210080E-01 | 0.4947954E-01 | 0.4698035E-01 | 0.4460039E-01 | 0.4233644E-01 |
| 0.4018500E-01 | 0.3814234E-01 | 0.3620453E-01 | 0.3436751E-01 | 0.3262718E-01 | 0.3097934E-01 |
| 0.2941984E-01 | 0.2794454E-01 | 0.2654936E-01 | 0.2523031E-01 | 0.2398350E-01 | 0.2280514E-01 |
| 0.2169159E-01 | | | | | |
| 0.6880173E-01 | 0.6570574E-01 | 0.6270506E-01 | 0.5980314E-01 | 0.5700256E-01 | 0.5430510E-01 |
| 0.5171176E-01 | 0.4922282E-01 | 0.4683791E-01 | 0.4455609E-01 | 0.4237591E-01 | 0.4029545E-01 |
| 0.3831246E-01 | 0.3642432E-01 | 0.3462819E-01 | 0.3292104E-01 | 0.3129967E-01 | 0.2976079E-01 |
| 0.2830104E-01 | 0.2691705E-01 | 0.2560543E-01 | 0.2436286E-01 | 0.2318602E-01 | 0.2207170E-01 |
| 0.2101675E-01 | | | | | |
| 0.6388413E-01 | 0.6117008E-01 | 0.5852320E-01 | 0.5594892E-01 | 0.5345164E-01 | 0.5103478E-01 |
| 0.4870087E-01 | 0.4645163E-01 | 0.4428802E-01 | 0.4221037E-01 | 0.4021839E-01 | 0.3831133E-01 |
| 0.3648794E-01 | 0.3474664E-01 | 0.3308553E-01 | 0.3150245E-01 | 0.2999505E-01 | 0.2856082E-01 |
| 0.2719712E-01 | 0.2590126E-01 | 0.2467051E-01 | 0.2350210E-01 | 0.2239328E-01 | 0.2134135E-01 |
| 0.2034361E-01 | | | | | |
| 0.5918692E-01 | 0.5682610E-01 | 0.5450838E-01 | 0.5224061E-01 | 0.5002854E-01 | 0.4787682E-01 |
| 0.4578915E-01 | 0.4376836E-01 | 0.4181652E-01 | 0.3993495E-01 | 0.3812436E-01 | 0.3638491E-01 |
| 0.3471630E-01 | 0.3311779E-01 | 0.3158831E-01 | 0.3012647E-01 | 0.2873069E-01 | 0.2739912E-01 |
| 0.2612984E-01 | 0.2492075E-01 | 0.2376970E-01 | 0.2267449E-01 | 0.2163287E-01 | 0.2064262E-01 |
| 0.1970149E-01 | | | | | |
| 0.5280411E-01 | 0.5094514E-01 | 0.4911168E-01 | 0.4730900E-01 | 0.4554161E-01 | 0.4381328E-01 |
| 0.4212714E-01 | 0.4048568E-01 | 0.3889089E-01 | 0.3734423E-01 | 0.3584674E-01 | 0.3439905E-01 |
| 0.3300145E-01 | 0.3165392E-01 | 0.3035618E-01 | 0.2910769E-01 | 0.2790774E-01 | 0.2675546E-01 |
| 0.2564982E-01 | 0.2458966E-01 | 0.2357378E-01 | 0.2260087E-01 | 0.2166957E-01 | 0.2077850E-01 |
| 0.1992625E-01 | | | | | |
| 0.4726953E-01 | 0.4580983E-01 | 0.4436495E-01 | 0.4293868E-01 | 0.4153430E-01 | 0.4015465E-01 |
| 0.3880213E-01 | 0.3747875E-01 | 0.3618618E-01 | 0.3492575E-01 | 0.3369851E-01 | 0.3250522E-01 |
| 0.3134642E-01 | 0.3022243E-01 | 0.2913338E-01 | 0.2807923E-01 | 0.2705977E-01 | 0.2607470E-01 |
| 0.2512357E-01 | 0.2420586E-01 | 0.2332095E-01 | 0.2246816E-01 | 0.2164676E-01 | 0.2085596E-01 |
| 0.2009493E-01 | | | | | |
| 0.4245228E-01 | 0.4131169E-01 | 0.4017953E-01 | 0.3905835E-01 | 0.3795042E-01 | 0.3685772E-01 |
| 0.3578199E-01 | 0.3472472E-01 | 0.3368719E-01 | 0.3267049E-01 | 0.3167551E-01 | 0.3070296E-01 |
| 0.2975343E-01 | 0.2882733E-01 | 0.2792497E-01 | 0.2704653E-01 | 0.2619210E-01 | 0.2536165E-01 |

Figure 16. Group B Sample Problems Program Results (Sheet 26 of 27)

| | | | | | |
|---|---|---|---|---|---|
| 0.2455511E-01 | 0.2377228E-01 | 0.2301295E-01 | 0.2227682E-01 | 0.2156355E-01 | 0.2087276E-01 |
| 0.2020403E-01 | | | | | |
| 0.3824390E-01 | 0.3735943E-01 | 0.3647963E-01 | 0.3560613E-01 | 0.3474038E-01 | 0.3388372E-01 |
| 0.3303730E-01 | 0.3220216E-01 | 0.3137924E-01 | 0.3056932E-01 | 0.2977308E-01 | 0.2899112E-01 |
| 0.2822393E-01 | 0.2747192E-01 | 0.2673542E-01 | 0.2601469E-01 | 0.2530991E-01 | 0.2462121E-01 |
| 0.2394865E-01 | 0.2329227E-01 | 0.2265203E-01 | 0.2202787E-01 | 0.2141969E-01 | 0.2082733E-01 |
| 0.2025066E-01 | | | | | |
| 0.3455431E-01 | 0.3387617E-01 | 0.3320052E-01 | 0.3252835E-01 | 0.3186054E-01 | 0.3119791E-01 |
| 0.3054123E-01 | 0.2989114E-01 | 0.2924825E-01 | 0.2861311E-01 | 0.2798620E-01 | 0.2736796E-01 |
| 0.2675875E-01 | 0.2615891E-01 | 0.2556872E-01 | 0.2498842E-01 | 0.2441820E-01 | 0.2385824E-01 |
| 0.2330865E-01 | 0.2276954E-01 | 0.2224098E-01 | 0.2172299E-01 | 0.2121561E-01 | 0.2071882E-01 |
| 0.2023260E-01 | | | | | |
| 0.3130845E-01 | 0.3079703E-01 | 0.3028689E-01 | 0.2977857E-01 | 0.2927258E-01 | 0.2876939E-01 |
| 0.2826945E-01 | 0.2777314E-01 | 0.2728084E-01 | 0.2679289E-01 | 0.2630960E-01 | 0.2583125E-01 |
| 0.2535810E-01 | 0.2489037E-01 | 0.2442828E-01 | 0.2397202E-01 | 0.2352173E-01 | 0.2307757E-01 |
| 0.2263967E-01 | 0.2220812E-01 | 0.2178302E-01 | 0.2136444E-01 | 0.2095245E-01 | 0.2054709E-01 |
| 0.2014839E-01 | | | | | |
| 0.2844351E-01 | 0.2806716E-01 | 0.2769141E-01 | 0.2731657E-01 | 0.2694288E-01 | 0.2657059E-01 |
| 0.2619994E-01 | 0.2583115E-01 | 0.2546441E-01 | 0.2509991E-01 | 0.2473785E-01 | 0.2437839E-01 |
| 0.2402167E-01 | 0.2366783E-01 | 0.2331703E-01 | 0.2296937E-01 | 0.2262496E-01 | 0.2228391E-01 |
| 0.2194631E-01 | 0.2161225E-01 | 0.2128181E-01 | 0.2095504E-01 | 0.2063201E-01 | 0.2031278E-01 |
| 0.1999739E-01 | | | | | |

Figure 16. Group B Sample Problems Program Results (Sheet 27 of 27)

# APPENDIX B. PROGRAM DECK SETUP, LISTINGS, AND MAPS

The program deck arrangement shown in Figure 17 contains a main program and six subprograms which are listed in this appendix. A listing of the main program, 7J370, is shown in Figure 18 followed by a map of the core storage locations in Figure 19.

The first subprogram UNIVEC is given in Figure 20 and storage map in Figure 21. Subroutine SELEK is shown in Figure 22 and the memory map in Figure 23.

The transformation subroutine, TXFRM, is presented in Figure 24 and the map of core storage in Figure 25. The listing and map of subroutine DOICU are presented in Figures 26 and 27. The listing and map of subroutine MAP are presented in Figures 28 and 29. Subroutine FACTOR listing and core storage are given in Figures 30 and 31. Figure 32 shows the variable formats used by this program.

This IBM FORTRAN IV computer program utilizes Fortran input tape 5 and output tape 6 for input/output data transmission when operating in the North American Aviation, Inc., version of IBM IBSYS (NAA SYS). Logical tape 3 is also required when card images are requested.

Those facilities operating under IBM IBSYS but utilizing different logical tape numbers may easily alter tape numbers by use of the IBSYS $NAME control card.

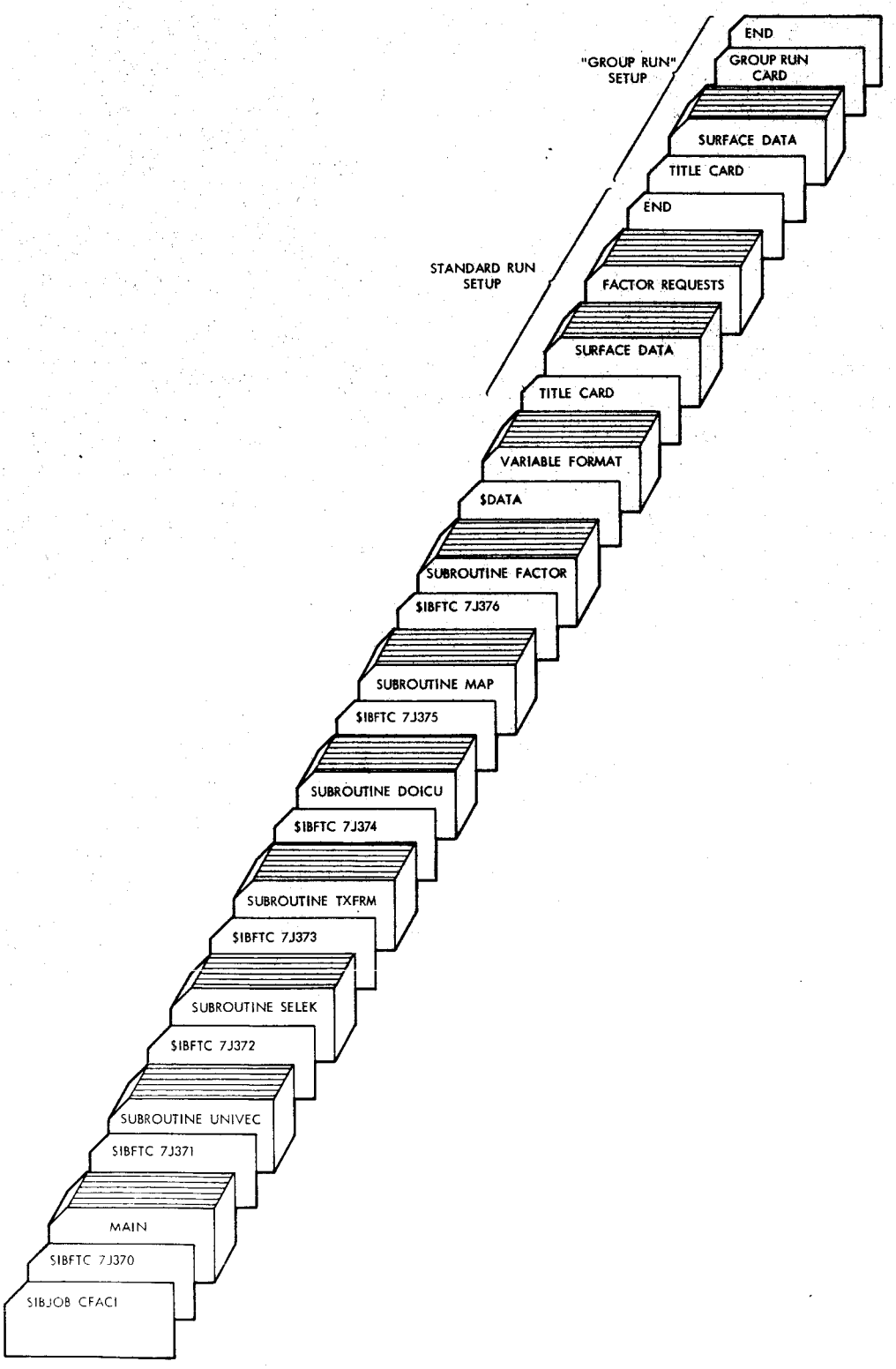



Figure 17. Program Deck Setup

```
      CFACI                                                    09/09/65          PAGE  1
          37007J      -  EFN    SOURCE STATEMENT  -  IFN(S)  -

C THERMAL ANALYSIS CONFAC PROGRAM-NASA CONTRACT NAS9-4133                  37000022
C MAIN PROGRAM- THERMAL ANALYSIS CONFAC PROGRAM-NASA CONTRACT NAS9-4133    37000030
C CONFAC I -ENGINEERING ANALYSES AND COMPUTER PROGRAMMING BY K.A. TOUPS,   37000040
C NORTH AMERICAN AVIATION,INC.,SPACE AND INFORMATION SYSTEMS DIVISION      37000050
C FORTRAN IV VERSION 7/31/65                                               37000060
C THIS COMPUTER PROGRAM COMPUTES CONFIGURATION AND FORM FACTORS BETWEEN    37000070
C SURFACES EXCHANGING RADIANT ENERGY.                                      37000080
C SUBROUTINES REQD ARE SELEK,UNIVEC,TXFRM,DOICU,MAP AND FACTOR.            37000090
C SEE NAA SPACE AND INFORMATION SYSTEMS REPORT SID 65-1043-1 FOR DETAILS   37000100
C OF PROGRAM STRUCTURE AND USE.                                            37000110
      INTEGER SL1,SL2,SL3,SL4,S5                                           37000115
      COMMON    P(3,34, 88),BUF(3),PN( 88),KD(4,30),PK(3,4,30),L(2,6),     37000120
     1LI(2),LP(2),X1(61,2),Y1(61  ),DX(61),AREA( 88),AREAX(2),FHP(3721),   37000130
     2NRNDA(1212),KP,KX,NHI,NHL,NVI,NVL,MO,DY,FAP,F(2),SL1,SL2,SL3,SL4,    37000140
     3S5                                                                   37000145
      DIMENSION INC(34),F1(12),F2(12),F3(12),F4(72),F5(24),F6(24),F7(24)   37000150
     1,F8(12),F9(48),F10(12),F11(36),F12(24),F13(12),F14(24),F15(36),F16   37000160
     2(12),F17(24),F18(12),F6A(12),F5A(24),F19(60),F20(84),F21(24),F22(2    37000170
     34),F11B(1)                                                           37000180
      DIMENSION TITLE(12),NDN(12),NPLDN( 88),KPDN( 32),V(3),N2(3),         37000190
     1NM(2,2),NSU(88),PP(3,34,88),DK(4,31),NCIM(14),C(107),TITLEI(14),     37000200
     1OCT(3),NFLG(2)                                                       37000210
      EQUIVALENCE (PP,P(4)),(KD,DK),(NCIM,NDN),(P,C),(TITLE,TITLEI),       37000220
     1(NDT,DT),(F11(15),F11B)                                              37000230
      DATA NGROUP/6HGROUPR/,FLGI/6HI00000/,NFLG/6H200000,6H900000/         37000240
      DATA OCT/077000000000,0007777777777,0600000000000/,IR/2H9R/          37000250
      NAMELIST/D/C                                                         37000260
   10 FORMAT(12A6)                                                         37000270
      READ(5,10)NEND,NBLNK,INC,F1,F2,F3,F4,F5,F6,F7,F8,F9,F10,F11,F12,     37000280
     1F13,F14,F15,F16,F17,F18,F6A,F5A,F19,F20,F21,F22                      37000290    1
      KPDN(1) =NBLNK                                                       37000300
      KPDN(2)=IR                                                           37000310
   20 READ(5,60)TITLEI                                                     37000320   29
      IM=0                                                                 37000330
C AN I IN COL 1 SIGNIFIES A CARD IMAGE PRINTOUT IS DESIRED                 37000340
      IF(FLGI.NE.AND(OCT(1),TITLE(1)))GO TO 100                            37000350
```

