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Technical Report 32-1416

Thermal Analysis System I: User's Manual

J. A. Hultberg

P. F. O'Brien

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JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA

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Preface

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Abstract

A computer program (Thermal Analysis System I) was written to calculate steady-state temperatures for a radiation-conduction-coupled constant-property thermal model. A two-region spectral analysis is provided for the radiation portion of the computation. The "script $\mathcal{S}$ " technique is used for infrared heat transfer and the radiosity technique is used for solar heat input. The program is designed for maximum ease of use from the user's standpoint. The rules for order and placement of user input data to the program are almost free-form. The output is formatted for ease of user understanding and diagnosis of errors. Some user control of output is provided.

Thermal Analysis System I: User's Manual

I. Introduction

Development of a temperature control system to maintain the various subsystems of a space vehicle within the proper temperature limits requires an understanding of the thermal properties of the components, the thermal coupling between the components themselves, and the coupling from the components to the surrounding environment. The Thermal Analysis System I (TAS I) is designed as an easy-to-use digital computer program for thermal design analysis. It fills the gap between "back of the envelope calculations" and computer codes that require complex user input and is useful in two ways: (1) it may be used when a problem does not justify, or time does not permit, an analysis requiring a complex computer program; or (2) it may serve as a stepping-stone to more complex thermal analysis programs. The thermal analyst who is accustomed to working with complex thermal analysis programs and their input formats probably would not save much time by using TAS I. It is intended mainly for use as a design tool by the temperature control engineer who performs thermal analysis for system design, and should be helpful for this purpose because the program coding is simplified and the input rules are easy to use and remember. The output is formatted for ease of user understanding and diagnosis of errors.

The program is written in FORTRAN IV and is operational on the IBM 7094, IBM 360.6, IBM 360/65, UNIVAC

1108 (EXEC 2), UNIVAC 1108 (EXEC 3), and CDC 6400. The code is written so that no changes are necessary in the FORTRAN statements when switching from one machine to another. The executive control cards must, of course, be changed from one computer installation to another, but this should offer no difficulty because conversions from the IBM 7094 to other machines have been easily accomplished by users without the aid of the author. Although some character recognition is used in the program, it is done in such a manner that the program remains word-length-independent. The TAS I physical program has been submitted to COSMIC,* the NASA agency for general distribution. A listing of the source program is given in the Appendix.

II. Analytic Procedures

The Thermal Analysis System I (TAS I) combines a thermal analysis program with subprograms to compute the infrared conductance, or $\mathcal{G}$, and the heat input due to solar heating.

The spectral analysis formulation is developed for two regions: (1) a solar region in which solar properties apply

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and (2) an infrared region in which the IR properties apply. This separation is possible because there are two widely different temperature levels being considered: the high solar temperature and the much lower spacecraft temperature. The energy in the solar region due to the IR radiation is negligible in comparison with the solar energy itself. This widely used assumption makes it possible to compute the heat inputs in the solar region separately from the IR heat transfer. Thus, the heat inputs in the solar region are not a function of the spacecraft temperature. The problem solution is therefore reduced to that of finding the spacecraft temperature distribution for a single wavelength region without the iteration procedures that would be necessary if multiple regions had to be considered.

III. Some Basic Relationships for Radiant Transfer in an Enclosure

Any real radiant-transfer system in an enclosure of arbitrary spatial distribution of boundary temperature, surface emissivity, and initial irradiation may be approximated or idealized by a finite set of discrete surfaces, each of which exhibits uniform temperature, radiant properties, and irradiation. The radiosity of discrete surface A(1) in an enclosure represented by N discrete surfaces is given by the conservation relationship

$$L(1) = L(01) + \rho(1) [F(1,1)L(1) + F(1,2)L(2) + \cdots + F(1,N)L(N)] \quad (1)$$

where

$L(1)$ = radiosity or flux density streaming from $A(1)$ into the enclosure

$$L(01) = \text{flux density entering the system at } A(1) \text{ for thermal excitation equal to } EIR(1) \sigma T^4(1)$$

$\rho(1) = 1 - EIR(1)$ or $1 - ESOL(1)$, the gray reflectance of $A(1)$ in some finite wavelength interval, dimensionless

$F(1,1), F(1,2)$ = the form factors that describe the direct flux transfer between the discrete surfaces, dimensionless

Relationships of the form of Eq. (1) may be written in the following matrix relationship for each discrete surface that defines the space:

$$\begin{bmatrix} [1 - \rho(1)F(1,1)] - \rho(1)F(1,2) & - \cdots & - \rho(1)F(1,N) \\ - \rho(2)F(2,1) + [1 - \rho(2)F(2,2)] & - \cdots & - \rho(2)F(2,N) \\ \vdots & & \vdots \\ - \rho(N)F(N,1) - \rho(N)F(N,2) & - \cdots & + [1 - \rho(N)F(N,N)] \end{bmatrix} \cdot \begin{bmatrix} L(1) \\ L(2) \\ \vdots \\ L(N) \end{bmatrix} = \begin{bmatrix} L(01) \\ L(02) \\ \vdots \\ L(0N) \end{bmatrix} \quad (2)$$

Equation (2) may be multiplied by the inverse of the transfer matrix to produce

$$\begin{bmatrix} L(1) \\ L(2) \\ \vdots \\ L(N) \end{bmatrix} = \begin{bmatrix} \frac{L(1,1)}{L(01)} & \frac{L(1,2)}{L(02)} & \cdots & \frac{L(1,N)}{L(0N)} \\ \frac{L(2,1)}{L(01)} & \frac{L(2,2)}{L(02)} & \cdots & \frac{L(2,N)}{L(0N)} \\ \vdots & \vdots & & \vdots \\ \frac{L(N,1)}{L(01)} & \frac{L(N,2)}{L(02)} & \cdots & \frac{L(N,N)}{L(0N)} \end{bmatrix} \cdot \begin{bmatrix} L(01) \\ L(02) \\ \vdots \\ L(0N) \end{bmatrix} \quad (3)$$

Inverse of transfer matrix

The elements of the inverse transfer matrix represent transfer functions for unit excitation of the system at one surface only. For example, $[L(1,2)/L(02)]$ is the radiosity $L(1,2)$ of surface $A(1)$ that results from single excitation of the system at $A(2)$, relative to the excitation radiosity $L(02)$. For thermal excitation at $A(2)$, the transfer function is $[L(1,2)/EIR(2)\sigma T^4(2)]$. Note that each element of the inverse transfer matrix is a function of the entire array of form factors and radiant surface properties that define the space.

Several useful conservation and reciprocity relationships exist between the elements of the inverse transfer matrix or the transfer functions. In any enclosure defined by N discrete surfaces the total radiosity of surface $A(1)$ is

$$L(1) = L(1,1) + L(1,2) + \cdots + L(1,N) \quad (4)$$

In a uniform temperature enclosure or blackbody cavity, the total radiosity of surface $A(1)$ is

$$L(1) = \sigma T^4(1) \quad (5)$$

and

$$T(1) = T(2) = \cdots = T(N) = T \quad (6)$$

With the substitution of Eqs. (5) and (6) in Eq. (4),

$$\frac{L(1,1)}{\sigma T^4(1)} + \frac{L(1,2)}{\sigma T^4(2)} + \cdots + \frac{L(1,N)}{\sigma T^4(N)} = \frac{\sigma T^4}{\sigma T^4} = 1 \quad (7)$$

Now multiplying each term on the left side of Eq. (7) by the emissivity ratios results in

$$\frac{EIR(1)}{EIR(1)} \frac{L(1,1)}{\sigma T^4(1)} + \frac{EIR(2)}{EIR(2)} \frac{L(1,2)}{\sigma T^4(2)} + \cdots + \frac{EIR(N)}{EIR(N)} \frac{L(1,N)}{\sigma T^4(N)} \quad (8)$$

Note that the denominator of each term is simply the flux density generated at or initially streaming into the enclosure at each surface. In terms of the notation defined in Eq. (1),

$$EIR(1) \frac{L(1,1)}{L(01)} + EIR(2) \frac{L(1,2)}{L(02)} + \cdots + EIR(N) \frac{L(1,N)}{L(0N)} = 1 \quad (9)$$

If the conservation equation (9) applies in the case of a uniform temperature enclosure or uniform excitation vector, it must also apply for any excitation distribution because the transfer functions depend only on the geometry and radiant-property transfer matrix that is postulated to be independent of the excitation vector.

Consider now the net radiant-flux transfer from discrete area $A(1)$ expressed verbally as

$$Q(1, \text{NET}) = \left[\begin{array}{c} \text{flux entering space at } A(1) \\ \text{after any self-absorption} \end{array} \right] - \left[\begin{array}{c} \text{flux absorbed at } A(1) \\ \text{from all other surfaces} \end{array} \right] \quad (10)$$

Equation (10) may also be expressed verbally as

$$\frac{Q(1, \text{NET})}{A(1)} = \left[\begin{array}{c} \text{total flux density} \\ \text{streaming from } A(1) \end{array} \right] - \left[\begin{array}{c} \text{total flux density incident at } A(1), \\ \text{including all multiple reflections} \end{array} \right] \quad (10a)$$

Equation (10a) is expressed in terms of radiosity and irradiation as

$$\frac{Q(1, \text{NET})}{A(1)} = L(1) - G(1 + 2 + 3 + \dots + N, 1) \quad (10b)$$

where

$G(1 + 2 + 3 + \dots + N, 1)$ = the irradiation at $A(1)$ from discrete surfaces $A(1), A(2), \dots, A(N)$

and

$$G(1 + 2 + 3 + \dots + N, 1) = F(1, 1) L(1) + F(1, 2) L(2) + \dots + F(1, N) L(N) \quad (10c)$$

Now substituting in Eq. (10b) for $L(2)$ the right-hand side of Eq. (1) and for $G(1 + 2 + 3 + \dots + N, 1)$ the right-hand side of Eq. (10c) results in

$$\begin{aligned} \frac{Q(1, \text{NET})}{A(1)} &= L(01) + \rho(1) F(1, 1) L(1) + \rho(1) F(1, 2) L(2) + \dots + \rho(1) F(1, N) L(N) - F(1, 1) L(1) \\ &\quad - F(1, 2) L(2) - \dots - F(1, N) L(N) \end{aligned} \quad (10d)$$

Then combining terms in Eq. (10d) gives

$$\frac{Q(1, \text{NET})}{A(1)} = L(01) - EIR(1) [F(1, 1) L(1) + F(1, 2) L(2) + \dots + F(1, N) L(N)] \quad (10e)$$

Expressed verbally, Eq. (10e) reads as

$$\frac{Q(1, \text{NET})}{A(1)} = \left[\begin{array}{c} \text{total flux density} \\ \text{generated at } A(1) \end{array} \right] - \left[\begin{array}{c} \text{total flux density} \\ \text{absorbed at } A(1) \end{array} \right] \quad (10f)$$

Verbal equations (10), (10a) and (10f) are all *identical* concepts.

Now Eq. (10e) may be expanded in terms of the transfer functions defined by the matrix equation (3) as follows:

$$\begin{aligned} \frac{Q(1, \text{NET})}{A(1)} = & L(01) - EIR(1) \left[F(1, 1) \frac{L(1, 1)}{L(01)} \cdot L(01) + F(1, 2) \frac{L(2, 1)}{L(01)} \cdot L(01) + \cdots + F(1, N) \frac{L(N, 1)}{L(01)} \cdot L(01) \right. \\ & + F(1, 1) \frac{L(1, 2)}{L(02)} \cdot L(02) + F(1, 2) \frac{L(2, 2)}{L(02)} \cdot L(02) + \cdots + F(1, N) \frac{L(N, 2)}{L(02)} \cdot L(02) \\ & + F(1, 1) \frac{L(1, 3)}{L(03)} \cdot L(03) + F(1, 2) \frac{L(2, 3)}{L(03)} \cdot L(03) + \cdots + F(1, N) \frac{L(N, 3)}{L(03)} \cdot L(03) \\ & \left. + \cdots + F(1, 1) \frac{L(1, N)}{L(0N)} \cdot L(0N) + F(1, 2) \frac{L(2, N)}{L(0N)} \cdot L(0N) + \cdots + F(1, N) \frac{L(N, N)}{L(0N)} \cdot L(0N) \right] \end{aligned} \quad (10g)$$

Combining terms with similar excitation yields

$$\begin{aligned} \frac{Q(1, \text{NET})}{A(1)} = & L(01) - EIR(1) L(01) \left[F(1, 1) \frac{L(1, 1)}{L(01)} + F(1, 2) \frac{L(2, 1)}{L(01)} + \cdots + F(1, N) \frac{L(N, 1)}{L(01)} \right] \\ & - EIR(1) L(02) \left[F(1, 1) \frac{L(1, 2)}{L(02)} + F(1, 2) \frac{L(2, 2)}{L(02)} + \cdots + F(1, N) \frac{L(N, 2)}{L(02)} \right] \\ & - EIR(1) L(03) \left[F(1, 1) \frac{L(1, 3)}{L(03)} + F(1, 2) \frac{L(2, 3)}{L(03)} + \cdots + F(1, N) \frac{L(N, 3)}{L(03)} \right] \\ & + \cdots + EIR(1) L(0N) \left[F(1, 1) \frac{L(1, N)}{L(0N)} + F(1, 2) \frac{L(2, N)}{L(0N)} + \cdots + F(1, N) \frac{L(N, N)}{L(0N)} \right] \end{aligned} \quad (10h)$$

For an enclosure with the excitation at $A(1)$, $A(2)$, $\cdots$, $A(N)$ only, Eq. (1) becomes

$$\begin{aligned} L(1, 1) &= L(01) + \rho(1) [F(1, 1) L(1, 1) + F(1, 2) L(2, 1) + \cdots + F(1, N) L(N, 1)] \\ L(1, 2) &= \rho(1) [F(1, 1) L(1, 2) + F(1, 2) L(2, 2) + \cdots + F(1, N) L(N, 2)] \\ \vdots & \\ L(1, N) &= \rho(1) [F(1, 1) L(1, N) + F(1, 2) L(2, N) + \cdots + F(1, N) L(N, N)] \end{aligned} \quad (10i)$$

Equations (10i) can be rearranged as

$$\begin{aligned} \frac{L(1, 1) - L(01)}{\rho(1) L(01)} &= \left[F(1, 1) \frac{L(1, 1)}{L(01)} + F(1, 2) \frac{L(2, 1)}{L(01)} + \cdots + F(1, N) \frac{L(N, 1)}{L(01)} \right] \\ \frac{L(1, 2)}{\rho(1) L(02)} &= \left[F(1, 1) \frac{L(1, 2)}{L(02)} + F(1, 2) \frac{L(2, 2)}{L(02)} + \cdots + F(1, N) \frac{L(N, 2)}{L(02)} \right] \\ \vdots & \\ \frac{L(1, N)}{\rho(1) L(0N)} &= \left[F(1, 1) \frac{L(1, N)}{L(0N)} + F(1, 2) \frac{L(2, N)}{L(0N)} + \cdots + F(1, N) \frac{L(N, N)}{L(0N)} \right] \end{aligned} \quad (10j)$$

Now substituting the left-hand parts of Eq. (10j) into (10h) results in

$$\frac{Q(1, \text{NET})}{A(1)} = L(01) - \frac{EIR(1)}{\rho(1)} L(01) \left[\frac{L(1, 1)}{L(01)} - 1 \right] - \frac{EIR(1)}{\rho(1)} L(02) \left[\frac{L(1, 2)}{L(02)} \right] - \frac{EIR(1)}{\rho(1)} L(03) \left[\frac{L(1, 3)}{L(03)} \right] \quad (10k)$$

The first two terms to the right of the equality sign of Eq. (10k) may be combined, and Eq. (10k) then reduces to Eq. (11).

Equation (10b) can be cast in yet another form by noting that the term in brackets on the right-hand side of Eq. (1) is the total irradiation of $A(1)$ from all regions that can be viewed from $A(1)$. That is, the irradiation term of Eq. (10c) may be substituted into Eq. (1) to give

$$L(1) = L(01) + \rho(1) G(1 + 2 + 3 + \dots + N, 1) \quad (10l)$$

Now the irradiation in Eq. (10l) may be expressed in terms of the radiosities and the reflectance as

$$G(1 + 2 + 3 + \dots + N, 1) = \frac{[L(1) - L(01)]}{\rho(1)} \quad (10m)$$

Substituting the right-hand side of Eq. (10m) into Eq. (10b) yields

$$\frac{Q(1, \text{NET})}{A(1)} = L(1) - \left[\frac{L(1) - L(01)}{\rho(1)} \right] = \frac{L(01)}{\rho(1)} - \left[\frac{(1 - \rho(1))}{\rho(1)} \right] L(1) \quad (10n)$$

With the notation that $L(01) = EIR(1) \sigma T^4(1)$ and $(1 - \rho(1)) = EIR(1)$, Eq. (10n) takes the form of

$$\frac{Q(1, \text{NET})}{A(1)} = \frac{L(01)}{\rho(1)} - \frac{EIR(1)}{\rho(1)} L(1) = \frac{EIR(1)}{\rho(1)} [\sigma T^4(1) - L(1)] \quad (10o)$$

Now substitute $L(1)$ in terms of the transfer functions of Eq. (3) and substitute in Eq. (10o) to give

$$\frac{Q(1, \text{NET})}{A(1)} = \frac{L(01)}{\rho(1)} - \frac{EIR(1)}{\rho(1)} \left[\frac{L(1, 1)}{L(01)} \cdot L(01) + \dots + \frac{L(1, N)}{L(0N)} \cdot L(0N) \right] \quad (10p)$$

Combining terms in Eq. (10p) results in

$$\frac{Q(1, \text{NET})}{A(1)} = \left[1 - EIR(1) \frac{L(1, 1)}{L(01)} \right] \frac{L(01)}{\rho(1)} - EIR(1) \left[\frac{L(1, 2)}{L(02)} \frac{L(02)}{\rho(1)} + \dots + \frac{L(1, N)}{L(0N)} \frac{L(0N)}{\rho(1)} \right] \quad (10q)$$

Equation (10q) is identical to Eqs. (10k) and (11).

In terms of the quantities defined in Eq. (3), verbal equation (10) becomes

$$\frac{Q(1, \text{NET})}{A(1)} = \left[1 - EIR(1) \frac{L(1, 1)}{L(01)} \right] \frac{L(01)}{\rho(1)} - EIR(1) \left[\frac{L(1, 2)}{L(02)} \frac{L(02)}{\rho(1)} + \frac{L(1, 3)}{L(03)} \frac{L(03)}{\rho(1)} + \dots + \frac{L(1, N)}{L(0N)} \frac{L(0N)}{\rho(1)} \right] \quad (11)$$

Equation (11) is divided by $A(1)$ so that the equation is in terms of flux density or Btu/hr-ft². The two terms on the right side of Eq. (11) correspond to the verbal equation (10). Note that each of the terms such as

$$\frac{L(1, 2)}{L(02)} \frac{L(02)}{\rho(1)}$$

represents an irradiation at $A(1)$. That is, $L(1, 2)/\rho(1)$ is the flux density of radiation onto $A(1)$ when $A(2)$ is the only source.

Equation (9) may be rearranged in the form

$$\left[1 - EIR(1) \frac{L(1,1)}{L(01)} \right] = EIR(2) \frac{L(1,2)}{L(02)} + \cdots + EIR(N) \frac{L(1,N)}{L(0N)} \quad (12)$$

Now substitute the left-hand side of Eq. (12) in Eq. (11) to obtain

$$\begin{aligned} \frac{Q(1, NET)}{A(1)} = & \left[EIR(2) \frac{L(1,2)}{L(02)} + \cdots + EIR(N) \frac{L(1,N)}{L(0N)} \right] \frac{L(01)}{\rho(1)} - EIR(1) \frac{L(1,2)}{L(02)} \frac{L(02)}{\rho(1)} \\ & - EIR(1) \frac{L(1,3)}{L(03)} \frac{L(03)}{\rho(1)} - \cdots - EIR(1) \frac{L(1,N)}{L(0N)} \frac{L(0N)}{\rho(1)} \end{aligned} \quad (13)$$

Now arranging Eq. (13) in doublets results in

$$\begin{aligned} \frac{Q(1, NET)}{A(1)} = & \left[EIR(2) \frac{L(1,2)}{L(02)} \frac{L(01)}{\rho(1)} - EIR(1) \frac{L(1,2)}{L(02)} \frac{L(02)}{\rho(1)} \right] + \left[EIR(3) \frac{L(1,3)}{L(03)} \frac{L(01)}{\rho(1)} - EIR(1) \frac{L(1,3)}{L(03)} \frac{L(03)}{\rho(1)} \right] \\ & + \cdots + \left[EIR(N) \frac{L(1,N)}{L(0N)} \frac{L(01)}{\rho(1)} - EIR(1) \frac{L(1,N)}{L(0N)} \frac{L(0N)}{\rho(1)} \right] \end{aligned} \quad (14)$$

For thermal excitation, $L(0N) = EIR(N) \sigma T^4(N)$ and Eq. (14) can be written in terms of the discrete surface temperatures as follows:

$$\begin{aligned} \frac{Q(1, NET)}{A(1)} = & \frac{EIR(1) EIR(2)}{\rho(1)} \frac{L(1,2)}{L(02)} [\sigma T^4(1) - \sigma T^4(2)] + \frac{EIR(1) EIR(3)}{\rho(1)} \frac{L(1,3)}{L(03)} [\sigma T^4(1) - \sigma T^4(3)] \\ & + \cdots + \frac{EIR(1) EIR(N)}{\rho(1)} \frac{L(1,N)}{L(0N)} [\sigma T^4(1) - \sigma T^4(N)] \end{aligned} \quad (15)$$

Professor H. C. Hottel (Ref. 1) of MIT has suggested the following notation for Eq. (15):

$$\begin{aligned} \frac{Q(1, NET)}{A(1)} = & \mathcal{F}(1,1) [\sigma T^4(1) - \sigma T^4(1)] + \mathcal{F}(1,2) [\sigma T^4(1) - \sigma T^4(2)] + \mathcal{F}(1,3) [\sigma T^4(1) - \sigma T^4(3)] \\ & + \cdots + \mathcal{F}(1,N) [\sigma T^4(1) - \sigma T^4(N)] \end{aligned} \quad (16)$$

Combining Eqs. (15) and (16) leads to

$$\frac{EIR(1)}{\rho(1)} \left[EIR(2) \frac{L(1,2)}{L(02)} + EIR(3) \frac{L(1,3)}{L(03)} + \cdots + EIR(N) \frac{L(1,N)}{L(0N)} \right] = \mathcal{F}(1,2) + \mathcal{F}(1,3) + \cdots + \mathcal{F}(1,N) \quad (17)$$

A conservation relationship for the Hottel terms, obtained from the net transfer relationship at A(1), takes the form

$$\frac{Q(1, NET)}{A(1)} = L(01) - EIR(1) [F(1,1) L(1) + F(1,2) L(2) + \cdots + F(1,N) L(N)] \quad (18)$$

In a uniform temperature enclosure, the net transfer is zero and $L(1) = L(2) = L(N) = \sigma T^4$. For this uniform temperature enclosure, Eq. (18) becomes

$$\frac{Q(1, NET)}{A(1)} = 0 = EIR(1) [\sigma T^4 - \sigma T^4 (F(1,1) + F(1,2) + \cdots + F(1,N))] \quad (19)$$

Because the sum of the form factors is unity, Eq. (19) becomes simply

$$\frac{Q(1, \text{NET})}{A(1)} = 0 = EIR(1)[\sigma T^* - \sigma T^*] \quad (20)$$

For a uniform temperature enclosure, Eq. (16) becomes

$$\frac{Q(1, \text{NET})}{A(1)} = 0 = [\mathcal{F}(1, 1) + \mathcal{F}(1, 2) + \mathcal{F}(1, 3) + \cdots + \mathcal{F}(1, N)] [\sigma T^* - \sigma T^*] \quad (21)$$

A conservation relationship, obtained by equating Eqs. (20) and (21), takes the form

$$\mathcal{F}(1, 1) + \mathcal{F}(1, 2) + \mathcal{F}(1, 3) + \cdots + \mathcal{F}(1, N) = EIR(1) \quad (22)$$

Equation (22) may be rearranged as

$$EIR(1) - \mathcal{F}(1, 1) = \mathcal{F}(1, 2) + \mathcal{F}(1, 3) + \cdots + \mathcal{F}(1, N) \quad (23)$$

Now substitute the left-hand side of Eq. (23) and the left-hand side of Eq. (12) into Eq. (17) to obtain

$$\frac{EIR(1)}{\rho(1)} \left[1 - EIR(1) \frac{L(1, 1)}{L(01)} \right] = EIR(1) - \mathcal{F}(1, 1) \quad (24)$$

Solving for $\mathcal{F}(1, 1)$ in Eq. (24) results in

$$\mathcal{F}(1, 1) = \frac{[EIR(1)]^2}{\rho(1)} \left[\frac{L(1, 1)}{L(01)} - 1 \right] \quad (25)$$

From Eqs. (15) and (16) we have

$$\mathcal{F}(1, 2) = \frac{EIR(1) EIR(2)}{\rho(1)} \left[\frac{L(1, 2)}{L(02)} \right] \quad (26)$$

and

$$\mathcal{F}(N, M) = \frac{EIR(N) EIR(M)}{\rho(N)} \frac{L(N, M)}{L(0M)} \quad (27)$$

Another useful form of Eq. (25), obtained from Eq. (1) when $A(1)$ is the only source, is

$$L(1, 1) = L(01) + \rho(1) [F(1, 1) L(1, 1) + F(1, 2) L(2, 1) + \cdots + F(1, N) L(N, 1)] \quad (28)$$

Now divide Eq. (28) through by $L(01)$ and rearrange terms to get

$$\frac{L(1, 1)}{L(01)} - 1 = \rho(1) \left[F(1, 1) \frac{L(1, 1)}{L(01)} + F(1, 2) \frac{L(2, 1)}{L(01)} + \cdots + F(1, N) \frac{L(N, 1)}{L(01)} \right] \quad (29)$$

Substituting the right-hand side of Eq. (29) into Eq. (25) gives

$$\mathcal{F}(1, 1) = EIR^2(1) \left[F(1, 1) \frac{L(1, 1)}{L(01)} + F(1, 2) \frac{L(2, 1)}{L(01)} + \cdots + F(1, N) \frac{L(N, 1)}{L(01)} \right] \quad (30)$$

Similarly,

$$\mathcal{G}(1, 2) = EIR(1) EIR(2) \left[F(1, 1) \frac{L(1, 2)}{L(02)} + F(1, 2) \frac{L(2, 2)}{L(02)} + \cdots + F(1, N) \frac{L(N, 2)}{L(02)} \right] \quad (31)$$

IV. Solution Scheme

The Hottel $\mathcal{G}$ -factor and the heat input due to the solar flux are calculated first for each set of conditions. The solution for temperatures then follows.

The elements of the matrix equation for calculation of $\mathcal{G}$ are of the form

$$\mathcal{G}(1, 1) = EIR^2(1) \left[F(1, 1) \frac{L(1, 1)}{L(01)} + F(1, 2) \frac{L(2, 1)}{L(01)} + \cdots + F(1, N) \frac{L(N, 1)}{L(01)} \right]$$

$$\mathcal{G}(1, 2) = EIR(1) EIR(2) \left[F(1, 1) \frac{L(1, 2)}{L(02)} + F(1, 2) \frac{L(2, 2)}{L(02)} + \cdots + F(1, N) \frac{L(N, 2)}{L(02)} \right]$$

A. Calculation of $\mathcal{G}$ -Factor

The calculation of $\mathcal{G}$ is performed in the following steps:

Step 1. A matrix is formed with elements of the form

$$A(I, J) = \delta(I, J) - (1 - EIR(I)) F(I, J)$$

where

$$\delta(I, J), \text{ the Kronecker delta,} = \begin{cases} 1 & \text{if } I = J \\ 0 & \text{if } I \neq J \end{cases}$$

A printout of this matrix can be obtained by setting*

$$PRINT(26) = 1$$

Step 2. The matrix is next inverted to become

$$[B] = [A]^{-1}$$

A printout of this matrix can be obtained by setting

$$PRINT(27) = 1$$

Step 3. The matrix is now multiplied by the shape factor matrix to give elements of the form

$$C(I, J) = \sum_K F(I, K) B(K, J)$$

A printout of this matrix can be obtained by setting

$$PRINT(28) = 1$$

Step 4. The matrix is now multiplied by the appropriate IR emittances to give a matrix with elements of the form

$$\mathcal{G}(I, J) = EIR(I) EIR(J) C(I, J)$$

This is the script $\mathcal{G}$ matrix and its printout may be requested by setting

$$PRINT(29) = 1$$

Step 5. The script $\mathcal{G}$ matrix is now multiplied by the area to give "the area times the script $\mathcal{G}$ matrix." A printout of this matrix may be requested by setting

$$PRINT(30) = 1$$

The elements of this matrix are also displayed in the detailed output in the fifth column (ASCRIPTFIR) of the tabular data for each node.