Figure 18. MAIN Program Listing (Sheet 1 of 11)

```
      IM=1                                                              37000360
   30 WRITE(6,40)                                                       37000370    35
   40 FORMAT(1H1)                                                       37000380
      REWIND 3                                                          37000390    36
      WRITE(3,60)TITLEI                                                 37000400    37
      WRITE(6,80)TITLEI                                                 37000410    39
   50 READ(5,60)NCIM                                                    37000420    41
   60 FORMAT(14A6)                                                      37000430
      WRITE(3,60)NCIM                                                   37000440    43
   70 WRITE(6,80)NCIM                                                   37000450    45
   80 FORMAT(1H 14A6)                                                   37000460
      IF(NEND-NCIM(1))50,90,50                                          37000470
   90 REWIND 3                                                          37000480    48
      READ(3,10)TITLE                                                   37000490    49
  100 TITLE(1)=OR(OCT(3),AND(OCT(2),TITLE(1)))                          37000500
      NR=0                                                              37000510
      NO=0                                                              37000520
C ALLOW BUFFER IN SURFACE DATA REGION FOR WORKING SPACE                 37000530
      I=8                                                               37000540
      J=0                                                               37000550
      NHI=24                                                            37000551
      NVI=24                                                            37000552
      NHL=25                                                            37000552
      NVL=25                                                            37000553
      S5=0                                                              37000555
  110 IF(IM)120,130,120                                                 37000560
  120 READ(3,10)NDN                                                     37000570    62
      GO TO 140                                                         37000580
  130 READ(5,10)NDN                                                     37000590
C TEST FOR SURFACE, TXFRM OR RUN DATA-                                  37000600    65
  140 IF(NDN  (1)-NBLNK)150,370,150                                     37000610
  150 IF(NDN  (2)-NBLNK)510,160,510                                     37000620
C TEST FOR SURFACE OR TXFRM DATA                                        37000630
C TEST IF COL 1 IS NUMERIC OR ALPHA                                     37000640
C IF ALPHA, 1 OR 2, GO TO SURFACE DATA PROCESS                          37000650
C IF 9, GO TO TXFRM DATA PROCESS. IF A NUMERAL 3-8, GO TO SURFACE       37000660
C PROCESS AND  PRINT WARNING LATER                                      37000670
```

Figure 18. MAIN Program Listing (Sheet 2 of 11)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
  160  DT=AND(OCT(1),NDN(1))                                              37000680
  170 IF(NDT-NFLG(2))180,360,180                                          37000690
C READ SURFACE DATA-                                                      37000700
  180 I=I+1                                                               37000710
      NSU(I)=0                                                            37000720
  190 IF(NFLG(1).LT.IABS(NDT))NSU(I)=-1                                   37000730
C IF THE MAX NO OF SURFACE DATA IS EXCEEDED, STOP JOB                     37000740
      IF(I.LE. 88)GO TO 210                                               37000750
  200 IA=19                                                               37000760
      GO TO 390                                                           37000770
C STORE NAME OF EACH SURFACE DATA-                                        37000780
  210 NPLDN (I)=NDN  (1)                                                  37000790
      IF(IM)220,250,220                                                   37000800
  220 IF(NDN(3)-NBLNK)230,240,230                                         37000810
  230 READ(3,D)                                                           37000820    91
      GO TO 270                                                           37000830
  240 READ(3,F2)PN(I),PP(1,1,I),PP(2,1,I),PP(3,1,I),PP(1,2,I),PP(2,2,I)  37000840    94
      GO TO 310                                                           37000850
  250 IF(NDN(3)-NBLNK)260,300,260                                         37000860
  260 READ(5,D)                                                           37000870   104
  270 PN(I)=C(1)                                                          37000880
      NOP=PN(I)                                                           37000890
      IF(NOP-32)280,280,320                                               37000900
  280 M=2                                                                 37000910
      DO 290   K=1,NOP                                                    37000920
      PP(1,K,I)= C(M)                                                     37000930
      PP(2,K,I)= C(M+1)                                                   37000940
      PP(3,K,I)= C(M+2)                                                   37000950
  290 M=M+3                                                               37000960
      GO TO 110                                                           37000970
  300 READ(5,F2)PN(I),PP(1,1,I),PP(2,1,I),PP(3,1,I),PP(1,2,I),PP(2,2,I)  37000980    127
  310 I1=PN(I)                                                            37000990
C IF THE MAX NO OF SURFACE DATA POINTS ARE EXCEEDED, STOP JOB             37001000
      IF(I1.LE.32)GO TO 330                                               37001010
  320 IA=21                                                               37001020
      NBLNK=NDN(1)                                                        37001030
      GO TO 390                                                           37001040
```

Figure 18. MAIN Program Listing (Sheet 3 of 11)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
  330 IF(IM)340,350,340                                          37001050
  340 READ(3,F2)PP(3,2,I),((PP(K,M,I),K=1,3),M=3,I1)             37001060    145
      GO TO 110                                                  37001070
  350 READ(5,F2)PP(3,2,I),((PP(K,M,I),K=1,3),M=3,I1)             37001080    157
      GO TO 110                                                  37001090
C READ TXFRM DATA-                                               37001100
  360 NDN(2)=NDN(1)                                              37001110
  370 J=J+1                                                      37001120
C IF THE MAX NO OF TXFRM DATA IS EXCEEDED, STOP JOB              37001130
      IF(J.LE.30)GO TO 420                                       37001140
  380 IA=23                                                      37001150
  390 F21(9)=F21(IA)                                             37001160
      F21(10)=F21(IA+1)                                          37001170
  400 WRITE(6,F21)NBLNK                                          37001180    179
  410 CALL EXIT                                                  37001190    181
      STOP                                                       37001200
C STORE NAME OF EACH TRANSFORMATION DATA-                        37001210
  420 KPDN(J+2)=NDN  (2)                                         37001220
      IF(NDN(3)-NBLNK)430,480,430                                37001230
  430 IF(IM)440,450,440                                          37001240
  440 READ(3,D)                                                  37001250    188
      GO TO 460                                                  37001260
  450 READ(5,D)                                                  37001270    191
  460 DO 470 K=1,3                                               37001280
      KD(K+1,J)=C(4*K-3)                                         37001290
      PK(1,K+1,J)=C(4*K-2)                                       37001300
      PK(2,K+1,J)=C(4*K-1)                                       37001310
  470 PK(3,K+1,J)=C(4*K)                                         37001320
      GO TO 110                                                  37001330
  480 IF(IM)490,500,490                                          37001340
  490 READ(3,F2)(DK(K,J),(PK(M,K,J),M=1,3),K=2,4)                37001350    211
      GO TO 505                                                  37001360
  500 READ(5,F2)(DK(K,J),(PK(M,K,J),M=1,3),K=2,4)                37001370    223
  505 KD(2,J)=DK(2,J)                                            37001380
      KD(3,J)=DK(3,J)                                            37001390
      KD(4,J)=DK(4,J)                                            37001400
      GO TO 110                                                  37001410
```

Figure 18. MAIN Program Listing (Sheet 4 of 11)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
C READ RUN DATA-                                                        37001420
  510 DO 520 K=1,12                                                     37001430
  520 NRNDA(K)=NDN(K)                                                   37001440
      DO 560 KL=13,1201,12                                              37001450
      NRED=KL+11                                                        37001460
      IF(IM)530,540,530                                                 37001470
  530 READ(3,10)(NRNDA(M),M=KL,NRED)                                    37001480    256
      GO TO 550                                                         37001490
  540 READ(5,10)(NRNDA(M),M=KL,NRED)                                    37001500
C TEST FOR END OF RUN DATA WHICH IS ALSO END OF THIS CASE-              37001510    262
  550 IF(NRNDA(KL)-NEND)560,570,560                                     37001520
  560 CONTINUE                                                          37001530
C TEST FOR A GROUP CARD WHICH SIGNIFIES THE USER DESIRES AUTOMATIC      37001540
C RUN INSTRUCTION GENERATION FOR SURFACES ENTERED                       37001550
  570 IF(NRNDA(1)-NGROUP)660,580,660                                    37001560
  580 KG=8                                                              37001570
      NO=1                                                              37001580
      KL=-5                                                             37001590
  590 KG=KG+1                                                           37001600
      IF(KG-I)610,600,610                                               37001610
  600 NO=0                                                              37001620
      IF(KL)20,20,680                                                   37001630
  610 MG=KG                                                             37001640
      GO TO 630                                                         37001650
  620 KL=-5                                                             37001660
  630 MG=MG+1                                                           37001670
      IF(MG-I)640,640,590                                               37001680
  640 KL=KL+6                                                           37001690
  650 NRNDA(KL)= NPLDN(KG)                                              37001700
      NRNDA(KL+1)=NPLDN(MG)                                             37001710
      NRNDA(KL+2)=NBLNK                                                 37001720
      NRNDA(KL+3)=NBLNK                                                 37001730
      NRNDA(KL+4)=NRNDA(5)                                              37001740
      NRNDA(KL+5)=NRNDA(6)                                              37001750
      IF(KL-1195)630,680,630                                            37001760
C EACH RUN DATA SET IS SIX WORDS-TEST LAST CARD FOR RUN DATA-           37001770
  660 KL=KL-6                                                           37001780
```

Figure 18. MAIN Program Listing (Sheet 5 of 11)

```
      IF(NRNDA(KL)-NBLNK)680,670,680                                    37001790
  670 KL=KL-6                                                           37001800
  680 IF(NR)880,690,880                                                 37001810
  690 WRITE(6,F4)TITLE                                                  37001820    308
      IF(I-8)880,880,700                                                37001830
  700 DO 840 K=9,I                                                      37001840
      IF(NSU(K).LT.0)WRITE(6,710)                                       37001850    316
  710 FORMAT(81H-WARNING-THE FOLLOWING DATA IS ASSUMED TO BE CLASS 1 OR 37001860
     12. THIS VERSION OF CONFAC /32H DOES NOT ACCEPT CLASS 3-8 DATA.)   37001870
      PN(K)=PN(K)+1.                                                    37001880
      N=PN(K)                                                           37001890
      NL=N+1                                                            37001900
C COMPUTE COMPONENTS OF A UNIT VECTOR NORMAL TO THE SURFACE FORMED BY   37001910
C POINTS 2, 3 AND N                                                     37001920
      CALL UNIVEC(0,K,N,2,3,V)                                          37001930    323
      DO 720 M=1,3                                                      37001940
C COMPLETE THE POLYGON FOR USE LATER                                    37001950
      P(M,NL,K)=P(M,2,K)                                                37001960
C ERECT A UNIT NORMAL VECTOR ABOVE 1ST DATA PT TO ORIENT SURFACE        37001970
  720 P(M,1,K) =P(M,2,K)+V(M)                                           37001980
      AREA(K)=0.                                                        37001990
      KP=K                                                              37002000
      SL1=1                                                             37002010
C ON THE FIRST PASS, DETERMINE WHETHER THE SURFACE DATA REPRESENTS A    37002020
C SUBSTANTIALLY PLANE SURFACE IN THE XY PLANE OF ITS CS                 37002030
      GO TO 750                                                         37002040
C IF NOT IN XY PLANE, AUX TXFRM THE COORDINATES AND RETEST PLANARITY    37002050
  730 SL1=0                                                             37002060
  740 LP(1)=K                                                           37002070
      KP=1                                                              37002080
      MO=-1                                                             37002090
      CALL TXFRM                                                        37002100    341
  750 DO 760     M=2,N                                                  37002110
      IF( ABS(P(3,M,KP))-.1 )760,760,770                                37002120
  760 CONTINUE                                                          37002130
C THE SURFACE IS SUBSTANTIALLY PLANE AND LIES IN X-Y PLANE              37002140
      NSU(K)=1                                                          37002150
```

Figure 18. MAIN Program Listing (Sheet 6 of 11)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
      GO TO 790                                                          37002160
  770 IF(SL1.NE.0)GO TO 730                                              37002170
  780 NSU(K)=0                                                           37002180
C STORE XN IN X1 FOR AREA COMPUTATION                                    37002190
  790 P(1,1,KP)=P(1,N,KP)                                                37002200
      DO 800  K2=2,N                                                     37002210
  800 AREA(K)=AREA(K)+P(2,K2,KP)*(P(1,K2-1,KP)-P(1,K2+1,KP))             37002220
C RESTORE X1                                                             37002230
      P(1,1,KP)=P(1,2,KP)                                                37002240
C IF THE AREA AND THE Z COORDINATE OF THE ORIENTATION VECTOR ARE UNLIKE   37002250
C IN SIGN, REVERSE THE ORIENTATION VECTOR                                37002260
      IF(AREA(K)*P(3,1,KP))810,830,830                                   37002270
  810 DO 820 M=1,3                                                       37002280
  820 P(M,1,K)=P(M,2,K)-V(M)                                             37002290
  830 AREA(K)= ABS(AREA(K))/2.                                           37002300
      N=PN(K)-1.                                                         37002310
  840 WRITE(6,F5A)NPLDN(K),NBLNK,(P(M,1,K),M=1,3),(M,PP(1,M,K),PP(2,M,K)37002320
     1,PP(3,M,K),M=1,N),(M,PP(1,M,KP),PP(2,M,KP),PP(3,M,KP),M=1,N)       37002330
C IF NO TXFRM DATA WAS ENTERED, PROCEED-                                 37002340    385
      IF(J)850,880,850                                                   37002350
                                                                         37002360
  850 DO 870 K=1,J                                                       37002370
C COMPUTE UNIT VECTOR NORMAL TO PLANE FORMED BY 3 TXFRM DATA POINTS      37002380
      CALL UNIVEC(1,K,2,3,4,V)                                           37002390    410
C CONSTRUCT UNIT VECTOR OVER POINT 3                                     37002400
      PK(1,1,K)=PK(1,3,K)+V(1)                                           37002410
      PK(2,1,K)=PK(2,3,K)+V(2)                                           37002420
  860 PK(3,1,K)=PK(3,3,K)+V(3)                                           37002430
  870  WRITE(6,F5)KPDN(K+2),NBLNK,(KD(M,K),PK(1,M,K),PK(2,M,K),PK(3,M,K),37002440    419
     1M=2,4)                                                             37002450
  880 M=NR                                                               37002460    431
      WRITE(6,F6)                                                        37002470
      DO 890 K=1,KL,6                                                    37002480
      M=M+1                                                              37002490
      KE=K+5                                                             37002500    436
  890 WRITE(6,F6A)M,(NRNDA(N),N=K,KE)                                    37002510
      IERR=0                                                             37002520
C COMMENCE EXECUTION OF RUN INSTRUCTIONS-
```

Figure 18. MAIN Program Listing (Sheet 7 of 11)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
  900 DO 1260 K1=1,KL,6                                                  37002530
      SL1=0                                                              37002540
      KE=K1+5                                                            37002550
      NR=NR+1                                                            37002560
C LOCATE THE DATA DESIRED FROM THE APPROPRIATE ARRAY,STORE IN ARRAY L    37002570
      CALL SELEK(K1  ,NPLDN, I,1)                                        37002580   450
      CALL SELEK(K1+1,NPLDN, I,2)                                        37002590   452
      CALL SELEK(K1+2, KPDN,J+2,3)                                       37002600   454
      CALL SELEK(K1+3, KPDN,J+2,4)                                       37002610   456
      CALL SELEK(K1+4,  INC,33,5)                                        37002620   458
      CALL SELEK(K1+5,  INC,33,6)                                        37002630   460
      WRITE(6,F7)TITLE,NR,(NRNDA(M),M=K1,KE)                             37002640
C IF THE RUN DATA NAME CANNOT BE MATCHED WITH DICTIONARY, PRINT ERROR,   37002650
C GO TO NEXT RUN-                                                        37002660   461
      IF(SL1)910,930,910                                                 37002670
  910 WRITE(6,F8)                                                        37002680   468
      IERR=IERR+1                                                        37002690
      IF(IERR-10)1260,920,920                                            37002700
  920 WRITE(6,F3)                                                        37002710   471
      GO TO 20                                                           37002720
  930 IERR=0                                                             37002730
      K=L(2,1)                                                           37002740
      IF(NSU(K).EQ.0)WRITE(6,940)NRNDA(K1)                               37002750   477
  940 FORMAT( 32H-WARNING-EXAMINATION OF SURFACE 1A6, 64H INDICATES IT I 37002760
     1S SUBSTANTIALLY NONPLANAR AND SHOULD NOT BE USED / 14H AS SURFACE   37002770
     21. )                                                               37002780
C ANALYZE DATA SELECTED, DETERMINE IF SAME DATA WAS USED IN LAST RUN     37002790
C AND ONLY CHANGES IN INCREMENTS ARE REQUESTED, AND IF PRIMARY           37002800
C TRANSFORMATIONS ARE REQUIRED.                                          37002810
C IF NO SURFACE AND TXFRM DATA IS CHANGED OVER THE LAST RUN, A CHANGE    37002830
C IN INCREMENT SIZE IS ASSUMED (SL1 OFF)                                 37002840
      IF(L(1,1)+L(1,2)+L(1,3)+L(1,4))950,1030,950                        37002850
  950 DO 1000 KP=1,2                                                     37002860
      KX=KP+2                                                            37002870
C IS A TRANSFORMATION REQD-                                              37002880
      IF(L(2,KX)-1)960,990,960                                           37002890
C ARE SURFACE KP SURFACE DATA OR TXFRM DATA CHANGED-                     37002900
```

Figure 18. MAIN Program Listing (Sheet 8 of 11)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
  960 IF(L(1,KP)+L(1,KX))980,970,980                                37002910
C PICKUP TRANSFORMED DATA FROM LAST RUN                             37002920
  970 LP(KP)=KP+6                                                   37002930
      GO TO 1COO                                                    37002940
C NEW DATA AND/OR NEW TXFRM-TXFRM SURFACE AS REQD                   37002950
  980 MO=0                                                          37002960
      CALL TXFRM                                                    37002970    496
      GO TO 1COO                                                    37002980
C NO TRANSFORM REQD, USE DATA SELECTED                              37002990
  990 ND=L(2,KP)                                                    37003000
      LP(KP)=ND                                                     37003010
 1000 CONTINUE                                                      37003020
C TRANSFER TO DOICU TO DETERMINE IF EACH PLANE SEES NONE, ALL OR PART OF37003030
C THE OTHER. DOICU ALSO COMPUTES NEW COORDINATES OF A SURFACE WHEN PART 37003040
C OF THE SURFACE IS NOT SEEN.                                       37003050
 1010 CALL DOICU                                                    37003060
C PREPARE SURFACE NAMES FOR OUTPUT                                  37003070    505
 1020 NM(1,1)=NRNDA(K1)                                             37003080
      NM(2,1)=NRNDA(K1+2)                                           37003090
      NM(1,2)=NRNDA(K1+1)                                           37003100
      NM(2,2)=NRNDA(K1+3)                                           37003110
      SL1=1                                                         37003120
 1030 IF(LI(1))1070,1040,1070                                       37003130
C IF NO PART OF EACH SURFACE IS SEEN BY THE OTHER, PRINT SAME PLUS THE 37003140
C COORDINATES OF ANY TRANSFORMED SURFACE FOR CHECKING .             37003150
 1040 WRITE(6,F9)NM                                                 37003160    513
      DO 1060 KP=1,2                                                37003170
      IF(NM(2,KP)-NBLNK)1050,1060,1050                              37003180
 1050 N=LP(KP)                                                      37003190
      NP=PN(N)-1.                                                   37003200
      WRITE(6,F10)NM(1,KP),NM(2,KP)                                 37003210    523
      WRITE(6,F5A)NM(1,KP),NM(2,KP),(P(M,1,N),M=1,3),(M,PP(1,M,N),  37003220
     1PP(2,M,N),PP(3,M,N),M=1,NP)                                   37003230    526
 1060 CONTINUE                                                      37003240
      GO TO 1260                                                    37003250
C SUB MAP SETS UP A GRID ACROSS THE SURFACE FROM WHICH FACTORS ARE TO BE37003260
C COMPUTED, AND ACROSS WHICH THEY WILL BE INTEGRATED.               37003270
```

Figure 18. MAIN Program Listing (Sheet 9 of 11)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
 1070 CALL MAP                                                          37003280
C SUB FACTOR COMPUTES THE PLANE POINT FACTOR FOR EACH X-Y VALUE IN THE  37003290
C GRID, NUMERICALLY INTEGRATES ALL FACTORS AND COMPUTES THE MEAN OF ALL 37003300
C AREA-WEIGHTED VALUES  WHICH IS THE RESULTING FACTOR FOR THE SITUATION 37003310    543
      CALL FACTOR                                                       37003320
C PRINT FACTOR RESULTS                                                  37003330    545
      WRITE(6,F11)NM,F(1)                                               37003340    546
      WRITE(6,F11B)FAP,AREA(1)                                          37003350    548
      SL4=0                                                             37003360
      DO 1180 KP=1,2                                                    37003370
C PRINT OUTPUT INDICATING HOW MUCH OF EACH SURFACE IS SEEN  IF PART IS  37003380
C OCCLUDED, AND THE TOTAL SURFACE AREA COMPUTED FROM ORIGINAL DATA-     37003390
      J1=L(2,KP)                                                        37003400
      J2= 3-KP                                                          37003410
      IF(LI(KP))1080,1260,1090                                          37003420
 1080 WRITE(6,F12)NM(1,KP),NM(2,KP),AREAX(KP),NM(1,J2),NM(2,J2)         37003430    557
 1090 WRITE(6,F13)NM(1,KP),NM(2,KP),AREA(J1)                            37003440    563
      GO TO(1110,1100),KP                                               37003450
 1100 F(2)=FAP/AREA(J1)                                                 37003460
      WRITE(6,F11)NM(1,2),NM(2,2),NM(1,1),NM(2,1),F(2)                  37003470
C IF THE SURFACE IS NONPLANAR, WARN ABOUT ACCURACY OF AREA COMPUTATION. 37003480    570
 1110 IF(NSU(J1))1130,1120,1130                                         37003490
 1120 WRITE(6,F14)                                                      37003500    574
      SL4=1                                                             37003510
 1130 GO TO (1140,1180),KP                                              37003520
C DETERMINE IF THE MAPPING AREA DIFFERS FROM THE FINAL SURFACE 1 AREA BY37003530
C MORE THAN THE SPECIFIED TOLERANCE.                                    37003540
 1140 IF(LI(1))1160,1160,1150                                           37003550
 1150 AREAX(1)=AREA(J1)                                                 37003560
 1160 IF( ABS(AREA(1)-AREAX(1))-.01*AREAX(1))1180,1180,1170             37003570
C IF SURFACE 1 WAS BISECTED. COMPARE THE MAPPING AREA WITH THE ACTIVE    37003580
C SURFACE. PRINT WARNING IF MAPPING AREA EXCEEDS TOLERANCE.             37003590
 1170 WRITE(6,F19)NM                                                    37003600    582
 1180 CONTINUE                                                          37003610
      IF(SL4)1190,1200,1190                                             37003620
C IF EITHER SURFACE IS NONPLANAR, PRINT WARNING ABOUT VALIDITY OF OUTPUT37003630
C AND PROGRAM RESTRICTIONS. PRINT FINAL SURFACE COORDINATES TO ASSIST   37003640
```

Figure 18. MAIN Program Listing (Sheet 10 of 11)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
      CFACI                                                    09/09/65          PAGE  11
          37007J      -  EFN    SOURCE STATEMENT  -  IFN(S)  -

C DETERMINATION OF VALIDITY.                                                  37003650
 1190 WRITE(6,F20)                                                            37003660    587
      GO TO 1210                                                              37003670
C IF A DETAILED OUTPUT WAS NOT REQUESTED, GO TO THE NEXT RUN-                 37003680
 1200 IF(S5)1210,1260,1210                                                    37003690
C PRINT FINAL COORDINATES OF SURFACES                                         37003700
 1210 WRITE(6,F22)                                                            37003710    591
 1220 DO 1230 KP=1,2                                                          37003720
      N=LP(KP)                                                                37003730
      NP=PN(N)-1.                                                             37003740
 1230 WRITE(6,F5A)NM(1,KP),NM(2,KP),(P(M,1,N),M=1,3),(M,PP(1,M,N),            37003750
     1PP(2,M,N),PP(3,M,N),M=1,NP)                                             37003760    598
      IF(S5)1240,1260,1240                                                    37003770
C PRINT SURFACE 1 MAPPING BOUNDARIES AND INCREMENT SIZES                      37003780
 1240 WRITE(6,F15)NM(1,1),NM(2,1),(X1(M,1),X1(M,2),Y1(M),M=1,NVL)             37003790    613
      WRITE(6,F16)NHI,NVI                                                     37003800    620
      WRITE(6,F17)                                                            37003810    621
      JS=1                                                                    37003820
      DO 1250 NL=1 , NVL                                                      37003830
      JE=NHL*NL                                                               37003840
C PRINT ALL PLANE POINT FACTORS COMPUTED                                      37003850
      WRITE(6,F18)(FHP(M),M=JS,JE)                                            37003860    625
 1250 JS=JE+1                                                                 37003870
 1260 CONTINUE                                                                37003880
      IF(N0)620,20,620                                                        37003890
      END                                                                     37003900
```

Figure 18. MAIN Program Listing (Sheet 11 of 11)

STORAGE MAP

MAIN PROGRAM

COMMON VARIABLES

COMMON BLOCK // ORIGIN CC001 LENGTH 34776

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| ○ | 00000 | R | BUF | 21420 | R | PN | 21423 | R |
| KD | 21553 | I | PK | 21743 | R | L | 22513 | I |
| LI | 22527 | I | LP | 22531 | I | X1 | 22533 | R |
| Y1 | 22725 | R | DX | 23022 | R | AREA | 23117 | R |
| AREAX | 23247 | R | FHP | 23251 | R | NRNDA | 32462 | I |
| KP | 34756 | I | KX | 34757 | I | NHI | 34760 | I |
| NHL | 34761 | I | NVI | 34762 | I | NVL | 34763 | I |
| M0 | 34764 | I | DY | 34765 | R | FAP | 34766 | R |
| F | 34767 | R | SL1 | 34771 | I | SL2 | 34772 | I |
| SL3 | 34773 | I | SL4 | 34774 | I | S5 | 34775 | I |
| PP | 00003 | R | P | 00000 | R | C | 00000 | R |
| DK | 21553 | R | | | | | | |

DIMENSIONED PROGRAM VARIABLES

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| INC | 35100 | I | F1 | 35142 | R | F2 | 35156 | R |
| F3 | 35172 | R | F4 | 35206 | R | F5 | 35316 | R |
| F6 | 35346 | R | F7 | 35376 | R | F8 | 35426 | R |
| F9 | 35442 | R | F10 | 35522 | R | F11 | 35034 | R |
| F12 | 35536 | R | F13 | 35566 | R | F14 | 35602 | R |
| F15 | 35632 | R | F16 | 35676 | R | F17 | 35712 | R |
| F18 | 35742 | R | F6A | 35756 | R | F5A | 35772 | R |
| F19 | 36022 | R | F20 | 36116 | R | F21 | 36242 | R |
| F22 | 36272 | R | F11B | 35052 | R | TITLE | 35015 | R |
| NDN | 34777 | I | NPLDN | 36322 | I | KPDN | 36452 | I |
| V | 36512 | R | N2 | 36515 | I | NM | 36520 | I |
| NSU | 36524 | I | NCIM | 34777 | I | TITLEI | 35015 | R |

Figure 19. MAIN Program Core Storage Map (Sheet 1 of 4)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

STORAGE MAP

| | | | | | |
|---|---|---|---|---|---|
| OCT | 36654 | R | NFLG | 36657 | I |

UNDIMENSIONED PROGRAM VARIABLES

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| NDT | 35033 | I | DT | 35033 | R | NEND | 36661 | I |
| NBLNK | 36662 | I | IR | 36663 | I | IM | 36664 | I |
| FLGI | 36665 | R | NR | 36666 | I | NO | 36667 | I |
| I | 36670 | I | J | 36671 | I | IA | 36672 | I |
| NOP | 36673 | I | M | 36674 | I | K | 36675 | I |
| I1 | 36676 | I | KL | 36677 | I | NRED | 36700 | I |
| NGROUP | 36701 | I | KG | 36702 | I | MG | 36703 | I |
| N | 36704 | I | NL | 36705 | I | KE | 36706 | I |
| IERR | 36707 | I | K1 | 36710 | I | ND | 36711 | I |
| NP | 36712 | I | J1 | 36713 | I | J2 | 36714 | I |
| JS | 36715 | I | JE | 36716 | I | | | |

ENTRY POINTS

| | | |
|---|---|---|
| ..... | SECTION | 4 |

SUBROUTINES CALLED

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| .FRDD. | SECTION | 5 | .FSLI. | SECTION | 6 | .FWRD. | SECTION | 7 |
| .FRWT. | SECTION | 8 | .FSLO. | SECTION | 9 | .FRDU. | SECTION | 10 |
| EXIT | SECTION | 11 | .EXIT. | SECTION | 12 | UNIVEC | SECTION | 13 |
| TXFRM | SECTION | 14 | SELEK | SECTION | 15 | DOICU | SECTION | 16 |
| MAP | SECTION | 17 | FACTOR | SECTION | 18 | .FXEM. | SECTION | 19 |
| .UNC5. | SECTION | 20 | .FRTN. | SECTION | 21 | .FCNV. | SECTION | 22 |
| .UNO6. | SECTION | 23 | .FFIL. | SECTION | 24 | .UNO3. | SECTION | 25 |
| CC.1 | SECTION | 26 | CC.2 | SECTION | 27 | CC.3 | SECTION | 28 |
| CC.4 | SECTION | 29 | SYSLOC | SECTION | 30 | | | |

Figure 19. MAIN Program Core Storage Map (Sheet 2 of 4)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

STORAGE MAP

EFN IFN CORRESPONDENCE

| EFN | IFN | LOCATION | EFN | IFN | LOCATION | EFN | IFN | LOCATION |
|---|---|---|---|---|---|---|---|---|
| 10 | FORMAT | 36775 | 20 | 29A | 37274 | 60 | FORMAT | 36777 |
| 100 | 51A | 37464 | 30 | 35A | 37323 | 40 | FORMAT | 36776 |
| 80 | FORMAT | 37000 | 50 | 41A | 37363 | 70 | 45A | 37411 |
| 90 | 48A | 37427 | 110 | 60A | 37502 | 120 | 62A | 37504 |
| 130 | 65A | 37520 | 140 | 67A | 37533 | 150 | 69A | 37536 |
| 370 | 170A | 40112 | 510 | 242A | 40362 | 160 | 71A | 37541 |
| 170 | 72A | 37550 | 180 | 74A | 37553 | 360 | 169A | 40110 |
| 190 | 77A | 37560 | 210 | 86A | 37577 | 200 | 84A | 37574 |
| 390 | 176A | 40124 | 220 | 89A | 37604 | 250 | 102A | 37644 |
| 230 | 91A | 37607 | 240 | 94A | 37615 | 270 | 106A | 37654 |
| 310 | 134A | 37762 | 260 | 104A | 37647 | 300 | 127A | 37734 |
| 280 | 111A | 37670 | 320 | 140A | 37775 | 290 | 122A | 37725 |
| 330 | 143A | 40002 | 340 | 145A | 40004 | 350 | 157A | 40046 |
| 420 | 183A | 40150 | 380 | 175A | 40122 | 400 | 179A | 40131 |
| 410 | 180A | 40141 | 430 | 186A | 40156 | 480 | 209A | 40234 |
| 440 | 188A | 40160 | 450 | 191A | 40166 | 460 | 193A | 40173 |
| 470 | 203A | 40225 | 490 | 211A | 40236 | 500 | 223A | 40277 |
| 505 | 234A | 40337 | 520 | 246A | 40363 | 560 | 270A | 40437 |
| 530 | 256A | 40377 | 540 | 262A | 40416 | 550 | 267A | 40434 |
| 570 | 273A | 40441 | 660 | 301A | 40527 | 580 | 275A | 40444 |
| 590 | 278A | 40452 | 610 | 284A | 40465 | 600 | 281A | 40460 |
| 680 | 306A | 40541 | 630 | 287A | 40472 | 620 | 286A | 40470 |
| 640 | 290A | 40501 | 650 | 291A | 40506 | 670 | 305A | 40536 |
| 880 | 430A | 41277 | 690 | 308A | 40543 | 700 | 311A | 40562 |
| 840 | 385A | 41060 | 710 | FORMAT | 37002 | 720 | 329A | 40652 |
| 750 | 342A | 40677 | 730 | 337A | 40665 | 740 | 338A | 40666 |
| 760 | 347A | 40722 | 770 | 351A | 40730 | 790 | 356A | 40735 |
| 780 | 354A | 40734 | 800 | 361A | 40777 | 810 | 373A | 41027 |
| 830 | 381A | 41044 | 820 | 376A | 41037 | 850 | 406A | 41176 |
| 870 | 419A | 41227 | 860 | 416A | 41224 | 890 | 436A | 41323 |
| 900 | 443A | 41346 | 1260 | 633A | 42476 | 910 | 468A | 41511 |
| 930 | 473A | 41535 | 920 | 471A | 41526 | 940 | FORMAT | 37027 |
| 950 | 481A | 41563 | 1030 | 511A | 41647 | 1000 | 502A | 41627 |
| 960 | 487A | 41602 | 990 | 498A | 41623 | 980 | 494A | 41616 |