Step 6. Finally, a printout of the Stefan-Boltzmann constant multiplied by the area script $\mathcal{G}$ matrix may be requested by setting

$$PRINT(31) = 1$$

*See Table 2, Section V, for values for PRINT vector

B. Calculation of Radiosity

The radiosity calculations necessary to determine the heat input from the solar flux are performed in the following steps:

Step 1. The elements of the excitation vector are of the form

$$L^*(I) = SOLCON \times ILUM(I) \times (1 - ESOL(I)) \times \cos(THETA(I))$$

These values may be printed by setting

$$PRINT(21) = 1$$

Step 2. The solar transfer matrix before inversion is found. Its elements are of the same form as used in the script $\mathcal{G}$ calculations, except solar emittances are used instead of IR emittances:

$$A(I, J) = \delta(I, J) - (1 - ESOL(I)) \times F(I, J)$$

Step 3. The solar transfer matrix is computed in the form

$$[B] = [A]^{-1}$$

This matrix may be printed by setting

$$PRINT(23) = 1$$

Step 4. Along with the matrix inversion process, the solar response vector $L^*(I)$ is computed. Its value may be printed by setting

$$PRINT(24) = 1$$

Step 5. Finally, the solar QNET vector is computed. Its values are of the form

$$\begin{aligned} QNET(I) = & -A(I) \times SOLCON \times ILUM(I) \\ & \times \cos(THETA(I)) + \sum_J (\delta(I, J) \\ & - F(I, J)) \times A(I) \times L^*(J) \end{aligned}$$

C. Numerical Techniques

To demonstrate the numerical techniques used in the calculations, it is necessary to develop the governing equations in matrix notation. The heat flow from node I to node J due to conduction or convection is

$$Q(I, J) = C(I, J)(T(I) - T(J))$$

where

$$Q(I, J) = \text{heat flow from node } I \text{ to node } J$$

$$C(I, J) = \text{conductance from node } I \text{ to node } J$$

$$T(I), T(J) = \text{temperatures of nodes } I \text{ and } J, \text{ respectively}$$

The heat flow from node I to node J , due to radiation, is

$$Q(I, J) = \sigma \mathcal{G}(I, J) \times A(I) \times (T^4(I) - T^4(J))$$

where

$$Q(I, J) = \text{heat flow from node } I \text{ to node } J$$

$$\sigma = \text{Stefan-Boltzmann constant}$$

$$\mathcal{G}(I, J) = \text{script } \mathcal{G} \text{ from node } I \text{ to node } J$$

$$T(I), T(J) = \text{temperatures of nodes } I \text{ and } J, \text{ respectively}$$

Since the rate of energy in steady state entering a node is equal to the rate of energy leaving a node, the energy balance may be written as follows:

$$Q(\text{CONDUCTION}) + Q(\text{RADIATION}) - P(\text{DISSIPATION} + \text{SOLAR INPUT}) = 0$$

When a mathematical thermal model is devised for a real spacecraft system for engineering purposes, it consists of conduction and irradiation terms connecting the various discrete elements with power in the form of electrical energy being dissipated in the node. Thus, the steady-state energy equation is

$$Q(I, J)(\text{CONDUCTION}) + Q(I, J)(\text{RADIATION}) - P(\text{DISSIPATION} + \text{SOLAR INPUT}) = 0$$

where the sign convention for power is negative for energy per unit time in and positive for energy per unit time out. In terms of actual discrete elements, the energy per unit time into node I due to conduction is

$$Q(\text{CONDUCTION}) = \sum_J C(I, J)(T(I) - T(J))$$

where

$$C(I, J) = \text{conductance from node } I \text{ to node } J; I \text{ denotes the node under consideration; } J \text{ denotes all nodes except node } I$$

The energy per unit into node I due to radiation is

$$Q(\text{RADIATION}) = \sum_J \sigma \times A(I) \times \mathcal{G}(I, J) \times (T^4(I) - T^4(J))$$

where

σ = Stefan-Boltzmann constant

A = area of node I

$\mathcal{G}(I, J)$ = script $\mathcal{G}$ from node I to node J (where node I and J have the same meaning as above)

The energy balance for node I may now be written in terms of the discrete thermal elements in the form

$$\sum_j (C(I, J) \times (T(I) - T(J)) + \sum_j \sigma A(I) \mathcal{G}(I, J) (T^4(I) - T^4(J)) - P(I) = 0$$

The energy balance written for all the nodes under consideration may be written in matrix form as follows:

$$[C][T] + [R][T^4] - [P] = 0$$

where

C = the symmetric conduction matrix whose elements are $C(I, J)$

R = the symmetric conduction matrix whose elements are $\sigma A(I) \mathcal{G}(I, J)$

T and T^4 = the temperature vectors whose elements are $T(I)$ and $T^4(J)$

P = the power vector, which includes not only the electrical power dissipation, but also the energy per unit time input from the solar radiosity

The solution of this matrix equation follows the Newton-Raphson iteration method described by Hildebrand (Ref. 2). For simplicity, the method is shown for two independent variables. The solution may then be extended for N unknowns.

Given two functions $f(x, y)$ and $g(x, y)$, which are simultaneous nonlinear algebraic equations, recurrence formulas of the following form may be written:

$$\begin{aligned} (x_{k+1} - x_k) f_x(x_k, y_k) + (y_{k+1} - y_k) f_y(x_k, y_k) &= -f(x_k, y_k) \\ (x_{k+1} - x_k) g_x(x_k, y_k) + (y_{k+1} - y_k) g_y(x_k, y_k) &= -g(x_k, y_k) \end{aligned}$$

This may be written in matrix form as

$$\begin{bmatrix} f_x & f_y \\ g_x & g_y \end{bmatrix} \begin{bmatrix} \Delta x_k \\ \Delta y_k \end{bmatrix} = - \begin{bmatrix} f(x_k, y_k) \\ g(x_k, y_k) \end{bmatrix}$$

where

$$\Delta x_k = x_{k+1} - x_k$$

$$\Delta y_k = y_{k+1} - y_k$$

The square matrix is recognized as having the elements of the Jacobian determinant. The corrections Δx_k and Δy_k are added to x_k and y_k , respectively, to yield the following iteration.

The radiation-conduction matrix equation for steady-state constant properties may be brought into the form suggested above in the following manner.

We want the result in the form

$$[S][T] = [A]$$

where $[S]$ is a square matrix and T and A are vectors. Furthermore, we want $[S]$ to have the elements of the Jacobian determinant.

A typical off-diagonal element is of the form

$$S(I, J) = C(I, J) + 4\sigma A(I) F(I, J) T^3(J)$$

and a diagonal element is of the form

$$S(I, I) = S(I, I) - C(I, J) - 4\sigma A(I) F(I, J) T^3(I)$$

The vector A then has the form

$$\begin{aligned} A(I) &= P(I) - Q(\text{SOLAR NET})(I) \\ &\quad - 3\sigma A(I) F(I, J) (T^4(I) - T^4(J)) \end{aligned}$$

This formulation allows the matrix equation to be solved for T . The imbalance in the equation is computed and if it is not within the required limits, the resulting values of T are used to generate a new S matrix and a new A vector for the next iteration.

Although the actual method used differs somewhat from that described in Ref. 2, the number of iterations required for solution remains the same for several sets of conditions that were tested. The method described here was used because it results directly in the required temperatures.

V. Program Input

Data input is prepared on four types of cards: comment cards, title cards, data cards, and control cards.

A. Comment Cards

A comment card is designated by the letter C in column 1. Comments are placed in successive columns. A comment card is printed in the output listing of the data deck. The comments serve as notes to the user and are not used by the program. Any number of comments may be used in the data. Once the program recognizes the C in column 1, the card is printed out and the program continues to process the next card. The COMMENT CARD field is COL 2-72.

B. Title Cards

A title card is designated by the letter T in column 1. A maximum of 10 title cards may be used. Title cards may be placed in basic data, case data, or a combination of both. The total number of title cards for any one case data block and the basic data block may not exceed 10. If the maximum number of title cards is exceeded, the title cards in excess of 10 will be printed as comment cards and only the first 10 title cards will be used as title cards. Title cards are printed at the top of each output statement. The TITLE CARD field is COL 2-72.

C. Data Cards

A data card is designated by a blank in column 1. Any number of data cards may be used to prescribe a problem that lies within the capacity of the machine. The DATA CARD field is COL 2-72.

Data cards are of three types: matrix, vector, and single value. A single value such as the solar constant is entered as

$$\text{SOLCON} = 430.$$

A vector value such as power is entered as

$$P(10) = -10.$$

A matrix value such as a view factor is entered as

$$F(2,3) = 0.5$$

The data input used in the program is actually a modified FORTRAN NAMELIST. The first column must be blank. Data must not be entered in columns 73-80; they must be left blank or used for sequence identification. The information in columns 73-80 will be printed with the card image. The program automatically inserts the beginning and ending characters required for NAMELIST. It also inserts a comma at the end of each card image

if it is not present. Some of the convenience features of NAMELIST that may be used are as follows:

Variables with a single subscript (i.e., vectors) may be entered in sequence as

$$A(1) = 1, 1.5, 3, 4.$$

which is the same as

$$A(1) = 1.$$

$$A(2) = 1.5$$

$$A(3) = 3.$$

$$A(4) = 4.$$

Variables with a double index (i.e., matrices) may be entered in sequence. Instead of entering each variable separately as

$$F(2,1) = 0.5$$

$$F(3,1) = 0.2$$

$$F(4,1) = 0.3$$

we may enter them as

$$F(2,1) = 0.5, 0.2, 0.3$$

It can be seen that the first index rotates most rapidly. Floating-point exponential notation may be employed for data as

$$A(29) = 1.76D + 12$$

$$\text{BOLTZ} = 0.1714D - 08$$

A list of the input variables for data cards is given in Table 1. Definitions of the symbols in Table 1 and examples of their use are listed as follows:

Symbol	Definition and use
N	Number of nodes. Nodes must be numbered sequentially so that N is the largest node number. Although the nodes must be numbered so that no node numbers are omitted, the data in a particular data block may be entered in any order. Example: 10-node problem Data input: N = 10 (integer)

Table 1. List of input variables for data cards

Symbol	Unspecified initial values
N	0
C(I, J)	0.0
F(I, J)	0.0
FA(I, J)	0.0
FAUSED	0
ESOL(I)	0.0
EIR(I)	0.0
ILUM(I)	1.0
THETA(I)	90.0
CT(I)	-500.0
T(I)	68.0
P(I)	0.0
SOLCON	442.0
RELTOL	1.D - 05
TNOTSP	68.0
BOLTZ	0.1714D - 08
PRINT(K)	0
ABSCVN	460.
NITER	15

C(I, J) Conductance from node I to node J.
Example: Conductance of 4.5 from node 5 to node 10
Data input: C(5, 10) = 4.5

F(I, J) Shape factor from node I to node J. The area A must also be entered.
Example: View factor of 0.5 from node 4 to node 9
Data input: F(4, 9) = 0.5

FA(I, J) FA product. The area A must also be entered from node I to node J.
Example: FA = 19.5 from node 3 to node 8; area of node 3 is 20; area of node 8 is 30
Data input: FA(3, 8) = 19.5
A(3) = 20.
A(8) = 30.

FAUSED Equals 1 if FA elements are input; equals 0 if F elements are used. The program assumes the value to be 0 unless 1 is input.
Example: It is desired to use FA elements in the input data.
Data input: FAUSED = 1 (integer)
Example: It is desired to use F elements in the input data.

Data input: No entry is necessary, and the program will automatically assume that the input will be F elements.

Either F or FA elements may be input; in either case, the area A(I) must also be entered so that the F elements, whose matrix is not symmetrical, may be calculated. If both sides of the matrix are symmetrical, the program will print an error message, pick one of the values as the correct value, calculate the other value, and proceed with the case. The data input must be either all F elements or all FA elements; F elements and FA elements cannot be used in the same problem.

EIR(I) Infrared emittance.
Example: IR emittance for node 5 is 0.85.
Data input: EIR(5) = 0.85

ESOL(I) Solar emittance.
Example: Solar emittance for node 6 is 0.5.
Data input: ESOL(6) = 0.5

ILUM(I) Fraction of the node exposed to direct solar flux. If a node is only partially exposed to the sun, ILUM would be used to reduce the node area in the shape factor calculation to that area exposed to solar flux. Normally this input would not be used because the user would usually define two nodes, one of which would be totally in the solar flux and the other totally in the shade. If no input is given for ILUM, the program assumes values as follows: If the theta value of the node is not equal to 90 deg, a value of 1.0 will be inferred. If the theta value of the node is 90 deg, there is no direct solar flux and the program enters 0 for the ILUM value.

Example: Node 10 is 25% exposed to direct solar flux and therefore 75% shadowed or not exposed to direct solar flux.

Data input: ILUM(10) = 0.25

Example: Node 11 is completely conduction-dependent and receives no radiant input.

Data input: No ILUM entry is necessary; the program will enter a value of 0.0.

Example: Node 12 is 100% exposed to direct solar flux. Data input: No ILUM entry is necessary; the program will enter a value of 1.0 when the theta value for node 12 is less than 90 deg.	P (I) Power input. The sign of the power input is determined by the convention "energy per unit time <i>in</i> is negative, and energy per unit time <i>out</i> is positive." Example: Node 15 represents an electronic module where 10 Btu/h of electrical power is being dissipated. Data input: $P(15) = -10$.
THETA (I) Angle from the normal to the surface to the sun. If THETA equals 90 deg, no direct solar energy is received at the surface. It is necessary to enter a THETA value only if a node receives direct solar flux. Example: Node 10 has a 0-deg angle from the normal of its surface to the sun. Data input: $THETA(10) = 0$. Example: Node 11 has a 30-deg angle from the normal of its surface to the sun. Data input: $THETA(11) = 30$. Example: Node 20 is a conduction-only node and has no radiation exchange. Data input: No THETA entry is required, and the program automatically enters a THETA value of 0.	SOLCON Solar constant. If no value is input, a value of 442. is automatically used by the program. Example: A run is being made in which the solar flux density is 420. Btu/h-ft². Data input: $SOLCON = 420$. Example: A run is being made in which the solar flux density is 442. Btu/h-ft². Data input: No entry is necessary, as the program will insert a value of 442. if no SOLCON is specified.
CT (I) Constant-temperature or boundary node. All problems require at least one constant-temperature node. In space applications, this is the space temperature. Example: Node 15 is a boundary node at a constant temperature of 200°F. Data input: $CT(15) = 200$.	RELTOL Relaxation tolerance of nodal flux. If the user does not specify a value, the program will automatically enter a value of 1×10^{-5}. Example: User wants the heat balance solved to better than 1×10^{-6} Btu/h on every node that is not a constant-temperature node. Data input: $RELTOL = 1.D - 06$ (Note that the exponent is denoted by D, not E. This is because double precision is being used.)
T (I) Starting temperature. If the user has intuitive insight into a problem, a starting temperature for a particular node may be specified. This will result in a slight saving in computer running time. The final answer will be the same whether or not a user-supplied starting temperature is specified. Example: User has prior knowledge that the resulting temperature of node 9—which is not a constant-temperature node—will be approximately 150°F. Data input: $T(9) = 150$.	TNOTSP Temperature not specified value. If no value is specified, the program will use 68 as the starting temperature for the iterations. This temperature is used on all nodes that are not constant-temperature nodes or that have not already been specified by T (I). Example: User expects the majority of temperatures in a particular problem to be about 150°F. Data input: $TNOTSP = 150$. (One or two iterations may be saved by judicious use of this parameter, but in general the computer time saving is insignificant.)

BOLTZ Stefan-Boltzmann constant. If the user does not specify a value, the program enters a value of 0.1714×10^{-8} .

Example: User wants to use a Stefan-Boltzmann constant of 0.1713×10^{-8} Btu/h-ft²-deg R⁴.

Data input: BOLTZ = 0.1713D - 08
(The exponent is denoted by D, not E, because the program is written in double precision.)

ABSCVN The value added to T that results in the absolute temperature. If the user does not specify a value, the program uses a value of 460.

Example: It is desired to have the program print out temperatures in degrees C.

Data input: ABSCVN = 273.
(It is also necessary to specify the proper BOLTZ and SOLCON.)

Example: It is desired to have the program print out absolute temperatures.

Data input: ABSCVN = 0.

PRINT(K) The various values, vectors, and matrices printed at user request are listed in Table 2.

NITER Maximum number of iterations to be used in the solution.

D. Control Cards

A control card is a special card used to control the flow and execution of data into the machine under control of the stored program. The following control cards are used:

END OF BASIC DATA

As this card indicates, it is used to designate the end of a basic data block.

END OF CASE

As this card indicates, it is used to designate the end of a particular case data block.

END OF PROBLEM

As this card indicates, it is used to designate the end of problem.

Following the END OF PROBLEM card the program will accept a new basic data block. All parameters are returned to their initial value by the program. For instance, if the user enters a solar constant, the program will not return it to its program set value of 442. The initial value will be set to the value as indicated in Table 1. If no data follow the end of problem card, the program will attempt to read a card, at which point the system will terminate the job. It is important that the control cards appear exactly as listed with a blank between each word, with the first word starting in column 1. If there is an error in the entered card, the message card error will appear to the right of the card image on the output and it will be ignored. The run will continue, with the probability that the results will be incorrect. The purpose for continuing the run is mainly to uncover other errors in the data.

VI. Program Output

The program output is arranged so that the user may determine that data input is correct and check that the heat balance is valid.

Table 2. Values for PRINT vector

Data input	Printout
PRINT(10) = 1	Prints N, BOLTZ, SOLCON, RELTOL
PRINT(11) = 1	Prints THE SYMMETRIC CONDUCTION MATRIX
PRINT(12) = 1	Prints THE SYMMETRIC FA MATRIX
PRINT(13) = 1	Prints THE F MATRIX
PRINT(14) = 1	Prints THE AREAS
PRINT(15) = 1	Prints THE INFRARED EMITTANCES
PRINT(16) = 1	Prints THE SOLAR EMITTANCES
PRINT(17) = 1	Prints THE ILLUMINATIONS
PRINT(18) = 1	Prints THE ANGLES THETA TO THE SUN
PRINT(19) = 1	Prints THE CONSTANT TEMPERATURE NODES TEMPERATURE
PRINT(20) = 1	Prints THE POWERS
PRINT(21) = 1	Prints THE EXCITATION VECTOR
PRINT(22) = 1	Prints THE SOLAR TRANSFER MATRIX BEFORE INVERSION
PRINT(23) = 1	Prints THE SOLAR TRANSFER MATRIX AFTER INVERSION
PRINT(24) = 1	Prints THE SOLAR RESPONSE VECTOR
PRINT(25) = 1	Prints THE SOLAR Q NET VECTOR
PRINT(26) = 1	Prints STEP 1 OF THE SCRIPT F MATRIX
PRINT(27) = 1	Prints STEP 2 OF THE SCRIPT F MATRIX
PRINT(28) = 1	Prints STEP 3 OF THE SCRIPT F MATRIX
PRINT(29) = 1	Prints THE SCRIPT F MATRIX
PRINT(30) = 1	Prints THE AREA TIMES THE SCRIPT F MATRIX
PRINT(31) = 1	Prints THE BOLTZ TIMES THE AREA SCRIPT F MATRIX

A one-line heading that gives the case number is included before a data input block and before each new block of output.

A history of all input cards is included with the output. This listing is used to locate errors and to facilitate identification if several runs have been made. To the right of each card image, the card name is printed (title card, comment card, data card, or control card).

The detailed nodal output is the minimum output from the program. The detail of each node includes all the input information about that node and information concerning the calculation of the heat balance around that node. The temperature, area, IR emittance, solar emittance, illumination factor, and theta angle (the angle from the normal to the surface to the sun) are listed.

A detailed listing of the heat balance follows. The headings refer to the columns that follow. The first column (NODE) lists the nodes that contribute to the heat balance. The second column (CONDUCTANCE) lists the conductance between the nodes listed in column 1 and the node under question. The third column (Q COMP) lists the Q-component contribution due to conduction and/or convection in the heat balance. Its value for a node is

$$Q(\text{CONDUCTION}) = C(I, J)(T(J) - T(I))$$

Its sign will be negative if heat is being conducted into the node and positive if heat is being transferred by conduction from the node.

The fourth column (F) lists the shape factor from the nodes listed in column 1 and the node under question. The fifth column (ASCRIPFIR) lists the area times script $\mathcal{F}$ for the IR region from the nodes listed in column 1 to the node under question. It is possible to have an $A(I)\mathcal{F}(I, J)$ term between two nodes even though there is a zero shape factor between the nodes due to multiple diffuse reflections. The sixth column (Q COMP) lists the Q-component contribution to the heat balance due to the infrared heat transfer. The Q-component value for a node I is

$$Q(\text{IR RADIATION}) = \sigma A(I)\mathcal{F}(I, J)(T^4(I) - T^4(J))$$

The seventh column (Q COMP) lists the Q-component contribution to the heat balance from the solar input. The value for a node I is

$$Q(\text{SOLAR RADIATION}) = A(I)(1 - F(I, J))L^*(I) - A(J) \times \text{SOLCON} \times \text{ILUM}(I) \times \cos \text{THETA}(I)$$

where

$$L^*(I) = \text{solar radiosity}$$

$$\text{SOLCON} = \text{solar constant}$$

$$\text{ILUM}(I) = \text{fraction of the surface exposed to the sun}$$

The Q-component value for a node $I \neq J$ is

$$Q(\text{SOLAR RADIATION}) = -A(I)(\mathcal{F}(I, J) \times L^*(J))$$

If the term $-A(I) \times \text{SOLCON} \times \text{ILUM}(I) \times \cos \text{THETA}(I)$ is not zero, it is listed immediately below the tabular listings with the comment DIRECT SOLAR. Its value appears in the Q COMP column for solar input and the comment DIRECT SOLAR appears on the same line to the left of the value.

The eighth column (TOTAL) lists the total contribution from each node listed in column 1 to the node under question. Of course, POWER and DIRECT SOLAR are also listed, since they contribute to the heat balance. If power is present it is listed in the next-to-the-last row in the tabular information and its value is listed in column 8.

The last row in the tabular information lists the totals for the various columns where appropriate. The Q-components due to conduction and convection, IR radiation, and solar flux are summed.

The totals of the contributions from various nodes are listed in the bottom row of the eighth column. This is the value of the heat balance. Its value for nonconstant-temperature nodes should be smaller than the relaxation tolerance (RELTOL) set by the program. The program initializes RELTOL to $1. \times 10^{-5}$ and the user may change this value if desired.

The temperature of a constant-temperature node is not changed by the program and its heat balance will probably not be zero. Its value represents the amount of energy per unit time passing through that particular

boundary. A constant-temperature node is recognized by the line THIS IS A CONSTANT TEMPERATURE NODE that appears immediately above the headings for the tabular data.

If special print outputs are requested, their titles correspond to those in Table 2. By requesting special print outputs, the user can verify the various computational steps in the infrared flux calculation and the solar radiosity calculation.

VII. Sample Problem

The sample problem chosen to illustrate the use of the program is that of an L-shape as shown in Fig. 1. The L-shape is infinite in the direction normal to the X-Y plane.

The solution of this problem has previously been discussed in Refs. 3 and 4. This problem, which was chosen because a reference solution is available, illustrates the method of using TAS I to obtain a temperature distribution for a particular geometry in which it is necessary to consider energy transfer in the infrared region and the solar region. The problem also requires the calculation of heat-transfer rate in the solar region due to direct solar flux and reflected solar energy. Conduction is not considered so that the computer solution may be compared with the analytic solution. However, the effect of conduction may be accounted for by the addition of the necessary data cards.

The assumptions made in the solution of the L-shape are (Ref. 3):

- (1) The surfaces are semigray opaque with solar properties *ESOL* and long-wave or infrared properties of *EIR*.
- (2) The surfaces emit and reflect diffusely.
- (3) The shape factors describe the direct view coupling between the discrete areas.
- (4) The discrete area or nodes are isothermal.
- (5) The surfaces are insulated from the rear.

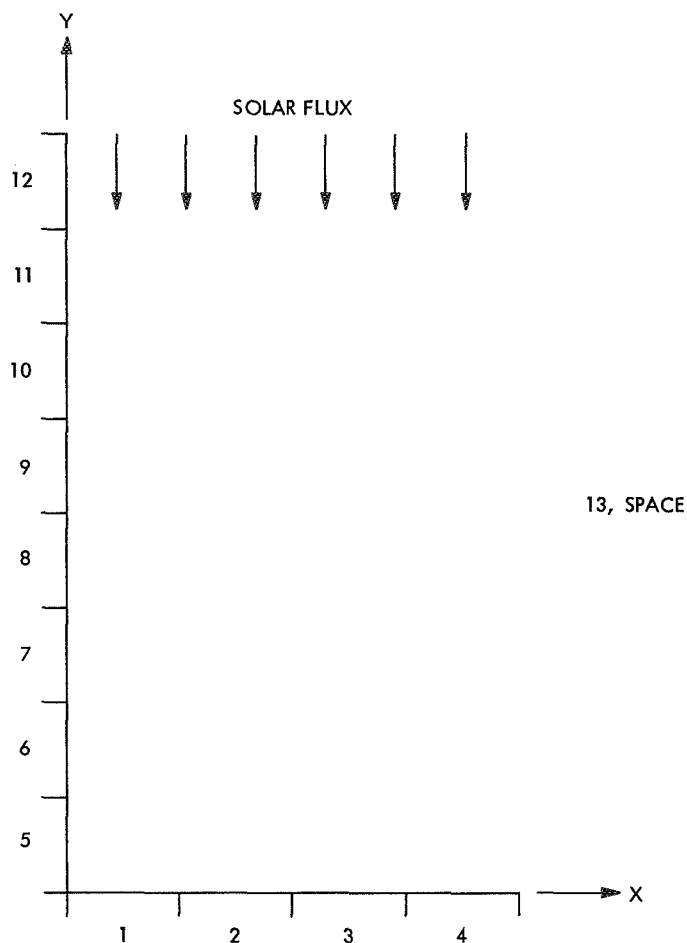


Fig. 1. Temperature distribution of an L-shape

- (6) There is no coupling with the solar source (i.e., the form factor to the sun is zero).
- (7) The surroundings are black and at absolute zero.

The discrete nodes and those associated with solar flux are shown in Fig. 1. Node 13 is the space node.

Since the L-shape is of infinite extent in one direction, the method outlined by Hottel (Ref. 1) (sometimes known as the method of crossed-uncrossed strings) may be used to calculate the view factors (*FA*). For example, the view factor $A(3) * F(3, 6)$ for an L-shape with $X = 1$ and $Y = 2$ may be computed as follows:

$$\begin{aligned}
 A(3) * F(3, 6) &= \frac{(\text{length of crossed strings} - \text{length of uncrossed strings})}{2.0} \\
 &= \frac{(\sqrt{0.5^2 + 0.5^2} + \sqrt{0.25^2 + 0.75^2}) - (\sqrt{0.5^2 + 0.25^2} + \sqrt{0.5^2 + 0.75^2})}{2.0} \\
 F(3, 6) &= 0.7454/\text{unit length}
 \end{aligned}$$

The other view factors may be computed in a similar way. If shape factors are required for geometries that are not infinite in one dimension, a numerical technique such as that used in the computer program CONFAC II (Ref. 5) must be used.

An example of handwritten data input listing for TAS I is shown in Table 3. The data input listing starts with a number of comment cards. These comment cards are used for notes or comments on the input data and they will appear in the output.

The first data card is

$$N = 13 \text{ (integer)}$$

This indicates the number of nodes (four along the X-axis, eight along the Y-axis, and one for space).

Next, the shape factors in F elements are listed. Again, the order of entry in a particular data block is unimportant. Any grouping most convenient to the user is acceptable. The comment cards with a "C" in column 1, but otherwise blank, are used for clarity in the input. Their use is completely optional. Title cards with a "T" in column 1 appear on the output that follows.

Next, the areas are listed. For this particular problem, the areas of the nodes on the L-shape are set equal to 1, while the area of space is equal to the distance from $Y = 2$ to $X = 1$. The areas have been entered separately, one to a data card. However, they could have been entered as follows:

$$A(1) = 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 1., 8.944$$

If one data card cannot contain all of the areas with columns 2 through 72, the user may put $A(1)$ through $A(10)$ on one card and $A(11)$ through $A(13)$ on the second card. Then the two data cards would appear as follows:

$$A(1) = 1., 1., 1., 1., 1., 1., 1., 1., 1., 1.,$$

$$A(11) = 1., 1., 8.944$$

The areas of all nodes involved in radiant transfer must be listed. The first character on each data card must always be a variable name.

The data cards following the areas are the angles theta to the solar input. Since nodes 1 through 4, which lie in the X-Z plane are normal to the sun, their angles are

zero. Because the sun is located at the zenith position, nodes 5 through 12 receive no direct sunlight, so their angles are 90 deg. The computer program assumes that a node receives no direct solar input and automatically sets all theta values equal to 90 deg. It is therefore necessary to enter a theta value for each node that receives direct solar energy. The comment concerning multiple entries on a data card also apply for angles theta.

The data cards following the angles theta list the long-wave or infrared emittance (EIR). Every node with a shape factor or a view factor must have an infrared emittance. If no emittance value is input, a zero value will be assumed and used in the calculation. This means that there will be no infrared heat transfer to or from this node. The comments concerning multiple entries on a data card also apply for emittances.

The next set of data cards describes the solar emittance or solar absorptance ($ESOL$). Every node with a form factor that receives solar energy either directly or through solar reflection requires a solar emittance value for the calculation. As for infrared emittance, if no value of solar emittance is specified, the computer program uses the initialized value of zero in the calculation.

Finally, the space temperature is defined. A value of $-459.$ is entered as a constant-temperature node (CT). Since this is a constant-temperature node, its temperature will remain as defined and it is not dependent on any of its properties. However, its properties affect the temperature of other nonconstant-temperature nodes with which it has energy exchange. At least one node in every problem must be a constant-temperature node. If this requirement is not met, the program will be unable to find a unique solution because none exists.

The last card in a data block is always a control card. Because this first block contains the basic data, an END OF BASIC DATA card is used. All subsequent cases will use the data contained in the basic data block and any case data in a case data block.