Figure 19. MAIN Program Core Storage Map (Sheet 3 of 4)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
     CFACI                                              STORAGE  MAP      09/09/65               PAGE  41
          37007J

970        491A      41612    1010      504A      41632    1020      506A      41635
1070       542A      42003    1040      513A      41651    1060      539A      41777
1050       519A      41673    1180      584A      42243    1080      557A      42055
1090       563A      42104    1110      571A      42160    1100      568A      42132
1130       575A      42175    1120      574A      42165    1140      576A      42204
1160       580A      42214    1150      578A      42207    1170      582A      42230
1190       587A      42250    1200      589A      42257    1210      591A      42261
1220       592A      42267    1230      598A      42306    1240      613A      42372
1250       630A      42471
   DECK LENGTH IN OCTAL IS     05440.
```

Figure 19. MAIN Program Core Storage Map (Sheet 4 of 4)

```
C THERMAL ANALYSIS CONFAC PROGRAM-NASA CONTRACT NAS9-4133                37100012
C CONFAC I -ENGINEERING ANALYSES AND COMPUTER PROGRAMMING BY K.A. TOUPS, 37100050
C NORTH AMERICAN AVIATION,INC.,SPACE AND INFORMATION SYSTEMS DIVISION    37100060
C FORTRAN IV VERSION 7/31/65                                             37100040
      SUBROUTINE UNIVEC(I,K,J,M,N,V)                                     37100080
C THIS SUBROUTINE COMPUTES THE DIRECTION COSINES OF A VECTOR NORMAL TO   37100090
C THE POINTS J,M,N IN ARRAY P(X,Y,K) OR PK(X,Y,K), AS CONTROLLED BY I.   37100100
C THE CROSS PRODUCT YIELDS A VECTOR NORMAL TO THE SURFACE. THIS VECTOR   37100110
C IS UNITIZED, THUS YIELDING THE DIRECTION COSINES OF A UNIT VECTOR,      37100120
C WHICH ARE ALSO THE XYZ VALUES DEFINING THE UNIT VECTOR.                37100130
C                                                                        37100140
      INTEGER SL1,SL2,SL3,SL4                                            37100150
      COMMON    P(3,34, 88),BUF(3),PN( 88),KD(4,30),PK(3,4,30),L(2,6),   37100160
     1LI(2),LP(2),X1(61,2),Y1(61  ),DX(61),AREA( 88),AREAX(2),FHP(3721),37100170
     2NRNDA(1212),KP,KX,NHI,NHL,NVI,NVL,MO,DY,FAP,F(2),SL1,SL2,SL3,SL4   37100180
      DIMENSION D(2,3),V(3)                                              37100190
C                                                                        37100200
      I1=N                                                               37100210
   10 DO 60  I2=1,2                                                      37100220
      IF(I)40,20,40                                                      37100230
   20 DO 30  I3=1,3                                                      37100240
   30 D(I2,I3)=P(I3,I1,K)-P(I3,M,K)                                      37100250
      GO TO 60                                                           37100260
   40 DO 50 I3=1,3                                                       37100270
   50 D(I2,I3)=PK(I3,I1,K)-PK(I3,M,K)                                    37100280
   60 I1=J                                                               37100290
      V(1)=D(1,2)*D(2,3)-D(2,2)*D(1,3)                                   37100300
      V(2)=D(2,1)*D(1,3)-D(1,1)*D(2,3)                                   37100310
      V(3)=D(1,1)*D(2,2)-D(2,1)*D(1,2)                                   37100320
      VL= SQRT(V(1)**2+V(2)**2+V(3)**2)                                  37100330   28
      V(1)=V(1)/VL                                                       37100340
      V(2)=V(2)/VL                                                       37100350
      V(3)=V(3)/VL                                                       37100360
      RETURN                                                             37100370
      END                                                                37100380
```

Figure 20. Subroutine UNIVEC Listing



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

STORAGE MAP

SUBROUTINE UNIVEC

COMMON VARIABLES

COMMON BLOCK // ORIGIN 00001 LENGTH 34775

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| P | 00000 | R | BUF | 21420 | R | PN | 21423 | R |
| KD | 21553 | I | PK | 21743 | R | L | 22513 | I |
| LI | 22527 | I | LP | 22531 | I | XI | 22533 | R |
| Y1 | 22725 | R | DX | 23022 | R | AREA | 23117 | R |
| AREAX | 23247 | R | FHP | 23251 | R | NRNDA | 32462 | I |
| KP | 34756 | I | KX | 34757 | I | NH1 | 34760 | I |
| NHL | 34761 | I | NVI | 34762 | I | NVL | 34763 | I |
| M0 | 34764 | I | DY | 34765 | R | FAP | 34766 | R |
| F | 34767 | R | SL1 | 34771 | I | SL2 | 34772 | I |
| SL3 | 34773 | I | SL4 | 34774 | I | | | |

DIMENSIONED PROGRAM VARIABLES

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| D | 34776 | R | | | | | | |

UNDIMENSIONED PROGRAM VARIABLES

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| I1 | 35004 | I | I2 | 35005 | I | VL | 35006 | R |

ENTRY POINTS

UNIVEC SECTION 4

Figure 21. Subroutine UNIVEC Core Storage Map (Sheet 1 of 2)





NORTH AMERICAN AVIATION, INC. SPACE and INFORMATION SYSTEMS DIVISION

CFACI 09/09/65 PAGE 43
37107J STORAGE MAP

SUBROUTINES CALLED

SQRT SECTION 5 SYSLOC SECTION 6

EFN IFN CORRESPONDENCE

| EFN | IFN | LOCATION | EFN | IFN | LOCATION | EFN | IFN | LOCATION |
|---|---|---|---|---|---|---|---|---|
| 10 | 2A | 35026 | 60 | 24A | 35126 | 40 | 16A | 35102 |
| 20 | 7A | 35055 | 30 | 10A | 35073 | 50 | 19A | 35120 |

DECK LENGTH IN OCTAL IS 00300.

Figure 21. Subroutine UNIVEC Core Storage Map (Sheet 2 of 2)

```
C THERMAL ANALYSIS CONFAC PROGRAM-NASA CONTRACT NAS9-4133                37200012
C CONFAC I -ENGINEERING ANALYSES AND COMPUTER PROGRAMMING BY K.A. TOUPS,37200020
C NORTH AMERICAN AVIATION,INC.,SPACE AND INFORMATION SYSTEMS DIVISION    37200030
C FORTRAN IV VERSION 7/31/65                                             37200040
      SUBROUTINE  SELEK(I,J,K,M)                                         37200050
C ARRAY J  CONTAINS THE NAMES OF EITHER SURFACE, TXFRM OR INCREMENTING   37200060
C DATA,AS SET BY THE ARGUMENT LIST IN THE MAIN PROGRAM. ARRAY NRNDA      37200070
C CONTAINS RUN DATA. THIS SUBROUTINE SELECTS THE DATA CORRESPONDING TO   37200080
C THE NAME, AND ALSO INDICATES IF THE SAME DATA WAS SELECTED FOR THE     37200090
C PREVIOUS RUN.                                                          37200100
C                                                                        37200110
      INTEGER SL1,SL2,SL3,SL4                                            37200120
      COMMON    P(3,34, 88),BUF(3),PN( 88),KD(4,30),PK(3,4,30),L(2,6),   37200130
     1LI(2),LP(2),X1(61,2),Y1(61  ),DX(61),AREA( 88),AREAX(2),FHP(3721),37200140
     2NRNDA(1212),KP,KX,NHI,NHL,NVI,NVL,MO,DY,FAP,F(2),SL1,SL2,SL3,SL4   37200150
      DIMENSION J(1)                                                     37200160
C                                                                        37200170
      DO 40 N=1,K                                                        37200180
      IF(NRNDA(I)-J(N))40,10,40                                          37200190
   10 IF(L(2,M)-N)20,30,20                                               37200200
   20 L(1,M)=1                                                           37200210
      L(2,M)=N                                                           37200220
      RETURN                                                             37200230
   30 L(1,M)=0                                                           37200240
      RETURN                                                             37200250
   40 CONTINUE                                                           37200260
      SL1=1                                                              37200270
      RETURN                                                             37200280
      END                                                                37200290
```

Figure 22. Subroutine SELEK Listing



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

CFACI
37207J

09/09/65 PAGE 44

STORAGE MAP

SUBROUTINE SELEK

COMMON VARIABLES

COMMON BLOCK // ORIGIN 00001 LENGTH 34775

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| P | 00000 | R | BUF | 21420 | R | PN | 21423 | R |
| KD | 21553 | I | PK | 21743 | R | L | 22513 | I |
| LI | 22527 | I | LP | 22531 | I | X1 | 22533 | R |
| Y1 | 22725 | R | DX | 23022 | R | AREA | 23117 | R |
| AREAX | 23247 | R | FHP | 23251 | R | NRNDA | 32462 | I |
| KP | 34756 | I | KX | 34757 | I | NHI | 34760 | I |
| NHL | 34761 | I | NVI | 34762 | I | NVL | 34763 | I |
| M0 | 34764 | I | DY | 34765 | R | FAP | 34766 | R |
| F | 34767 | R | SL1 | 34771 | I | SL2 | 34772 | I |
| SL3 | 34773 | I | SL4 | 34774 | I | | | |

UNDIMENSIONED PROGRAM VARIABLES

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| N | 34776 | I | | | | | | |

ENTRY POINTS

SELEK SECTION 4

SUBROUTINES CALLED

SYSLOC SECTION 5

EFN IFN CORRESPONDENCE

Figure 23. Subroutine SELEK Core Storage Map (Sheet 1 of 2)

```
                                                                    PAGE  45
                                                                    LOCATION
                                                                    35035
                                                    09/09/65
                                                                    IFN
                                                                    11A
                                                    EFN
                                                    20
                                    STORAGE  MAP
                                    LOCATION
                                    35032
                    IFN
                    8A
                                    LOCATION        EFN
                                    35044           10
                    IFN             35042
                    16A
                    14A                     00104.
CFAC1
  37207J
EFN
40
30
  DECK LENGTH IN OCTAL IS
```

Figure 23. Subroutine SELEK Core Storage Map (Sheet 2 of 2)

```
C THERMAL ANALYSIS CONFAC PROGRAM-NASA CONTRACT NAS9-4133                37300012
C CONFAC I -ENGINEERING ANALYSES AND COMPUTER PROGRAMMING BY K.A. TOUPS, 37300020
C NORTH AMERICAN AVIATION,INC.,SPACE AND INFORMATION SYSTEMS DIVISION    37300030
C FORTRAN IV VERSION 7/31/65                                             37300040
      SUBROUTINE TXFRM                                                   37300050
C THIS SUBROUTINE IS DIVIDED INTO TWO PARTS- THE FIRST SECTION TRANS-    37300060
C FORMS A SURFACE SO THAT ALL Z COORDINATES ARE ZERO,I.E.,THE SURFACE    37300070
C LIES IN THE X-Y PLANE OF THE NEW CS. THE OTHER SURFACE IS THEN ALSO    37300080
C TRANSFORMED INTO THIS SYSTEM IN  ITS PROPER POSITION RELATIVE TO THE   37300090
C FIRST SURFACE. THIS IS TERMED AN AUXILIARY TRANSFORMATION              37300100
C THE SECOND SECTION TRANSFORMS THE COORDINATES OF A GIVEN SURFACE TO    37300110
C SOME POSITION SPECIFIED BY THE TRANSFORMATION DATA POINTS. THIS IS     37300120
C TERMED A PRIMARY TRANSFORMATION.                                       37300130
C                                                                        37300140
      INTEGER SL1,SL2,SL3,SL4                                            37300150
      COMMON    P(3,34, 88),BUF(3),PN( 88),KD(4,30),PK(3,4,30),L(2,6),   37300160
     1LI(2),LP(2),X1(61,2),Y1(61  ),DX(61),AREA( 88),AREAX(2),FHP(3721),37300170
     2NRNDA(1212),KP,KX,NHI,NHL,NVI,NVL,MO,DY,FAP,F(2),SL1,SL2,SL3,SL4   37300180
      DIMENSION R(4,3),COSA(3,3),COSB(3,3),C1(3),T(3),U(3),DI(3,3),V(3)  37300190
C                                                                        37300200
C START OF AUXILIARY TRANSFORMATION                                      37300210
      IF(MO)10,110,10                                                    37300220
C LOCATE ARRAY IN WHICH NEW CS AXES WILL BE ORIENTED.                    37300230
   10 J1=LP(KP)                                                          37300240
C THE Z AXIS OF THE NEW CS LIES ALONG THE UNIT VECTOR ERECTED PREVIOUSLY 37300250
C ABOVE POINT 2.(HEAD END IS POINT 1). THE X-AXIS IS ALIGNED FROM POINT  37300260
C 2 TO 3.                                                                37300270
      DO 20 M=1,3                                                        37300280
   20 DI(M,1)=P(M,3,J1)-P(M,2,J1)                                        37300290
      DV= SQRT(DI(1,1)**2+DI(2,1)**2+DI(3,1)**2)                         37300300   15
      DO 30 M=1,3                                                        37300310
C COMPUTE DIRECTION COSINES OF NEW X-AXIS RELATIVE TO OLD X-Y-Z          37300320
      COSB(1,M)=DI(M,1)/DV                                               37300330
C COMPUTE DIRECTION COSINES OF NEW Z-AXIS RELATIVE TO OLD X-Y-Z          37300340
   30 COSB(3,M)=P(M,1,J1)-P(M,2,J1)                                      37300350
C COMPUTE DIRECTION COSINES OF NEW Y-AXIS RELATIVE TO OLD X-Y-Z          37300360
```

Figure 24. Subroutine TXFRM Listing (Sheet 1 of 5)



NORTH AMERICAN AVIATION, INC. SPACE and INFORMATION SYSTEMS DIVISION

```
C USE VECTOR CROSS OF OTHER COMPONENTS.                                  37300370
      COSB(2,1)=COSB(3,2)*COSB(1,3)-COSB(1,2)*COSB(3,3)                  37300380
      COSB(2,2)=COSB(1,1)*COSB(3,3)-COSB(3,1)*COSB(1,3)                  37300390
      COSB(2,3)=COSB(3,1)*COSB(1,2)-COSB(1,1)*COSB(3,2)                  37300400
C COMPUTE TRANSLATION COMPONENTS H,K,L MOVING OLD ORIGIN TO NEW ORIGIN   37300410
C AT POINT 2.                                                            37300420
      DO 40 K=1,3                                                        37300430
   40 U(K)=-P(1,2,J1)*COSB(K,1)-P(2,2,J1)*COSB(K,2)-P(3,2,J1)*COSB(K,3)  37300440
C TRANSFORM SURFACES AS REQUIRED AND STORE IN J OF P                     37300450
      IF(MO)50,110,60                                                    37300460
   50 KM=1                                                               37300470
      KX=0                                                               37300480
      GO TO 70                                                           37300490
   60 KM=2                                                               37300500
   70 DO 100 K=1,KM                                                      37300510
      J=KX+K                                                             37300520
      J1=LP(K)                                                           37300530
      LP(K)=J                                                            37300540
      J2=PN(J1)+1.                                                       37300550
      PN(J)=PN(J1)                                                       37300560
      DO 100 I=1,J2                                                      37300570
      DO 100 M=1,3                                                       37300580
      P(M,I,J)=P(1,I,J1)*COSB(M,1)+P(2,I,J1)*COSB(M,2)+P(3,I,J1)*COSB(M,  37300590
     13)+U(M)                                                            37300600
   80 IF(ABS(P(M,I,J)).LE.1.E-4)P(M,I,J)=0.                              37300620
  100 CONTINUE                                                           37300640
      RETURN                                                             37300650
C START OF PRIMARY TRANSFORMATION SECTION                                37300660
C SELECT ARRAY TO BE TRANSFORMED                                         37300670
  110 ND=L(2,KP)                                                         37300680
C SELECT TRANSFORMATION DATA ARRAY CONSISTING OF COORDINATES OF THREE    37300690
C SPECIFIED POINTS FROM NEW CS, AND A FOURTH(NO.1 IN THE ARRAY) COMPUTED  37300700
C FROM THE VECTOR X-PRODUCT OF OTHER THREE                               37300710
      NC=L(2,KX) -2                                                      37300720
C THE 1 IS ADDED BECAUSE THE INTERNAL SUBSCRIPTS IN ARRAY P ARE 1 HIGHER 37300730
C THAN THE NOS. ENTERED IN DATA                                          37300740
C TEST FOR AN ORIENTATION REVERSAL REQUEST                               37300750
```

Figure 24. Subroutine TXFRM Listing (Sheet 2 of 5)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
      IF(NC)120,240,120                                                 37300760
  120 NP=KD(3,NC)+1                                                     37300770
C COMPUTE A FOURTH POINT FROM THE THREE COORDINATES IN SURFACE DATA     37300780
C CORRESPONDING TO THE FOURTH POINT IN TRANSFORMATION DATA              37300790
      CALL UNIVEC(0,ND,KD(2,NC)+1,NP,KD(4,NC)+1,V)                      37300800
C THE FOLLOWING FUNDAMENTAL EQUATION IS SOLVED FOR THE NEW CS AXES      37300810
C DIRECTION COSINES RELATIIVE TO OLD, ALONG WITH THE TRANSLATION COMP   37300820
C                                                                       37300830
C X,Y,Z=XP*COS(A1,B1,G1)+YP*COS(A2,B2,G2)+ZP*COS(A3,B3,G3)+H,K,L        37300840
C                                                                       37300850
C THIS EQUATION IS WRITTEN FOUR TIMES  FORMING A 4X4 DETERMINANT, AND   37300860
C SOLVED FOR COS(A2,B2,G2) AND COS(A3,B3,G3) BY CRAMERS RULE. COS(A1,B1,37300870
C G1) IS THEN DERIVED BY THE X-PRODUCT OF THE Y-Z UNIT VECTORS(DCOSINES)37300880
C ARRAY R CONTAINS THE OLD COORDINATES,ARRAY PK CONTAINS THE NEW.       37300890    90
      R(1,1)=P(1,NP,ND)+V(1)                                            37300900
      R(1,2)=P(2,NP,ND)+V(2)                                            37300910
      R(1,3)=P(3,NP,ND)+V(3)                                            37300920
C COMPUTE DIRECTION COSINES OF NEW AXES BY MEANS OF A 4X4 DETERMINANT   37300930
C WITH 4TH COLUMN 1'S(COEFFICIENT OF TRANSLATION COMPONENT).            37300940
C COMPUTE Y AND Z AXIS DCOSINES BY CRAMERS RULE                         37300950
      DO 130 I=2,4                                                      37300960
      N=KD(I,NC)+1                                                      37300970
      DO 130 J=1,3                                                      37300980
  130 R(I,J)=P(J,N,ND)                                                  37300990
      N=0                                                               37301000
      CD=1.                                                             37301010
C START LOOP TO COMPUTE Y AND Z DCOSINES                                37301020
  140 DO 220 I=2,3                                                      37301030
      DO 150  K=1,4                                                     37301040
C STORE THE ITH COLUMN OF R IN TEMPORARY C1                             37301050
  150 C1(K)=R(K,I)                                                      37301060
      DO 200 J=1,3                                                      37301070
C ON THE FIRST PASS, COMPUTE THE COEFFICIENT DETERMINANT FROM R.        37301080
      IF(N)160,180,160                                                  37301090
C PLACE X,Y AND Z VALUES FOR POINTS 1-4 SUCCESSIVELY FROM PK INTO R ITH 37301100
  160 DO 170 K=1,4                                                      37301110
  170 R(K,I)=PK(J,K,NC)                                                 37301120
```

Figure 24. Subroutine TXFRM Listing (Sheet 3 of 5)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
C COMPUTE COMMON FACTOR IN EXPANDED DETERMINANT                          37301130
  180 A= R(3,3)-R(4,3)                                                  37301140
      B= R(3,2)-R(4,2)                                                  37301150
      C= R(3,2)*R(4,3)-R(4,2)*R(3,3)                                    37301160
      D= R(3,1)-R(4,1)                                                  37301170
      E= R(3,1)*R(4,3)-R(4,1)*R(3,3)                                    37301180
      F= R(3,1)*R(4,2)-R(4,1)*R(3,2)                                    37301190
C COMPUTE COEFFICIENT DETERMINANT ON FIRST PASS, AND DIRECTION COSINES  37301200
C ON SUCCESSIVE PASSES                                                  37301210
      COSA(J,I)=  (R(1,1)*(A*R(2,2)-B*R(2,3)+C)+R(1,3)*(B*R(2,1)-D*R(2,37301220
     1)+F)-R(1,2)*(A*R(2,1)-D*R(2,3)+ E)-C*R(2,1)+E*R(2,2)-F*R(2,3))/CD 37301230
      IF(N)200,190,200                                                  37301240
  190 CD=COSA(1,2)                                                      37301250
      N=1                                                               37301260
      GO TO 140                                                         37301270
  200 CONTINUE                                                          37301280
C RESTORE ITH COLUMN OF R FROM TEMPORARY C1                             37301290
      DO 210 K=1,4                                                      37301300
  210 R(K,I)=C1(K)                                                      37301310
  220 CONTINUE                                                          37301320
C COMPUTE THE X-AXIS DCOSINES BY THE VECTOR X-PRODUCT OF YXZ DCOSINES.  37301330
      COSA(1,1)=COSA(2,2)*COSA(3,3)-COSA(2,3)*COSA(3,2)                 37301340
      COSA(2,1)=COSA(1,3)*COSA(3,2)-COSA(1,2)*COSA(3,3)                 37301350
      COSA(3,1)=COSA(1,2)*COSA(2,3)-COSA(1,3)*COSA(2,2)                 37301360
C COMPUTE TRANSLATION COMPONENTS H,L,K                                  37301370
      DO  230 I=1,3                                                     37301380
  230 T(I)=PK(I,1,NC)-R(1,1)*COSA(I,1)-R(1,2)*COSA(I,2)-R(1,3)*COSA(I,3)37301390
  240 LN=KP+6                                                           37301400
      NDL=PN(ND)+1.                                                     37301410
      LP(KP)=LN                                                         37301420
      PN(LN)=PN(ND)                                                     37301430
      IF(NC)280,250,280                                                 37301440
  250 DO 260 I=1,3                                                      37301450
  260 P(I,1,LN)=P(I,2,ND)-(P(I,1,ND)-P(I,2,ND))                         37301460
      J3=NDL+2                                                          37301470
      DO 270 I=2,NDL                                                    37301480
      DO 270 J=1,3                                                      37301490
```

Figure 24. Subroutine TXFRM Listing (Sheet 4 of 5)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
      CFACI                                                    09/09/65          PAGE  21
          37307J      -  EFN    SOURCE STATEMENT  -  IFN(S)  -

          J4=J3-I                                                                37301500
        270 P(J,J4,LN)=P(J,I,ND)                                                 37301510
          RETURN                                                                 37301520
      C TRANSFORM ALL COORDINATES TO NEW CS  AND STORE IN LN                     37301530
        280 DO 310 I=1,NDL                                                       37301540
          DO 310 J=1,3                                                           37301550
          P(J,I,LN)=P(1,I,ND)*COSA(J,1)+P(2,I,ND)*COSA(J,2)+P(3,I,ND)*COSA(J37301560
         1,3)+T(J)                                                               37301570
        290  IF(ABS(P(J,I,LN)).LE.1.E-4)P(J,I,LN)=0.                           37301590
        310 CONTINUE                                                             37301610
        320 RETURN                                                               37301620
          END                                                                    37301630
```

Figure 24. Subroutine TXFRM Listing (Sheet 5 of 5)

CFACI 09/09/65 PAGE 46
37307J

STORAGE MAP

SUBROUTINE TXFRM

COMMON VARIABLES

COMMON BLOCK // ORIGIN 00001 LENGTH 34775

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| P | 00000 | R | BUF | 21420 | R | PN | 21423 | R |
| KD | 21553 | I | PK | 21743 | R | L | 22513 | I |
| LI | 22527 | I | LP | 22531 | I | XL | 22533 | R |
| Y1 | 22725 | R | DX | 23022 | R | AREA | 23117 | R |
| AREAX | 23247 | R | FHP | 23251 | R | NRNDA | 32462 | I |
| KP | 34756 | I | KX | 34757 | I | NHI | 34760 | I |
| NHL | 34761 | I | NVI | 34762 | I | NVL | 34763 | I |
| M0 | 34764 | I | DY | 34765 | R | FAP | 34766 | R |
| F | 34767 | R | SL1 | 34771 | I | SL2 | 34772 | I |
| SL3 | 34773 | I | SL4 | 34774 | I | | | |

DIMENSIONED PROGRAM VARIABLES

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| R | 34776 | R | COSA | 35012 | R | COSB | 35023 | R |
| C1 | 35034 | R | T | 35037 | R | U | 35042 | R |
| DI | 35045 | R | V | 35056 | R | | | |

UNDIMENSIONED PROGRAM VARIABLES

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| J1 | 35061 | I | DV | 35062 | R | K | 35063 | I |
| KM | 35064 | I | J | 35065 | I | J2 | 35066 | I |
| I | 35067 | I | ND | 35070 | I | NC | 35071 | I |
| NP | 35072 | I | N | 35073 | I | CD | 35074 | R |
| A | 35075 | R | B | 35076 | R | C | 35077 | R |
| D | 35100 | R | E | 35101 | R | LN | 35102 | I |

Figure 25. Subroutine TXFRM Core Storage Map (Sheet 1 of 2)

CFACI
37307J

09/09/65 PAGE 47

STORAGE MAP

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NDL | 35103 | I | J3 | 35104 | I | J4 | 35105 | I |

ENTRY POINTS

TXFRM SECTION 4

SUBROUTINES CALLED

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SQRT | SECTION | 5 | UNIVEC | SECTION | 6 | CC.1 | SECTION | 7 |
| CC.2 | SECTION | 8 | CC.3 | SECTION | 9 | CC.4 | SECTION | 10 |
| SYSLOC | SECTION | 11 | | | | | | |

EFN IFN CORRESPONDENCE

| EFN | IFN | LOCATION | EFN | IFN | LOCATION | EFN | IFN | LOCATION |
|---|---|---|---|---|---|---|---|---|
| 10 | 3A | 35137 | 110 | 79A | 35435 | 20 | 9A | 35152 |
| 30 | 21A | 35213 | 40 | 30A | 35260 | 50 | 41A | 35301 |
| 60 | 44A | 35305 | 70 | 45A | 35307 | 100 | 74A | 35426 |
| 80 | 69A | 35416 | 120 | 85A | 35452 | 240 | 156A | 36043 |
| 130 | 102A | 35543 | 140 | 109A | 35555 | 220 | 142A | 35767 |
| 150 | 115A | 35566 | 200 | 134A | 35753 | 160 | 122A | 35611 |
| 180 | 129A | 35626 | 170 | 125A | 35621 | 190 | 132A | 35746 |
| 210 | 138A | 35763 | 230 | 148A | 36024 | 280 | 187A | 36160 |
| 250 | 164A | 36065 | 260 | 168A | 36103 | 270 | 181A | 36140 |
| 310 | 206A | 36243 | 290 | 201A | 36233 | 320 | 210A | 36247 |

DECK LENGTH IN OCTAL IS 01307.

Figure 25. Subroutine TXFRM Core Storage Map (Sheet 2 of 2)

```
C THERMAL ANALYSIS CONFAC PROGRAM-NASA CONTRACT NAS9-4133                37400012
C CONFAC I -ENGINEERING ANALYSES AND COMPUTER PROGRAMMING BY K.A. TOUPS, 37400020
C NORTH AMERICAN AVIATION,INC.,SPACE AND INFORMATION SYSTEMS DIVISION    37400030
C FORTRAN IV VERSION 7/31/65                                             37400040
      SUBROUTINE DOICU                                                   37400050
C THIS SUBROUTINE DETERMINES WHETHER THE SURFACES SEE EACH OTHER IN      37400060
C WHOLE OR IN PART, AND IF IN PART, COMPUTES THE COORDINATES AND AREA OF 37400070
C THE PORTION OF EACH SURFACE WHICH IS SEEN BY THE OTHER                 37400080
C                                                                        37400090
      INTEGER SL1,SL2,SL3,SL4                                            37400100
      COMMON    P(3,34, 88),BUF(3),PN( 88),KD(4,30),PK(3,4,30),L(2,6),   37400110
     1LI(2),LP(2),X1(61,2),Y1(61  ),DX(61),AREA( 88),AREAX(2),FHP(3721), 37400120
     2NRNDA(1212),KP,KX,NHI,NHL,NVI,NVL,MO,DY,FAP,F(2),SL1,SL2,SL3,SL4   37400130
      DIMENSION V(3)                                                     37400140
C                                                                        37400150
      KL=2                                                               37400160
      DO 80  KP=1,2                                                      37400170
C SELECT POSITION OF SURFACE KP IN ARRAY P                               37400180
      JP=LP(KP)                                                          37400190
C DO LIKEWISE FOR SURFACE KL                                             37400200
      JL=LP(KL)                                                          37400210
C ML= NO.OF POINTS DEFINING  SURFACE JL                                  37400220
      ML=PN(JL)                                                          37400230
C COMPUTE COMPONENTS OF UNIT VECTOR IN SURFACE KP                        37400240
      DXP= P(1,1,JP)-P(1,2,JP)                                           37400250
      DYP= P(2,1,JP)-P(2,2,JP)                                           37400260
      DZP= P(3,1,JP)-P(3,2,JP)                                           37400270
C INITIALIZE SENSE LIGHTS AND FLAG                                       37400280
      SL1=0                                                              37400290
      SL2=0                                                              37400300
      LI(KL)=1                                                           37400310
      DO 40  I=2,ML                                                      37400320
C COMPUTE COMPONENTS OF VECTOR FROM POINT 2 IN KP (UNIT VECTOR ORIGIN)   37400330
C TO POINT I IN SURFACE KL.                                              37400340
      DXL= P(1,I,JL)-P(1,2,JP)                                           37400350
      DYL= P(2,I,JL)-P(2,2,JP)                                           35400360
```