The data cards unique to the first case follow next. Any number of comment cards may again be used. The number of title cards is limited to a total of 10 between the basic data card and the case being processed. The maximum of 10 title cards apportioned between the basic data and the case data is arbitrary so long as the maximum limit is not exceeded. If the limit is exceeded, the excess title cards will be printed as comment cards and processing will continue. The first case in the sample problem

Table 3. Example of handwritten data input listing for sample problem

PROGRAM: <i>TAS</i>		DATE		PUNCHING INSTRUCTIONS		GRAPHIC PUNCH		PAGE 1 OF 3		CARD ELECTRO NUMBER																																																																					
STATEMENT NUMBER		DATE		PUNCHING INSTRUCTIONS		GRAPHIC PUNCH		PAGE 1 OF 3		CARD ELECTRO NUMBER																																																																					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
FORTHAN Coding Form																																																																															
FORTHAN STATEMENT																																																																															
TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY STEP RISER=Y, STEP TREAD=X LOCAL RADIATION EQUILIBRIUM TEMPERATURES IN SEMIGRAY ENCLOSURES, BOBBO, R.P., ALLEN, G.E., AND OTHERS, P.W., AEROSPACE TECHNOLOGY RESEARCH REPORT, SSD 60476P REPORT NUMBER 17 DECEMBER 1966 HUGHES AIRCRAFT COMPANY SIPAGE SYSTEMS DIVISION LOS ANGELES, CALIFORNIA REF. 3. BOBBO, R.P., RADIATION FROM A DIRECTIONAL SOURCE, BEAM DIVERGENCE IN SOLAR SIMULATORS, J. ENGR. FOR POWER, TRANS. ASME, SER. A, VOL. 87, NO 3, 1965, PP. 259-269. FIGURE 1. TEMPERATURE DISTRIBUTION OF AN L-SHAPE, Y=2X 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80																																																																															

FORTTRAN Coding Form

PROGRAM		TAS		PAGE 2 OF 8		CARD ELECTRO NUMBER*	
PROGRAMMER		J. A. HULTBERG		DATE		PUNCHING INSTRUCTIONS	
STATEMENT NUMBER		PORTAN STATEMENT		GRAPHIC PUNCH		IDENTIFICATION SEQUENCE	
1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9
10	10	10	10	10	10	10	10
11	11	11	11	11	11	11	11
12	12	12	12	12	12	12	12
13	13	13	13	13	13	13	13
14	14	14	14	14	14	14	14
15	15	15	15	15	15	15	15
16	16	16	16	16	16	16	16
17	17	17	17	17	17	17	17
18	18	18	18	18	18	18	18
19	19	19	19	19	19	19	19
20	20	20	20	20	20	20	20
21	21	21	21	21	21	21	21
22	22	22	22	22	22	22	22
23	23	23	23	23	23	23	23
24	24	24	24	24	24	24	24
25	25	25	25	25	25	25	25
26	26	26	26	26	26	26	26
27	27	27	27	27	27	27	27
28	28	28	28	28	28	28	28
29	29	29	29	29	29	29	29
30	30	30	30	30	30	30	30
31	31	31	31	31	31	31	31
32	32	32	32	32	32	32	32
33	33	33	33	33	33	33	33
34	34	34	34	34	34	34	34
35	35	35	35	35	35	35	35
36	36	36	36	36	36	36	36
37	37	37	37	37	37	37	37
38	38	38	38	38	38	38	38
39	39	39	39	39	39	39	39
40	40	40	40	40	40	40	40
41	41	41	41	41	41	41	41
42	42	42	42	42	42	42	42
43	43	43	43	43	43	43	43
44	44	44	44	44	44	44	44
45	45	45	45	45	45	45	45
46	46	46	46	46	46	46	46
47	47	47	47	47	47	47	47
48	48	48	48	48	48	48	48
49	49	49	49	49	49	49	49
50	50	50	50	50	50	50	50
51	51	51	51	51	51	51	51
52	52	52	52	52	52	52	52
53	53	53	53	53	53	53	53
54	54	54	54	54	54	54	54
55	55	55	55	55	55	55	55
56	56	56	56	56	56	56	56
57	57	57	57	57	57	57	57
58	58	58	58	58	58	58	58
59	59	59	59	59	59	59	59
60	60	60	60	60	60	60	60
61	61	61	61	61	61	61	61
62	62	62	62	62	62	62	62
63	63	63	63	63	63	63	63
64	64	64	64	64	64	64	64
65	65	65	65	65	65	65	65
66	66	66	66	66	66	66	66
67	67	67	67	67	67	67	67
68	68	68	68	68	68	68	68
69	69	69	69	69	69	69	69
70	70	70	70	70	70	70	70
71	71	71	71	71	71	71	71
72	72	72	72	72	72	72	72
73	73	73	73	73	73	73	73
74	74	74	74	74	74	74	74
75	75	75	75	75	75	75	75
76	76	76	76	76	76	76	76
77	77	77	77	77	77	77	77
78	78	78	78	78	78	78	78
79	79	79	79	79	79	79	79
80	80	80	80	80	80	80	80

FORTRAN Coding Form

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Table 3 (contd)

PROGRAM		DATE		PUNCHING INSTRUCTIONS		GRAPHIC PUNCH		PAGE 4 OF 8		CARD ELECTRO NUMBER		IDENTIFICATION SEQUENCE																																																																			
PROGRAMMER		DATE		PUNCHING INSTRUCTIONS		GRAPHIC PUNCH		PAGE 4 OF 8		CARD ELECTRO NUMBER		IDENTIFICATION SEQUENCE																																																																			
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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
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Table 3 (contd)

FORTRAN Coding Form

PROGRAM		DATE		PUNCHING INSTRUCTIONS		GRAPHIC PUNCH		PAGE 5 OF 8		CARD ELECTRO NUMBER		IDENTIFICATION SEQUENCE																																																																			
PROGRAMMER		DATE		PUNCHING INSTRUCTIONS		GRAPHIC PUNCH		PAGE 5 OF 8		CARD ELECTRO NUMBER		IDENTIFICATION SEQUENCE																																																																			
STATEMENT NUMBER		DATE		PUNCHING INSTRUCTIONS		GRAPHIC PUNCH		PAGE 5 OF 8		CARD ELECTRO NUMBER		IDENTIFICATION SEQUENCE																																																																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
<i>TAS</i> <i>JA HULTBERG</i> <i>ETA(8)=0.90</i> <i>ETA(9)=0.90</i> <i>ETA(10)=0.90</i> <i>EIR(11)=0.90</i> <i>EIR(12)=0.90</i> <i>EIR(13)=1.0</i> <i>ESOL(1)=0.18</i> <i>ESOL(2)=0.18</i> <i>ESOL(3)=0.18</i> <i>ESOL(4)=0.18</i> <i>ESOL(5)=0.18</i> <i>ESOL(6)=0.18</i> <i>ESOL(7)=0.18</i> <i>ESOL(8)=0.18</i> <i>ESOL(9)=0.18</i> <i>ESOL(10)=0.18</i> <i>ESOL(11)=0.18</i> <i>ESOL(12)=0.18</i> <i>ESOL(13)=1.0</i> <i>CTC(13)=-459.0</i> <i>END OF BASIC DATA</i> <i>CASE 1, V=2X AND WHITE PAINT SURFACE</i>																																																																															

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[illegible]

Table 3 (contd)

[illegible]

contains no data card, only comment cards. The temperatures listed are the results of the first case. They are shown as comment cards so that the card deck will be complete with answers from the first case to be used as a check case. The last card in the first-case data block is an END OF CASE control card. Therefore, the first case consists of the data in the basic data block and the data in the first-case data block.

The second case consists of only one data card. This card requests all of the additional output information to be printed. This is done by using the sequential method of entering data on a single card. Thus PRINT(10) through PRINT(31) (see Table 2) are all set equal to 1. If only certain additional outputs are required, they can be requested by separate cards. If we had wanted only those outputs requested by PRINT(10), PRINT(12), and PRINT(15), we could have requested them in several ways. The first method would be input

PRINT(10) = 1

PRINT(12) = 1

PRINT(15) = 1

Another method would be to write

PRINT(10) = 1, PRINT(12) = 1, PRINT(15) = 1

or, finally,

PRINT(10) = 1, 0, 1, 0, 0, 1

The second-case data block is entered with an END OF CASE control card. The second case is processed by the

program initializing itself, the basic data, and finally reading the second-case data block. Any basic data which were overwritten in the first-case data block will be re-stored for subsequent case runs and the user is not required to re-enter the basic data values.

The third case involves changes in the *EIR* and *ESOL* values for the L-shape. This then gives the results for Case b discussed by Bobco (Refs. 3, 4). The third data block is also ended with an END OF CASE control card.

The fourth and final case illustrates the method by which the system of units may be changed. This fourth data block is also ended with an END OF CASE control card.

Finally, an END OF PROBLEM control card follows the last END OF CASE control card. Its purpose is to signal the program that a new basic data block may follow. The sample problem consists of only one problem with four cases. Therefore, when the program expects to find a new basic data block and none is present, control is returned to the computer executive system and the job is terminated.

The output for the sample problem is given in Table 4. The format of the output is described in Sect. VI. Note that all the shape factors sum to 1 as they should for any node with radiation exchange. Also note that only nodes 1 through 4 receive direct solar input as indicated by a THETA value not equal to 90 deg and also indicated in the solar portion of the tabulated output.

Table 4. Computer printout of sample problem: temperature distribution of an L-shape

T	I	A	S	1, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 0	TITLE CARD
C				TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY	COMMENT CARD
C				STEP RISER=Y, STEP TREAD=X	COMMENT CARD
C				LOCAL RADIATION EQUILIBRIUM TEMPERATURES IN SEMIGRAY ENCLOSURES,	COMMENT CARD
C				BOBCO,R.P., ALLENY,G.E., AND OTHMER,P,W.,	COMMENT CARD
C				AEROSPACE TECHNOLOGY RESEARCH REPORT,	COMMENT CARD
C				SSD 60475R REPORT NUMBER 17 DECEMBER 1966	COMMENT CARD
C				HUGHES AIRCRAFT COMPANY	COMMENT CARD
C				SPACE SYSTEMS DIVISION	COMMENT CARD
C				LOSANGELES, CALIFORNIA	COMMENT CARD
C				REF. 3, BOBCO, R.P., RADIATION FROM A DIRECTIONAL SOURCE, BEAM	COMMENT CARD
C				DIVERGENCE IN SOLAR SIMULATORS, J. ENGR. FOR POWER, TRANS.ASME,	COMMENT CARD
C				SER.A, VOL.87, NO 3, 1965, PP.259-269.	COMMENT CARD
C				FIGURE 1. TEMPERATURE DISTRIBUTION OF AN L-SHAPE, Y=2X	COMMENT CARD
C				1 2 3 4 5 6 7	COMMENT CARD
C				C2345678901234567890123456789012345678901234567890123456789012	COMMENT CARD
C				N=13	DATA CARD
C				F(1,5)= .29289	DATA CARD
C				F(1,6)= .08907	DATA CARD
C				F(1,7)= .03689	DATA CARD
C				F(1,8)= .01959	DATA CARD
C				F(1,9)= .01204	DATA CARD
C				F(1,10)=.00813	DATA CARD
C				F(1,11)=.00585	DATA CARD
C				F(1,12)=.00441	DATA CARD
C				F(1,13)=.53113	DATA CARD
C				F(2,5)= .08907	DATA CARD
C				F(2,6)= .11475	DATA CARD
C				F(2,7)= .07454	DATA CARD
C				F(2,8)= .04712	DATA CARD
C				F(2,9)= .03144	DATA CARD
C				F(2,10)=.02218	DATA CARD
C				F(2,11)=.01638	DATA CARD
C				F(2,12)=.01254	DATA CARD
C				F(2,13)=.59198	DATA CARD
C				F(3,5)= .03689	DATA CARD
C				F(3,6)= .07454	DATA CARD
C				F(3,7)= .07002	DATA CARD
C				F(3,8)= .05461	DATA CARD
C				F(3,9)= .04104	DATA CARD
C				F(3,10)=.03107	DATA CARD
C				F(3,11)=.02399	DATA CARD
C				F(3,12)=.01894	DATA CARD
C				F(3,13)=.64890	DATA CARD
C				F(4,5)= .01959	DATA CARD
C				F(4,6)= .04712	DATA CARD
C				F(4,7)= .05461	DATA CARD
C				F(4,8)= .05025	DATA CARD
C				F(4,9)= .04234	DATA CARD
C				F(4,10)=.03464	DATA CARD
C				F(4,11)=.02821	DATA CARD
C				F(4,12)=.02311	DATA CARD
C				F(4,13)=.70013	DATA CARD
C				F(5,13)=.56156	DATA CARD
C				F(6,13)=.67452	DATA CARD
C				F(7,13)=.76396	DATA CARD
C				F(8,13)=.82843	DATA CARD
C				F(9,13)=.87314	DATA CARD
C				F(10,13)=.90398	DATA CARD
C				F(11,13)=.92557	DATA CARD
C				F(12,13)=.94100	DATA CARD
C				A(1)=1.0	DATA CARD
C				A(2)=1.0	DATA CARD
C				A(3)=1.0	DATA CARD
C				A(4)=1.0	DATA CARD
C				A(5)=1.0	DATA CARD
C				A(6)=1.0	DATA CARD
C				A(7)=1.0	DATA CARD
C				A(8)=1.0	DATA CARD
C				A(9)=1.0	DATA CARD
C				A(10)=1.0	DATA CARD
C				A(11)=1.0	DATA CARD
C				A(12)=1.0	DATA CARD
C				A(13)=8.944272	DATA CARD
C				THETA(1)=0.0	DATA CARD
C				THETA(2)=0.0	DATA CARD
C				THETA(3)=0.0	DATA CARD
C				THETA(4)=0.0	DATA CARD
C				EIR(1)=0.90	DATA CARD
C				EIR(2)=0.90	DATA CARD
C				EIR(3)=0.90	DATA CARD
C				EIR(4)=0.90	DATA CARD
C				EIR(5)=0.90	DATA CARD
C				EIR(6)=0.90	DATA CARD
C				EIR(7)=0.90	DATA CARD
C				EIR(8)=0.90	DATA CARD
C				EIR(9)=0.90	DATA CARD
C				EIR(	

Table 4 (contd)

C		COMMENT CARD
	ESOL(1)=0.18	DATA CARD
	ESOL(2)=0.18	DATA CARD
	ESOL(3)=0.18	DATA CARD
	ESOL(4)=0.18	DATA CARD
	ESOL(5)=0.18	DATA CARD
	ESOL(6)=0.18	DATA CARD
	ESOL(7)=0.18	DATA CARD
	ESOL(8)=0.18	DATA CARD
	ESOL(9)=0.18	DATA CARD
	ESOL(10)=0.18	DATA CARD
	ESOL(11)=0.18	DATA CARD
	ESOL(12)=0.18	DATA CARD
	ESOL(13)=1.0	DATA CARD
	CT(13)=-459.0	DATA CARD
	END OF BASIC DATA	CONTROL CARD

TAS 1, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 1
TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
STEP RISER=Y, STEP TREAD=X
CASE 1, Y=2X AND WHITE PAINT SURFACE

CARD	CASE 1, Y=2X AND WHITE PAINT SURFACE	TITLE CARD
1	THE RESULTING TEMPERATURES ARE	COMMENT CARD
2	CASE 1 CASE 4	COMMENT CARD
3	DEG F DEG C	COMMENT CARD
4	T(1) 66.24 19.02	COMMENT CARD
5	T(2) 49.20 9.56	COMMENT CARD
6	T(3) 39.89 4.38	COMMENT CARD
7	T(4) 34.11 1.17	COMMENT CARD
8	T(5) 12.79 -10.67	COMMENT CARD
9	T(6) -27.19 -32.89	COMMENT CARD
10	T(7) -62.91 -52.73	COMMENT CARD
11	T(8) -94.37 -70.20	COMMENT CARD
12	T(9) -121.45 -85.25	COMMENT CARD
13	T(10) -144.50 -98.05	COMMENT CARD
14	T(11) -164.12 -108.96	COMMENT CARD
15	T(12) -180.92 -118.29	COMMENT CARD
16	T(13) -459.00 -272.78 A CONSTANT TEMPERATURE NODE	COMMENT CARD
17	END OF CASE	CONTROL CARD

TAS I, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 1
TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
STEP RISER=Y, STEP TREAD=X
CASE 1, Y=2X AND WHITE PAINT SURFACE

THE RESIDUES ARE																			
1	=	-0.22356963D	02	2	=	-0.11339817D	02	3	=	-0.28987155D	01	4	=	0.40090641D	01	5	=	0.38734681D	02
6	=	0.60359433D	02	7	=	0.76932599D	02	8	=	0.88744152D	02	9	=	0.96891237D	02	10	=	0.10249620D	03
11	=	0.10641417D	03	12	=	0.10921168D	03	13	=	-0.24151977D	04								

THE TEMPERATURES ARE

1 = 0.6800000000	02	2 = 0.6800000000	02	3 = 0.6800000000	02	4 = 0.6800000000	02	5 = 0.6800000000	02
6 = 0.6800000000	02	7 = 0.6800000000	02	8 = 0.6800000000	02	9 = 0.6800000000	02	10 = 0.6800000000	02
11 = 0.6800000000	02	12 = 0.6800000000	02	13 = -0.4590000000	03				

THE RESIDUES ARE																			
1	=	-0.42535637D	01	2	=	-0.53402384D	01	3	=	-0.47119868D	01	4	=	-0.36726924D	01	5	=	0.50219929D	01
6	=	0.11852708D	02	7	=	0.18124068D	02	8	=	0.23077140D	02	9	=	0.26718371D	02	10	=	0.29326499D	02
11	=	0.31198392D	02	12	=	0.32559117D	02	13	=	-0.19278998D	04								

THE TEMPERATURES ARE

1 = 0.6625273402	2 = 0.5018102702	3 = 0.4205584502	4 = 0.3723913802	5 = 0.2085949802
6 = -0.4404554601	7 = -0.2177357602	8 = -0.3364547102	9 = -0.4168838802	10 = -0.4717108902
11 = -0.5098366202	12 = -0.5369716602	13 = -0.4590000003		

```

THE RESIDUES ARE
1 = -0.416923350 00 2 = -0.881360620 00 3 = -0.105016600 01 4 = -0.105912430 01 5 = 0.104120610 00
6 = 0.803201040 00 7 = 0.212145490 01 8 = 0.371191080 01 9 = 0.523095710 01 10 = 0.651537390 01
11 = 0.754280040 01 12 = 0.834651840 01 13 = -0.179898080 04

```

THE TEMPERATURES ARE

1 = 0.066243994D 02	2 = 0.49203445D 02	3 = 0.39903569D 02	4 = 0.34143775D 02	5 = 0.12988041D 02
6 = -0.25540004D 02	7 = -0.57473399D 02	8 = -0.82582336D 02	9 = -0.10139868D 03	10 = -0.11516982D 03
11 = -0.12523707D 03	12 = -0.13266244D 03	13 = -0.45900000D 03		

```

THE RESIDUES ARE
1 = -0.249537170D-01    2 = -0.659157720D-01    3 = -0.905417600D-01    4 = -0.100926410D 00    5 = -0.176622670D-02
6 = 0.258150700D-02    7 = 0.404537320D-01    8 = 0.162018370D 00    9 = 0.389614310D 00   10 = 0.695552390D 00
11 = 0.103306910D 00   12 = 0.136412860D 01   13 = -0.177140330D 04

```

```

THE TEMPERATURES ARE
1 = 0.6624399302 02 2 = 0.4920062302 02 3 = 0.3988959002 02 4 = 0.3411444702 02 5 = 0.1278715902 02
6 = -0.2718415102 02 7 = -0.6280298402 02 8 = -0.9382573502 02 9 = -0.1198298102 02 10 = -0.1409627602 02
11 = -0.1578563202 03 12 = -0.1712583002 03 13 = -0.4590000002 03

```

THE RESIDUES ARE

1 = 0.53645589D-03	2 = -0.14946159D-02	3 = -0.21887189D-02	4 = -0.25823931D-02	5 = -0.42157859D-04
6 = -0.50258155D-04	7 = -0.25139260D-04	8 = 0.32755244D-03	9 = 0.27365911D-02	10 = 0.11276139D-01
11 = 0.30737026D-01	12 = 0.63745309D-01	13 = -0.17681019D-04		

THE TEMPERATURES ARE

1 = 0.066243993D 02	2 = -0.49200623D 02	3 = -0.39889589D 02	4 = -0.34114444D 02	5 = -0.12787031D 02
6 = -0.27193567D 02	7 = -0.62912181D 02	8 = -0.94365023D 02	9 = -0.12143819D 02	10 = -0.14443804D 03
11 = -0.16392400D 03	12 = -0.18044526D 03	13 = -0.45900000D 03		

THE RESIDUES ARE

1 = -0.82645983D-06	2 = -0.23339067D-05	3 = -0.34953383D-05	4 = -0.42252475D-05	5 = -0.66165924D-07
6 = -0.80106506D-07	7 = -0.67991275D-07	8 = -0.51168017D-07	9 = 0.10056181D-06	10 = 0.30962271D-05
11 = 0.29882602D-04	12 = 0.16159605D-03	13 = -0.17680002D 04		

```

THE PARAMETERS ARE
1 = 0.662439993D 02 2 = 0.49200623D 02 3 = 0.39889589D 02 4 = 0.34114444D 02 5 = 0.12787031D 02
6 = -0.27193567D 02 7 = -0.62912226D 02 8 = -0.94366218D 02 9 = -0.12144972D 03 10 = -0.14449629D 03
11 = -0.16412184D 03 12 = -0.18091821D 03 13 = -0.45900000D 03

```

Table 4 (contd)

THE RESIDUES ARE
 1 = -0.45901061D-11 2 = -0.12477130D-10 3 = -0.18793855D-10 4 = -0.22687630D-10 5 = -0.38014036D-12
 6 = -0.42277293D-12 7 = -0.41922021D-12 8 = -0.38014036D-12 9 = -0.24691360D-12 10 = 0.48849813D-13
 11 = 0.28209435D-10 12 = 0.10463522D-08 13 = -0.17680000D 04

THE TEMPERATURES ARE
 1 = 0.66243993D 02 2 = 0.49200623D 02 3 = 0.39889589D 02 4 = 0.34114444D 02 5 = 0.12787031D 02
 6 = -0.27193567D 02 7 = -0.62912226D 02 8 = -0.94366218D 02 9 = -0.12144972D 03 10 = -0.14449631D 03
 11 = -0.16412202D 03 12 = -0.18091942D 03 13 = -0.45900000D 03

TAS I, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 1
 TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
 STEP RISER=Y, STEP TREAD=X
 CASE 1, Y=2X AND WHITE PAINT SURFACE

ENERGY PER UNIT TIME IN IS NEGATIVE AND ENERGY PER UNIT TIME OUT IS POSITIVE

DETAIL OF NODE 1 TEMPERATURE = 66.24 AREA = 0.1000D 01
 IR EMITTANCE = 0.9000 SOLAR EMITTANCE = 0.1800
 ILUM = 0.1000D 01 THETA = 0.00000D-38
 NODE CONDUCTANCE Q COMP F ASCTPTFTIR Q COMP Q COMP TOTAL
 1 0.0000D-38 0.0000D-38 0.0000D-38 0.7763D-02 -0.0000D-38 0.4087D 03 0.4087D 03
 2 0.0000D-38 0.0000D-38 0.0000D-38 0.3301D-02 0.5354D-01 -0.0000D-38 0.5354D-01
 3 0.0000D-38 0.0000D-38 0.0000D-38 0.1790D-02 0.4372D-01 -0.0000D-38 0.4372D-01
 4 0.0000D-38 0.0000D-38 0.0000D-38 0.1135D-02 0.3324D-01 -0.0000D-38 0.3324D-01
 5 0.0000D-38 0.0000D-38 0.2929D 00 0.2375D 00 0.1088D 02 -0.4229D 02 -0.3141D 02
 6 0.0000D-38 0.0000D-38 0.8907D-01 0.7227D-01 0.5153D 01 -0.9325D 01 -0.4171D 01
 7 0.0000D-38 0.0000D-38 0.3689D-01 0.2995D-01 0.2661D 01 -0.2774D 01 -0.1128D 00
 8 0.0000D-38 0.0000D-38 0.1959D-01 0.1591D-01 0.1604D 01 -0.1066D 01 0.5387D 00
 9 0.0000D-38 0.0000D-38 0.1204D-01 0.9784D-02 0.1066D 01 -0.4831D 00 0.5827D 00
 10 0.0000D-38 0.0000D-38 0.8130D-02 0.6608D-02 0.7564D 00 -0.2465D 00 0.5099D 00
 11 0.0000D-38 0.0000D-38 0.5850D-02 0.4756D-02 0.5627D 00 -0.1374D 00 0.4253D 00
 12 0.0000D-38 0.0000D-38 0.4410D-02 0.3586D-02 0.4341D 00 -0.8205D-01 0.3520D 00
 13 0.0000D-38 0.0000D-38 0.5311D 00 0.5056D 00 0.6646D 02 -0.0000D-38 0.6646D 02
 TOTALS 0.0000D-38 0.1000D 01 0.8971D 02 -0.8971D 02 -0.4583D-11

DETAIL OF NODE 2 TEMPERATURE = 49.20 AREA = 0.1000D 01
 IR EMITTANCE = 0.9000 SOLAR EMITTANCE = 0.1800
 ILUM = 0.1000D 01 THETA = 0.00000D-38
 NODE CONDUCTANCE Q COMP F ASCTPTFTIR Q COMP Q COMP TOTAL
 1 0.0000D-38 -0.0000D-38 0.0000D-38 0.3301D-02 -0.5354D-01 -0.0000D-38 -0.5354D-01
 2 0.0000D-38 0.0000D-38 0.0000D-38 0.2496D-02 -0.0000D-38 0.3916D 03 0.3916D 03
 3 0.0000D-38 0.0000D-38 0.0000D-38 0.1803D-02 0.1479D-01 -0.0000D-38 0.1479D-01
 4 0.0000D-38 0.0000D-38 0.0000D-38 0.1333D-02 0.1741D-01 -0.0000D-38 0.1741D-01
 5 0.0000D-38 0.0000D-38 0.8907D-01 0.7227D-01 0.2139D 01 -0.1286D 02 -0.1072D 02
 6 0.0000D-38 0.0000D-38 0.1147D 00 0.9303D-01 0.5124D 01 -0.1201D 02 -0.6889D 01
 7 0.0000D-38 0.0000D-38 0.7454D-01 0.6043D-01 0.4388D 01 -0.5605D 01 -0.1217D 01
 8 0.0000D-38 0.0000D-38 0.4712D-01 0.3820D-01 0.3232D 01 -0.2563D 01 0.6685D 00
 9 0.0000D-38 0.0000D-38 0.3144D-01 0.2549D-01 0.2363D 01 -0.1261D 01 0.1102D 01
 10 0.0000D-38 0.0000D-38 0.2218D-01 0.1798D-01 0.1767D 01 -0.6726D 00 0.1094D 01
 11 0.0000D-38 0.0000D-38 0.1638D-01 0.1328D-01 0.1356D 01 -0.3847D 00 0.9713D 00
 12 0.0000D-38 0.0000D-38 0.1254D-01 0.1017D-01 0.1066D 01 -0.2333D 00 0.8327D 00
 13 0.0000D-38 0.0000D-38 0.5920D 00 0.5602D 00 0.6455D 02 -0.0000D-38 0.6455D 02
 TOTALS 0.0000D-38 0.1000D 01 0.8597D 02 -0.8597D 02 -0.1246D-10

DETAIL OF NODE 3 TEMPERATURE = 39.89 AREA = 0.1000D 01
 IR EMITTANCE = 0.9000 SOLAR EMITTANCE = 0.1800
 ILUM = 0.1000D 01 THETA = 0.00000D-38
 NODE CONDUCTANCE Q COMP F ASCTPTFTIR Q COMP Q COMP TOTAL
 1 0.0000D-38 -0.0000D-38 0.0000D-38 0.1790D-02 -0.4372D-01 -0.0000D-38 -0.4372D-01
 2 0.0000D-38 -0.0000D-38 0.0000D-38 0.1803D-02 -0.1479D-01 -0.0000D-38 -0.1479D-01
 3 0.0000D-38 0.0000D-38 0.0000D-38 0.1491D-02 -0.0000D-38 0.3828D 03 0.3828D 03
 4 0.0000D-38 0.0000D-38 0.0000D-38 0.1194D-02 -0.5805D-02 -0.0000D-38 0.5805D-02
 5 0.0000D-38 0.0000D-38 0.3689D-01 0.2996D-01 0.6408D 00 -0.5327D 01 -0.4686D 01
 6 0.0000D-38 0.0000D-38 0.7454D-01 0.6043D-01 0.2833D 01 -0.7803D 01 -0.4970D 01
 7 0.0000D-38 0.0000D-38 0.7002D-01 0.5675D-01 0.3656D 01 -0.5265D 01 -0.1609D 01
 8 0.0000D-38 0.0000D-38 0.5461D-01 0.4426D-01 0.3381D 01 -0.2971D 01 0.4107D 00
 9 0.0000D-38 0.0000D-38 0.4104D-01 0.3326D-01 0.2811D 01 -0.1647D 01 0.1164D 01
 10 0.0000D-38 0.0000D-38 0.3107D-01 0.2518D-01 0.2267D 01 -0.9422D 00 0.1325D 01
 11 0.0000D-38 0.0000D-38 0.2399D-01 0.1944D-01 0.1826D 01 -0.5634D 00 0.1262D 01
 12 0.0000D-38 0.0000D-38 0.1894D-01 0.1535D-01 0.1483D 01 -0.3524D 00 0.1131D 01
 13 0.0000D-38 0.0000D-38 0.6489D 00 0.6091D 00 0.6519D 02 -0.0000D-38 0.6519D 02
 TOTALS 0.0000D-38 0.1000D 01 0.8404D 02 -0.8404D 02 -0.1876D-10

DETAIL OF NODE 4 TEMPERATURE = 34.11 AREA = 0.1000D 01
 IR EMITTANCE = 0.9000 SOLAR EMITTANCE = 0.1800
 ILUM = 0.1000D 01 THETA = 0.00000D-38
 NODE CONDUCTANCE Q COMP F ASCTPTFTIR Q COMP Q COMP TOTAL
 1 0.0000D-38 -0.0000D-38 0.0000D-38 0.1135D-02 -0.3324D-01 -0.0000D-38 -0.3324D-01
 2 0.0000D-38 -0.0000D-38 0.0000D-38 0.1333D-02 -0.1741D-01 -0.0000D-38 -0.1741D-01
 3 0.0000D-38 -0.0000D-38 0.0000D-38 0.1194D-02 -0.5805D-02 -0.0000D-38 -0.5805D-02
 4 0.0000D-38 0.0000D-38 0.0000D-38 0.1008D-02 -0.0000D-38 0.3776D 03 0.3776D 03
 5 0.0000D-38 0.0000D-38 0.1959D-01 0.1592D-01 0.2632D 00 -0.2829D 01 -0.2566D 01
 6 0.0000D-38 0.0000D-38 0.4712D-01 0.3821D-01 0.1606D 01 -0.4933D 01 -0.3327D 01
 7 0.0000D-38 0.0000D-38 0.5461D-01 0.4426D-01 0.2636D 01 -0.4106D 01 -0.1470D 01
 8 0.0000D-38 0.0000D-38 0.5025D-01 0.4072D-01 0.2913D 01 -0.2733D 01 0.1796D 00
 9 0.0000D-38 0.0000D-38 0.4234D-01 0.3431D-01 0.2733D 01 -0.1699D 01 0.1034D 01
 10 0.0000D-38 0.0000D-38 0.3464D-01 0.2807D-01 0.2391D 01 -0.1050D 01 0.1341D 01
 11 0.0000D-38 0.0000D-38 0.2821D-01 0.2286D-01 0.2035D 01 -0.6625D 00 0.1373D 01
 12 0.0000D-38 0.0000D-38 0.2311D-01 0.1873D-01 0.1719D 01 -0.4300D 00 0.1289D 01
 13 0.0000D-38 0.0000D-38 0.7001D 00 0.6523D 00 0.6664D 02 -0.0000D-38 0.6664D 02
 TOTALS 0.0000D-38 0.1000D 01 0.8288D 02 -0.8288D 02 -0.2270D-10

Table 4 (contd)

DETAIL OF NODE 5 TEMPERATURE = 12.79 AREA = 0.1000D 01
 IR EMISSANCE = 0.9000 SOLAR EMISSANCE = 0.1800
 ILUM = 0.0000D-38 THETA = 0.9000D 02