Figure 26. Subroutine DOICU Listing (Sheet 1 of 5)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
      DZL= P(3,I,JL)-P(3,2,JP)                                          35400370
C COMPUTE THE DOT PRODUCT RESULTING FROM UNIT VECTOR IN DP AND VECTOR    37400380
C FORMED BY THE KP UNIT VECTOR ORIGIN AND POINT I IN SURFACE KL          37400390
      CS=DXL*DXP+DYL*DYP+DZL*DZP                                        37400400
C IF THE DOT PRODUCT IS POS, GO TO SET SL1. IF 0, CONTINUE TO NEXT PT.-  37400410
C IF NEG, COMPUTE COSINE AND COMPARE WITH TOLERANCE                      37400420
      IF(CS)10,40,20                                                    37400430
C IF COSINE IS NEG AND GREATER THAN TOLERANCE, GO TO SET SL2             37400440
   10 IF(CS/ SQRT(DXL**2+DYL**2+DZL**2)+.0001)30,40,40                  37400450
C SET  SL1 IF THIS POINT IS ABOVE THE REF PLANE OF SURFACE KP.           37400460    31
   20 SL1=1                                                             37400470
C IF SL2 IS ON, THEN SURFACE KL IS BISECTED BY SURFACE KP                37400480
      IF(SL2)60,40,60                                                   37400490
C SET  SL2 IF THIS POINT IS BELOW THE REF PLANE OF SURFACE KP.           37400500
   30 SL2=1                                                             37400510
C IF SL1 IS ON, THEN SURFACE KL IS BISECTED BY THE REF PLANE OF SURF KP  37400520
      IF(SL1)60,40,60                                                   37400530
   40 CONTINUE                                                          37400540
C FLOW TO THIS POINT MEANS SURFACE KL IS NOT BISECTED BY KP.             37400550
C IF SL1 IS NOT ON, NO POINT IN KL IS ABOVE SURFACE KP REF PLANE .       37400560
      IF(SL1)70,50,70                                                   37400570
C NONE OF KL IS SEEN BY KP, SET FLAG TO TRIGGER DIAGNOSTICS, RETURN MP   37400580
   50 LI(1) =0                                                          37400590
      GO TO 330                                                         37400600
C PART OF KL IS SEEN BY KP                                               37400610
   60 LI(KL)=-1                                                         37400620
C ALL OF KL IS SEEN BY KP (LI(KL)=1, INTIAL VALUE)                       37400630
   70 KL=1                                                              37400640
C TEST VIEW FROM OTHER SURFACE REF PLANE                                 37400650
   80 CONTINUE                                                          37400660
C IF A SURFACE IS TO BE BISECTED, ALL COORDINATES ARE TRANSFORMED TO THE 37400670
C REF PLANE OF THE OTHER SURFACE. THEN, THE POINT WHERE Z-COORDINATES    37400680
C CHANGE SIGN ARE DETECTED AND A NEW POINT COMPUTED WHERE Z=0. RENUMBER-  37400690
C ING OF POINTS IS PERFORMED AS THE SURFACE IS REDEFINED TO EXCLUDE ALL  37400700
C NEG Z SURFACES.                                                        37400710
C                                                                        37400720
C START WITH THE REF PLANE IN SURFACE 2.                                 37400730
```

Figure 26. Subroutine DOICU Listing (Sheet 2 of 5)





NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
      KP=2                                                              37400740
C THIS NUMBER CONTROLS LOCATION OF TRANSFORMED SURFACE COORD IN ARRAY P  37400750
      KX=4                                                              37400760
      DO 320  KL=1,2                                                    37400770
      GO TO(90,100),KL                                                  37400780
C IF SURFACE 2 IS NOT BISECTED, NO AUXILIARY TRANSFORMATION IS REQUIRED  37400790
C FOR THAT PURPOSE. HOWEVER, SURFACE 1 MUST BE IN THE XY PLANE WITH THE  37400800
C ORIENTATION VECTOR POINTING TOWARD THE Z-AXIS, IF NOT ALREADY THERE    37400810
   90 IF(LI(KL))100,50,310                                              37400820
C SELECT POSITION OF SURFACE KP IN ARRAY P                              37400830
  100 JP=LP(KP)                                                         37400840
C PICKUP LAST POINT. POINTS 1,2 AND LAST POINT FORM REFERENCE PLANE.     37400850
      MP=PN(JP)                                                         37400860
C IS THE REF PLANE OF SURF KP IN XY PLANE WITHIN TOLERANCE INDICATED     37400870
C FLOW TO 140   INDICATES THE SURFACE IS NOT IN XY PLANE.               37400880
      IF(  ABS(P(3, 2,JP))-.0001)110,110,140                            37400890
  110 IF(  ABS(P(3, 3,JP))-.0001)120,120,140                            37400900
  120 IF(  ABS(P(3,MP,JP))-.0001)130,130,140                            37400910
C FLOW TO 150   INDICATES ORIENTATION VECTOR IS NOT POINTING TO +Z AXIS  37400920
  130 IF(P(3,1,JP))140,140,150                                          37400930
  140 MO=1                                                              37400940
      CALL TXFRM                                                        37400950
C PROCEED TO BISECT SURFACE KL IF REQUIRED                              37400960   77
  150 IF(LI(KL))160,50,310                                              37400970
C PICKUP SUBSCRIPTS OF SURFACES IN ARRAY P                              37400980
  160 JL=LP(KL)                                                         37400990
      ML=PN(JL)                                                         37401000
C TEST Z-COORDINATES OF SURFACE KL, COMPUTE X,Y AT TRANSITION AND RENUM- 37401010
C BER POINTS ABOVE HORIZON.                                             37401020
      K=1                                                               37401030
      DO 220   M=2,ML                                                   37401040
C IF Z IS POSITIVEOR ZERO, USE THE POINT.                               37401050
C IF Z FOR THIS POINT IS NEGATIVE AND THE NEXT POINT IS POS, COMPUTE     37401060
C X,Y AT THE INTERSECTION OF LINE M,M+1 AND THE XY PLANE OF THE SURF KL  37401070
      IF(P(3,M,JL).LT.0.)IF(P(3,M+1,JL))220,220,200                     37401080
C ADVANCE TO THE NEXT SUBSCRIPT TO NEW POSITION IN KP OF ARRAY P.        37401100
  180 K=K+1                                                             37401110
```

Figure 26. Subroutine DOICU Listing (Sheet 3 of 5)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
      P(1,K,KL)=P(1,M,JL)                                                    37401120
      P(2,K,KL)=P(2,M,JL)                                                    37401130
      P(3,K,KL)=P(3,M,JL)                                                    37401140
C IF Z FOR THIS POINT IS POSITIVE AND THE NEXT POINT IS NEG, COMPUTE         37401150
C X,Y AT THE INTERSECTION OF LINE M,M+1 AND THE XY PLANE OF THE SURF KL      37401160
      IF(P(3,M,JL))220,220,190                                               37401170
  190 IF(P(3,M+1,JL))200,220,220                                             37401180
  200 K=K+1                                                                  37401190
C COMPUTE X,Y AT HORIZON(Z=0) FROM TRACE OF LINE SEGMENT M-M+1 ON XZ AND     37401200
C YZ PLANES.                                                                 37401210
      ZC=P(3,M,JL)/(P(3,M+1,JL)-P(3,M,JL))                                   37401220
      DO 210  I=1,2                                                          37401230
  210 P(I,K,KL)=P(I,M,JL)-ZC*(P(I,M+1,JL)-P(I,M,JL))                         37401240
      P(3,K,KL)=0.                                                           37401250
  220 CONTINUE                                                               37401260
      LP(KL)=KL                                                              37401270
      PN(KL)=K                                                               37401280
C COMPUTE ORIENTATION UNIT VECTOR COMPONENTS FROM OLD DATA(ARRAY JL) AND      37401290
C USE TO RESTORE UNIT VECTOR IN NEW ARRAY KL, AND FOR USE IN AREA COMP-      37401300
C UTATION- ADD POINT K+1 EQUAL TO POINT 2 FOR USE LATER                      37401310
C                                                                            37401320
      SL1=1                                                                  37401330
      SL2=1                                                                  37401340
      DO 290    M=1,3                                                        37401350
      V(M)=P(M,1,JL)-P(M,2,JL)                                               37401360
      P(M,1,KL)=P(M,2,KL)+V(M)                                               37401370
      P(M,K+1,KL)=P(M,2,KL)                                                  37401380
      IF(SL1)230,250,230                                                     37401390
  230 SL1=0                                                                  37401400
      IF( ABS(V(M))-.1)240,240,280                                           37401410
  240 SL1=1                                                                  37401420
  250 IF(SL2)260,270,260                                                     37401430
  260 SL2=0                                                                  37401440
      N1=M                                                                   37401450
      GO TO 290                                                              37401460
  270 N2=M                                                                   37401470
      GO TO 290                                                              37401480
```

Figure 26. Subroutine DOICU Listing (Sheet 4 of 5)





NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
  280 DC=V(M)                                                                  37401490
  290 CONTINUE                                                                 37401500
C                                                                              37401510
      AREAX(KL)=0.                                                             37401520
C SAVE POINT 1                                                                 37401530
      P1=P(N1,1,KL)                                                            37401540
C PUT COORDINATE OF LAST POINT IN THIS SPOT FOR AREA COMPUTATION               37401550
      P(N1,1,KL)=P(N1,K,KL)                                                    37401560
C COMPUTE PROJECTED AREA ON N1,N2 PRINCIPAL PLANE                              37401570
      DO  300  M=2,K                                                           37401580
  300 AREAX(KL)=AREAX(KL)+P(N2,M,KL) * (P(N1,M-1,KL)-P(N1,M+1,KL))             37401590
C FIND PLANE AREA                                                              37401600
      AREAX(KL)= ABS(AREAX(KL)/DC/2.)                                          37401610
C RESTORE COORDINATE IN UNIT VECTOR                                            37401620
      P(N1,1,KL)=P1                                                            37401630
C GO TO SURFACE 2 BISECTION IF REQD                                            37401640
  310 KP=1                                                                     37401650
      KX=2                                                                     37401660
  320 CONTINUE                                                                 37401670
  330 RETURN                                                                   37401680
      END                                                                      37401690
```

Figure 26. Subroutine DOICU Listing (Sheet 5 of 5)

STORAGE MAP

SUBROUTINE DOICU

COMMON VARIABLES

COMMON BLOCK // ORIGIN 00001 LENGTH 34775

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| P | 00000 | R | BUF | 21420 | R | PN | 21423 | R |
| KD | 21553 | I | PK | 21743 | R | L | 22513 | I |
| LI | 22527 | I | LP | 22531 | I | X1 | 22533 | R |
| Y1 | 22725 | R | DX | 23022 | R | AREA | 23117 | R |
| AREAX | 23247 | R | FHP | 23251 | R | NRNDA | 32462 | I |
| KP | 34756 | I | KX | 34757 | I | NHI | 34760 | I |
| NHL | 34761 | I | NVI | 34762 | I | NVL | 34763 | I |
| MØ | 34764 | I | DY | 34765 | R | FAP | 34766 | R |
| F | 34767 | R | SL1 | 34771 | I | SL2 | 34772 | I |
| SL3 | 34773 | I | SL4 | 34774 | I | | | |

DIMENSIONED PROGRAM VARIABLES

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| V | 34776 | R | | | | | | |

UNDIMENSIONED PROGRAM VARIABLES

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| KL | 35001 | I | JP | 35002 | I | JL | 35003 | I |
| ML | 35004 | I | DXP | 35005 | R | DYP | 35006 | R |
| DZP | 35007 | R | I | 35010 | I | DXL | 35011 | R |
| DYL | 35012 | R | DZL | 35013 | R | CS | 35014 | R |
| MP | 35015 | I | K | 35016 | I | M | 35017 | I |
| ZC | 35020 | R | N1 | 35021 | I | N2 | 35022 | I |
| DC | 35023 | R | P1 | 35024 | R | | | |

Figure 27. Subroutine DOICU Core Storage Map (Sheet 1 of 2)





NORTH AMERICAN AVIATION, INC. SPACE and INFORMATION SYSTEMS DIVISION

```
CFACI                                                09/09/65          PAGE  49
     37407J                          STORAGE  MAP

                                     ENTRY POINTS

     DOICU        SECTION     4


                                     SUBROUTINES CALLED

     SQRT         SECTION     5      TXFRM        SECTION     6      .FXEM.       SECTION     7
     E.1          SECTION     8      E.2          SECTION     9      E.3          SECTION     10
     E.4          SECTION     11     CC.1         SECTION     12     CC.2         SECTION     13
     CC.3         SECTION     14     CC.4         SECTION     15     SYSLOC       SECTION     16

                                                  EFN    IFN    CORRESPONDENCE

EFN          IFN          LOCATION     EFN          IFN          LOCATION     EFN          IFN          LOCATION
80            47A          35270       40            39A          35252       10            30A          35212
20            33A          35241       30            36A          35246       60            44A          35261
70            46A          35266       50            42A          35257       330           175A         36033
320           172A         36030       90            56A          35311       100           59A          35314
310           170A         36024       110           66A          35345       140           75A          35411
120           69A          35361       130           72A          35401       150           78A          35416
160           81A          35421       220           121A         35613       200           107A         35531
180           94A          35475       190           104A         35526       210           114A         35570
290           152A         35726       230           138A         35701       250           143A         35713
240           142A         35711       280           150A         35724       260           145A         35715
270           148A         35721       300           160A         35776
  DECK LENGTH IN OCTAL IS     01113.
```

Figure 27. Subroutine DOICU Core Storage Map (Sheet 2 of 2)

```
C THERMAL ANALYSIS CONFAC PROGRAM-NASA CONTRACT NAS9-4133                37500012
C CONFAC I -ENGINEERING ANALYSES AND COMPUTER PROGRAMMING BY K.A. TOUPS, 37500020
C NORTH AMERICAN AVIATION,INC.,SPACE AND INFORMATION SYSTEMS DIVISION    37500030
C FORTRAN IV VERSION 7/31/65                                             37500040
      SUBROUTINE  MAP                                                    37500050
C GIVEN THE COORDINATES OF THE SURFACE FROM WHICH THE FACTOR IS DESIRED, 37500060
C THIS SUBROUTINE COMPUTES THOSE POINTS ON THE SURFACE FROM WHICH THE    37500070
C PLANE POINT FACTOR TO THE RECEIVING SURFACE WILL BE COMPUTED.          37500080
C                                                                        37500090
      INTEGER SL1,SL2,SL3,SL4,S5                                         37500100
      COMMON    P(3,34, 88),BUF(3),PN( 88),KD(4,30),PK(3,4,30),L(2,6),   37500110
     1LI(2),LP(2),X1(61,2),Y1(61  ),DX(61),AREA( 88),AREAX(2),FHP(3721), 37500120
     2NRNDA(1212),KP,KX,NHI,NHL,NVI,NVL,MO,DY,FAP,F(2),SL1,SL2,SL3,SL4,  37500130
     3S5                                                                 37500135
      DIMENSION N(100,2)                                                 37500140
C                                                                        37500150
C CONTINUE TO USE THE SAME OUTPUT MODE AND INCREMENTS UNLESS OTHERWISE   37500160
C SPECIFIED. NHI,NVI AND S5 ARE INITIALIZED IN MP.                       37500170
      DO 30 I=5,6                                                        37500180
      L(2,I)=L(2,I)-1                                                    37500185
      IF(10-L(2,I))10,30,30                                              37500190
 10   L(2,I)=L(2,I)-22                                                   37500200
      IF(L(2,I))15,20,20                                                 37500205
 15   S5=0                                                               37500210
      L(2,I)=L(2,I)+11                                                   37500215
      GO TO 30                                                           37500220
 20   S5=1                                                               37500230
   30 CONTINUE                                                           37500240
      IF(L(2,5))40,50,40                                                 37500270
 40   NHI=L(2,5)*6                                                       37500280
      NHL=NHI+1                                                          37500290
   50 IF(L(2,6))60,70,60                                                 37500300
 60   NVI=L(2,6)*6                                                       37500320
      NVL=NVI+1                                                          37500340
 70   IF(SL1)80,230,80                                                   37500360
C IF THE SAME SURFACE WAS USED IN THE PRIOR RUN, DO NOT REPROCESS.       37500350
```