NODE	CONDUCTANCE	Q COMP	F	ASCRIPFTFIR	Q COMP	Q COMP	TOTAL
1	0.0000D-38	-0.0000D-38	0.2929D 00	0.2375D 00	-0.1088D 02	-0.1197D 03	-0.1306D 03
2	0.0000D-38	-0.0000D-38	0.8907D-01	0.7227D-01	-0.2139D 01	-0.3488D 02	-0.3702D 02
3	0.0000D-38	-0.0000D-38	0.3689D-01	0.2996D-01	-0.6408D 00	-0.1412D 02	-0.1476D 02
4	0.0000D-38	-0.0000D-38	0.1959D-01	0.1592D-01	-0.2632D 00	-0.7396D 01	-0.7660D 01
5	0.0000D-38	0.0000D-38	0.0000D-38	0.7742D-02	-0.0000D-38	0.1444D 03	0.1444D 03
6	0.0000D-38	0.0000D-38	0.0000D-38	0.3243D-02	0.8269D-01	-0.0000D-38	0.8269D-01
7	0.0000D-38	0.0000D-38	0.0000D-38	0.1712D-02	0.7564D-01	-0.0000D-38	0.7364D-01
8	0.0000D-38	0.0000D-38	0.0000D-38	0.1049D-02	0.5772D-01	-0.0000D-38	0.5772D-01
9	0.0000D-38	0.0000D-38	0.0000D-38	0.7035D-03	0.4441D-01	-0.0000D-38	0.4441D-01
10	0.0000D-38	0.0000D-38	0.0000D-38	0.5016D-03	0.3444D-01	-0.0000D-38	0.3444D-01
11	0.0000D-38	0.0000D-38	0.0000D-38	0.3741D-03	0.2712D-01	-0.0000D-38	0.2712D-01
12	0.0000D-38	0.0000D-38	0.0000D-38	0.2889D-03	0.2174D-01	-0.0000D-38	0.2174D-01
13	0.0000D-38	0.0000D-38	0.5616D 00	0.5287D 00	0.4528D 02	-0.0000D-38	0.4528D 02
TOTALS		0.0000D-38	0.1000D 01		0.3170D 02	-0.3170D 02	-0.3766D-12

DETAIL OF NODE 6 TEMPERATURE = -27.19 AREA = 0.1000D 01
 IR EMISSANCE = 0.9000 SOLAR EMISSANCE = 0.1800
 ILUM = 0.0000D-38 THETA = 0.9000D 02

NODE	CONDUCTANCE	Q COMP	F	ASCRIPFTFIR	Q COMP	Q COMP	TOTAL
1	0.0000D-38	-0.0000D-38	0.8907D-01	0.7227D-01	-0.5153D 01	-0.3640D 02	-0.4156D 02
2	0.0000D-38	-0.0000D-38	0.1147D 00	0.9303D-01	-0.5124D 01	-0.4494D 02	-0.5006D 02
3	0.0000D-38	-0.0000D-38	0.7454D-01	0.6043D-01	-0.2833D 01	-0.2854D 02	-0.3137D 02
4	0.0000D-38	-0.0000D-38	0.4712D-01	0.3821D-01	-0.1606D 01	-0.1779D 02	-0.1940D 02
5	0.0000D-38	-0.0000D-38	0.0000D-38	0.3243D-02	-0.8269D-01	-0.0000D-38	-0.8269D-01
6	0.0000D-38	0.0000D-38	0.0000D-38	0.2342D-02	-0.0000D-38	0.1047D 03	0.1047D 03
7	0.0000D-38	0.0000D-38	0.0000D-38	0.1592D-02	0.2790D-01	-0.0000D-38	0.2790D-01
8	0.0000D-38	0.0000D-38	0.0000D-38	0.1102D-02	0.3252D-01	-0.0000D-38	0.3252D-01
9	0.0000D-38	0.0000D-38	0.0000D-38	0.7893D-03	0.2970D-01	-0.0000D-38	0.2970D-01
10	0.0000D-38	0.0000D-38	0.0000D-38	0.5852D-03	0.2526D-01	-0.0000D-38	0.2526D-01
11	0.0000D-38	0.0000D-38	0.0000D-38	0.4474D-03	0.2103D-01	-0.0000D-38	0.2103D-01
12	0.0000D-38	0.0000D-38	0.0000D-38	0.3513D-03	0.1747D-01	-0.0000D-38	0.1747D-01
13	0.0000D-38	0.0000D-38	0.6745D 00	0.6256D 00	0.3763D 02	-0.0000D-38	0.3763D 02
TOTALS		0.0000D-38	0.1000D 01		0.2298D 02	-0.2298D 02	-0.4334D-12

DETAIL OF NODE 7 TEMPERATURE = -62.91 AREA = 0.1000D 01
 IR EMISSANCE = 0.9000 SOLAR EMISSANCE = 0.1800
 ILUM = 0.0000D-38 THETA = 0.9000D 02

NODE	CONDUCTANCE	Q COMP	F	ASCRIPFTFIR	Q COMP	Q COMP	TOTAL
1	0.0000D-38	-0.0000D-38	0.3689D-01	0.2995D-01	-0.2661D 01	-0.1508D 02	-0.1774D 02
2	0.0000D-38	-0.0000D-38	0.7454D-01	0.6043D-01	-0.4388D 01	-0.2919D 02	-0.3358D 02
3	0.0000D-38	-0.0000D-38	0.7002D-01	0.5675D-01	-0.3656D 01	-0.2681D 02	-0.3046D 02
4	0.0000D-38	-0.0000D-38	0.5461D-01	0.4426D-01	-0.2636D 01	-0.2062D 02	-0.2325D 02
5	0.0000D-38	-0.0000D-38	0.0000D-38	0.1712D-02	0.7364D-01	-0.0000D-38	0.7364D-01
6	0.0000D-38	-0.0000D-38	0.0000D-38	0.1592D-02	-0.2790D-01	-0.0000D-38	-0.2790D-01
7	0.0000D-38	0.0000D-38	0.0000D-38	0.1200D-02	-0.0000D-38	0.7519D 02	0.7519D 02
8	0.0000D-38	0.0000D-38	0.0000D-38	0.8758D-03	0.1049D-01	-0.0000D-38	0.1049D-01
9	0.0000D-38	0.0000D-38	0.0000D-38	0.6464D-03	0.1299D-01	-0.0000D-38	0.1299D-01
10	0.0000D-38	0.0000D-38	0.0000D-38	0.4880D-03	0.1251D-01	-0.0000D-38	0.1251D-01
11	0.0000D-38	0.0000D-38	0.0000D-38	0.3775D-03	0.1113D-01	-0.0000D-38	0.1113D-01
12	0.0000D-38	0.0000D-38	0.0000D-38	0.2988D-03	0.9625D-02	-0.0000D-38	0.9625D-02
13	0.0000D-38	0.0000D-38	0.7639D 00	0.7014D 00	0.2989D 02	-0.0000D-38	0.2989D 02
TOTALS		0.0000D-38	0.1000D 01		0.1650D 02	-0.1650D 02	-0.4157D-12

DETAIL OF NODE 8 TEMPERATURE = -94.37 AREA = 0.1000D 01
 IR EMISSANCE = 0.9000 SOLAR EMISSANCE = 0.1800
 ILUM = 0.0000D-38 THETA = 0.9000D 02

NODE	CONDUCTANCE	Q COMP	F	ASCRIPFTFIR	Q COMP	Q COMP	TOTAL
1	0.0000D-38	-0.0000D-38	0.1959D-01	0.1591D-01	-0.1604D 01	-0.8006D 01	-0.9611D 01
2	0.0000D-38	-0.0000D-38	0.4712D-01	0.3820D-01	-0.3232D 01	-0.1845D 02	-0.2169D 02
3	0.0000D-38	-0.0000D-38	0.5461D-01	0.4426D-01	-0.3381D 01	-0.2091D 02	-0.2429D 02
4	0.0000D-38	-0.0000D-38	0.5025D-01	0.4072D-01	-0.2913D 01	-0.1897D 02	-0.2189D 02
5	0.0000D-38	-0.0000D-38	0.0000D-38	0.1049D-02	-0.5772D-01	-0.0000D-38	-0.5772D-01
6	0.0000D-38	-0.0000D-38	0.0000D-38	0.1102D-02	-0.3252D-01	-0.0000D-38	-0.3252D-01
7	0.0000D-38	-0.0000D-38	0.0000D-38	0.8758D-03	-0.1049D-01	-0.0000D-38	-0.1049D-01
8	0.0000D-38	0.0000D-38	0.0000D-38	0.6575D-03	-0.0000D-38	0.5440D 02	0.5440D 02
9	0.0000D-38	0.0000D-38	0.0000D-38	0.4933D-03	0.4004D-02	-0.0000D-38	0.4004D-02
10	0.0000D-38	0.0000D-38	0.0000D-38	0.3762D-03	0.5136D-02	-0.0000D-38	0.5136D-02
11	0.0000D-38	0.0000D-38	0.0000D-38	0.2929D-03	0.5126D-02	-0.0000D-38	0.5126D-02
12	0.0000D-38	0.0000D-38	0.0000D-38	0.2329D-03	0.4712D-02	-0.0000D-38	0.4712D-02
13	0.0000D-38	0.0000D-38	0.8284D 00	0.7558D 00	0.2315D 02	-0.0000D-38	0.2315D 02
TOTALS		0.0000D-38	0.1000D 01		0.1194D 02	-0.1194D 02	-0.3677D-12

DETAIL OF NODE 9 TEMPERATURE = -121.45 AREA = 0.1000D 01
 IR EMISSANCE = 0.9000 SOLAR EMISSANCE = 0.1800
 ILUM = 0.0000D-38 THETA = 0.9000D 02

NODE	CONDUCTANCE	Q COMP	F	ASCRIPFTFIR	Q COMP	Q COMP	TOTAL
1	0.0000D-38	-0.0000D-38	0.1204D-01	0.9784D-02	-0.1066D 01	-0.4921D 01	-0.5987D 01
2	0.0000D-38	-0.0000D-38	0.3144D-01	0.2549D-01	-0.2363D 01	-0.1231D 02	-0.1468D 02
3	0.0000D-38	-0.0000D-38	0.4104D-01	0.3326D-01	-0.2811D 01	-0.1571D 02	-0.1892D 02
4	0.0000D-38	-0.0000D-38	0.4234D-01	0.3431D-01	-0.2733D 01	-0.1599D 02	-0.1872D 02
5	0.0000D-38	-0.0000D-38	0.0000D-38	0.7035D-03	-0.4441D-01	-0.0000D-38	-0.4441D-01
6	0.0000D-38	-0.0000D-38	0.0000D-38	0.7893D-03	-0.2970D-01	-0.0000D-38	-0.2970D-01
7	0.0000D-38	-0.0000D-38	0.0000D-38	0.6464D-03	-0.1299D-01	-0.0000D-38	-0.1299D-01
8	0.0000D-38	-0.0000D-38	0.0000D-38	0.4933D-03	-0.4004D-02	-0.0000D-38	-0.4004D-02
9	0.0000D-38	0.0000D-38	0.0000D-38	0.3737D-03	-0.0000D-38	0.4012D 02	0.4012D 02
10	0.0000D-38	0.0000D-38	0.0000D-38	0.2867D-03	0.1586D-02	-0.0000D-38	0.1586D-02
11	0.0000D-38	0.0000D-38	0.0000D-38	0.2241D-03	0.2102D-02	-0.0000D-38	0.2102D-02
12	0.0000D-38	0.0000D-38	0.0000D-38	0.1786D-03	0.2164D-02	-0.0000D-38	0.2164D-02
13	0.0000D-38	0.0000D-38	0.8731D 00	0.7935D 00	0.1787D 02	-0.0000D-38	0.1787D 02
TOTALS		0.0000D-38	0.1000D 01		0.8808D 01	-0.8808D 01	-0.2451D-12

Table 4 (contd)

DETAIL OF NODE 10		TEMPERATURE = -144.50	AREA = 0.10000 01				
		IR EMISSION = 0.9000	SOLAR EMISSION = 0.1800				
		ILUM = 0.00000-38	THETA = 0.90000 02				
NODE	CONDUCTANCE	Q COMP	F	ASCRIP TETR	Q COMP	Q COMP	TOTAL
1	0.00000-38	-0.00000-38	0.81300-02	0.66080-02	-0.75640 00	-0.32320 01	-0.40700 01
2	0.00000-38	-0.00000-38	0.22180-01	0.17980-01	-0.17670 01	-0.86860 01	-0.10450 02
3	0.00000-38	-0.00000-38	0.31070-01	0.25180-01	-0.22670 01	-0.11890 02	-0.14160 02
4	0.00000-38	-0.00000-38	0.45440-01	0.37440-01	-0.31180 02	-0.15470 02	-0.15470 02
5	0.00000-38	-0.00000-38	0.00000-38	0.50160-03	-0.34440-01	-0.00000-38	-0.34440-01
6	0.00000-38	-0.00000-38	0.00000-38	0.58520-03	-0.25260-01	-0.00000-38	-0.25260-01
7	0.00000-38	-0.00000-38	0.00000-38	0.48800-03	-0.12510-01	-0.00000-38	-0.12510-01
8	0.00000-38	-0.00000-38	0.00000-38	0.37620-03	-0.51360-02	-0.00000-38	-0.51360-02
9	0.00000-38	-0.00000-38	0.00000-38	0.28670-03	-0.15860-02	-0.00000-38	-0.15860-02
10	0.00000-38	-0.00000-38	0.00000-38	0.22070-03	-0.00000-38	0.30330 02	0.30330 02
11	0.00000-38	-0.00000-38	0.00000-38	0.17290-03	0.66080-02	-0.00000-38	0.65300-03
12	0.00000-38	-0.00000-38	0.00000-38	0.13800-03	0.90910-03	-0.00000-38	0.90910-03
13	0.00000-38	-0.00000-38	0.90400 00	0.81940 00	-0.13920 02	-0.00000-38	-0.13920 02
TOTALS		0.00000-38	0.10000 01		0.66570 01	-0.66570 01	0.56840-03

DETAIL OF NODE		11	TEMPERATURE = -164.12	AREA = 0.10000 01			
			IR EMITTANCE = 0.9000	SOLAR EMITTANCE = 0.1800			
			ILUM = 0.00000-38	THETA = 0.90000 02			
NODE	CONDUCTANCE	Q COMP	F	ASCRIPPTFTR	Q COMP	Q COMP	TOTAL
1	0.00000-38	-0.00000-38	0.58500-02	0.47560-02	-0.56270 00	-0.23910 01	-0.29950 01
2	0.00000-38	-0.00000-38	0.16380-01	0.13280-01	-0.13560 01	-0.64510 01	-0.77710 01
3	0.00000-38	-0.00000-38	0.23990-01	0.19440-01	-0.18260 01	-0.91840 01	-0.11010 02
4	0.00000-38	-0.00000-38	0.22850-01	0.22180-01	-0.22850 02	-0.12690 02	-0.12690 02
5	0.00000-38	-0.00000-38	0.00000-38	0.0410-03	-0.27120-01	-0.00000-38	-0.27120-01
6	0.00000-38	-0.00000-38	0.00000-38	0.44740-03	-0.21030-01	-0.00000-38	-0.21030-01
7	0.00000-38	-0.00000-38	0.00000-38	0.37750-03	-0.11130-01	-0.00000-38	-0.11130-01
8	0.00000-38	-0.00000-38	0.00000-38	0.29290-03	-0.51260-02	-0.00000-38	-0.51260-02
9	0.00000-38	-0.00000-38	0.00000-38	0.22410-03	-0.21020-02	-0.00000-38	-0.21020-02
10	0.00000-38	-0.00000-38	0.00000-38	0.17290-03	-0.66530-03	-0.00000-38	-0.66530-03
11	0.00000-38	-0.00000-38	0.00000-38	0.13570-03	-0.00000-38	-0.23490 02	0.23490 02
12	0.00000-38	-0.00000-38	0.00000-38	0.03950 00	-0.10060-03	-0.29000-03	-0.29000-03
13	0.00000-38	-0.00000-38	0.92560 00	0.87500 00	-0.11000 02	-0.00000-38	0.11000 02
TOTALS		0.00000-38	0.10000 01		0.51550 01	-0.51550 01	0.28220-10

DETAIL OF NODE 12		TEMPERATURE = -180.92	AREA = 0.10000 01				
		IR EMITTANCE = 0.9000	SOLAR EMITTANCE = 0.1800				
		ILUM = 0.00000 02	THETA = 0.90000 02				
NODE	CONDUCTANCE	Q COMP	F	ASCRIP TTFIR	Q COMP	Q COMP	TOTAL
1	0.00000-38	-0.00000-38	0.44100-02	0.35860-02	-0.43410 00	-0.18020 01	-0.22360 01
2	0.00000-38	-0.00000-38	0.12540-01	0.10170-01	-0.10660 01	-0.49110 01	-0.59770 01
3	0.00000-38	-0.00000-38	0.18940-01	0.15350-01	-0.14830 01	-0.72510 01	-0.87840 01
4	0.00000-38	-0.00000-38	0.3110-01	0.2310-01	-0.2110-01	-0.10460 01	-0.10460 01
5	0.00000-38	-0.00000-38	0.00000-38	0.28890-03	-0.21740-01	-0.00000-38	-0.21740-01
6	0.00000-38	-0.00000-38	0.00000-38	0.35130-03	-0.17470-01	-0.00000-38	-0.17470-01
7	0.00000-38	-0.00000-38	0.00000-38	0.29880-03	-0.96250-02	-0.00000-38	-0.96250-02
8	0.00000-38	-0.00000-38	0.00000-38	0.23290-03	-0.47120-02	-0.00000-38	-0.47120-02
9	0.00000-38	-0.00000-38	0.00000-38	0.17860-03	-0.21640-02	-0.00000-38	-0.21640-02
10	0.00000-38	-0.00000-38	0.00000-38	0.13800-03	-0.90910-03	-0.00000-38	-0.90910-03
11	0.00000-38	-0.00000-38	0.10360-01	0.10360-01	-0.10360-01	-0.29690 01	-0.29690 01
12	0.00000-38	-0.00000-38	0.00000-38	0.86630-04	-0.00000-38	-0.18610 02	-0.18610 02
13	0.00000-38	-0.00000-38	0.94100 00	0.85050 00	0.88430 01	-0.00000-38	0.88430 01
TOTALS		0.00000-38	0.10000 01		0.08040 01	-0.40840 01	0.10470-08

DETAIL OF NODE		13	TEMPERATURE = -459.00	AREA = 0.89440 01		
			IR EMITTANCE = 1.0000	SOLAR EMITTANCE = 1.0000		
			ILUM = 0.00000-38	THETA = 0.90000 02		
THIS IS A CONSTANT TEMPERATURE NODE						
NODE	CONDUCTANCE	Q COMP	F	ASCRIPTFITR	Q COMP	Q COMP
1	0.00000-38	-0.00000-38	0.59380-01	0.50560 00	-0.66640 02	-0.21710 03
2	0.00000-38	-0.00000-38	0.66190-01	0.56020 00	-0.64550 02	-0.23180 03
3	0.00000-38	-0.00000-38	0.72550-01	0.60910 00	-0.65190 02	-0.24840 03
4	0.00000-38	-0.00000-38	0.78280-01	0.65230 00	-0.66640 02	-0.26430 03
5	0.00000-38	-0.00000-38	0.62780-01	0.52870 00	-0.45280 02	-0.81090 02
6	0.00000-38	-0.00000-38	0.57410-01	0.62560 00	-0.37630 02	-0.70610 02
7	0.00000-38	-0.00000-38	0.85410-01	0.70140 00	-0.29890 02	-0.57440 02
8	0.00000-38	-0.00000-38	0.92620-01	0.75580 00	-0.23150 02	-0.45060 02
9	0.00000-38	-0.00000-38	0.79350 00	-0.17870 02	-0.35030 02	-0.52960 02
10	0.00000-38	-0.00000-38	0.10110 00	-0.59400 02	-0.38020 02	-0.41330 02
11	0.00000-38	-0.00000-38	0.10350 00	-0.83750 00	-0.11000 02	-0.21740 02
12	0.00000-38	-0.00000-38	0.10520 00	0.85050 00	-0.88430 01	-0.17510 02
13	0.00000-38	0.00000-38	0.00000-38	0.70470 00	-0.00000-38	0.00000-38
TOTALS		0.00000-38	0.10000 01		-0.45060 03	-0.13180 04

[illegible]

NAME2		
N	=	13,
BOLTZ	=	0.1714000000000000D-08,
SOLCON	=	0.4419999999999999D 03,
RELTOL	=	0.9999999999999997D-05,
ABSCVN	=	0.4599999999999999D 03,
NITER	=	15,
END		

Table 4 (contd)

TAS I, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 2
TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
STEP RISER=Y, STEP TREAD=X
CASE 2, SAME CONDITIONS AS CASE 1, BUT DETAILED PRINTOUT REQUESTED

THE SYMMETRIC CONDUCTION MATRIX IS

```

ROW 1
1 = 0.00000000D-38 2 = 0.00000000D-38 3 = 0.00000000D-38 4 = 0.00000000D-38 5 = 0.00000000D-38
6 = 0.00000000D-38 7 = 0.00000000D-38 8 = 0.00000000D-38 9 = 0.00000000D-38 10 = 0.00000000D-38
11 = 0.00000000D-38 12 = 0.00000000D-38 13 = 0.00000000D-38

ROW 2
1 = 0.00000000D-38 2 = 0.00000000D-38 3 = 0.00000000D-38 4 = 0.00000000D-38 5 = 0.00000000D-38
6 = 0.00000000D-38 7 = 0.00000000D-38 8 = 0.00000000D-38 9 = 0.00000000D-38 10 = 0.00000000D-38
11 = 0.00000000D-38 12 = 0.00000000D-38 13 = 0.00000000D-38

ROW 3
1 = 0.00000000D-38 2 = 0.00000000D-38 3 = 0.00000000D-38 4 = 0.00000000D-38 5 = 0.00000000D-38
6 = 0.00000000D-38 7 = 0.00000000D-38 8 = 0.00000000D-38 9 = 0.00000000D-38 10 = 0.00000000D-38
11 = 0.00000000D-38 12 = 0.00000000D-38 13 = 0.00000000D-38

ROW 4
1 = 0.00000000D-38 2 = 0.00000000D-38 3 = 0.00000000D-38 4 = 0.00000000D-38 5 = 0.00000000D-38
6 = 0.00000000D-38 7 = 0.00000000D-38 8 = 0.00000000D-38 9 = 0.00000000D-38 10 = 0.00000000D-38
11 = 0.00000000D-38 12 = 0.00000000D-38 13 = 0.00000000D-38

ROW 5
1 = 0.00000000D-38 2 = 0.00000000D-38 3 = 0.00000000D-38 4 = 0.00000000D-38 5 = 0.00000000D-38
6 = 0.00000000D-38 7 = 0.00000000D-38 8 = 0.00000000D-38 9 = 0.00000000D-38 10 = 0.00000000D-38
11 = 0.00000000D-38 12 = 0.00000000D-38 13 = 0.00000000D-38

ROW 6
1 = 0.00000000D-38 2 = 0.00000000D-38 3 = 0.00000000D-38 4 = 0.00000000D-38 5 = 0.00000000D-38
6 = 0.00000000D-38 7 = 0.00000000D-38 8 = 0.00000000D-38 9 = 0.00000000D-38 10 = 0.00000000D-38
11 = 0.00000000D-38 12 = 0.00000000D-38 13 = 0.00000000D-38

ROW 7
1 = 0.00000000D-38 2 = 0.00000000D-38 3 = 0.00000000D-38 4 = 0.00000000D-38 5 = 0.00000000D-38
6 = 0.00000000D-38 7 = 0.00000000D-38 8 = 0.00000000D-38 9 = 0.00000000D-38 10 = 0.00000000D-38
11 = 0.00000000D-38 12 = 0.00000000D-38 13 = 0.00000000D-38

ROW 8
1 = 0.00000000D-38 2 = 0.00000000D-38 3 = 0.00000000D-38 4 = 0.00000000D-38 5 = 0.00000000D-38
6 = 0.00000000D-38 7 = 0.00000000D-38 8 = 0.00000000D-38 9 = 0.00000000D-38 10 = 0.00000000D-38
11 = 0.00000000D-38 12 = 0.00000000D-38 13 = 0.00000000D-38

ROW 9
1 = 0.00000000D-38 2 = 0.00000000D-38 3 = 0.00000000D-38 4 = 0.00000000D-38 5 = 0.00000000D-38
6 = 0.00000000D-38 7 = 0.00000000D-38 8 = 0.00000000D-38 9 = 0.00000000D-38 10 = 0.00000000D-38
11 = 0.00000000D-38 12 = 0.00000000D-38 13 = 0.00000000D-38

ROW 10
1 = 0.00000000D-38 2 = 0.00000000D-38 3 = 0.00000000D-38 4 = 0.00000000D-38 5 = 0.00000000D-38
6 = 0.00000000D-38 7 = 0.00000000D-38 8 = 0.00000000D-38 9 = 0.00000000D-38 10 = 0.00000000D-38
11 = 0.00000000D-38 12 = 0.00000000D-38 13 = 0.00000000D-38

ROW 11
1 = 0.00000000D-38 2 = 0.00000000D-38 3 = 0.00000000D-38 4 = 0.00000000D-38 5 = 0.00000000D-38
6 = 0.00000000D-38 7 = 0.00000000D-38 8 = 0.00000000D-38 9 = 0.00000000D-38 10 = 0.00000000D-38
11 = 0.00000000D-38 12 = 0.00000000D-38 13 = 0.00000000D-38

ROW 12
1 = 0.00000000D-38 2 = 0.00000000D-38 3 = 0.00000000D-38 4 = 0.00000000D-38 5 = 0.00000000D-38
6 = 0.00000000D-38 7 = 0.00000000D-38 8 = 0.00000000D-38 9 = 0.00000000D-38 10 = 0.00000000D-38
11 = 0.00000000D-38 12 = 0.00000000D-38 13 = 0.00000000D-38

ROW 13
1 = 0.00000000D-38 2 = 0.00000000D-38 3 = 0.00000000D-38 4 = 0.00000000D-38 5 = 0.00000000D-38
6 = 0.00000000D-38 7 = 0.00000000D-38 8 = 0.00000000D-38 9 = 0.00000000D-38 10 = 0.00000000D-38
11 = 0.00000000D-38 12 = 0.00000000D-38 13 = 0.00000000D-38

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TAS I, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 2
TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
STEP RISER=Y, STEP TREAD=X
CASE 2, SAME CONDITIONS AS CASE 1, BUT DETAILED PRINTOUT REQUESTED

THE SYMMETRIC FA MATRIX IS

```

ROW 1
1 = 0.00000000D-38 2 = 0.00000000D-38 3 = 0.00000000D-38 4 = 0.00000000D-38 5 = 0.29289000D 00
6 = 0.89070000D-01 7 = 0.36890000D-01 8 = 0.19590000D-01 9 = 0.12040000D-01 10 = 0.81300000D-02
11 = 0.58500000D-02 12 = 0.44100000D-02 13 = 0.53113000D 00

ROW 2
1 = 0.00000000D-38 2 = 0.00000000D-38 3 = 0.00000000D-38 4 = 0.00000000D-38 5 = 0.89070000D-01
6 = 0.11475000D 00 7 = 0.74540000D-01 8 = 0.47120000D-01 9 = 0.31440000D-01 10 = 0.22180000D-01
11 = 0.16380000D-01 12 = 0.12540000D-01 13 = 0.59198000D 00

ROW 3
1 = 0.00000000D-38 2 = 0.00000000D-38 3 = 0.00000000D-38 4 = 0.00000000D-38 5 = 0.36890000D-01
6 = 0.74540000D-01 7 = 0.70020000D-01 8 = 0.54610000D-01 9 = 0.41040000D-01 10 = 0.31070000D-01
11 = 0.23990000D-01 12 = 0.18940000D-01 13 = 0.64890000D 00

ROW 4
1 = 0.00000000D-38 2 = 0.00000000D-38 3 = 0.00000000D-38 4 = 0.00000000D-38 5 = 0.19590000D-01
6 = 0.47120000D-01 7 = 0.54610000D-01 8 = 0.50250000D-01 9 = 0.42340000D-01 10 = 0.34640000D-01
11 = 0.28210000D-01 12 = 0.23110000D-01 13 = 0.70013000D 00

ROW 5
1 = 0.29289000D 00 2 = 0.89070000D-01 3 = 0.36890000D-01 4 = 0.19590000D-01 5 = 0.00000000D-38
6 = 0.00000000D-38 7 = 0.00000000D-38 8 = 0.00000000D-38 9 = 0.00000000D-38 10 = 0.00000000D-38
11 = 0.00000000D-38 12 = 0.00000000D-38 13 = 0.56156000D 00

ROW 6
1 = 0.89070000D-01 2 = 0.11475000D 00 3 = 0.74540000D-01 4 = 0.47120000D-01 5 = 0.00000000D-38
6 = 0.00000000D-38 7 = 0.00000000D-38 8 = 0.00000000D-38 9 = 0.00000000D-38 10 = 0.00000000D-38
11 = 0.00000000D-38 12 = 0.00000000D-38 13 = 0.67452000D 00

```

Table 4 (contd)

```

ROW 7
1 = 0.368900000-01 2 = 0.745400000-01 3 = 0.700200000-01 4 = 0.546100000-01 5 = 0.000000000-38
6 = 0.000000000-38 7 = 0.000000000-38 8 = 0.000000000-38 9 = 0.000000000-38 10 = 0.000000000-38
11 = 0.000000000-38 12 = 0.000000000-38 13 = 0.763940000 00

ROW 8
1 = 0.195900000-01 2 = 0.471200000-01 3 = 0.546100000-01 4 = 0.502500000-01 5 = 0.000000000-38
6 = 0.000000000-38 7 = 0.000000000-38 8 = 0.000000000-38 9 = 0.000000000-38 10 = 0.000000000-38
11 = 0.000000000-38 12 = 0.000000000-38 13 = 0.828430000 00

ROW 9
1 = 0.120400000-01 2 = 0.314400000-01 3 = 0.410400000-01 4 = 0.423400000-01 5 = 0.000000000-38
6 = 0.000000000-38 7 = 0.000000000-38 8 = 0.000000000-38 9 = 0.000000000-38 10 = 0.000000000-38
11 = 0.000000000-38 12 = 0.000000000-38 13 = 0.873140000 00

ROW 10
1 = 0.813000000-02 2 = 0.221800000-01 3 = 0.310700000-01 4 = 0.346400000-01 5 = 0.000000000-38
6 = 0.000000000-38 7 = 0.000000000-38 8 = 0.000000000-38 9 = 0.000000000-38 10 = 0.000000000-38
11 = 0.000000000-38 12 = 0.000000000-38 13 = 0.903980000 00

ROW 11
1 = 0.585000000-02 2 = 0.163800000-01 3 = 0.239900000-01 4 = 0.282100000-01 5 = 0.000000000-38
6 = 0.000000000-38 7 = 0.000000000-38 8 = 0.000000000-38 9 = 0.000000000-38 10 = 0.000000000-38
11 = 0.000000000-38 12 = 0.000000000-38 13 = 0.925570000 00

ROW 12
1 = 0.441000000-02 2 = 0.125400000-01 3 = 0.189400000-01 4 = 0.231100000-01 5 = 0.000000000-38
6 = 0.000000000-38 7 = 0.000000000-38 8 = 0.000000000-38 9 = 0.000000000-38 10 = 0.000000000-38
11 = 0.000000000-38 12 = 0.000000000-38 13 = 0.941000000 00

ROW 13
1 = 0.531130000 00 2 = 0.591980000 00 3 = 0.648900000 00 4 = 0.700130000 00 5 = 0.561560000 00
6 = 0.674520000 00 7 = 0.763940000 00 8 = 0.828430000 00 9 = 0.873140000 00 10 = 0.903980000 00
11 = 0.925570000 00 12 = 0.941000000 00 13 = 0.000000000-38
.....

TAS 1, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 2
TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
STEP RISER=Y, STEP TREAD=X
CASE 2, SAME CONDITIONS AS CASE 1, BUT DETAILED PRINTOUT REQUESTED

THE F MATRIX IS

ROW 1
1 = 0.000000000-38 2 = 0.000000000-38 3 = 0.000000000-38 4 = 0.000000000-38 5 = 0.292890000 00
6 = 0.890700000-01 7 = 0.368900000-01 8 = 0.195900000-01 9 = 0.120400000-01 10 = 0.813000000-02
11 = 0.585000000-02 12 = 0.441000000-02 13 = 0.531130000 00

ROW 2
1 = 0.000000000-38 2 = 0.000000000-38 3 = 0.000000000-38 4 = 0.000000000-38 5 = 0.890700000-01
6 = 0.114750000 00 7 = 0.745400000-01 8 = 0.471200000-01 9 = 0.314400000-01 10 = 0.221800000-01
11 = 0.163800000-01 12 = 0.125400000-01 13 = 0.591980000 00

ROW 3
1 = 0.000000000-38 2 = 0.000000000-38 3 = 0.000000000-38 4 = 0.000000000-38 5 = 0.368900000-01
6 = 0.745400000-01 7 = 0.700200000-01 8 = 0.546100000-01 9 = 0.410400000-01 10 = 0.310700000-01
11 = 0.239900000-01 12 = 0.189400000-01 13 = 0.648900000 00

ROW 4
1 = 0.000000000-38 2 = 0.000000000-38 3 = 0.000000000-38 4 = 0.000000000-38 5 = 0.195900000-01
6 = 0.471200000-01 7 = 0.546100000-01 8 = 0.502500000-01 9 = 0.423400000-01 10 = 0.346400000-01
11 = 0.282100000-01 12 = 0.231100000-01 13 = 0.700130000 00

ROW 5
1 = 0.292890000 00 2 = 0.890700000-01 3 = 0.368900000-01 4 = 0.195900000-01 5 = 0.000000000-38
6 = 0.000000000-38 7 = 0.000000000-38 8 = 0.000000000-38 9 = 0.000000000-38 10 = 0.000000000-38
11 = 0.000000000-38 12 = 0.000000000-38 13 = 0.561560000 00

ROW 6
1 = 0.890700000-01 2 = 0.114750000 00 3 = 0.745400000-01 4 = 0.471200000-01 5 = 0.000000000-38
6 = 0.000000000-38 7 = 0.000000000-38 8 = 0.000000000-38 9 = 0.000000000-38 10 = 0.000000000-38
11 = 0.000000000-38 12 = 0.000000000-38 13 = 0.674520000 00

ROW 7
1 = 0.368900000-01 2 = 0.745400000-01 3 = 0.700200000-01 4 = 0.546100000-01 5 = 0.000000000-38
6 = 0.000000000-38 7 = 0.000000000-38 8 = 0.000000000-38 9 = 0.000000000-38 10 = 0.000000000-38
11 = 0.000000000-38 12 = 0.000000000-38 13 = 0.763940000 00

ROW 8
1 = 0.195900000-01 2 = 0.471200000-01 3 = 0.546100000-01 4 = 0.502500000-01 5 = 0.000000000-38
6 = 0.000000000-38 7 = 0.000000000-38 8 = 0.000000000-38 9 = 0.000000000-38 10 = 0.000000000-38
11 = 0.000000000-38 12 = 0.000000000-38 13 = 0.828430000 00

ROW 9
1 = 0.120400000-01 2 = 0.314400000-01 3 = 0.410400000-01 4 = 0.423400000-01 5 = 0.000000000-38
6 = 0.000000000-38 7 = 0.000000000-38 8 = 0.000000000-38 9 = 0.000000000-38 10 = 0.000000000-38
11 = 0.000000000-38 12 = 0.000000000-38 13 = 0.873140000 00

ROW 10
1 = 0.813000000-02 2 = 0.221800000-01 3 = 0.310700000-01 4 = 0.346400000-01 5 = 0.000000000-38
6 = 0.000000000-38 7 = 0.000000000-38 8 = 0.000000000-38 9 = 0.000000000-38 10 = 0.000000000-38
11 = 0.000000000-38 12 = 0.000000000-38 13 = 0.903980000 00

ROW 11
1 = 0.585000000-02 2 = 0.163800000-01 3 = 0.239900000-01 4 = 0.282100000-01 5 = 0.000000000-38
6 = 0.000000000-38 7 = 0.000000000-38 8 = 0.000000000-38 9 = 0.000000000-38 10 = 0.000000000-38
11 = 0.000000000-38 12 = 0.000000000-38 13 = 0.925570000 00

ROW 12
1 = 0.441000000-02 2 = 0.125400000-01 3 = 0.189400000-01 4 = 0.231100000-01 5 = 0.000000000-38
6 = 0.000000000-38 7 = 0.000000000-38 8 = 0.000000000-38 9 = 0.000000000-38 10 = 0.000000000-38
11 = 0.000000000-38 12 = 0.000000000-38 13 = 0.941000000 00

ROW 13
1 = 0.593821390-01 2 = 0.661853750-01 3 = 0.725492250-01 4 = 0.782769130-01 5 = 0.627843160-01
6 = 0.754136280-01 7 = 0.854110880-01 8 = 0.926212890-01 9 = 0.976200190-01 10 = 0.101068040 00
11 = 0.103481870 00 12 = 0.105207000 00 13 = 0.000000000-38
.....

```

Table 4 (contd)

TAS I, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 2
 TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
 STEP RISER=Y, STEP TREAD=X
 CASE 2, SAME CONDITIONS AS CASE 1, BUT DETAILED PRINTOUT REQUESTED

THE AREAS ARE
 1 = 0.100000000 01 2 = 0.100000000 01 3 = 0.100000000 01 4 = 0.100000000 01 5 = 0.100000000 01
 6 = 0.100000000 01 7 = 0.100000000 01 8 = 0.100000000 01 9 = 0.100000000 01 10 = 0.100000000 01
 11 = 0.100000000 01 12 = 0.100000000 01 13 = 0.894427200 01

THE IR EMITTANCES ARE
 1 = 0.900000000 00 2 = 0.900000000 00 3 = 0.900000000 00 4 = 0.900000000 00 5 = 0.900000000 00
 6 = 0.900000000 00 7 = 0.900000000 00 8 = 0.900000000 00 9 = 0.900000000 00 10 = 0.900000000 00
 11 = 0.900000000 00 12 = 0.900000000 00 13 = 0.100000000 01

THE SOLAR EMITTANCES ARE
 1 = 0.180000000 00 2 = 0.180000000 00 3 = 0.180000000 00 4 = 0.180000000 00 5 = 0.180000000 00
 6 = 0.180000000 00 7 = 0.180000000 00 8 = 0.180000000 00 9 = 0.180000000 00 10 = 0.180000000 00
 11 = 0.180000000 00 12 = 0.180000000 00 13 = 0.100000000 01

THE ILLUMINATIONS ARE
 1 = 0.100000000 01 2 = 0.100000000 01 3 = 0.100000000 01 4 = 0.100000000 01 5 = 0.000000000-38
 6 = 0.000000000-38 7 = 0.000000000-38 8 = 0.000000000-38 9 = 0.000000000-38 10 = 0.000000000-38
 11 = 0.000000000-38 12 = 0.000000000-38 13 = 0.000000000-38

THE ANGLES THETA TO THE SUN ARE
 1 = 0.000000000-38 2 = 0.000000000-38 3 = 0.000000000-38 4 = 0.000000000-38 5 = 0.900000000 02
 6 = 0.900000000 02 7 = 0.900000000 02 8 = 0.900000000 02 9 = 0.900000000 02 10 = 0.900000000 02
 11 = 0.900000000 02 12 = 0.900000000 02 13 = 0.900000000 02

THE CONSTANT TEMPERATURE NODES ARE
 1 = -0.500000000 03 2 = -0.500000000 03 3 = -0.500000000 03 4 = -0.500000000 03 5 = -0.500000000 03
 6 = -0.500000000 03 7 = -0.500000000 03 8 = -0.500000000 03 9 = -0.500000000 03 10 = -0.500000000 03
 11 = -0.500000000 03 12 = -0.500000000 03 13 = -0.459000000 03

THE POWERS ARE
 1 = 0.000000000-38 2 = 0.000000000-38 3 = 0.000000000-38 4 = 0.000000000-38 5 = 0.000000000-38
 6 = 0.000000000-38 7 = 0.000000000-38 8 = 0.000000000-38 9 = 0.000000000-38 10 = 0.000000000-38
 11 = 0.000000000-38 12 = 0.000000000-38 13 = 0.000000000-38

.....

TAS I, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 2
 TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
 STEP RISER=Y, STEP TREAD=X
 CASE 2, SAME CONDITIONS AS CASE 1, BUT DETAILED PRINTOUT REQUESTED

THE EXCITATION VECTOR IS
 1 = 0.362440000 03 2 = 0.362440000 03 3 = 0.362440000 03 4 = 0.362440000 03 5 = 0.000000000-38
 6 = 0.000000000-38 7 = 0.000000000-38 8 = 0.000000000-38 9 = 0.000000000-38 10 = 0.000000000-38
 11 = 0.000000000-38 12 = 0.000000000-38 13 = 0.000000000-38

.....

TAS I, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 2
 TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
 STEP RISER=Y, STEP TREAD=X
 CASE 2, SAME CONDITIONS AS CASE 1, BUT DETAILED PRINTOUT REQUESTED

THE SOLAR TRANSFER MATRIX BEFORE INVERSION IS

ROW 1
 1 = -0.100000000 01 2 = -0.000000000-38 3 = -0.000000000-38 4 = -0.000000000-38 5 = -0.240169800 00
 6 = -0.730374000-01 7 = -0.302498000-01 8 = -0.160638000-01 9 = -0.987280000-02 10 = -0.666660000-02
 11 = -0.479700000-02 12 = -0.361620000-02 13 = -0.435526600 00

ROW 2
 1 = -0.000000000-38 2 = 0.100000000 01 3 = -0.000000000-38 4 = -0.000000000-38 5 = -0.730374000-01
 6 = -0.940950000-01 7 = -0.611228000-01 8 = -0.386384000-01 9 = -0.257808000-01 10 = -0.181876000-01
 11 = -0.134316000-01 12 = -0.102828000-01 13 = -0.485423600 00

ROW 3
 1 = -0.000000000-38 2 = -0.000000000-38 3 = 0.100000000 01 4 = -0.000000000-38 5 = -0.302498000-01
 6 = -0.611228000-01 7 = -0.574164000-01 8 = -0.447802000-01 9 = -0.336528000-01 10 = -0.254774000-01
 11 = -0.196718000-01 12 = -0.155308000-01 13 = -0.532098000 00

ROW 4
 1 = -0.000000000-38 2 = -0.000000000-38 3 = -0.000000000-38 4 = 0.100000000 01 5 = -0.160638000-01
 6 = -0.386384000-01 7 = -0.447802000-01 8 = -0.412050000-01 9 = -0.347188000-01 10 = -0.284048000-01
 11 = -0.231322000-01 12 = -0.189502000-01 13 = -0.574106600 00

ROW 5
 1 = -0.240169800 00 2 = -0.730374000-01 3 = -0.302498000-01 4 = -0.160638000-01 5 = 0.100000000 01
 6 = -0.000000000-38 7 = -0.000000000-38 8 = -0.000000000-38 9 = -0.000000000-38 10 = -0.000000000-38
 11 = -0.000000000-38 12 = -0.000000000-38 13 = -0.460479200 00

ROW 6
 1 = -0.730374000-01 2 = -0.940950000-01 3 = -0.611228000-01 4 = -0.386384000-01 5 = -0.000000000-38
 6 = 0.100000000 01 7 = -0.000000000-38 8 = -0.000000000-38 9 = -0.000000000-38 10 = -0.000000000-38
 11 = -0.000000000-38 12 = -0.000000000-38 13 = -0.553106400 00

ROW 7
 1 = -0.302498000-01 2 = -0.611228000-01 3 = -0.574164000-01 4 = -0.447802000-01 5 = -0.000000000-38
 6 = 0.000000000 01 7 = 0.100000000 01 8 = -0.000000000-38 9 = -0.000000000-38 10 = -0.000000000-38
 11 = -0.000000000-38 12 = -0.000000000-38 13 = -0.626430800 00

ROW 8
 1 = -0.160638000-01 2 = -0.386384000-01 3 = -0.447802000-01 4 = -0.412050000-01 5 = -0.000000000-38
 6 = -0.000000000-38 7 = -0.000000000-38 8 = 0.100000000 01 9 = -0.000000000-38 10 = -0.000000000-38
 11 = -0.000000000-38 12 = -0.000000000-38 13 = -0.679312600 00

ROW 9
 1 = -0.987280000-02 2 = -0.257808000-01 3 = -0.336528000-01 4 = -0.347188000-01 5 = -0.000000000-38
 6 = -0.000000000-38 7 = -0.000000000-38 8 = -0.000000000-38 9 = 0.100000000 01 10 = -0.000000000-38
 11 = -0.000000000-38 12 = -0.000000000-38 13 = -0.715974800 00

Table 4 (contd)

```

ROW 10
1 = -0.66666000D-02 2 = -0.18187600D-01 3 = -0.25477400D-01 4 = -0.28404800D-01 5 = -0.00000000D-38
6 = -0.00000000D-38 7 = -0.00000000D-38 8 = -0.00000000D-38 9 = -0.00000000D-38 10 = 0.10000000D 01
11 = -0.00000000D-38 12 = -0.00000000D-38 13 = -0.74126360D 00

ROW 11
1 = -0.47970000D-02 2 = -0.13431600D-01 3 = -0.19671800D-01 4 = -0.23132200D-01 5 = -0.00000000D-38
6 = -0.00000000D-38 7 = -0.00000000D-38 8 = -0.00000000D-38 9 = -0.00000000D-38 10 = -0.00000000D-38
11 = 0.10000000D 01 12 = -0.00000000D-38 13 = -0.75896740D 00

ROW 12
1 = -0.36162000D-02 2 = -0.10282800D-01 3 = -0.15530800D-01 4 = -0.18950200D-01 5 = -0.00000000D-38
6 = -0.00000000D-38 7 = -0.00000000D-38 8 = -0.00000000D-38 9 = -0.00000000D-38 10 = -0.00000000D-38
11 = -0.00000000D-38 12 = 0.10000000D 01 13 = -0.77162000D 00

ROW 13
1 = -0.00000000D-38 2 = -0.00000000D-38 3 = -0.00000000D-38 4 = -0.00000000D-38 5 = -0.00000000D-38
6 = -0.00000000D-38 7 = -0.00000000D-38 8 = -0.00000000D-38 9 = -0.00000000D-38 10 = -0.00000000D-38
11 = -0.00000000D-38 12 = -0.00000000D-38 13 = 0.10000000D 01

```

TAS I, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 2
 TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
 STEP RISER=Y, STEP TREAD=X
 CASE 2, SAME CONDITIONS AS CASE 1, BUT DETAILED PRINTOUT REQUESTED

THE SOLAR TRANSFER MATRIX AFTER INVERSION IS

```

ROW 1
1 = 0.10700515D 01 2 = 0.30270782D-01 3 = 0.16641565D-01 4 = 0.10655861D-01 5 = 0.25987954D 00
6 = 0.82431015D-01 7 = 0.35651750D-01 8 = 0.19542996D-01 9 = 0.12274804D-01 10 = 0.84108198D-02
11 = 0.61134852D-02 12 = 0.46411762D-02 13 = 0.71981824D 00

ROW 2
1 = 0.30270782D-01 2 = 0.10223610D 01 3 = 0.16054686D-01 4 = 0.11845446D-01 5 = 0.82616649D-01
6 = 0.99848992D-01 7 = 0.64857494D-01 8 = 0.41195680D-01 9 = 0.27607686D-01 10 = 0.19541595D-01
11 = 0.14466988D-01 12 = 0.11096014D-01 13 = 0.74048267D 00

ROW 3
1 = 0.16641565D-01 2 = 0.16054686D-01 3 = 0.10131155D 01 4 = 0.10456724D-01 5 = 0.35983910D-01
6 = 0.65054610D-01 7 = 0.60122411D-01 8 = 0.46686038D-01 9 = 0.35035420D-01 10 = 0.26511509D-01
11 = 0.20467162D-01 12 = 0.16157918D-01 13 = 0.75478826D 00

ROW 4
1 = 0.10655861D-01 2 = 0.11845446D-01 3 = 0.10456724D-01 4 = 0.10087686D 01 5 = 0.19945348D-01
6 = 0.41509223D-01 7 = 0.46819613D-01 8 = 0.42663428D-01 9 = 0.35785722D-01 10 = 0.29206760D-01
11 = 0.23750960D-01 12 = 0.19439107D-01 13 = 0.76584757D 00

ROW 5
1 = 0.25987954D 00 2 = 0.82616649D-01 3 = 0.35983910D-01 4 = 0.19945348D-01 5 = 0.10698582D 01
6 = 0.29724833D-01 7 = 0.15870288D-01 8 = 0.98000428D-02 9 = 0.65990999D-02 10 = 0.47184316D-02
11 = 0.35255640D-02 12 = 0.27261341D-02 13 = 0.72257535D 00

ROW 6
1 = 0.82431015D-01 2 = 0.99848992D-01 3 = 0.65054610D-01 4 = 0.41509223D-01 5 = 0.29724833D-01
6 = 0.10209960D 01 7 = 0.14190562D-01 8 = 0.98057051D-02 9 = 0.70184310D-02 10 = 0.52020309D-02
11 = 0.39764937D-02 12 = 0.31217721D-02 13 = 0.75108167D 00

ROW 7
1 = 0.35651750D-01 2 = 0.64857494D-01 3 = 0.60122411D-01 4 = 0.46819613D-01 5 = 0.15870288D-01
6 = 0.14190562D-01 7 = 0.10105913D 01 8 = 0.77001881D-02 9 = 0.56728689D-02 10 = 0.42789426D-02
11 = 0.33079180D-02 12 = 0.26168307D-02 13 = 0.77109756D 00

ROW 8
1 = 0.19542996D-01 2 = 0.41195680D-01 3 = 0.46686038D-01 4 = 0.42663428D-01 5 = 0.98000428D-02
6 = 0.98057051D-02 7 = 0.77001881D-02 8 = 0.10057542D 01 9 = 0.43073406D-02 10 = 0.32808209D-02
11 = 0.25523690D-02 12 = 0.20278303D-02 13 = 0.78484300D 00

ROW 9
1 = 0.12274804D-01 2 = 0.27607686D-01 3 = 0.35035420D-01 4 = 0.35785722D-01 5 = 0.65990999D-02
6 = 0.70184310D-02 7 = 0.56728689D-02 8 = 0.43073406D-02 9 = 0.10032544D 01 10 = 0.24930464D-02
11 = 0.19467099D-02 12 = 0.15505472D-02 13 = 0.79416170D 00

ROW 10
1 = 0.84108198D-02 2 = 0.19541595D-01 3 = 0.26511509D-01 4 = 0.29206760D-01 5 = 0.47184316D-02
6 = 0.52020309D-02 7 = 0.42789426D-02 8 = 0.32808209D-02 9 = 0.24930464D-02 10 = 0.10019165D 01
11 = 0.14999673D-02 12 = 0.11965764D-02 13 = 0.80051373D 00

ROW 11
1 = 0.61134852D-02 2 = 0.14466988D-01 3 = 0.20467162D-01 4 = 0.23750960D-01 5 = 0.35255640D-02
6 = 0.39764937D-02 7 = 0.33079180D-02 8 = 0.25523690D-02 9 = 0.19467099D-02 10 = 0.14999673D-02
11 = 0.10011757D 01 12 = 0.93882557D-03 13 = 0.80493002D 00

ROW 12
1 = 0.46411762D-02 2 = 0.11096014D-01 3 = 0.16157918D-01 4 = 0.19439107D-01 5 = 0.27261341D-02
6 = 0.31217721D-02 7 = 0.26168307D-02 8 = 0.20278303D-02 9 = 0.15505472D-02 10 = 0.11965764D-02
11 = 0.93882557D-03 12 = 0.10007502D 01 13 = 0.80807267D 00

ROW 13
1 = 0.00000000D-38 2 = 0.00000000D-38 3 = 0.00000000D-38 4 = 0.00000000D-38 5 = 0.00000000D-38
6 = 0.00000000D-38 7 = 0.00000000D-38 8 = 0.00000000D-38 9 = 0.00000000D-38 10 = 0.00000000D-38
11 = 0.00000000D-38 12 = 0.00000000D-38 13 = 0.10000000D 01

```

TAS I, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 2
 TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
 STEP RISER=Y, STEP TREAD=X
 CASE 2, SAME CONDITIONS AS CASE 1, BUT DETAILED PRINTOUT REQUESTED

THE RESPONSE VECTOR IS

```

1 = 0.40869450D 03 2 = 0.39162798D 03 3 = 0.38283395D 03 4 = 0.37756341D 03 5 = 0.14440532D 03
6 = 0.10468855D 03 7 = 0.75188637D 02 8 = 0.54397946D 02 9 = 0.40123424D 02 10 = 0.30325602D 02
11 = 0.23485603D 02 12 = 0.18605973D 02 13 = 0.00000000D-38

```

THE SOLAR QNET VECTOR IS

```

1 = -0.89713426D 02 2 = -0.85967117D 02 3 = -0.84036720D 02 4 = -0.82879773D 02 5 = -0.31698728D 02
6 = -0.22980413D 02 7 = -0.16504823D 02 8 = -0.11941013D 02 9 = -0.88075809D 01 10 = -0.66568396D 01
11 = -0.51553763D 01 12 = -0.40841501D 01 13 = -0.13175740D 04

```

Table 4 (contd)

TAS 1, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 2
 TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
 STEP RISER=Y, STEP TREAD=X
 CASE 2, SAME CONDITIONS AS CASE 1, BUT DETAILED PRINTOUT REQUESTED

STEP 1 OF THE SCRIPT F MATRIX IS

```

ROW 1
1 = 0.100000000 01 2 = -0.000000000-38 3 = -0.000000000-38 4 = -0.000000000-38 5 = -0.292890000-01
6 = -0.890700000-02 7 = -0.368900000-02 8 = -0.195900000-02 9 = -0.120400000-02 10 = -0.813000000-03
11 = -0.585000000-03 12 = -0.441000000-03 13 = -0.531130000-01

ROW 2
1 = -0.000000000-38 2 = 0.100000000 01 3 = -0.000000000-38 4 = -0.000000000-38 5 = -0.890700000-02
6 = -0.114750000-01 7 = -0.745400000-02 8 = -0.471200000-02 9 = -0.314400000-02 10 = -0.221800000-02
11 = -0.163800000-02 12 = -0.125400000-02 13 = -0.591980000-01

ROW 3
1 = -0.000000000-38 2 = -0.000000000-38 3 = 0.100000000 01 4 = -0.000000000-38 5 = -0.368900000-02
6 = -0.745400000-02 7 = -0.700200000-02 8 = -0.546100000-02 9 = -0.410400000-02 10 = -0.310700000-02
11 = -0.239900000-02 12 = -0.189400000-02 13 = -0.648900000-01

ROW 4
1 = -0.000000000-38 2 = -0.000000000-38 3 = -0.000000000-38 4 = 0.100000000 01 5 = -0.195900000-02
6 = -0.471200000-02 7 = -0.546100000-02 8 = -0.502500000-02 9 = -0.423400000-02 10 = -0.346400000-02
11 = -0.282100000-02 12 = -0.231100000-02 13 = -0.700130000-01

ROW 5
1 = -0.292890000-01 2 = -0.890700000-02 3 = -0.368900000-02 4 = -0.195900000-02 5 = 0.100000000 01
6 = -0.000000000-38 7 = -0.000000000-38 8 = -0.000000000-38 9 = -0.000000000-38 10 = -0.000000000-38
11 = -0.000000000-38 12 = -0.000000000-38 13 = -0.561560000-01

ROW 6
1 = -0.890700000-02 2 = -0.114750000-01 3 = -0.745400000-02 4 = -0.471200000-02 5 = -0.000000000-38
6 = 0.100000000 01 7 = -0.000000000-38 8 = -0.000000000-38 9 = -0.000000000-38 10 = -0.000000000-38
11 = -0.000000000-38 12 = -0.000000000-38 13 = -0.674520000-01

ROW 7
1 = -0.368900000-02 2 = -0.745400000-02 3 = -0.700200000-02 4 = -0.546100000-02 5 = -0.000000000-38
6 = -0.000000000-38 7 = 0.100000000 01 8 = -0.000000000-38 9 = -0.000000000-38 10 = -0.000000000-38
11 = -0.000000000-38 12 = -0.000000000-38 13 = -0.763940000-01

ROW 8
1 = -0.195900000-02 2 = -0.471200000-02 3 = -0.546100000-02 4 = -0.502500000-02 5 = -0.000000000-38
6 = -0.000000000-38 7 = -0.000000000-38 8 = 0.100000000 01 9 = -0.000000000-38 10 = -0.000000000-38
11 = -0.000000000-38 12 = -0.000000000-38 13 = -0.828430000-01

ROW 9
1 = -0.120400000-02 2 = -0.314400000-02 3 = -0.410400000-02 4 = -0.423400000-02 5 = -0.000000000-38
6 = -0.000000000-38 7 = -0.000000000-38 8 = -0.000000000-38 9 = 0.100000000 01 10 = -0.000000000-38
11 = -0.000000000-38 12 = -0.000000000-38 13 = -0.873140000-01

ROW 10
1 = -0.813000000-03 2 = -0.221800000-02 3 = -0.310700000-02 4 = -0.346400000-02 5 = -0.000000000-38
6 = -0.000000000-38 7 = -0.000000000-38 8 = -0.000000000-38 9 = -0.000000000-38 10 = 0.100000000 01
11 = -0.000000000-38 12 = -0.000000000-38 13 = -0.903980000-01

ROW 11
1 = -0.585000000-03 2 = -0.163800000-02 3 = -0.239900000-02 4 = -0.282100000-02 5 = -0.000000000-38
6 = -0.000000000-38 7 = -0.000000000-38 8 = -0.000000000-38 9 = -0.000000000-38 10 = -0.000000000-38
11 = 0.100000000 01 12 = -0.000000000-38 13 = -0.925570000-01

ROW 12
1 = -0.441000000-03 2 = -0.125400000-02 3 = -0.189400000-02 4 = -0.231100000-02 5 = -0.000000000-38
6 = -0.000000000-38 7 = -0.000000000-38 8 = -0.000000000-38 9 = -0.000000000-38 10 = -0.000000000-38
11 = -0.000000000-38 12 = 0.100000000 01 13 = -0.941000000-01

ROW 13
1 = -0.000000000-38 2 = -0.000000000-38 3 = -0.000000000-38 4 = -0.000000000-38 5 = -0.000000000-38
6 = -0.000000000-38 7 = -0.000000000-38 8 = -0.000000000-38 9 = -0.000000000-38 10 = -0.000000000-38
11 = -0.000000000-38 12 = -0.000000000-38 13 = 0.100000000 01

```

TAS 1, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 2
 TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
 STEP RISER=Y, STEP TREAD=X
 CASE 2, SAME CONDITIONS AS CASE 1, BUT DETAILED PRINTOUT REQUESTED

STEP 2 OF THE SCRIPT F MATRIX IS

```

ROW 1
1 = 0.100095840 01 2 = 0.407501060-03 3 = 0.221037680-03 4 = 0.140171040-03 5 = 0.293217910-01
6 = 0.892252090-02 7 = 0.369788630-02 8 = 0.196470910-02 9 = 0.120793580-02 10 = 0.815855350-03
11 = 0.587153860-03 12 = 0.442676250-03 13 = 0.561811030-01

ROW 2
1 = 0.407501060-03 2 = 0.100030820 01 3 = 0.222640300-03 4 = 0.164577690-03 5 = 0.892282390-02
6 = 0.114846010-01 7 = 0.746025810-02 8 = 0.471629320-02 9 = 0.314707010-02 10 = 0.222027670-02
11 = 0.163974160-02 12 = 0.125536820-02 13 = 0.622456080-01

ROW 3
1 = 0.221037680-03 2 = 0.222640300-03 3 = 0.100018400 01 4 = 0.147426010-03 5 = 0.369842470-02
6 = 0.746058990-02 7 = 0.700656850-02 8 = 0.546422780-02 9 = 0.410634550-02 10 = 0.310875590-02
11 = 0.240035130-02 12 = 0.189506590-02 13 = 0.676760970-01

ROW 4
1 = 0.140171040-03 2 = 0.164577690-03 3 = 0.147426010-03 4 = 0.100012440 01 5 = 0.196535900-02
6 = 0.471682220-02 7 = 0.546445560-02 8 = 0.502748040-02 9 = 0.423581800-02 10 = 0.346536800-02
11 = 0.282205620-02 12 = 0.231183500-02 13 = 0.724727870-01

ROW 5
1 = 0.293217910-01 2 = 0.892282390-02 3 = 0.369842470-02 4 = 0.196535900-02 5 = 0.100095580 01
6 = 0.400387430-03 7 = 0.211308010-03 8 = 0.129558760-03 9 = 0.868564590-04 10 = 0.619284480-04
11 = 0.461856320-04 12 = 0.356668920-04 13 = 0.587475410-01

ROW 6
1 = 0.892252090-02 2 = 0.114846010-01 3 = 0.746058990-02 4 = 0.471682220-02 5 = 0.400387430-03
6 = 0.100028910 01 7 = 0.196519010-03 8 = 0.136038970-03 9 = 0.974395870-04 10 = 0.722459790-04
11 = 0.552355620-04 12 = 0.433674550-04 13 = 0.695126230-01

```

Table 4 (contd)