Figure 28. Subroutine MAP Listing (Sheet 1 of 4)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
C                                                                       37500370
   80 ND=LP(1)                                                          37500380
      M1=PN(ND)                                                         37500390
C DETERMINE THE SUBSCRIPTS OF THE COORDINATES HAVING THE MIN AND THE MAX37500400
C VALUE OF Y.                                                           37500410
      YMIN=1.E+30                                                       37500420
      YMAX=-1.E+30                                                      37500430
      DO 120 K=2,M1                                                     37500440
      IF(P(2,K,ND)-YMIN)90,90,100                                       37500450
   90 YMIN=P(2,K,ND)                                                    37500460
      MN =K                                                             37500470
  100 IF(P(2,K,ND)-YMAX)120,120,110                                     37500480
  110 YMAX=P(2,K,ND)                                                    37500490
      MX = K                                                            37500500
  120 CONTINUE                                                          37500510
      N(1,1)=MN                                                         37500520
      N(1,2)=MN                                                         37500530
C STARTING FROM YMIN, AND MOVING TOWARD YMAX CLOCKWISE, STORE SUBSCRIPTS37500540
C OF POINTS IN ARRAY P DEFINING THE SURFACE INTO THE ARRAY N(  ,1). DO  37500550
C THE SAME FOR POINTS ON THE RIGHT FROM YMIN TO YMAX,BUT STORE IN N(  ,2)37500560
  130 I1=-1                                                             37500570
  140 DO 220 I=1,2                                                      37500580
      DO 200   J=2,M1                                                   37500590
      N(J,I)=N(J-1,I)+I1                                                37500600
      IF(I1)170,190,150                                                 37500610
  150 IF(N(J,I)-M1)190,190,160                                          37500620
C IF THE LAST POINT IS ENCOUNTERED BEFORE YMAX, 2 IS THE NEXT POINT     37500630
  160 N(J,I)=2                                                          37500640
      GO TO 190                                                         37500650
  170 IF(N(J,I)-1)190,180,190                                           37500660
C IF POINT 1 IS ENCOUNTERED PRIOR TO YMAX, THE LAST POINT IS THE NEXT   37500670
C POINT                                                                 37500680
  180 N (J,I)=M1                                                        37500690
C GO TO THE OTHER SIDE IF YMAX IS ENCOUNTERED                           37500700
  190 IF(N(J,I)-MX)200,210,200                                          37500710
  200 CONTINUE                                                          37500720
  210 I1=1                                                              37500730
```

Figure 28. Subroutine MAP Listing (Sheet 2 of 4)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
      N(J+1,I)=MX                                                       37500740
      N(J+2,I)=MX                                                       37500741
  220 CONTINUE                                                          37500750
C THE FOLLOWING INSTRUCTIONS COMPUTE THE POINTS OF INTERSECTION OF EACH 37500760
C HORIZONTAL GRID LINE AND THE LINE SEGMENTS FORMING THE SURF BOUNDARY  37500770
C COMPUTE THE VERTICAL INCREMENT                                        37500780
  230 DY=(YMAX-YMIN)/ FLOAT(NVI)                                        37500790
      Y1(1)=YMIN                                                        37500800
C COMPUTE THE HORIZONTAL GRID LINES                                     37500810
      Y1(NVL)=YMAX                                                      37500820
      DO 240  I=2,NVI                                                   37500830
  240 Y1(I)=Y1(I-1)+DY                                                  37500840
C COMPUTE VALUE OF TOLERANCE FOR USE IN MAPPING SURFACE 1.              37500850
      DT=.01*DY                                                         37500860
C STARTING WITH THE LEFT BOUNDARY, COMPUTE THE INTERSECTION OF HORZ     37500870
C GRID LINES AND LINE SEGMENTS FORMING BOUNDARY OF SURFACE 1.           37500880
      DO 350 I=1,2                                                      37500890
C SET MAPPING LINE COUNTER                                              37500900
      K=1                                                               37500910
C SET UP LOOP TO DETERMINE INTERSECTION OF MAPPING LINE WITH BOUNDARY   37500920
C LINE SEGMENT J1-J2                                                    37500930
      DO 340 J=1,M1                                                     37500940
      J1=N(J,I)                                                         37500950
      J2=N(J+1,I)                                                       37500960
      J3=N(J+2,I)                                                       37500970
      YD=P(2,J2,ND)-P(2,J1,ND)                                          37500971
      IF(YD)2000,250,3000                                               37500972
 2000 IF(DT-ABS(YD))2200,3000,3000                                      37500973
C IF Y-COORDINATE OF J2 IS LESS THAN J1,THIS SURFACE CANNOT BE MAPPED   37500974
 2200 WRITE(6,3500)J1,J2                                                37500975  111
 3500 FORMAT(99HODIFFICULTY IN MAPPING SURFACE 1 HAS BEEN ENCOUNTERED-A 3750097L
     1MAPPING LINE CROSSES SURFACE 1 BOUNDARY AT  / 36H MORE THAN TWO PO37500977
     2INTS. LINE ELEMENT  I2,1H-I2,56H CANNOT BE REACHED WITHOUT CROSSIN37500978
     3G A PRECEDING ELEMENT./66H THIS SURFACE MUST BE REARRANGED BEFORE 37500979
     4IT CAN BE PROPERLY MAPPED./ 39H THE FORM FACTOR IS PROBABLY INCORR37500980
     5ECT.)                                                             37500981
 3000 SLI=(P(1,J2,ND)-P(1,J1,ND))/YD                                    37500982
```

Figure 28. Subroutine MAP Listing (Sheet 3 of 4)





NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
C IS THE POINT J2 NEAR THE MAPPING LINE WITHIN THE TOLERANCE DT-          37500990
  250 PD=Y1(K)-P(2,J2,ND)                                                 37501000
      IF( ABS(PD)-DT)280,280,260                                          37501010
C IF THE MAPPING LINE IS BELOW THE POINT J2, COMPUTE THE VALUE OF X AT    37501020
C THE INTERSECTION OF LINE J1-J2 AND THE MAPPING LINE                     37501030
C IF THE MAPPING LINE IS ABOVE THE POINT J2, CONTINUE J-LOOP TO SELECT    37501040
C NEXT LINE SEGMENT BUT DO NOT SELECT A NEW MAPPING LINE                  37501050
  260 IF(PD)600,280,340                                                   37501060
C COMPUTE X , GO TO NEXT MAPPING LINE BUT USE SAME BOUNDARY LINE SEGMENT  37501070
  600 X1(K,I)=P(1,J1,ND)+(Y1(K)-P(2,J1,ND))*SLI                           37501080
      K=K+1                                                               37501100
      GO TO 250                                                           37501110
C IS THE NEXT POINT (J3) ALSO NEAR THE MAPPING LINE                       37501120
  280 IF( ABS(Y1(K)-P(2,J3,ND))-DT)290,290,320                            37501130
C IF J3 IS NOT THE OUTERMOST POINT, CONTINUE J-LOOP WITH SAME MAP LINE.   37501140
C IF J3 IS THE OUTERMOST POINT, USE POINT AND SELECT NEXT MAPPING LINE.   37501150
C IF THE X-VALUES ARE EQUAL, USE J2 AND SELECT NEXT MAPPING LINE IF ANY.  37501160
  290 IF(P(1,J2,ND)-P(1,J3,ND))300,320,310                                37501170
  300 GO TO(320,340),I                                                    37501180
  310 GO TO(340,320),I                                                    37501190
  320 X1(K,I)=P(1,J2,ND)                                                  37501200
      IF(K-NVL)330,350,350                                                37501210
C GO TO NEXT MAPPING LINE AND NEXT BOUNDARY LINE SEGMENT                  37501220
  330 K=K+1                                                               37501230
  340 CONTINUE                                                            37501240
  350 CONTINUE                                                            37501250
  360 HNI=NHI                                                             37501260
      AR=0.                                                               37501270
C COMPUTE THE MAPPING AREA                                                37501280
      DO 370 K=1,NVL                                                      37501290
      DXL=X1(K,2)-X1(K,1)                                                 37501300
      AR=AR+DXL                                                           37501310
  370 DX(K)=DXL/HNI                                                       37501320
      AREA(1)=(AR -(DXL +X1(1,2)-X1(1,1))/2.)*DY                          37501330
      RETURN                                                              37501340
      END                                                                 37501350
```

Figure 28. Subroutine MAP Listing (Sheet 4 of 4)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

STORAGE MAP

SUBROUTINE MAP

COMMON VARIABLES

COMMON BLOCK // ORIGIN 00001 LENGTH 34776

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| P | 00000 | R | BUF | 21420 | R | PN | 21423 | R |
| KD | 21553 | I | PK | 21743 | R | L | 22513 | I |
| LI | 22527 | I | LP | 22531 | I | X1 | 22533 | R |
| Y1 | 22725 | R | DX | 23022 | R | AREA | 23117 | R |
| AREAX | 23247 | R | FHP | 23251 | R | NRNDA | 32462 | I |
| KP | 34756 | I | KX | 34757 | I | NHI | 34760 | I |
| NHL | 34761 | I | NVI | 34762 | I | NVL | 34763 | I |
| MØ | 34764 | I | DY | 34765 | R | FAP | 34766 | R |
| F | 34767 | R | SL1 | 34771 | I | SL2 | 34772 | I |
| SL3 | 34773 | I | SL4 | 34774 | I | S5 | 34775 | I |

DIMENSIONED PROGRAM VARIABLES

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| N | 34777 | I | | | | | | |

UNDIMENSIONED PROGRAM VARIABLES

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| I | 35307 | I | ND | 35310 | I | M1 | 35311 | I |
| YMIN | 35312 | R | YMAX | 35313 | R | K | 35314 | I |
| MN | 35315 | I | MX | 35316 | I | I1 | 35317 | I |
| J | 35320 | I | CT | 35321 | R | J1 | 35322 | I |
| J2 | 35323 | I | J3 | 35324 | I | YD | 35325 | R |
| SLI | 35326 | R | PD | 35327 | R | HNI | 35330 | R |
| AR | 35331 | R | DXL | 35332 | R | | | |

Figure 29. Subroutine MAP Core Storage Map (Sheet 1 of 2)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

CFACI 37507J

09/09/65 PAGE 51

STORAGE MAP

ENTRY POINTS

MAP SECTION 4

SUBROUTINES CALLED

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| .FWRD. | SECTION | 5 | .FXEM. | SECTION | 6 | .UNO6. | SECTION | 7 |
| .FFIL. | SECTION | 8 | .FCNV. | SECTION | 9 | E.1 | SECTION | 10 |
| E.2 | SECTION | 11 | E.3 | SECTION | 12 | E.4 | SECTION | 13 |
| CC.1 | SECTION | 14 | CC.2 | SECTION | 15 | CC.3 | SECTION | 16 |
| CC.4 | SECTION | 17 | SYSLOC | SECTION | 18 | | | |

EFN IFN CORRESPONDENCE

| EFN | IFN | LOCATION | EFN | IFN | LOCATION | EFN | IFN | LOCATION |
|---|---|---|---|---|---|---|---|---|
| 30 | 20A | 35476 | 10 | 9A | 35461 | 15 | 14A | 35467 |
| 20 | 19A | 35474 | 40 | 24A | 35503 | 50 | 26A | 35511 |
| 60 | 28A | 35513 | 70 | 30A | 35521 | 80 | 32A | 35523 |
| 230 | 84A | 35702 | 120 | 48A | 35576 | 90 | 41A | 35562 |
| 100 | 43A | 35566 | 110 | 46A | 35572 | 130 | 51A | 35605 |
| 140 | 52A | 35607 | 220 | 81A | 35677 | 200 | 75A | 35662 |
| 170 | 67A | 35652 | 190 | 72A | 35657 | 150 | 61A | 35643 |
| 160 | 64A | 35647 | 180 | 70A | 35655 | 210 | 77A | 35664 |
| 240 | 89A | 35731 | 350 | 144A | 36300 | 340 | 142A | 36276 |
| 2000 | 109A | 36023 | 250 | 115A | 36071 | 3000 | 112A | 36043 |
| 2200 | 111A | 36031 | 3500 | FORMAT | 35361 | 280 | 127A | 36156 |
| 260 | 119A | 36115 | 600 | 121A | 36120 | 290 | 131A | 36202 |
| 320 | 137A | 36246 | 300 | 135A | 36230 | 310 | 136A | 36237 |
| 330 | 141A | 36273 | 360 | 147A | 36302 | 370 | 153A | 36325 |

DECK LENGTH IN OCTAL IS 01377.



Figure 29. Subroutine MAP Core Storage Map (Sheet 2 of 2)

```
C THERMAL ANALYSIS CONFAC PROGRAM-NASA CONTRACT NAS9-4133                37600012
C CONFAC I -ENGINEERING ANALYSES AND COMPUTER PROGRAMMING BY K.A. TOUPS, 37600020
C NORTH AMERICAN AVIATION,INC.,SPACE AND INFORMATION SYSTEMS DIVISION    37600030
C FORTRAN IV VERSION 7/31/65                                             37600040
      SUBROUTINE FACTOR                                                  37600050
C THIS SUBROUTINE COMPUTES THE CONFIGURATION FACTOR BETWEEN TWO SURFACES 37600060
C THE PLANE POINT FACTORS ARE COMPUTED BY A METHOD BASED ON THE NUSSELT  37600070
C UNIT SPHERE. THE AREA-WEIGHTED MEAN OF ALL FACTORS IS FOUND BY         37600080
C INTEGRATION USING THE TRAPEZOIDAL RULE.                                37600090
C                                                                        37600100
      INTEGER SL1,SL2,SL3,SL4,S5                                         37600110
      COMMON    P(3,34, 88),BUF(3),PN( 88),KD(4,30),PK(3,4,30),L(2,6),   37600120
     1LI(2),LP(2),X1(61,2),Y1(61  ),DX(61),AREA( 88),AREAX(2),FHP(3721), 37600130
     2NRNDA(1212),KP,KX,NHI,NHL,NVI,NVL,MO,DY,FAP,F(2),SL1,SL2,SL3,SL4,  37600140
     3S5                                                                 37600145
      DIMENSION FV(61),XP(34),YP(34),FH(61),C1(34),C2(34),C3(34)         37600150
C                                                                        37600160
      F=0.                                                               37600170
      J10=L(2,1)                                                         37600180
C LOCATE THE ARRAY CONTAINING THE FINAL COORDINATES OF SURFACE 2.        37600190
      J2=LP(2)                                                           37600200
C M= NO. OF POINTS DEFINING SURFACE 2                                    37600210
      M=PN(J2)                                                           37600220
      ML=M+1                                                             37600230
C COMPUTE A CONSTANT IN Z OF SURFACE 2  FOR LATER COMPUTATION OF VECTOR  37600240
C DOT PRODUCT                                                            37600250
      DO 10 J=2,M                                                        37600260
   10 C1(J)=P(3,J,J2)*P(3,J+1,J2)                                        37600270
      JC=0                                                               37600280
C START WITH LOWEST HORIZONTAL GRID LINE, MOVING UP TO YMAX              37600290
      DO 320 K=1,NVL                                                     37600300
      FV(K)=0.                                                           37600310
C LOCATE THE POINTSFROM WHICH THE PLANE POINT FACTOR WILL BE COMPUTED-   37600320
      DO 50 J=2,ML                                                       37600330
C START AT LEFT BOUNDARY OF SURFACE1 AND MOVE TO RIGHT(CONSTANT Y)       37600340
      XP(J)=P(1,J,J2)-X1(K,1)                                            37600350
```

Figure 30. Subroutine FACTOR Listing (Sheet 1 of 4)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
      YP(J)=P(2,J,J2)-Y1(K)                                              37600360
C ZERO OUT COMPUTATIONAL ERROR                                           37600370
      IF( ABS(XP(J))-1.E-6)20,20,30                                      37600380
   20 XP(J)=0.                                                           37600390
   30 IF( ABS(YP(J))-1.E-6)40,40,50                                      37600400
   40 YP(J)=0.                                                           37600410
   50 CONTINUE                                                           37600420
C COMPUTE THE PART OF THE VECTOR CROSS  PRODUCT INVARIANT FOR EACH HORZ  37600430
C GRID LINE (CONSTANT Y AND Z)                                           37600440
      DO 60 J=2,M                                                        37600450
C COMPUTE FUNCTION OF SINE OF ANGLE FORMED BY J,J+1 IN SURFACE 2.        37600460
      C2(J)=(YP(J)*P(3,J+1,J2)- YP(J+1)*P(3,J,J2))**2                    37600470
   60 C3(J)= YP(J)*YP(J+1)                                               37600480
C COMPUTE PLANE POINT FACTOR FUNCTION FOR EACH INCREMENT OF X ALONG GRID 37600490
      DO 290 I=1,NHL                                                     37600500
   70 FH(I)=0.                                                           37600510
      DO 170 J=2,M                                                       37600520
      ANG=0.                                                             37600530
      FS1= C2(J)+(XP(J)*P(3,J+1,J2)-XP(J+1)*P(3,J,J2))**2                37600540
C THIS X-PRODUCT IN X,Y REVEALS THE PROJECTED AREA OF THE TRIANGLE       37600550
C ORIGIN,J,J+1 ON THE X-Y PLANE                                          37600560
      FS2= XP(J)*YP(J+1)-XP(J+1)*YP(J)                                   37600570
C IF THE PROJECTED AREA IS NOT ZERO, PROCEED TO COMPUTE THE PROJECTED    37600580
C AREA FUNCTION OF THE CIRCULAR SECTOR FORMED BY THE TRIANGLE AND UNIT   37600590
C SPHERE                                                                 37600600
      IF(FS2)130,80,130                                                  37600610
C IF Z-S ARE ZERO, THE ORIGIN LIES ALONG THE EXTENDED LINE OR WITHIN THE 37600620
C LINE SEGMENT (A BOUNDARY OF SURFACE 2 LIES ON SURFACE 1)               37600630
C IS THE ORIGIN ON THE LINE SEGMENT ENDS,SOMEWHERE BETWEEN,OR ON AN      37600640
C EXTENSION                                                              37600650
   80 IF(P(3,J,J2)+P(3,J+1,J2))170,90,170                                37600660
   90 IF(XP(J)*XP(J+1))120,100,170                                       37600670
  100 IF(YP(J)*YP(J+1))120,110,170                                       37600680
C IF PRECISELY ON THE END OF THE LINE SEGMENT, ADD PI/2  SO THAT THE     37600690
C FINAL RESULT WILL REFLECT THE VALUE APPROACHING THE END, RATHER THAN   37600700
C ZERO                                                                   37600710
  110 FH(I)=FH(I)+1.5707963                                              37600720
```