```

ROW 7
1 = 0.369788630-02 2 = 0.746025810-02 3 = 0.700656850-02 4 = 0.546445560-02 5 = 0.211308010-03
6 = 0.196519010-03 7 = 0.100014820 01 8 = 0.108118660-03 9 = 0.797987690-04 10 = 0.602515170-04
11 = 0.466071530-04 12 = 0.368847290-04 13 = 0.779348730-01

ROW 8
1 = 0.196470910-02 2 = 0.471629320-02 3 = 0.546422780-02 4 = 0.502748040-02 5 = 0.129558760-03
6 = 0.136038970-03 7 = 0.108118660-03 8 = 0.100008120 01 9 = 0.609050790-04 10 = 0.464505950-04
11 = 0.361658480-04 12 = 0.287484230-04 13 = 0.839801150-01

ROW 9
1 = 0.120793580-02 2 = 0.314707010-02 3 = 0.410634550-02 4 = 0.423581800-02 5 = 0.868564590-04
6 = 0.974395870-04 7 = 0.797987690-04 8 = 0.609050790-04 9 = 0.100004610 01 10 = 0.353935420-04
11 = 0.276619090-04 12 = 0.220455190-04 13 = 0.881619350-01

ROW 10
1 = 0.815855350-03 2 = 0.222027670-02 3 = 0.310875590-02 4 = 0.346536800-02 5 = 0.619284480-04
6 = 0.722459790-04 7 = 0.602515170-04 8 = 0.464505950-04 9 = 0.353935420-04 10 = 0.100002730 01
11 = 0.213477970-04 12 = 0.170404680-04 13 = 0.910430510-01

ROW 11
1 = 0.587153860-03 2 = 0.163974160-02 3 = 0.240035130-02 4 = 0.282205620-02 5 = 0.461856320-04
6 = 0.552355620-04 7 = 0.466071530-04 8 = 0.361658480-04 9 = 0.276619090-04 10 = 0.213477970-04
11 = 0.100001670 01 12 = 0.133832080-04 13 = 0.930586250-01

ROW 12
1 = 0.442676250-03 2 = 0.125536820-02 3 = 0.189506590-02 4 = 0.231183500-02 5 = 0.356668920-04
6 = 0.433674550-04 7 = 0.368847290-04 8 = 0.287484230-04 9 = 0.220455190-04 10 = 0.170404680-04
11 = 0.133832080-04 12 = 0.100001070 01 13 = 0.944984950-01

ROW 13
1 = 0.000000000-38 2 = 0.000000000-38 3 = 0.000000000-38 4 = 0.000000000-38 5 = 0.000000000-38
6 = 0.000000000-38 7 = 0.000000000-38 8 = 0.000000000-38 9 = 0.000000000-38 10 = 0.000000000-38
11 = 0.000000000-38 12 = 0.000000000-38 13 = 0.100000000 01

TAS 1, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 2
TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
STEP RISER=Y, STEP TREAD=X
CASE 2, SAME CONDITIONS AS CASE 1, BUT DETAILED PRINTOUT REQUESTED

STEP 3 OF THE SCRIPT F MATRIX IS

ROW 1
1 = 0.958425550-02 2 = 0.407501060-02 3 = 0.221037680-02 4 = 0.140171040-02 5 = 0.293217910 00
6 = 0.892252090-01 7 = 0.369788630-01 8 = 0.196470910-01 9 = 0.120793580-01 10 = 0.815855350-02
11 = 0.587153860-02 12 = 0.442676250-02 13 = 0.561811030 00

ROW 2
1 = 0.407501060-02 2 = 0.308172420-02 3 = 0.222640300-02 4 = 0.164577690-02 5 = 0.892282390-01
6 = 0.114846010 00 7 = 0.746025810-01 8 = 0.471629320-01 9 = 0.314707010-01 10 = 0.222027670-01
11 = 0.163974160-01 12 = 0.125536820-01 13 = 0.622456080 00

ROW 3
1 = 0.221037680-02 2 = 0.222640300-02 3 = 0.184013910-02 4 = 0.147426010-02 5 = 0.369842470-01
6 = 0.746058990-01 7 = 0.700656850-01 8 = 0.546422780-01 9 = 0.410634550-01 10 = 0.310875590-01
11 = 0.240035130-01 12 = 0.189506590-01 13 = 0.676760970 00

ROW 4
1 = 0.140171040-02 2 = 0.164577690-02 3 = 0.147426010-02 4 = 0.124422450-02 5 = 0.196535900-01
6 = 0.471682220-01 7 = 0.546445560-01 8 = 0.502748040-01 9 = 0.423581800-01 10 = 0.346536800-01
11 = 0.282205620-01 12 = 0.231183500-01 13 = 0.724727870 00

ROW 5
1 = 0.293217910 00 2 = 0.892282390-01 3 = 0.369842470-01 4 = 0.196535900-01 5 = 0.955775150-02
6 = 0.400387430-02 7 = 0.211308010-02 8 = 0.129558760-02 9 = 0.868564590-03 10 = 0.619284480-03
11 = 0.461856320-03 12 = 0.356668920-03 13 = 0.587475410 00

ROW 6
1 = 0.892252090-01 2 = 0.114846010 00 3 = 0.746058990-01 4 = 0.471682220-01 5 = 0.400387430-02
6 = 0.289095590-02 7 = 0.196519010-02 8 = 0.136038970-02 9 = 0.974395870-03 10 = 0.722459790-03
11 = 0.552355620-03 12 = 0.433674550-03 13 = 0.695126230 00

ROW 7
1 = 0.369788630-01 2 = 0.746025810-01 3 = 0.700656850-01 4 = 0.546445560-01 5 = 0.211308010-02
6 = 0.196519010-02 7 = 0.148151650-02 8 = 0.108118660-02 9 = 0.797987690-03 10 = 0.602515170-03
11 = 0.466071530-03 12 = 0.368847290-03 13 = 0.779348730 00

ROW 8
1 = 0.196470910-01 2 = 0.471629320-01 3 = 0.546422780-01 4 = 0.502748040-01 5 = 0.129558760-02
6 = 0.136038970-02 7 = 0.108118660-02 8 = 0.811752760-03 9 = 0.609050790-03 10 = 0.464505950-03
11 = 0.361658480-03 12 = 0.287484230-03 13 = 0.839801150 00

ROW 9
1 = 0.120793580-01 2 = 0.314707010-01 3 = 0.410634550-01 4 = 0.423581800-01 5 = 0.868564590-03
6 = 0.974395870-03 7 = 0.797987690-03 8 = 0.609050790-03 9 = 0.461356380-03 10 = 0.353935420-03
11 = 0.276619090-03 12 = 0.220455190-03 13 = 0.881619350 00

ROW 10
1 = 0.815855350-02 2 = 0.222027670-01 3 = 0.310875590-01 4 = 0.346536800-01 5 = 0.619284480-03
6 = 0.722459790-03 7 = 0.602515170-03 8 = 0.464505950-03 9 = 0.353935420-03 10 = 0.272508040-03
11 = 0.213477970-03 12 = 0.170404680-03 13 = 0.910430510 00

ROW 11
1 = 0.587153860-02 2 = 0.163974160-01 3 = 0.240035130-01 4 = 0.282205620-01 5 = 0.461856320-03
6 = 0.552355620-03 7 = 0.466071530-03 8 = 0.361658480-03 9 = 0.276619090-03 10 = 0.213477970-03
11 = 0.167488450-03 12 = 0.133832080-03 13 = 0.930586250 00

ROW 12
1 = 0.442676250-02 2 = 0.125536820-01 3 = 0.189506590-01 4 = 0.231183500-01 5 = 0.356668920-03
6 = 0.433674550-03 7 = 0.368847290-03 8 = 0.287484230-03 9 = 0.220455190-03 10 = 0.170404680-03
11 = 0.133832080-03 12 = 0.107013570-03 13 = 0.944984950 00

ROW 13
1 = 0.628123820-01 2 = 0.695927050-01 3 = 0.756641760-01 4 = 0.810270390-01 5 = 0.656817470-01
6 = 0.777174740-01 7 = 0.871338360-01 8 = 0.938926220-01 9 = 0.985680390-01 10 = 0.101789220 00
11 = 0.104042700 00 12 = 0.105652530 00 13 = 0.787838650-01

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Table 4 (contd)

TAS I, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 2
 TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
 STEP RISER=Y, STEP TREAD=X
 CASE 2, SAME CONDITIONS AS CASE 1, BUT DETAILED PRINTOUT REQUESTED

THE SCRIPT F MATRIX IS

```

ROW 1
1 = 0.77632469D-02 2 = 0.33007586D-02 3 = 0.17904052D-02 4 = 0.11353854D-02 5 = 0.23750651D 00
6 = 0.72272419D-01 7 = 0.29952879D-01 8 = 0.15914144D-01 9 = 0.97842796D-02 10 = 0.66084284D-02
11 = 0.47559462D-02 12 = 0.35856776D-02 13 = 0.50562992D 00

ROW 2
1 = 0.33007586D-02 2 = 0.24961966D-02 3 = 0.18033864D-02 4 = 0.13330793D-02 5 = 0.72274874D-01
6 = 0.93025268D-01 7 = 0.60428090D-01 8 = 0.38201975D-01 9 = 0.25491268D-01 10 = 0.17984241D-01
11 = 0.13281907D-01 12 = 0.10168482D-01 13 = 0.56021047D 00

ROW 3
1 = 0.17904052D-02 2 = 0.18033864D-02 3 = 0.14905127D-02 4 = 0.11941507D-02 5 = 0.29957240D-01
6 = 0.60430778D-01 7 = 0.56753205D-01 8 = 0.44260245D-01 9 = 0.33261399D-01 10 = 0.25180923D-01
11 = 0.19442846D-01 12 = 0.15350034D-01 13 = 0.60908488D 00

ROW 4
1 = 0.11353854D-02 2 = 0.13330793D-02 3 = 0.11941507D-02 4 = 0.10078218D-02 5 = 0.15919408D-01
6 = 0.38206260D-01 7 = 0.44262090D-01 8 = 0.40722591D-01 9 = 0.34310126D-01 10 = 0.28069481D-01
11 = 0.22858656D-01 12 = 0.18725863D-01 13 = 0.65225509D 00

ROW 5
1 = 0.23750651D 00 2 = 0.72274874D-01 3 = 0.29957240D-01 4 = 0.15919408D-01 5 = 0.77417787D-02
6 = 0.32431381D-02 7 = 0.17115949D-02 8 = 0.10494260D-02 9 = 0.70353732D-03 10 = 0.50162043D-03
11 = 0.37410362D-03 12 = 0.28890182D-03 13 = 0.52872787D 00

ROW 6
1 = 0.72272419D-01 2 = 0.93025268D-01 3 = 0.60430778D-01 4 = 0.38206260D-01 5 = 0.32431381D-02
6 = 0.23416743D-02 7 = 0.15918040D-02 8 = 0.11019157D-02 9 = 0.78926065D-03 10 = 0.58519243D-03
11 = 0.44740805D-03 12 = 0.35127638D-03 13 = 0.62561361D 00

ROW 7
1 = 0.29952879D-01 2 = 0.60428090D-01 3 = 0.56753205D-01 4 = 0.44262090D-01 5 = 0.17115949D-02
6 = 0.15918040D-02 7 = 0.12000284D-02 8 = 0.87576111D-03 9 = 0.64637003D-03 10 = 0.48803728D-03
11 = 0.37751794D-03 12 = 0.29876631D-03 13 = 0.70141385D 00

ROW 8
1 = 0.15914144D-01 2 = 0.38201975D-01 3 = 0.44260245D-01 4 = 0.40722591D-01 5 = 0.10494260D-02
6 = 0.11019157D-02 7 = 0.87576111D-03 8 = 0.65751974D-03 9 = 0.49333114D-03 10 = 0.37624982D-03
11 = 0.29294337D-03 12 = 0.23286223D-03 13 = 0.75582104D 00

ROW 9
1 = 0.97842796D-02 2 = 0.25491268D-01 3 = 0.33261399D-01 4 = 0.34310126D-01 5 = 0.70353732D-03
6 = 0.78926065D-03 7 = 0.64637003D-03 8 = 0.49333114D-03 9 = 0.37369867D-03 10 = 0.28668769D-03
11 = 0.22406146D-03 12 = 0.17856871D-03 13 = 0.79345741D 00

ROW 10
1 = 0.66084284D-02 2 = 0.17984241D-01 3 = 0.25180923D-01 4 = 0.28069481D-01 5 = 0.50162043D-03
6 = 0.58519243D-03 7 = 0.48803728D-03 8 = 0.37624982D-03 9 = 0.28668769D-03 10 = 0.22073151D-03
11 = 0.17291716D-03 12 = 0.13802779D-03 13 = 0.81938746D 00

ROW 11
1 = 0.47559462D-02 2 = 0.13281907D-01 3 = 0.19442846D-01 4 = 0.22858656D-01 5 = 0.37410362D-03
6 = 0.44740805D-03 7 = 0.37751794D-03 8 = 0.29294337D-03 9 = 0.22406146D-03 10 = 0.17291716D-03
11 = 0.13566565D-03 12 = 0.10840399D-03 13 = 0.83752762D 00

ROW 12
1 = 0.35856776D-02 2 = 0.10168482D-01 3 = 0.15350034D-01 4 = 0.18725863D-01 5 = 0.28890182D-03
6 = 0.35127638D-03 7 = 0.29876631D-03 8 = 0.23286223D-03 9 = 0.17856871D-03 10 = 0.13802779D-03
11 = 0.10840399D-03 12 = 0.86680994D-04 13 = 0.85048645D 00

ROW 13
1 = 0.56531143D-01 2 = 0.62633435D-01 3 = 0.68097759D-01 4 = 0.72924335D-01 5 = 0.59113573D-01
6 = 0.69945727D-01 7 = 0.78420452D-01 8 = 0.84503360D-01 9 = 0.88711235D-01 10 = 0.91610302D-01
11 = 0.93638434D-01 12 = 0.95087275D-01 13 = 0.78783865D-01

```

TAS I, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 2
 TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
 STEP RISER=Y, STEP TREAD=X
 CASE 2, SAME CONDITIONS AS CASE 1, BUT DETAILED PRINTOUT REQUESTED

THE AREA SCRIPT F MATRIX IS

```

ROW 1
1 = 0.77632469D-02 2 = 0.33007586D-02 3 = 0.17904052D-02 4 = 0.11353854D-02 5 = 0.23750651D 00
6 = 0.72272419D-01 7 = 0.29952879D-01 8 = 0.15914144D-01 9 = 0.97842796D-02 10 = 0.66084284D-02
11 = 0.47559462D-02 12 = 0.35856776D-02 13 = 0.50562992D 00

ROW 2
1 = 0.33007586D-02 2 = 0.24961966D-02 3 = 0.18033864D-02 4 = 0.13330793D-02 5 = 0.72274874D-01
6 = 0.93025268D-01 7 = 0.60428090D-01 8 = 0.38201975D-01 9 = 0.25491268D-01 10 = 0.17984241D-01
11 = 0.13281907D-01 12 = 0.10168482D-01 13 = 0.56021047D 00

ROW 3
1 = 0.17904052D-02 2 = 0.18033864D-02 3 = 0.14905127D-02 4 = 0.11941507D-02 5 = 0.29957240D-01
6 = 0.60430778D-01 7 = 0.56753205D-01 8 = 0.44260245D-01 9 = 0.33261399D-01 10 = 0.25180923D-01
11 = 0.19442846D-01 12 = 0.15350034D-01 13 = 0.60908488D 00

ROW 4
1 = 0.11353854D-02 2 = 0.13330793D-02 3 = 0.11941507D-02 4 = 0.10078218D-02 5 = 0.15919408D-01
6 = 0.38206260D-01 7 = 0.44262090D-01 8 = 0.40722591D-01 9 = 0.34310126D-01 10 = 0.28069481D-01
11 = 0.22858656D-01 12 = 0.18725863D-01 13 = 0.65225509D 00

ROW 5
1 = 0.23750651D 00 2 = 0.72274874D-01 3 = 0.29957240D-01 4 = 0.15919408D-01 5 = 0.77417787D-02
6 = 0.32431381D-02 7 = 0.17115949D-02 8 = 0.10494260D-02 9 = 0.70353732D-03 10 = 0.50162043D-03
11 = 0.37410362D-03 12 = 0.28890182D-03 13 = 0.52872787D 00

ROW 6
1 = 0.72272419D-01 2 = 0.93025268D-01 3 = 0.60430778D-01 4 = 0.38206260D-01 5 = 0.32431381D-02
6 = 0.23416743D-02 7 = 0.15918040D-02 8 = 0.11019157D-02 9 = 0.78926065D-03 10 = 0.58519243D-03
11 = 0.44740805D-03 12 = 0.35127638D-03 13 = 0.62561361D 00

```

Table 4 (contd)

ROW 7									
1 =	0.29952879D-01	2 =	0.60428090D-01	3 =	0.56753205D-01	4 =	0.44262090D-01	5 =	0.17115949D-02
6 =	0.15918040D-02	7 =	0.12000284D-02	8 =	0.87576111D-03	9 =	0.64637003D-03	10 =	0.48803728D-03
11 =	0.37751794D-03	12 =	0.29876631D-03	13 =	0.70141385D 00				
ROW 8									
1 =	0.15914144D-01	2 =	0.38201975D-01	3 =	0.44260245D-01	4 =	0.40722591D-01	5 =	0.10494260D-02
6 =	0.11019157D-02	7 =	0.87576111D-03	8 =	0.65751974D-03	9 =	0.49333114D-03	10 =	0.37624982D-03
11 =	0.29294337D-03	12 =	0.23286223D-03	13 =	0.75582104D 00				
ROW 9									
1 =	0.97842796D-02	2 =	0.25491268D-01	3 =	0.33261399D-01	4 =	0.34310126D-01	5 =	0.70353732D-03
6 =	0.78926065D-03	7 =	0.64637003D-03	8 =	0.49333114D-03	9 =	0.37369867D-03	10 =	0.28668769D-03
11 =	0.22406146D-03	12 =	0.17856871D-03	13 =	0.79345741D 00				
ROW 10									
1 =	0.66084284D-02	2 =	0.17984241D-01	3 =	0.25180923D-01	4 =	0.28069481D-01	5 =	0.50162043D-03
6 =	0.58519243D-03	7 =	0.48803728D-03	8 =	0.37624982D-03	9 =	0.28668769D-03	10 =	0.22073151D-03
11 =	0.17291716D-03	12 =	0.13802779D-03	13 =	0.81938746D 00				
ROW 11									
1 =	0.47559462D-02	2 =	0.13281907D-01	3 =	0.19442846D-01	4 =	0.22858656D-01	5 =	0.37410362D-03
6 =	0.44740805D-03	7 =	0.37751794D-03	8 =	0.29294337D-03	9 =	0.22406146D-03	10 =	0.17291716D-03
11 =	0.13566565D-03	12 =	0.10840399D-03	13 =	0.83752762D 00				
ROW 12									
1 =	0.35856776D-02	2 =	0.10168482D-01	3 =	0.15350034D-01	4 =	0.18725863D-01	5 =	0.28890182D-03
6 =	0.35127638D-03	7 =	0.29876631D-03	8 =	0.23286223D-03	9 =	0.17856871D-03	10 =	0.13802779D-03
11 =	0.10840399D-03	12 =	0.86680994D-04	13 =	0.85048645D 00				
ROW 13									
1 =	0.50562992D 00	2 =	0.56021047D 00	3 =	0.60908488D 00	4 =	0.65225509D 00	5 =	0.52872787D 00
6 =	0.62561361D 00	7 =	0.70141385D 00	8 =	0.75582104D 00	9 =	0.79345741D 00	10 =	0.81938746D 00
11 =	0.83752762D 00	12 =	0.85048645D 00	13 =	0.70466432D 00				
TAS I, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 2									
TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY									
STEP RISER=Y, STEP TREAD=X									
CASE 2, SAME CONDITIONS AS CASE 1, BUT DETAILED PRINTOUT REQUESTED									
THE BOLTZ TIMES THE AREA SCRIPT F MATRIX IS									
ROW 1									
1 =	0.13306205D-10	2 =	0.56575003D-11	3 =	0.30687545D-11	4 =	0.19460506D-11	5 =	0.40708615D-09
6 =	0.12387493D-09	7 =	0.51339235D-10	8 =	0.27276843D-10	9 =	0.16770255D-10	10 =	0.11326846D-10
11 =	0.81516919D-11	12 =	0.61458515D-11	13 =	0.86664969D-09				
ROW 2									
1 =	0.56575003D-11	2 =	0.42784809D-11	3 =	0.30910043D-11	4 =	0.22848980D-11	5 =	0.12387913D-09
6 =	0.15944531D-09	7 =	0.10357375D-09	8 =	0.65478186D-10	9 =	0.43692033D-10	10 =	0.30824989D-10
11 =	0.22765188D-10	12 =	0.17428779D-10	13 =	0.96020075D-09				
ROW 3									
1 =	0.30687545D-11	2 =	0.30910043D-11	3 =	0.25547387D-11	4 =	0.20467743D-11	5 =	0.51346709D-10
6 =	0.10357835D-09	7 =	0.97274993D-10	8 =	0.75862060D-10	9 =	0.57010037D-10	10 =	0.43160102D-10
11 =	0.33325038D-10	12 =	0.26309958D-10	13 =	0.10439715D-08				
ROW 4									
1 =	0.19460506D-11	2 =	0.22848980D-11	3 =	0.20467743D-11	4 =	0.17274066D-11	5 =	0.27285865D-10
6 =	0.65485530D-10	7 =	0.75865223D-10	8 =	0.69798521D-10	9 =	0.58807556D-10	10 =	0.48111091D-10
11 =	0.39179736D-10	12 =	0.32096129D-10	13 =	0.11179652D-08				
ROW 5									
1 =	0.40708615D-09	2 =	0.12387913D-09	3 =	0.51346709D-10	4 =	0.27285865D-10	5 =	0.13269409D-10
6 =	0.55587388D-11	7 =	0.29336736D-11	8 =	0.17987161D-11	9 =	0.12058630D-11	10 =	0.85977742D-12
11 =	0.64121360D-12	12 =	0.49517773D-12	13 =	0.90623957D-09				
ROW 6									
1 =	0.12387493D-09	2 =	0.15944531D-09	3 =	0.10357835D-09	4 =	0.65485530D-10	5 =	0.55587388D-11
6 =	0.40136297D-11	7 =	0.27283520D-11	8 =	0.18886835D-11	9 =	0.13527928D-11	10 =	0.10030198D-11
11 =	0.76685740D-12	12 =	0.60208772D-12	13 =	0.10723017D-08				
ROW 7									
1 =	0.51339235D-10	2 =	0.10357375D-09	3 =	0.97274993D-10	4 =	0.75865223D-10	5 =	0.29336736D-11
6 =	0.27283520D-11	7 =	0.20568486D-11	8 =	0.15010545D-11	9 =	0.11078782D-11	10 =	0.83649591D-12
11 =	0.64706575D-12	12 =	0.51208545D-12	13 =	0.12022233D-08				
ROW 8									
1 =	0.27276843D-10	2 =	0.65478186D-10	3 =	0.75862060D-10	4 =	0.69798521D-10	5 =	0.17987161D-11
6 =	0.18886835D-11	7 =	0.15010545D-11	8 =	0.11269888D-11	9 =	0.84556957D-12	10 =	0.64489219D-12
11 =	0.50210493D-12	12 =	0.39912586D-12	13 =	0.12954773D-08				
ROW 9									
1 =	0.16770255D-10	2 =	0.43692033D-10	3 =	0.57010037D-10	4 =	0.58807556D-10	5 =	0.12058630D-11
6 =	0.13527928D-11	7 =	0.11078782D-11	8 =	0.84556957D-12	9 =	0.64051952D-12	10 =	0.49138271D-12
11 =	0.38404134D-12	12 =	0.30606676D-12	13 =	0.13599860D-08				
ROW 10									
1 =	0.11326846D-10	2 =	0.30824989D-10	3 =	0.43160102D-10	4 =	0.48111091D-10	5 =	0.85977742D-12
6 =	0.10030198D-11	7 =	0.83649591D-12	8 =	0.64489219D-12	9 =	0.49138271D-12	10 =	0.37833381D-12
11 =	0.29638001D-12	12 =	0.23657964D-12	13 =	0.14044301D-08				
ROW 11									
1 =	0.81516919D-11	2 =	0.22765188D-10	3 =	0.33325038D-10	4 =	0.39179736D-10	5 =	0.64121360D-12
6 =	0.76685740D-12	7 =	0.64706575D-12	8 =	0.50210493D-12	9 =	0.38404134D-12	10 =	0.29638001D-12
11 =	0.23253092D-12	12 =	0.18580443D-12	13 =	0.14355223D-08				
ROW 12									
1 =	0.61458515D-11	2 =	0.17428779D-10	3 =	0.26309958D-10	4 =	0.32096129D-10	5 =	0.49517773D-12
6 =	0.60208772D-12	7 =	0.51208545D-12	8 =	0.39912586D-12	9 =	0.30606676D-12	10 =	0.23657964D-12
11 =	0.18580443D-12	12 =	0.14857122D-12	13 =	0.14577338D-08				
ROW 13									
1 =	0.86664969D-09	2 =	0.96020075D-09	3 =	0.10439715D-08	4 =	0.11179652D-08	5 =	0.90623957D-09
6 =	0.10723017D-08	7 =	0.12022233D-08	8 =	0.12954773D-08	9 =	0.13599860D-08	10 =	0.14044301D-08
11 =	0.14355223D-08	12 =	0.14577338D-08	13 =	0.12077946D-08				

Table 4 (contd)

TAS 1, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 2
 TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
 STEP RISER=Y, STEP TREAD=X
 CASE 2, SAME CONDITIONS AS CASE 1, BUT DETAILED PRINTOUT REQUESTED

THE RESIDUES ARE
 1 = -0.45901061D-11 2 = -0.12477130D-10 3 = -0.18793855D-10 4 = -0.22687630D-10 5 = -0.38014036D-12
 6 = -0.42277293D-12 7 = -0.41922021D-12 8 = -0.38014036D-12 9 = -0.24691360D-12 10 = 0.48849813D-13
 11 = 0.28209435D-10 12 = 0.10465522D-08 13 = -0.17680000D 04

THE TEMPERATURES ARE
 1 = 0.66243993D 02 2 = 0.49200623D 02 3 = 0.39889589D 02 4 = 0.34114444D 02 5 = 0.12787031D 02
 6 = -0.27193567D 02 7 = -0.62912226D 02 8 = -0.94366218D 02 9 = -0.12144972D 03 10 = -0.14449631D 03
 11 = -0.16412202D 03 12 = -0.18091942D 03 13 = -0.45900000D 03

TAS 1, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 2
 TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
 STEP RISER=Y, STEP TREAD=X
 CASE 2, SAME CONDITIONS AS CASE 1, BUT DETAILED PRINTOUT REQUESTED

ENERGY PER UNIT TIME IN IS NEGATIVE AND ENERGY PER UNIT TIME OUT IS POSITIVE

DETAIL OF NODE 1 TEMPERATURE = 66.24 AREA = 0.1000D 01
 IR EMITTANCE = 0.9000 SOLAR EMITTANCE = 0.1800
 ILUM = 0.1000D 01 THETA = 0.00000D-38
 Q COMP F ASCRIPFTIR Q COMP Q COMP TOTAL
 DIRECT SOLAR -0.4420D 03 -0.4420D 03
 1 0.0000D-38 0.0000D-38 0.0000D-38 0.7763D-02 -0.0000D-38 0.4087D 03 0.4087D 03
 2 0.0000D-38 0.0000D-38 0.0000D-38 0.3301D-02 0.5354D-01 -0.0000D-38 0.5354D-01
 3 0.0000D-38 0.0000D-38 0.0000D-38 0.1790D-02 0.4372D-01 -0.0000D-38 0.4372D-01
 4 0.0000D-38 0.0000D-38 0.0000D-38 0.1135D-02 0.3324D-01 -0.0000D-38 0.3324D-01
 5 0.0000D-38 0.0000D-38 0.2929D 00 0.2375D 00 0.1088D 02 -0.4229D 02 -0.3141D 02
 6 0.0000D-38 0.0000D-38 0.8907D-01 0.7227D-01 0.5153D 01 -0.9325D 01 -0.4171D 01
 7 0.0000D-38 0.0000D-38 0.3689D-01 0.2995D-01 0.2661D 01 -0.2774D 01 -0.1128D 00
 8 0.0000D-38 0.0000D-38 0.1959D-01 0.1591D-01 0.1604D 01 -0.1066D 01 0.5387D 00
 9 0.0000D-38 0.0000D-38 0.1204D-01 0.9784D-01 0.1066D 01 -0.4831D 00 0.5827D 00
 10 0.0000D-38 0.0000D-38 0.5120D-02 0.6608D-02 0.7564D 00 0.2465D 00 0.5099D 00
 11 0.0000D-38 0.0000D-38 0.9850D-02 0.4756D-02 0.5627D 00 -0.1374D 00 0.4253D 00
 12 0.0000D-38 0.0000D-38 0.4410D-02 0.3586D-02 0.4341D 00 -0.8205D-01 0.3520D 00
 13 0.0000D-38 0.0000D-38 0.5311D 00 0.5056D 00 0.6646D 02 -0.0000D-38 0.6646D 02
 TOTALS 0.0000D-38 0.1000D 01 0.8971D 02 -0.8971D 02 -0.4583D-11

DETAIL OF NODE 2 TEMPERATURE = 49.20 AREA = 0.1000D 01
 IR EMITTANCE = 0.9000 SOLAR EMITTANCE = 0.1800
 ILUM = 0.1000D 01 THETA = 0.00000D-38
 Q COMP F ASCRIPFTIR Q COMP Q COMP TOTAL
 DIRECT SOLAR -0.4420D 03 -0.4420D 03
 1 0.0000D-38 -0.0000D-38 0.0000D-38 0.3301D-02 -0.5354D-01 -0.0000D-38 -0.5354D-01
 2 0.0000D-38 0.0000D-38 0.0000D-38 0.2496D-02 0.0000D-38 0.3916D 03 0.3916D 03
 3 0.0000D-38 0.0000D-38 0.0000D-38 0.1803D-02 0.1479D-01 -0.0000D-38 0.1479D-01
 4 0.0000D-38 0.0000D-38 0.0000D-38 0.1333D-02 0.1741D-01 -0.0000D-38 0.1741D-01
 5 0.0000D-38 0.0000D-38 0.8907D-01 0.7227D-01 0.2139D 01 -0.1286D 02 -0.1072D 02
 6 0.0000D-38 0.0000D-38 0.1147D 00 0.9303D-01 0.5124D 01 -0.1201D 02 -0.6889D 01
 7 0.0000D-38 0.0000D-38 0.7454D-01 0.6043D-01 0.4388D 01 -0.5605D 01 -0.1217D 01
 8 0.0000D-38 0.0000D-38 0.4712D-01 0.3820D-01 0.3232D 01 -0.2563D 01 0.6685D 00
 9 0.0000D-38 0.0000D-38 0.3144D-01 0.2549D-01 0.2363D 01 -0.1261D 01 0.1102D 01
 10 0.0000D-38 0.0000D-38 0.2218D-01 0.1798D-01 0.1767D 01 -0.6726D 00 0.1094D 01
 11 0.0000D-38 0.0000D-38 0.1638D-01 0.1328D-01 0.1356D 01 -0.3847D 00 0.9713D 00
 12 0.0000D-38 0.0000D-38 0.1254D-01 0.1017D-01 0.1066D 01 -0.2333D 00 0.8327D 00
 13 0.0000D-38 0.0000D-38 0.5920D 00 0.5602D 00 0.6455D 02 -0.0000D-38 0.6455D 02
 TOTALS 0.0000D-38 0.1000D 01 0.8597D 02 -0.8597D 02 -0.1246D-10

DETAIL OF NODE 3 TEMPERATURE = 39.89 AREA = 0.1000D 01
 IR EMITTANCE = 0.9000 SOLAR EMITTANCE = 0.1800
 ILUM = 0.1000D 01 THETA = 0.00000D-38
 Q COMP F ASCRIPFTIR Q COMP Q COMP TOTAL
 DIRECT SOLAR -0.4420D 03 -0.4420D 03
 1 0.0000D-38 -0.0000D-38 0.0000D-38 0.1790D-02 -0.4372D-01 -0.0000D-38 -0.4372D-01
 2 0.0000D-38 -0.0000D-38 0.0000D-38 0.1803D-02 -0.1479D-01 -0.0000D-38 -0.1479D-01
 3 0.0000D-38 0.0000D-38 0.0000D-38 0.1491D-02 -0.0000D-38 0.3828D 03 0.3828D 03
 4 0.0000D-38 0.0000D-38 0.0000D-38 0.1194D-02 0.5805D-02 -0.0000D-38 0.5805D-02
 5 0.0000D-38 0.0000D-38 0.3689D-01 0.2996D-01 0.6408D 00 -0.5327D 01 -0.4686D 01
 6 0.0000D-38 0.0000D-38 0.7454D-01 0.6043D-01 0.2833D 01 -0.7803D 01 -0.4970D 01
 7 0.0000D-38 0.0000D-38 0.7002D-01 0.5675D-01 0.3656D 01 -0.5265D 01 -0.1609D 01
 8 0.0000D-38 0.0000D-38 0.5461D-01 0.4426D-01 0.3381D 01 -0.2971D 01 0.4107D 00
 9 0.0000D-38 0.0000D-38 0.4104D-01 0.3326D-01 0.2811D 01 -0.1647D 01 0.1164D 01
 10 0.0000D-38 0.0000D-38 0.3107D-01 0.2518D-01 0.2267D 01 -0.9422D 00 0.1325D 01
 11 0.0000D-38 0.0000D-38 0.2399D-01 0.1944D-01 0.1826D 01 -0.5634D 00 0.1262D 01
 12 0.0000D-38 0.0000D-38 0.1894D-01 0.1535D-01 0.1483D 01 -0.3524D 00 0.1131D 01
 13 0.0000D-38 0.0000D-38 0.6489D 00 0.6091D 00 0.6519D 02 -0.0000D-38 0.6519D 02
 TOTALS 0.0000D-38 0.1000D 01 0.8404D 02 -0.8404D 02 -0.1876D-10

DETAIL OF NODE 4 TEMPERATURE = 34.11 AREA = 0.1000D 01
 IR EMITTANCE = 0.9000 SOLAR EMITTANCE = 0.1800
 ILUM = 0.1000D 01 THETA = 0.00000D-38
 Q COMP F ASCRIPFTIR Q COMP Q COMP TOTAL
 DIRECT SOLAR -0.4420D 03 -0.4420D 03
 1 0.0000D-38 -0.0000D-38 0.0000D-38 0.1135D-02 -0.3324D-01 -0.0000D-38 -0.3324D-01
 2 0.0000D-38 -0.0000D-38 0.0000D-38 0.1333D-02 -0.1741D-01 -0.0000D-38 -0.1741D-01
 3 0.0000D-38 -0.0000D-38 0.0000D-38 0.1194D-02 -0.5805D-02 -0.0000D-38 -0.5805D-02
 4 0.0000D-38 0.0000D-38 0.0000D-38 0.1008D-02 -0.0000D-38 0.3776D 03 0.3776D 03
 5 0.0000D-38 0.0000D-38 0.1959D-01 0.1592D-01 0.2632D 00 -0.2829D 01 -0.2566D 01
 6 0.0000D-38 0.0000D-38 0.4712D-01 0.3821D-01 0.1606D 01 -0.4933D 01 -0.3327D 01
 7 0.0000D-38 0.0000D-38 0.5461D-01 0.4426D-01 0.2636D 01 -0.4106D 01 -0.1470D 01
 8 0.0000D-38 0.0000D-38 0.5025D-01 0.4072D-01 0.2913D 01 -0.2733D 01 0.1796D 00
 9 0.0000D-38 0.0000D-38 0.4234D-01 0.3431D-01 0.2733D 01 -0.1699D 01 0.1034D 01
 10 0.0000D-38 0.0000D-38 0.3464D-01 0.2807D-01 0.2391D 01 -0.1050D 01 0.1341D 01
 11 0.0000D-38 0.0000D-38 0.2821D-01 0.2286D-01 0.2035D 01 -0.6625D 00 0.1373D 01
 12 0.0000D-38 0.0000D-38 0.2311D-01 0.1873D-01 0.1719D 01 -0.4300D 00 0.1289D 01
 13 0.0000D-38 0.0000D-38 0.7001D 00 0.6523D 00 0.6664D 02 -0.0000D-38 0.6664D 02
 TOTALS 0.0000D-38 0.1000D 01 0.8288D 02 -0.8288D 02 -0.2270D-10

Table 4 (contd)

DETAIL OF NODE 5 TEMPERATURE = 12.79 AREA = 0.10000 01
 IR EMITTANCE = 0.9000 SOLAR EMITTANCE = 0.1800
 ILUM = 0.00000-38 THETA = 0.900000 02

NODE	CONDUCTANCE	Q COMP	F	ASCRIPFTTIR	Q COMP	Q COMP	TOTAL
1	0.00000-38	-0.00000-38	0.29290 00	0.23750 00	-0.10880 02	-0.11970 03	-0.13060 03
2	0.00000-38	-0.00000-38	0.89070-01	0.72270-01	-0.21390 01	-0.34880 02	-0.37020 02
3	0.00000-38	-0.00000-38	0.36890-01	0.29960-01	-0.64080 00	-0.14120 02	-0.14760 02
4	0.00000-38	-0.00000-38	0.19590-01	0.15920-01	-0.26320 00	-0.73960 01	-0.76600 01
5	0.00000-38	0.00000-38	0.00000-38	0.77420-02	-0.00000-38	0.14440 03	0.14440 03
6	0.00000-38	0.00000-38	0.00000-38	0.32430-02	0.82690-01	-0.00000-38	0.82690-01
7	0.00000-38	0.00000-38	0.00000-38	0.17120-02	0.73640-01	-0.00000-38	0.73640-01
8	0.00000-38	0.00000-38	0.00000-38	0.10490-02	0.57720-01	-0.00000-38	0.57720-01
9	0.00000-38	0.00000-38	0.00000-38	0.70350-03	0.44410-01	-0.00000-38	0.44410-01
10	0.00000-38	0.00000-38	0.00000-38	0.50160-03	0.34440-01	-0.00000-38	0.34440-01
11	0.00000-38	0.00000-38	0.00000-38	0.37410-03	0.27120-01	-0.00000-38	0.27120-01
12	0.00000-38	0.00000-38	0.00000-38	0.28890-03	0.21740-01	-0.00000-38	0.21740-01
13	0.00000-38	0.00000-38	0.56160 00	0.52870 00	0.45280 02	-0.00000-38	0.45280 02
TOTALS		0.00000-38	0.10000 01		0.31700 02	-0.31700 02	-0.37660-12

DETAIL OF NODE 6 TEMPERATURE = -27.19 AREA = 0.10000 01
 IR EMITTANCE = 0.9000 SOLAR EMITTANCE = 0.1800
 ILUM = 0.00000-38 THETA = 0.900000 02

NODE	CONDUCTANCE	Q COMP	F	ASCRIPFTTIR	Q COMP	Q COMP	TOTAL
1	0.00000-38	-0.00000-38	0.89070-01	0.72270-01	-0.51530 01	-0.36400 02	-0.41560 02
2	0.00000-38	-0.00000-38	0.11470 00	0.93030-01	-0.51240 01	-0.44940 02	-0.50060 02
3	0.00000-38	-0.00000-38	0.74540-01	0.60430-01	-0.28540 01	-0.28540 02	-0.31370 02
4	0.00000-38	-0.00000-38	0.47120-01	0.38210-01	-0.16060 01	-0.17790 02	-0.19400 02
5	0.00000-38	-0.00000-38	0.00000-38	0.32430-02	-0.82690-01	-0.00000-38	-0.82690-01
6	0.00000-38	0.00000-38	0.00000-38	0.23420-02	-0.00000-38	0.10470 03	0.10470 03
7	0.00000-38	0.00000-38	0.00000-38	0.15920-02	0.27900-01	-0.00000-38	0.27900-01
8	0.00000-38	0.00000-38	0.00000-38	0.11020-02	0.32520-01	-0.00000-38	0.32520-01
9	0.00000-38	0.00000-38	0.00000-38	0.78930-03	0.29700-01	-0.00000-38	0.29700-01
10	0.00000-38	0.00000-38	0.00000-38	0.58520-03	0.25260-01	-0.00000-38	0.25260-01
11	0.00000-38	0.00000-38	0.00000-38	0.00000-38	0.21030-01	-0.00000-38	0.21030-01
12	0.00000-38	0.00000-38	0.00000-38	0.35130-03	0.17470-01	-0.00000-38	0.17470-01
13	0.00000-38	0.00000-38	0.67450 00	0.62560 00	0.37630 02	-0.00000-38	0.37630 02
TOTALS		0.00000-38	0.10000 01		0.22980 02	-0.22980 02	-0.43340-12

DETAIL OF NODE 7 TEMPERATURE = -62.91 AREA = 0.10000 01
 IR EMITTANCE = 0.9000 SOLAR EMITTANCE = 0.1800
 ILUM = 0.00000-38 THETA = 0.900000 02

NODE	CONDUCTANCE	Q COMP	F	ASCRIPFTTIR	Q COMP	Q COMP	TOTAL
1	0.00000-38	-0.00000-38	0.36890-01	0.29950-01	-0.26610 01	-0.15080 02	-0.17740 02
2	0.00000-38	-0.00000-38	0.74540-01	0.60430-01	-0.43880 01	-0.29190 02	-0.33580 02
3	0.00000-38	-0.00000-38	0.70020-01	0.56750-01	-0.36560 01	-0.26810 02	-0.30460 02
4	0.00000-38	-0.00000-38	0.54610-01	0.44260-01	-0.26360 01	-0.20620 02	-0.23250 02
5	0.00000-38	-0.00000-38	0.00000-38	0.17120-02	-0.73640-01	-0.00000-38	-0.73640-01
6	0.00000-38	-0.00000-38	0.00000-38	0.15920-02	-0.27900-01	-0.00000-38	-0.27900-01
7	0.00000-38	0.00000-38	0.00000-38	0.12000-02	-0.00000-38	0.75190 02	0.75190 02
8	0.00000-38	0.00000-38	0.00000-38	0.87580-03	0.10490-01	-0.00000-38	0.10490-01
9	0.00000-38	0.00000-38	0.00000-38	0.64640-03	0.12990-01	-0.00000-38	0.12990-01
10	0.00000-38	0.00000-38	0.00000-38	0.48800-03	0.12510-01	-0.00000-38	0.12510-01
11	0.00000-38	0.00000-38	0.00000-38	0.37750-03	0.11130-01	-0.00000-38	0.11130-01
12	0.00000-38	0.00000-38	0.00000-38	0.29880-03	0.96250-02	-0.00000-38	0.96250-02
13	0.00000-38	0.00000-38	0.76390 00	0.70140 00	0.29890 02	-0.00000-38	0.29890 02
TOTALS		0.00000-38	0.10000 01		0.16500 02	-0.16500 02	-0.41570-12

DETAIL OF NODE 8 TEMPERATURE = -94.37 AREA = 0.10000 01
 IR EMITTANCE = 0.9000 SOLAR EMITTANCE = 0.1800
 ILUM = 0.00000-38 THETA = 0.900000 02

NODE	CONDUCTANCE	Q COMP	F	ASCRIPFTTIR	Q COMP	Q COMP	TOTAL
1	0.00000-38	-0.00000-38	0.19590-01	0.15910-01	-0.16040 01	-0.80060 01	-0.96110 01
2	0.00000-38	-0.00000-38	0.47120-01	0.38200-01	-0.32320 01	-0.18450 02	-0.21690 02
3	0.00000-38	-0.00000-38	0.54610-01	0.44260-01	-0.33810 01	-0.20910 02	-0.24290 02
4	0.00000-38	-0.00000-38	0.50250-01	0.40720-01	-0.29130 01	-0.18970 02	-0.21890 02
5	0.00000-38	-0.00000-38	0.00000-38	0.10490-02	-0.57720-01	-0.00000-38	-0.57720-01
6	0.00000-38	-0.00000-38	0.00000-38	0.11020-02	-0.32520-01	-0.00000-38	-0.32520-01
7	0.00000-38	-0.00000-38	0.00000-38	0.87580-03	-0.10490-01	-0.00000-38	-0.10490-01
8	0.00000-38	0.00000-38	0.00000-38	0.65750-03	-0.00000-38	0.54400 02	0.54400 02
9	0.00000-38	0.00000-38	0.00000-38	0.49330-03	0.40040-02	-0.00000-38	0.40040-02
10	0.00000-38	0.00000-38	0.00000-38	0.37620-03	0.51360-02	-0.00000-38	0.51360-02
11	0.00000-38	0.00000-38	0.00000-38	0.29290-03	0.51260-02	-0.00000-38	0.51260-02
12	0.00000-38	0.00000-38	0.00000-38	0.23290-03	0.47120-02	-0.00000-38	0.47120-02
13	0.00000-38	0.00000-38	0.82840 00	0.75580 00	0.23150 02	-0.00000-38	0.23150 02
TOTALS		0.00000-38	0.10000 01		0.11940 02	-0.11940 02	-0.36770-12

DETAIL OF NODE 9 TEMPERATURE = -121.45 AREA = 0.10000 01
 IR EMITTANCE = 0.9000 SOLAR EMITTANCE = 0.1800
 ILUM = 0.00000-38 THETA = 0.900000 02

NODE	CONDUCTANCE	Q COMP	F	ASCRIPFTTIR	Q COMP	Q COMP	TOTAL
1	0.00000-38	-0.00000-38	0.12040-01	0.97840-02	-0.10660 01	-0.49210 01	-0.59870 01
2	0.00000-38	-0.00000-38	0.31440-01	0.25490-01	-0.23630 01	-0.12310 02	-0.14680 02
3	0.00000-38	-0.00000-38	0.41040-01	0.33260-01	-0.28110 01	-0.15710 02	-0.18520 02
4	0.00000-38	-0.00000-38	0.42340-01	0.34310-01	-0.27330 01	-0.15990 02	-0.18720 02
5	0.00000-38	-0.00000-38	0.00000-38	0.70350-03	0.44410-01	-0.00000-38	0.44410-01
6	0.00000-38	-0.00000-38	0.00000-38	0.78930-03	-0.29700-01	-0.00000-38	-0.29700-01
7	0.00000-38	-0.00000-38	0.00000-38	0.64640-03	-0.12990-01	-0.00000-38	-0.12990-01
8	0.00000-38	-0.00000-38	0.00000-38	0.49330-03	-0.40040-02	-0.00000-38	-0.40040-02
9	0.00000-38	0.00000-38	0.00000-38	0.37370-03	-0.00000-38	0.40120 02	0.40120 02
10	0.00000-38	0.00000-38	0.00000-38	0.28670-03	0.15860-02	-0.00000-38	0.15860-02
11	0.00000-38	0.00000-38	0.00000-38	0.22410-03	0.21020-02	-0.00000-38	0.21020-02
12	0.00000-38	0.00000-38	0.00000-38	0.17860-03	0.21640-02	-0.00000-38	0.21640-02
13	0.00000-38	0.00000-38	0.87310 00	0.79350 00	0.17870 02	-0.00000-38	0.17870 02
TOTALS		0.00000-38	0.10000 01		0.88080 01	-0.88080 01	-0.24510-12

Table 4 (contd)

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DETAIL OF NODE 10  TEMPERATURE = -144.50      AREA = 0.10000 01
                   IR EMITTANCE = 0.9000      SOLAR EMITTANCE = 0.1800
                   ILUM = 0.00000-38          THETA = 0.900000 02
NODE CONDUCTANCE  Q COMP      F      ASCRIPFTFIR  Q COMP  Q COMP      TOTAL
1  0.00000-38 -0.00000-38  0.81300-02  0.66080-02 -0.75640 00 -0.33230 01 -0.40790 01
2  0.00000-38 -0.00000-38  0.22180-01  0.17980-01 -0.17670 01 -0.86860 01 -0.10450 02
3  0.00000-38 -0.00000-38  0.31070-01  0.25180-01 -0.22670 01 -0.11890 02 -0.14160 02
4  0.00000-38 -0.00000-38  0.34640-01  0.28070-01 -0.23910 01 -0.13080 02 -0.15470 02
5  0.00000-38 -0.00000-38  0.00000-38  0.50160-03 -0.34440-01 -0.00000-38 -0.34440-01
6  0.00000-38 -0.00000-38  0.00000-38  0.58920-03 -0.25260-01 -0.00000-38 -0.25260-01
7  0.00000-38 -0.00000-38  0.00000-38  0.48800-03 -0.12510-01 -0.00000-38 -0.12510-01
8  0.00000-38 -0.00000-38  0.00000-38  0.37620-03 -0.51360-02 -0.00000-38 -0.51360-02
9  0.00000-38 -0.00000-38  0.00000-38  0.28670-03 -0.15860-02 -0.00000-38 -0.15860-02
10 0.00000-38  0.00000-38  0.00000-38  0.22070-03 -0.00000-38  0.30330 02  0.30330 02
11 0.00000-38  0.00000-38  0.00000-38  0.17290-03  0.66530-03 -0.00000-38  0.66530-03
12 0.00000-38  0.00000-38  0.00000-38  0.13800-03  0.90910-03 -0.00000-38  0.90910-03
13 0.00000-38  0.00000-38  0.90400 00  0.81940 00  0.13920 02 -0.00000-38  0.13920 02
TOTALS          0.00000-38  0.10000 01          0.66570 01 -0.66570 01  0.56840-13

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DETAIL OF NODE 11  TEMPERATURE = -164.12      AREA = 0.10000 01
                   IR EMITTANCE = 0.9000      SOLAR EMITTANCE = 0.1800
                   ILUM = 0.00000-38          THETA = 0.900000 02
NODE CONDUCTANCE  Q COMP      F      ASCRIPFTFIR  Q COMP  Q COMP      TOTAL
1  0.00000-38 -0.00000-38  0.58500-02  0.47560-02 -0.56270 00 -0.23910 01 -0.29540 01
2  0.00000-38 -0.00000-38  0.16380-01  0.13280-01 -0.13560 01 -0.64150 01 -0.77710 01
3  0.00000-38 -0.00000-38  0.23990-01  0.19440-01 -0.18260 01 -0.91840 01 -0.11010 02
4  0.00000-38 -0.00000-38  0.28210-01  0.22860-01 -0.20350 01 -0.10650 02 -0.12690 02
5  0.00000-38 -0.00000-38  0.00000-38  0.37410-03 -0.27120-01 -0.00000-38 -0.27120-01
6  0.00000-38 -0.00000-38  0.00000-38  0.44740-03 -0.21030-01 -0.00000-38 -0.21030-01
7  0.00000-38 -0.00000-38  0.00000-38  0.37750-03 -0.11130-01 -0.00000-38 -0.11130-01
8  0.00000-38 -0.00000-38  0.00000-38  0.29290-03 -0.51260-02 -0.00000-38 -0.51260-02
9  0.00000-38 -0.00000-38  0.00000-38  0.22410-03 -0.21020-02 -0.00000-38 -0.21020-02
10 0.00000-38 -0.00000-38  0.00000-38  0.17290-03 -0.66530-03 -0.00000-38 -0.66530-03
11 0.00000-38  0.00000-38  0.00000-38  0.13570-03 -0.00000-38  0.23490 02  0.23490 02
12 0.00000-38  0.00000-38  0.00000-38  0.10840-03  0.29690-03 -0.00000-38  0.29690-03
13 0.00000-38  0.00000-38  0.92560 00  0.83750 00  0.11000 02 -0.00000-38  0.11000 02
TOTALS          0.00000-38  0.10000 01          0.51550 01 -0.51550 01  0.28220-10

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DETAIL OF NODE 12  TEMPERATURE = -180.92      AREA = 0.10000 01
                   IR EMITTANCE = 0.9000      SOLAR EMITTANCE = 0.1800
                   ILUM = 0.00000-38          THETA = 0.900000 02
NODE CONDUCTANCE  Q COMP      F      ASCRIPFTFIR  Q COMP  Q COMP      TOTAL
1  0.00000-38 -0.00000-38  0.44100-02  0.35860-02 -0.43410 00 -0.18020 01 -0.22360 01
2  0.00000-38 -0.00000-38  0.12540-01  0.10170-01 -0.10660 01 -0.49110 01 -0.59770 01
3  0.00000-38 -0.00000-38  0.18940-01  0.15350-01 -0.14830 01 -0.72510 01 -0.87340 01
4  0.00000-38 -0.00000-38  0.23110-01  0.18730-01 -0.17190 01 -0.87250 01 -0.10440 02
5  0.00000-38 -0.00000-38  0.00000-38  0.28890-03 -0.21740-01 -0.00000-38 -0.21740-01
6  0.00000-38 -0.00000-38  0.00000-38  0.35130-03 -0.17470-01 -0.00000-38 -0.17470-01
7  0.00000-38 -0.00000-38  0.00000-38  0.29880-03 -0.96250-02 -0.00000-38 -0.96250-02
8  0.00000-38 -0.00000-38  0.00000-38  0.23290-03 -0.47120-02 -0.00000-38 -0.47120-02
9  0.00000-38 -0.00000-38  0.00000-38  0.17860-03 -0.21640-02 -0.00000-38 -0.21640-02
10 0.00000-38 -0.00000-38  0.00000-38  0.13800-03 -0.90910-03 -0.00000-38 -0.90910-03
11 0.00000-38 -0.00000-38  0.00000-38  0.10840-03 -0.29690-03 -0.00000-38 -0.29690-03
12 0.00000-38 -0.00000-38  0.00000-38  0.86680-04 -0.00000-38  0.18610 02  0.18610 02
13 0.00000-38 -0.00000-38  0.94100 00  0.85050 00  0.88430 01 -0.00000-38  0.88430 01
TOTALS          0.00000-38  0.10000 01          0.40840 01 -0.40840 01  0.10470-08

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DETAIL OF NODE 13  TEMPERATURE = -459.00      AREA = 0.89440 01
                   IR EMITTANCE = 1.0000      SOLAR EMITTANCE = 1.0000
                   ILUM = 0.00000-38          THETA = 0.900000 02
THIS IS A CONSTANT TEMPERATURE NODE
NODE CONDUCTANCE  Q COMP      F      ASCRIPFTFIR  Q COMP  Q COMP      TOTAL
1  0.00000-38 -0.00000-38  0.59380-01  0.50560 00 -0.66460 02 -0.21710 03 -0.28350 03
2  0.00000-38 -0.00000-38  0.66190-01  0.56020 00 -0.64550 02 -0.23180 03 -0.29640 03
3  0.00000-38 -0.00000-38  0.72550-01  0.60910 00 -0.65190 02 -0.24840 03 -0.31360 03
4  0.00000-38 -0.00000-38  0.78280-01  0.65230 00 -0.66640 02 -0.26430 03 -0.33100 03
5  0.00000-38 -0.00000-38  0.62780-01  0.52870 00 -0.45280 02 -0.81090 02 -0.12640 03
6  0.00000-38 -0.00000-38  0.75410-01  0.62560 00 -0.37630 02 -0.70610 02 -0.10820 03
7  0.00000-38 -0.00000-38  0.85410-01  0.70140 00 -0.29890 02 -0.57440 02 -0.87330 02
8  0.00000-38 -0.00000-38  0.92620-01  0.75980 00 -0.23150 02 -0.45060 02 -0.68220 02
9  0.00000-38 -0.00000-38  0.97620-01  0.79350 00 -0.17870 02 -0.35030 02 -0.52900 02
10 0.00000-38 -0.00000-38  0.10110 00  0.81940 00 -0.13920 02 -0.27410 02 -0.41330 02
11 0.00000-38 -0.00000-38  0.10350 00  0.83750 00 -0.11000 02 -0.21740 02 -0.32740 02
12 0.00000-38 -0.00000-38  0.10520 00  0.85050 00 -0.88430 01 -0.17510 02 -0.26350 02
13 0.00000-38  0.00000-38  0.00000-38  0.70470 00 -0.00000-38  0.00000-38  0.00000-38
TOTALS          0.00000-38  0.10000 01          -0.45040 03 -0.13180 04 -0.17680 04

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Table 4 (contd)

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TAS 1, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 3
TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
STEP RISER=Y, STEP TREAD=X
CASE 3, Y=2X AND ALUMINUM SURFACE
T C 1 2 3 4 5 6 7 TITLE CARD
C 2345678901234567890123456789012345678901234567890123456789012 COMMENT CARD
EIR(1)=0.10 DATA CARD
EIR(2)=0.10 DATA CARD
EIR(3)=0.10 DATA CARD
EIR(4)=0.10 DATA CARD
EIR(5)=0.10 DATA CARD
EIR(6)=0.10 DATA CARD
EIR(7)=0.10 DATA CARD
EIR(8)=0.10 DATA CARD
EIR(9)=0.10 DATA CARD
EIR(10)=0.10 DATA CARD
EIR(11)=0.10 DATA CARD
EIR(12)=0.10 DATA CARD
C ESOL(1)=0.20 COMMENT CARD
ESOL(2)=0.20 DATA CARD
ESOL(3)=0.20 DATA CARD
ESOL(4)=0.20 DATA CARD
ESOL(5)=0.20 DATA CARD
ESOL(6)=0.20 DATA CARD
ESOL(7)=0.20 DATA CARD
ESOL(8)=0.20 DATA CARD
ESOL(9)=0.20 DATA CARD
ESOL(10)=0.20 DATA CARD
ESOL(11)=0.20 DATA CARD
ESOL(12)=0.20 DATA CARD
END OF CASE CONTROL CARD

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TAS I,      MAY 6, 1969 VERSION,  JAH X2777, CASE NUMBER  3
TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
STEP RISER=Y, STEP TREAD=X
CASE 3, Y=2X AND ALUMINUM SURFACE

THE RESIDUES ARE
1 = -0.86527702 02      2 = -0.839818720 02      3 = -0.82658641D 02      4 = -0.81861432D 02      5 = -0.26362534D 02
6 = -0.19282755D 02      7 = -0.13390031D 02      8 = -0.10074103D 02      9 = -0.74374763D 01      10 = -0.56243660D 01
11 = -0.43572739D 01      12 = -0.34526736D 01      13 = -0.13424805D 04

THE TEMPERATURES ARE
1 = 0.66243993D 02      2 = 0.49200623D 02      3 = 0.39885959D 02      4 = 0.34114444D 02      5 = 0.12787031D 02
6 = -0.27193567D 02      7 = -0.62912228D 02      8 = -0.94366218D 02      9 = -0.12144972D 03      10 = -0.14449631D 03
11 = -0.16412202D 03      12 = -0.18091942D 03      13 = -0.45900000D 03

THE RESIDUES ARE
1 = 0.58202905D 03      2 = 0.66537534D 03      3 = 0.72021534D 03      4 = 0.75825648D 03      5 = 0.41714133D 02
6 = 0.31720618D 02      7 = 0.23250236D 02      8 = 0.16982015D 02      9 = 0.12589775D 02      10 = 0.95438471D 01
11 = 0.74050850D 01      12 = 0.58737235D 01      13 = -0.46429556D 04

THE TEMPERATURES ARE
1 = 0.86116019D 03      2 = 0.99686659D 03      3 = 0.10196238D 04      4 = 0.10350234D 04      5 = 0.44313700D 03
6 = 0.37974657D 03      7 = 0.31563366D 03      8 = 0.25648755D 03      9 = 0.20456734D 03      10 = 0.15996012D 03
11 = 0.12177107D 03      12 = 0.88979577D 02      13 = -0.45900000D 03

THE RESIDUES ARE
1 = 0.16131569D 03      2 = 0.18817337D 03      3 = 0.20579057D 03      4 = 0.21799145D 03      5 = 0.72119301D 01
6 = 0.56057697D 01      7 = 0.41747047D 01      8 = 0.30419522D 01      9 = 0.22602928D 01      10 = 0.17157042D 01
11 = 0.13323183D 01      12 = 0.10573771D 01      13 = -0.25676435D 04

THE TEMPERATURES ARE
1 = 0.65798741D 03      2 = 0.67854883D 03      3 = 0.69231843D 03      4 = 0.70186266D 03      5 = 0.29604816D 03
6 = 0.24033818D 03      7 = 0.18584038D 03      8 = 0.13614009D 03      9 = 0.92716685D 02      10 = 0.55494068D 02
11 = 0.23667210D 02      12 = -0.36405066D 01      13 = -0.45900000D 03

THE RESIDUES ARE
1 = 0.33679545D 02      2 = 0.41837164D 02      3 = 0.47252092D 02      4 = 0.51023918D 02      5 = -0.23569690D 00
6 = -0.16774066D 00      7 = -0.11805885D 00      8 = -0.84590897D 01      9 = -0.62076344D -01      10 = -0.46781140D -01
11 = -0.36163856D -01      12 = -0.28615468D -01      13 = -0.19491030D 04

THE TEMPERATURES ARE
1 = 0.48554385D 03      2 = 0.49007431D 03      3 = 0.49442743D 03      4 = 0.49768455D 03      5 = 0.24117723D 03
6 = -0.18483980D 03      7 = 0.13543785D 03      8 = 0.89145995D 02      9 = 0.48908508D 02      10 = 0.14506164D 02
11 = -0.14867147D 02      12 = -0.40047792D 02      13 = -0.45900000D 03