Figure 30. Subroutine FACTOR Listing (Sheet 2 of 4)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
      GO TO 170                                                          37600730
C IF SOMEWHERE BETWEEN THE ENDS, ADD PI   SO THAT THE FINAL RESULT WILL  37600740
C BE THE FACTOR APPROACHING THE BOUNDARY                                 37600750
  120 FH(I)=FH(I)+3.1415927                                              37600760
      GO TO 170                                                          37600770
C COMPUTE THE CROSS PRODUCT OF VECTORS TO POINTS DEFINING LINE SEGMENT   37600780
  130 FS3= SQRT(FS1+FS2**2)                                              37600790
C COMPUTE THE COSINE OF ANGLE BETWEEN THE CIRCULAR SECTOR AND X-Y PLANE  37600800
C (K-COMPONENT OF X-PRODUCT )                                            37600810    89
      CSG=FS2/FS3                                                        37600820
C COMPUTE THE DOT PRODUCT SAME VECTORS                                   37600830
      FCS = XP(J)*XP(J+1)+C3(J)+ C1(J)                                   37600840
C COMPUTE THE ANGLE BETWEEN VECTOR IN RADIANS                            37600850
      IF(FCS)140,150,160                                                 37600860
  140 ANG=3.1415927                                                      37600870
      GO TO 160                                                          37600880
  150 FH(I)=FH(I)-1.5707963*CSG                                          37600890
      GO TO 170                                                          37600900
  160 FH(I)=FH(I)-(   ATAN(FS3/FCS)+ANG)*CSG                             37600910    102
  170 CONTINUE                                                           37600920
C A NEG AREA RESULTS WHEN THE ORDER OF COMPUTATION REVERSES(THE BACKSIDE37600930
C OF SURFACE 2 IS VIEWED). THIS MAY BE DELIBERATED INDUCED FROM THE      37600940
C RECONSTRUCTION OF A BISECTED NONPLANAR SURFACE,TXFRM ROUNDOFF, OR BY A37600950
C SURFACE WHICH SHOULD BE BUT IS NOT QUITE PLANAR                        37600960
      IF(FH(I))180,210,210                                               37600970
  180 IF(FH(I)+.0001)190,200,200                                         37600980
  190 FH(I)=FH(I)+6.2831853                                              37600990
      GO TO 210                                                          37601000
  200 FH(I)=0.                                                           37601010
C IF A DETAILED PRINTOUT WAS REQUESTED, COMPUTE THE POINT FACTOR         37601020
  210 IF(S5)220,230,220                                                  37601030
  220 JC=JC+1                                                            37601040
      FHP(JC)=FH(I)/6.2831853                                            37601050
C IF THE LAST POINT ON THE LINE IS REACHED, USE THE MAP BOUNDARY VALUE   37601060
C FOR THE POINT TO AVOID ERROR BUILDUP IN X                              37601070
  230 IF(I-NHI)270,240,300                                               37601080
  240 DO 260 J=2,ML                                                      37601090
```

Figure 30. Subroutine FACTOR Listing (Sheet 3 of 4)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
      XP(J)=P(1,J,J2)-X1(K,2)                                          37601100
C MAKE NEAR ZERO VALUES ZERO                                           37601110
      IF( ABS(XP(J))-1.E-6)250,250,260                                 37601120
  250 XP(J)=0.                                                         37601130
  260 CONTINUE                                                         37601140
      GO TO 290                                                        37601150
C MOVE THE ORIGIN(THE POSITION OF THE POINT RELATIVE TO SURFACE 2) TO   37601160
C THE RIGHT AN INCREMENT AND CONTINUE                                  37601170
  270 DO 280 J=2,ML                                                    37601180
  280 XP(J)=XP(J)-DX(K)                                                37601190
  290 CONTINUE                                                         37601200
C INTEGRATE THE FUNCTION FH ALONG THE HORIZONTAL GRID                  37601210
  300 DO 310 I=2,NHI                                                   37601220
  310 FV(K)= FV(K)+FH(I)                                               37601230
      FV(K)=(FV(K)+(FH(1)+FH(NHL))/2.)*DX(K)                           37601240
  320 CONTINUE                                                         37601250
C INTEGRATE THE FUNCTION FV ALONG THE VERTICAL. DIVIDE BY 2 TO CONVERT 37601260
C FH TO AREA, BY PI TO CONVERT THIS TO A POINT FACTOR, AND BY THE MAPPED37601270
C AREA TO YIELD THE MEAN OF ALL FACTORS.                               37601280
      DO 330 K=2,NVI                                                   37601290
  330 F=F+FV(K)                                                        37601300
      F= ABS(F+(FV(1)+FV(NVL))/2.)*DY/ AREA(1)/6.2831853               37601310
C IF A PART OF SURFACE 1 IS SHADOWED, THE FACTOR MUST BE REDUCED TO    37601320
C REFLECT THIS.                                                        37601330
      IF(LI(1) )340,350,350                                            37601340
  340 F =F * AREAX(1)/AREA(J10)                                        37601350
C COMPUTE THE FACTOR X AREA PRODUCT                                    37601360
  350 FAP=F*AREA(J10)                                                  37601370
  360 RETURN                                                           37601380
      END                                                              37601390
```

Figure 30. Subroutine FACTOR Listing (Sheet 4 of 4)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

STORAGE MAP

SUBROUTINE FACTOR

COMMON VARIABLES

COMMON BLOCK // ORIGIN 00001 LENGTH 34776

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| P | 00000 | R | BUF | 21420 | R | PN | 21423 | R |
| KD | 21553 | I | PK | 21743 | R | L | 22513 | I |
| LI | 22527 | I | LP | 22531 | I | X1 | 22533 | R |
| Y1 | 22725 | R | DX | 23022 | R | AREA | 23117 | R |
| AREAX | 23247 | R | FHP | 23251 | R | NRNDA | 32462 | I |
| KP | 34756 | I | KX | 34757 | I | NHI | 34760 | I |
| NHL | 34761 | I | NVI | 34762 | I | NVL | 34763 | I |
| MØ | 34764 | I | DY | 34765 | R | FAP | 34766 | R |
| F | 34767 | R | SL1 | 34771 | I | SL2 | 34772 | I |
| SL3 | 34773 | I | SL4 | 34774 | I | S5 | 34775 | I |

DIMENSIONED PROGRAM VARIABLES

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| FV | 34777 | R | XP | 35074 | R | YP | 35136 | R |
| FH | 35200 | R | C1 | 35275 | R | C2 | 35337 | R |
| C3 | 35401 | R | | | | | | |

UNDIMENSIONED PROGRAM VARIABLES

| SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE | SYMBOL | LOCATION | TYPE |
|---|---|---|---|---|---|---|---|---|
| J10 | 35443 | I | J2 | 35444 | I | M | 35445 | I |
| NL | 35446 | I | JC | 35447 | I | K | 35450 | I |
| I | 35451 | I | ANG | 35452 | R | FS1 | 35453 | R |
| FS2 | 35454 | R | FS3 | 35455 | R | CSG | 35456 | R |
| FCS | 35457 | R | | | | | | |

Figure 31. Subroutine FACTOR Core Storage Map (Sheet 1 of 2)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

STORAGE MAP

ENTRY POINTS

FACTOR SECTION 4

SUBROUTINES CALLED

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SQRT | SECTION | 5 | ATAN | SECTION | 6 | CC.1 | SECTION | 7 |
| CC.2 | SECTION | 8 | CC.3 | SECTION | 9 | CC.4 | SECTION | 10 |
| SYSLOC | SECTION | 11 | | | | | | |

EFN IFN CORRESPONDENCE

| EFN | IFN | LOCATION | EFN | IFN | LOCATION | EFN | IFN | LOCATION |
|---|---|---|---|---|---|---|---|---|
| 10 | 10A | 35531 | 320 | 161A | 36166 | 50 | 38A | 35655 |
| 20 | 31A | 35644 | 30 | 33A | 35645 | 40 | 36A | 35654 |
| 60 | 47A | 35674 | 290 | 147A | 36142 | 70 | 54A | 35713 |
| 170 | 105A | 36054 | 130 | 88A | 36002 | 80 | 68A | 35755 |
| 90 | 72A | 35760 | 120 | 84A | 35776 | 100 | 76A | 35765 |
| 110 | 80A | 35772 | 140 | 95A | 36026 | 150 | 97A | 36031 |
| 160 | 101A | 36037 | 180 | 109A | 36062 | 210 | 118A | 36073 |
| 190 | 112A | 36066 | 200 | 116A | 36072 | 220 | 120A | 36075 |
| 230 | 124A | 36106 | 270 | 139A | 36134 | 240 | 126A | 36113 |
| 300 | 149A | 36144 | 260 | 136A | 36130 | 250 | 134A | 36127 |
| 280 | 142A | 36135 | 310 | 152A | 36151 | 330 | 167A | 36174 |
| 340 | 173A | 36223 | 350 | 175A | 36230 | 360 | 177A | 36234 |

Figure 31. Subroutine FACTOR Core Storage Map (Sheet 2 of 2)



NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

```
$DATA                                                                    37700000
END                          1    2    3    4    5    6    7    8     937700010
    10N     N    1N   2N   3N   4N   5N   6N   7N   8N   9N   10N    1037700020
D     D    1D   2D   3D   4D   5D   6D   7D   8D   9D   10D          37700025
(1H1/(1H 12A6))                                                          37700030
(6E12.0)                                                                 37700040
( 50H1HI- I HOPE YOU ARE GLAD I STOPPED THIS- K.A.TOUPS)                 37700050
(1H133X42HNAA SPACE AND INFORMATION SYSTEMS DIVISION/40X28HCONFIGURATION37700060
 FACTOR PROGRAM//50X8HCONFAC I//1H018X12A6/1H045X18HI N P U T  D A T A/137700070
H039X31HSURFACE AND TRANSFORMATION DATA/47HOTHE FIRST DATA SET ARE THE 037700080
RIGINAL INPUT DATA/90H THE SET IMMEDIATELY FOLLOWING ARE THE ORIGINAL DA37700090
TA REFERENCED TO THE PLANE FORMED BY THE/97H 1,2 AND LAST DATA POINTS, I37700100
F THE ORIGINAL DATA WERE NOT SUBSTANTIALLY IN THE XY PLANE OF ITS CS  ) 37700110
(13HODATA NAME- *2A6,1H*/1H02(5HPOINT  7X1HX14X1HY14X1HZ11X)/    2( I5,137700120
X,3E15.7,3X)))                                                           37700130
(1H-/10H-RUN DATA-  ///48H   RUN   SURF   SURF  SURF1  SURF2   HORZ   VE37700140
RT/48H    NO    1      2    TXFRM  TXFRM   INCR   INCR)                  37700150
(1H116X,12A6/8H-RUN NO.  I4,28H   DATA USED FOR THIS RUN- *1A6,1H*1A6,1H37700160
*/(2(39X,1H*1A6,1H*1A6,1H*/)))                                           37700170
(61H-ONE OR MORE OF ABOVE SYMBOLS IS INCORRECT. THIS RUN ABORTED.)       37700180
(18H-NONE OF SURFACE *2A6,22H* IS SEEN BY SURFACE *2A6,1H*//104H IF THE 37700190
ABOVE RESULT IS UNEXPECTED, DO NOT BECOME ALARMED- IT HAPPENS TO THE BES37700200
T OF EM. JUST CHECK YOUR/105H DATA-ESPECIALLY BE SURE THAT YOU ENTERED A37700210
LL POINTS IN CC ORDER, AS THEY APPEAR WHEN FACING THE SURFACE.)          37700220
(10HOSURFACE *1A6,22H* WAS TRANSFORMED BY *1A6,19H* TO THE FOLLOWING-)   37700230
(31HOTHE FORM FACTOR FROM SURFACE *2A6,14H* TO SURFACE *2A6,3H* =F8.5)   37700240
          (32HOTHE EXCHANGE COEFFICIENT (FA) =E14.5,9H SQ UNITS/1H018X37700250
18HTHE MAPPING AREA =E14.7,9H SQ UNITS)                                  37700260
(25H-ONLY A PART OF SURFACE *2A6,25H*, COMPRISING  AN AREA OF E14.7,10H  37700270
 SQ UNITS,/15H SEES SURFACE *2A6,1H*)                                    37700280
(22HOTHE AREA OF SURFACE *2A6,3H* =  E14.7,10H SQ UNITS.)                37700290
(96H THIS SURFACE IS NONPLANAR-THE COMPUTED AREAS AND THE FACTOR FROM TH37700300
IS SURFACE MAY BE INCORRECT.)                                            37700310
( 47HOCOORDINATES OF POINTS ON BOUNDARY OF SURF    *2A6,21H* FOR EACH Y  37700320
INTERVAL     /1H06X,6HX-LEFT9X,7HX-RIGHT10X,1HY22X,6HX-LEFT9X,7HX-RIGHT137700330
0X,1HY// (1X,3E15.7,10X,3E15.7))                                         37700340
(30H-NO. OF HORIZONTAL INCREMENTS=I3,29H  NO. OF VERTICAL INCREMENTS=I3)37700350
(74H-THE FOLLOWING ARE PLANE POINT CONFIGURATION FACTORS COMPUTED FOR TH37700360
IS RUN/48H LOWEST GRID LINE FIRST, FROM X-LEFT TO X-RIGHT.///)           37700370
(6E16.7)                                                                 37700380
(2(I6,2H *1A6,1H*1A6,1H*1A6,1H*1A6,1H*1A6,1H*1A6,1H*))                   37700390
( 16HO    DATA NAME *2A6,1H*/1H02(5HPOINT  7X1HX14X1HY14X1HZ11X)/6X3E15.37700400
7,45H (INTERNALLY GENERATED ORIENTATION VECTOR)   /2(I5,1X3E15.7,3X))   37700410
```

Figure 32. Variable Formats (Sheet 1 of 2)

```
( 16HOWARNING-WARNING/  77H THE MAPPING AREA IS MORE THAN 1 PERCENT DIFF37700420
ERENT FROM THE AREA IN SURFACE *2A6,  9H* SEEN BY/10H SURFACE *2A6, 71H*37700430
. THIS MAY BE CAUSED BY WRONG SURFACE DATA ENTRY (THE SURFACE BOUNDARY/ 37700440
105H CROSSES A MAPPING LINE IN MORE THAN TWO PLACES), OR TOO COARSE INCR37700450
EMENTS.  THE FACTOR MAY BE INCORRECT.)                                  37700460
(  16H-WARNING-WARNING/ 35HOAN INCORRECT FACTOR WILL RESULT IF/44H 1) SU37700470
RFACE 1 IS SUBSTANTIALLY NONPLANAR, OR/ 95H 2) IF SURFACE 2 IS NONPLANAR37700480
, AND THE INPUT DATA DOES NOT DEFINE THE SILHOUETTE AS IT ACTUALLY/     37700490
68H    APPEARS FROM ANY AND ALL POINTS ON THE ACTIVE SIDE OF SURFACE 1. 37700500
/91HOSTUDY THE FINAL SURFACE COORDINATES BELOW.  NO LARGE NEGATIVE Z COO37700510
RDINATES SHOULD APPEAR.)                                                37700520
                                                                        37700530
( 55H1YOU HAVE EXCEEDED THE MAX ALLOWABLE NO OF              1A6        37700540
/29H THE JOB CANNOT BE CONTINUED.)  SURFACES.   PTS IN SURF TXFRM DATA  37700550
( 83H-THE FOLLOWING ARE THE (FINAL) SURFACE COORDINATES USED FOR THE FAC37700560
TOR COMPUTATION-)                                                       37700570
```

Figure 32. Variable Formats (Sheet 2 of 2)