THE RESIDUES ARE
1 = 0.30412155D 01      2 = 0.45260307D 01      3 = 0.56146263D 01      4 = 0.64143513D 01      5 = -0.16467004D 00
6 = -0.14405424D 00      7 = -0.11136674D 00      8 = -0.83404266D -01      9 = -0.62673124D -01      10 = -0.47888881D -01
11 = -0.37343687D -01      12 = -0.29720394D -01      13 = -0.17869151D 04

THE TEMPERATURES ARE
1 = 0.42611407D 03      2 = 0.41805224D 03      3 = 0.41454381D 03      4 = 0.41275340D 03      5 = 0.23404454D 03
6 = 0.17948244D 03      7 = 0.12829293D 03      8 = 0.82403016D 02      9 = 0.42581610D 02      10 = 0.85638754D 01
11 = -0.20467230D 02      12 = -0.45347279D 02      13 = -0.45900000D 03

THE RESIDUES ARE
1 = 0.33089446D 01      2 = 0.75630194D -01      3 = 0.11766699D 02      4 = 0.15430458D 00      5 = -0.28209451D -02
6 = -0.30279940D -02      7 = -0.25299244D -02      8 = -0.19613618D -02      9 = -0.15014131D -02      10 = -0.11597614D -02
11 = -0.91058362D -03      12 = -0.72800976D -03      13 = -0.17683660D 04

THE TEMPERATURES ARE
1 = 0.41958724D 03      2 = 0.40819189D 03      3 = 0.40221988D 03      4 = 0.39861821D 03      5 = 0.23393307D 03
6 = 0.17931809D 03      7 = 0.12816064D 03      8 = 0.82277182D 02      9 = 0.42460123D 02      10 = 0.84489154D 01
11 = -0.20576082D 02      12 = -0.45450614D 02      13 = -0.45900000D 03

THE RESIDUES ARE
1 = 0.38805058D -05      2 = 0.22178038D -04      3 = 0.55134681D -04      4 = 0.96237505D -04      5 = -0.86863766D -06
6 = -0.12639403D -05      7 = -0.11665499D -05      8 = -0.94964522D -06      9 = -0.74642371D -06      10 = -0.58562216D -06
11 = -0.46434183D -06      12 = -0.37368497D -06      13 = -0.17680022D 03

THE TEMPERATURES ARE
1 = 0.41951387D 03      2 = 0.40802136D 03      3 = 0.40195059D 03      4 = 0.39826145D 03      5 = 0.23393305D 03
6 = -0.17931805D 03      7 = 0.12816063D 03      8 = 0.82277137D 02      9 = 0.42460079D 02      10 = 0.84488731D 01
11 = -0.20576123D 02      12 = -0.45450650D 02      13 = -0.45900000D 03

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Table 4 (contd)

THE RESIDUES ARE
 1 = -0.38369308D-12 2 = 0.14779289D-11 3 = 0.11759482D-10 4 = 0.37310599D-10 5 = -0.27711167D-12
 6 = -0.40145665D-12 7 = -0.39257486D-12 8 = -0.33395509D-12 9 = -0.26911806D-12 10 = -0.21582736D-12
 11 = -0.15765167D-12 12 = -0.13278267D-12 13 = -0.17680000D 04

THE TEMPERATURES ARE
 1 = 0.41951386D 03 2 = 0.40802131D 03 3 = 0.40195046D 03 4 = 0.39826123D 03 5 = 0.23393305D 03
 6 = 0.17931805D 03 7 = 0.12816060D 03 8 = 0.82275137D 02 9 = 0.42460079D 02 10 = 0.84488731D 01
 11 = -0.20976123D 02 12 = -0.45450653D 02 13 = -0.45900000D 03

TAS I, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 3
 TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
 STEP RISER=Y, STEP TREAD=X
 CASE 3, Y=2X AND ALUMINUM SURFACE

ENERGY PER UNIT TIME IN IS NEGATIVE AND ENERGY PER UNIT TIME OUT IS POSITIVE

DETAIL OF NODE 1 TEMPERATURE = 419.51 AREA = 0.1000D 01
 IR EMITTANCE = 0.1000 SOLAR EMITTANCE = 0.2000
 ILUM = 0.1000D 01 THETA = 0.00000D-38
 Q COMP F ASCTPTFTIR Q COMP Q COMP TOTAL
 NODE CONDUCTANCE
 1 0.0000D-38 0.0000D-38 0.0000D-38 0.9550D-03 -0.0000D-38 0.3963D 03 0.3963D 03
 2 0.0000D-38 0.0000D-38 0.0000D-38 0.4141D-03 0.2177D-01 -0.0000D-38 0.2177D-01
 3 0.0000D-38 0.0000D-38 0.0000D-38 0.2283D-03 0.1815D-01 -0.0000D-38 0.1815D-01
 4 0.0000D-38 0.0000D-38 0.0000D-38 0.1465D-03 0.1400D-01 -0.0000D-38 0.1400D-01
 5 0.0000D-38 0.0000D-38 0.2929D 00 0.3224D-02 0.2025D 01 -0.4005D 02 -0.3802D 02
 6 0.0000D-38 0.0000D-38 0.8907D-01 0.1032D-02 0.7626D 00 -0.8840D 01 -0.8077D 01
 7 0.0000D-38 0.0000D-38 0.3689D-01 0.4500D-03 0.3692D 00 -0.2631D 01 -0.2262D 01
 8 0.0000D-38 0.0000D-38 0.1959D-01 0.2481D-03 0.2177D 00 -0.1011D 01 -0.7933D 00
 9 0.0000D-38 0.0000D-38 0.1204D-01 0.1546D-03 0.1434D 00 -0.4584D 00 -0.3150D 00
 10 0.0000D-38 0.0000D-38 0.8130D-02 0.1075D-03 0.1014D 00 -0.2339D 00 -0.1326D 00
 11 0.0000D-38 0.0000D-38 0.5850D-02 0.7828D-04 0.7528D-01 -0.1304D 00 -0.5509D-01
 12 0.0000D-38 0.0000D-38 0.4410D-02 0.5950D-04 0.5801D-01 -0.7786D-01 -0.1985D-01
 13 0.0000D-38 0.0000D-38 0.5311D 00 0.9290D-01 0.9528D 02 -0.0000D-38 0.9528D 02
 TOTALS 0.0000D-38 0.1000D 01 0.9909D 02 -0.9909D 02 -0.3482D-12

DETAIL OF NODE 2 TEMPERATURE = 408.02 AREA = 0.1000D 01
 IR EMITTANCE = 0.1000 SOLAR EMITTANCE = 0.2000
 ILUM = 0.1000D 01 THETA = 0.00000D-38
 Q COMP F ASCTPTFTIR Q COMP Q COMP TOTAL
 NODE CONDUCTANCE
 1 0.0000D-38 -0.0000D-38 0.0000D-38 0.4141D-03 -0.2177D-01 -0.0000D-38 -0.2177D-01
 2 0.0000D-38 0.0000D-38 0.0000D-38 0.3044D-03 -0.0000D-38 0.3806D 03 0.3806D 03
 3 0.0000D-38 0.0000D-38 0.0000D-38 0.2182D-03 0.5879D-02 -0.0000D-38 0.5879D-02
 4 0.0000D-38 0.0000D-38 0.0000D-38 0.1609D-03 0.6926D-02 -0.0000D-38 0.6926D-02
 5 0.0000D-38 0.0000D-38 0.8907D-01 0.1034D-02 0.5954D 00 -0.1218D 02 -0.1158D 02
 6 0.0000D-38 0.0000D-38 0.1147D 00 0.1234D-02 0.8471D 00 -0.1139D 02 -0.1054D 02
 7 0.0000D-38 0.0000D-38 0.7454D-01 0.8012D-03 0.6153D 00 -0.5316D 01 -0.4701D 01
 8 0.0000D-38 0.0000D-38 0.4712D-01 0.5094D-03 0.4202D 00 -0.2432D 01 -0.2012D 01
 9 0.0000D-38 0.0000D-38 0.3144D-01 0.3417D-03 0.2952D 00 -0.1197D 01 -0.9018D 00
 10 0.0000D-38 0.0000D-38 0.2218D-01 0.2420D-03 0.2155D 00 -0.6382D 00 -0.4227D 00
 11 0.0000D-38 0.0000D-38 0.1638D-01 0.1793D-03 0.1630D 00 -0.3650D 00 -0.2021D 00
 12 0.0000D-38 0.0000D-38 0.1254D-01 0.1375D-03 0.1269D 00 -0.2214D 00 -0.9453D-01
 13 0.0000D-38 0.0000D-38 0.5920D 00 0.9442D-01 0.9188D 02 -0.0000D-38 0.9188D 02
 TOTALS 0.0000D-38 0.1000D 01 0.9515D 02 -0.9515D 02 0.1513D-11

DETAIL OF NODE 3 TEMPERATURE = 401.95 AREA = 0.1000D 01
 IR EMITTANCE = 0.1000 SOLAR EMITTANCE = 0.2000
 ILUM = 0.1000D 01 THETA = 0.00000D-38
 Q COMP F ASCTPTFTIR Q COMP Q COMP TOTAL
 NODE CONDUCTANCE
 1 0.0000D-38 -0.0000D-38 0.0000D-38 0.2283D-03 -0.1815D-01 -0.0000D-38 -0.1815D-01
 2 0.0000D-38 -0.0000D-38 0.0000D-38 0.2182D-03 -0.5879D-02 -0.0000D-38 -0.5879D-02
 3 0.0000D-38 0.0000D-38 0.0000D-38 0.1778D-03 -0.0000D-38 0.3725D 03 0.3725D 03
 4 0.0000D-38 0.0000D-38 0.0000D-38 0.1416D-03 0.2279D-02 -0.0000D-38 0.2279D-02
 5 0.0000D-38 0.0000D-38 0.3689D-01 0.4550D-03 0.2496D 00 -0.5044D 01 -0.4795D 01
 6 0.0000D-38 0.0000D-38 0.7454D-01 0.8042D-03 0.5306D 00 -0.7398D 01 -0.6867D 01
 7 0.0000D-38 0.0000D-38 0.7002D-01 0.7406D-03 0.5488D 00 -0.4994D 01 -0.4445D 01
 8 0.0000D-38 0.0000D-38 0.5461D-01 0.5745D-03 0.4584D 00 -0.2818D 01 -0.2360D 01
 9 0.0000D-38 0.0000D-38 0.4104D-01 0.4310D-03 0.3607D 00 -0.1562D 01 -0.1202D 01
 10 0.0000D-38 0.0000D-38 0.3107D-01 0.3261D-03 0.2816D 00 -0.8941D 00 -0.6124D 00
 11 0.0000D-38 0.0000D-38 0.2399D-01 0.2518D-03 0.2221D 00 -0.5346D 00 -0.3125D 00
 12 0.0000D-38 0.0000D-38 0.1894D-01 0.1987D-03 0.1780D 00 -0.3344D 00 -0.1564D 00
 13 0.0000D-38 0.0000D-38 0.6489D 00 0.9545D-01 0.9031D 02 -0.0000D-38 0.9031D 02
 TOTALS 0.0000D-38 0.1000D 01 0.9312D 02 -0.9312D 02 0.1180D-10

DETAIL OF NODE 4 TEMPERATURE = 398.26 AREA = 0.1000D 01
 IR EMITTANCE = 0.1000 SOLAR EMITTANCE = 0.2000
 ILUM = 0.1000D 01 THETA = 0.00000D-38
 Q COMP F ASCTPTFTIR Q COMP Q COMP TOTAL
 NODE CONDUCTANCE
 1 0.0000D-38 -0.0000D-38 0.0000D-38 0.1465D-03 -0.1400D-01 -0.0000D-38 -0.1400D-01
 2 0.0000D-38 -0.0000D-38 0.0000D-38 0.1609D-03 -0.6926D-02 -0.0000D-38 -0.6926D-02
 3 0.0000D-38 -0.0000D-38 0.0000D-38 0.1416D-03 -0.2279D-02 -0.0000D-38 -0.2279D-02
 4 0.0000D-38 0.0000D-38 0.0000D-38 0.1186D-03 -0.0000D-38 0.3676D 03 0.3676D 03
 5 0.0000D-38 0.0000D-38 0.1959D-01 0.2542D-03 0.1354D 00 -0.2679D 01 -0.2543D 01
 6 0.0000D-38 0.0000D-38 0.4712D-01 0.5141D-03 0.3309D 00 -0.4677D 01 -0.4346D 01
 7 0.0000D-38 0.0000D-38 0.5461D-01 0.5765D-03 0.4179D 00 -0.3895D 01 -0.3477D 01
 8 0.0000D-38 0.0000D-38 0.5025D-01 0.5242D-03 0.4098D 00 -0.2593D 01 -0.2183D 01
 9 0.0000D-38 0.0000D-38 0.4234D-01 0.4393D-03 0.3606D 00 -0.1612D 01 -0.1251D 01
 10 0.0000D-38 0.0000D-38 0.3464D-01 0.3583D-03 0.3037D 00 -0.9968D 00 -0.6931D 00
 11 0.0000D-38 0.0000D-38 0.2821D-01 0.2913D-03 0.2523D 00 -0.6287D 00 -0.3764D 00
 12 0.0000D-38 0.0000D-38 0.2311D-01 0.2384D-03 0.2096D 00 -0.4080D 00 -0.1984D 00
 13 0.0000D-38 0.0000D-38 0.7001D 00 0.9624D-01 0.8950D 02 -0.0000D-38 0.8950D 02
 TOTALS 0.0000D-38 0.1000D 01 0.9190D 02 -0.9190D 02 0.3733D-10

Table 4 (contd)

DETAIL OF NODE 5 TEMPERATURE = 233.93 AREA = 0.10000 01
 IR EMISSANCE = 0.1000 SOLAR EMISSANCE = 0.2000
 ILUM = 0.00000-38 THETA = 0.900000 02

NODE	CONDUCTANCE	Q COMP	F	ASCRIPFTTIR	Q COMP	Q COMP	TOTAL
1	0.00000-38	-0.00000-38	0.29290-01	0.32240-02	-0.20250 01	-0.11610 03	-0.11810 03
2	0.00000-38	-0.00000-38	0.89070-01	0.10340-02	-0.59540 00	-0.33900 02	-0.34490 02
3	0.00000-38	-0.00000-38	0.36890-01	0.45500-03	-0.24960 00	-0.13740 02	-0.13990 02
4	0.00000-38	-0.00000-38	0.19590-01	0.25420-03	-0.13540 00	-0.72010 01	-0.73360 01
5	0.00000-38	-0.00000-38	0.00000-38	0.95230-03	-0.00000-38	0.13670 03	0.13670 03
6	0.00000-38	-0.00000-38	0.00000-38	0.40660-03	0.45170-01	-0.00000-38	0.45170-01
7	0.00000-38	-0.00000-38	0.00000-38	0.21760-03	0.41850-01	-0.00000-38	0.41850-01
8	0.00000-38	-0.00000-38	0.00000-38	0.13460-03	0.33540-01	-0.00000-38	0.33540-01
9	0.00000-38	-0.00000-38	0.00000-38	0.90690-04	0.26140-01	-0.00000-38	0.26140-01
10	0.00000-38	-0.00000-38	0.00000-38	0.64880-04	0.20430-01	-0.00000-38	0.20430-01
11	0.00000-38	-0.00000-38	0.00000-38	0.48500-04	0.16180-01	-0.00000-38	0.16180-01
12	0.00000-38	-0.00000-38	0.00000-38	0.37510-04	0.13010-01	-0.00000-38	0.13010-01
13	0.00000-38	-0.00000-38	0.56160 00	0.93080-01	0.36990 02	-0.00000-38	0.36990 02
TOTALS		0.00000-38	0.10000 01		0.34190 02	-0.34190 02	-0.26650-12

DETAIL OF NODE 6 TEMPERATURE = 179.32 AREA = 0.10000 01
 IR EMISSANCE = 0.1000 SOLAR EMISSANCE = 0.2000
 ILUM = 0.00000-38 THETA = 0.900000 02

NODE	CONDUCTANCE	Q COMP	F	ASCRIPFTTIR	Q COMP	Q COMP	TOTAL
1	0.00000-38	-0.00000-38	0.89070-01	0.10320-02	-0.76260 00	-0.35300 02	-0.36070 02
2	0.00000-38	-0.00000-38	0.11470 00	0.12340-02	-0.84710 00	-0.43670 02	-0.44520 02
3	0.00000-38	-0.00000-38	0.74540-01	0.80420-03	-0.53060 00	-0.27760 02	-0.28290 02
4	0.00000-38	-0.00000-38	0.47120-01	0.51410-03	-0.33090 00	-0.17320 02	-0.17650 02
5	0.00000-38	-0.00000-38	0.00000-38	0.40660-03	-0.45170-01	-0.00000-38	-0.45170-01
6	0.00000-38	-0.00000-38	0.00000-38	0.29590-03	-0.00000-38	0.99250 02	0.99250 02
7	0.00000-38	-0.00000-38	0.00000-38	0.15250-03	0.15670-01	-0.00000-38	0.15670-01
8	0.00000-38	-0.00000-38	0.00000-38	0.13330-03	0.18410-01	-0.00000-38	0.18410-01
9	0.00000-38	-0.00000-38	0.00000-38	0.95380-04	0.16890-01	-0.00000-38	0.16890-01
10	0.00000-38	-0.00000-38	0.00000-38	0.70690-04	0.14410-01	-0.00000-38	0.14410-01
11	0.00000-38	-0.00000-38	0.00000-38	0.54030-04	0.12020-01	-0.00000-38	0.12020-01
12	0.00000-38	-0.00000-38	0.00000-38	0.42420-04	0.99980-02	-0.00000-38	0.99980-02
13	0.00000-38	-0.00000-38	0.67450 00	0.95140-01	0.27240 02	-0.00000-38	0.27240 02
TOTALS		0.00000-38	0.10000 01		0.24810 02	-0.24810 02	-0.39440-12

DETAIL OF NODE 7 TEMPERATURE = 128.16 AREA = 0.10000 01
 IR EMISSANCE = 0.1000 SOLAR EMISSANCE = 0.2000
 ILUM = 0.00000-38 THETA = 0.900000 02

NODE	CONDUCTANCE	Q COMP	F	ASCRIPFTTIR	Q COMP	Q COMP	TOTAL
1	0.00000-38	-0.00000-38	0.36890-01	0.45000-03	-0.36920 00	-0.14620 02	-0.14990 02
2	0.00000-38	-0.00000-38	0.74540-01	0.80120-03	-0.61530 00	-0.28370 02	-0.28980 02
3	0.00000-38	-0.00000-38	0.70020-01	0.74060-03	-0.54880 00	-0.26080 02	-0.26630 02
4	0.00000-38	-0.00000-38	0.54610-01	0.57650-03	-0.41790 00	-0.20070 02	-0.20490 02
5	0.00000-38	-0.00000-38	0.00000-38	0.21760-03	-0.41850-01	-0.00000-38	-0.41850-01
6	0.00000-38	-0.00000-38	0.00000-38	0.19290-03	-0.15670-01	-0.00000-38	-0.15670-01
7	0.00000-38	-0.00000-38	0.00000-38	0.14370-03	-0.00000-38	0.71320 02	0.71320 02
8	0.00000-38	-0.00000-38	0.00000-38	0.10440-03	0.59390-02	-0.00000-38	0.59390-02
9	0.00000-38	-0.00000-38	0.00000-38	0.76870-04	0.73690-02	-0.00000-38	0.73690-02
10	0.00000-38	-0.00000-38	0.00000-38	0.57970-04	0.71060-02	-0.00000-38	0.71060-02
11	0.00000-38	-0.00000-38	0.00000-38	0.44810-04	0.63270-02	-0.00000-38	0.63270-02
12	0.00000-38	-0.00000-38	0.00000-38	0.35440-04	0.54760-02	-0.00000-38	0.54760-02
13	0.00000-38	-0.00000-38	0.76390 00	0.96560-01	0.19810 02	-0.00000-38	0.19810 02
TOTALS		0.00000-38	0.10000 01		0.17830 02	-0.17830 02	-0.38900-12

DETAIL OF NODE 8 TEMPERATURE = 82.28 AREA = 0.10000 01
 IR EMISSANCE = 0.1000 SOLAR EMISSANCE = 0.2000
 ILUM = 0.00000-38 THETA = 0.900000 02

NODE	CONDUCTANCE	Q COMP	F	ASCRIPFTTIR	Q COMP	Q COMP	TOTAL
1	0.00000-38	-0.00000-38	0.19590-01	0.24810-03	-0.21770 00	-0.77640 01	-0.79820 01
2	0.00000-38	-0.00000-38	0.47120-01	0.50940-03	-0.42020 00	-0.17930 02	-0.18350 02
3	0.00000-38	-0.00000-38	0.54610-01	0.57450-03	-0.45880 00	-0.20340 02	-0.20800 02
4	0.00000-38	-0.00000-38	0.50250-01	0.52420-03	-0.40980 00	-0.18470 02	-0.18880 02
5	0.00000-38	-0.00000-38	0.00000-38	0.13460-03	-0.33540-01	-0.00000-38	-0.33540-01
6	0.00000-38	-0.00000-38	0.00000-38	0.13330-03	-0.18410-01	-0.00000-38	-0.18410-01
7	0.00000-38	-0.00000-38	0.00000-38	0.10440-03	-0.59390-02	-0.00000-38	-0.59390-02
8	0.00000-38	-0.00000-38	0.00000-38	0.77920-04	-0.00000-38	0.51610 02	0.51610 02
9	0.00000-38	-0.00000-38	0.00000-38	0.58300-04	0.22720-02	-0.00000-38	0.22720-02
10	0.00000-38	-0.00000-38	0.00000-38	0.44390-04	0.29160-02	-0.00000-38	0.29160-02
11	0.00000-38	-0.00000-38	0.00000-38	0.34530-04	0.29110-02	-0.00000-38	0.29110-02
12	0.00000-38	-0.00000-38	0.00000-38	0.27430-04	0.26770-02	-0.00000-38	0.26770-02
13	0.00000-38	-0.00000-38	0.82840 00	0.97530-01	0.14460 02	-0.00000-38	0.14460 02
TOTALS		0.00000-38	0.10000 01		0.12900 02	-0.12900 02	-0.32860-12

DETAIL OF NODE 9 TEMPERATURE = 42.46 AREA = 0.10000 01
 IR EMISSANCE = 0.1000 SOLAR EMISSANCE = 0.2000
 ILUM = 0.00000-38 THETA = 0.900000 02

NODE	CONDUCTANCE	Q COMP	F	ASCRIPFTTIR	Q COMP	Q COMP	TOTAL
1	0.00000-38	-0.00000-38	0.12040-01	0.15650-03	-0.14340 00	-0.47720 01	-0.49150 01
2	0.00000-38	-0.00000-38	0.31440-01	0.34170-03	-0.29520 00	-0.11970 02	-0.12260 02
3	0.00000-38	-0.00000-38	0.41040-01	0.43100-03	-0.36070 00	-0.15290 02	-0.15650 02
4	0.00000-38	-0.00000-38	0.42340-01	0.43930-03	-0.36060 00	-0.15560 02	-0.15920 02
5	0.00000-38	-0.00000-38	0.00000-38	0.90690-04	-0.26140-01	-0.00000-38	-0.26140-01
6	0.00000-38	-0.00000-38	0.00000-38	0.95380-04	-0.16890-01	-0.00000-38	-0.16890-01
7	0.00000-38	-0.00000-38	0.00000-38	0.76870-04	-0.73690-02	-0.00000-38	-0.73690-02
8	0.00000-38	-0.00000-38	0.00000-38	0.58300-04	-0.22720-02	-0.00000-38	-0.22720-02
9	0.00000-38	-0.00000-38	0.00000-38	0.44020-04	-0.00000-38	0.38070 02	0.38070 02
10	0.00000-38	-0.00000-38	0.00000-38	0.33710-04	-0.90050-03	-0.00000-38	-0.90050-03
11	0.00000-38	-0.00000-38	0.00000-38	0.26320-04	0.11930-02	-0.00000-38	0.11930-02
12	0.00000-38	-0.00000-38	0.00000-38	0.20960-04	0.12290-02	-0.00000-38	0.12290-02
13	0.00000-38	-0.00000-38	0.87310 00	0.98190-01	0.10730 02	-0.00000-38	0.10730 02
TOTALS		0.00000-38	0.10000 01		0.95170 01	-0.95170 01	-0.26820-12

Table 4 (contd)

DETAIL OF NODE		10	TEMPERATURE =	8.45	AREA =	0.10000 01		
			IR EMISSIONANCE =	0.1000	SOLAR EMISSIONANCE =	0.2000		
			ILUM =	0.0000	THETA =	0.90000 02		
NODE	CONDUCTANCE	Q COMP	F	ASCRIPITFTIR	Q COMP	Q COMP	TOTAL	
1	0.00000-38	-0.00000-38	0.81300-02	0.10750-03	-0.1050 00	-0.32220 01	-0.33240 01	
2	0.00000-38	-0.00000-38	0.22180-01	0.24200-03	-0.2150 00	-0.1150 01	-0.09000 02	
3	0.00000-38	-0.00000-38	0.31070-02	0.32610-03	-0.28160 00	-0.11570 02	-0.11880 02	
4	0.00000-38	-0.00000-38	0.34640-01	0.35830-03	-0.30370 00	-0.12730 02	-0.13040 02	
5	0.00000-38	-0.00000-38	0.00000-38	0.64880-04	-0.20430-01	-0.00000-38	-0.20430-01	
6	0.00000-38	-0.00000-38	0.00000-38	0.70690-04	-0.14410-01	-0.00000-38	-0.14410-01	
7	0.00000-38	-0.00000-38	0.00000-38	0.57970-04	-0.71060-02	-0.00000-38	-0.71060-02	
8	0.00000-38	-0.00000-38	0.00000-38	0.44390-04	-0.29160-02	-0.00000-38	-0.29160-02	
9	0.00000-38	-0.00000-38	0.00000-38	0.25910-04	-0.00000-38	-0.00000-38	-0.00000-38	
10	0.00000-38	0.00000-38	0.00000-38	0.25910-04	-0.00000-38	0.28780 02	0.28780 02	
11	0.00000-38	0.00000-38	0.00000-38	0.20270-04	0.37770-03	-0.00000-38	0.37770-03	
12	0.00000-38	0.00000-38	0.00000-38	0.16170-04	0.51620-03	-0.00000-38	0.51620-03	
13	0.00000-38	0.00000-38	0.9040 00	0.98630 00	0.81410 01	-0.00000-38	0.81410 01	
TOTALS		0.00000-38	0.10000 01		0.71940 01	-0.71940 01	-0.20610-12	

DETAIL OF NODE		TEMPERATURE = -20.58		AREA = 0.10000 01			
		IR EMISSION = 0.1000		SOLAR EMISSION = 0.2000			
		ILLUM = 0.000000		THETA = 0.900000 02			
NODE	CONDUCTANCE	Q COMP	F	ASCRIPTEFTR	Q COMP	Q COMP	TOTAL
1	0.00000-38	-0.00000-38	0.58500-02	0.78280-04	-0.75280-01	-0.23190 01	-0.23940 01
2	0.00000-38	-0.00000-38	0.16300-01	0.17930-01			-0.2940 01
3	0.00000-38	-0.00000-38	0.23990-01	0.25180-03	-0.22210 00	-0.89350 01	-0.91580 01
4	0.00000-38	-0.00000-38	0.28210-01	0.29130-03	-0.25230 00	-0.10370 02	-0.10620 02
5	0.00000-38	-0.00000-38	0.00000-38	0.48500-04	-0.16180-01	-0.00000-38	-0.16180-01
6	0.00000-38	-0.00000-38	0.00000-38	0.54030-04	-0.12020-01	-0.00000-38	-0.12020-01
7	0.00000-38	-0.00000-38	0.00000-38	0.44810-04	-0.63270-02	-0.00000-38	-0.63270-02
8	0.00000-38	-0.00000-38	0.00000-38	0.34530-04	-0.29110-02	-0.00000-38	-0.29110-02
9	0.00000-38	-0.00000-38	0.00000-38	0.26230-04	-0.11930-02	-0.00000-38	-0.11930-02
10	0.00000-38	-0.00000-38	0.00000-38	0.20270-04			-0.3770-03
11	0.00000-38	-0.00000-38	0.00000-38	0.15890-04	-0.00000-38	0.22290 02	0.22290 02
12	0.00000-38	-0.00000-38	0.00000-38	0.12680-04	0.16850-03	-0.00000-38	0.16850-03
13	0.00000-38	-0.00000-38	0.92560 00	0.98940-01	0.63230 01	-0.00000-38	0.63230 01
TOTALS		0.00000-38	0.10000 01		0.55720 01	-0.55720 01	-0.15010-12

DETAIL OF NODE 12		TEMPERATURE = -45.45		AREA = 0.10000D 01			
		IR EMITTANCE = 0.1000		SOLAR EMITTANCE = 0.2000			
		ILUM = 0.00000D-38		THETA = 0.90000D 02			
NODE	CONDUCTANCE	Q COMP	F	ASCRIPITFTR	Q COMP	Q COMP	TOTAL
1	0.00000D-38	-0.00000D-38	0.4410D-02	0.59500D-04	-0.58010D-01	-0.1748D 01	-0.18060D 01
2	0.00000D-38	-0.00000D-38	0.12540D-01	0.13750D-03	-0.1269D 00	-0.4343D 01	-0.48990D 01
3	0.00000D-38	-0.00000D-38	0.1894D-01	0.1987D-03	-0.1905D 01	-0.7232D 01	-0.7320D 01
4	0.00000D-38	-0.00000D-38	0.2311D-01	0.2384D-03	-0.2096D 00	-0.8495D 01	-0.8705D 01
5	0.00000D-38	-0.00000D-38	0.0600D-38	0.3751D-04	-0.1301D-01	-0.0000D-38	-0.1301D-01
6	0.00000D-38	-0.00000D-38	0.0000D-38	0.4262D-04	-0.9998D-02	-0.0000D-38	-0.9998D-02
7	0.00000D-38	-0.00000D-38	0.0000D-38	0.3544D-04	-0.5476D-02	-0.0000D-38	-0.5476D-02
8	0.00000D-38	-0.00000D-38	0.0000D-38	0.2743D-04	-0.2677D-02	-0.0000D-38	-0.2677D-02
9	0.00000D-38	-0.00000D-38	0.0000D-38	0.2096D-04	-0.1229D-02	-0.0000D-38	-0.1229D-02
10	0.00000D-38	-0.00000D-38	0.0000D-38	0.1907D-04	-0.1070D-02	-0.0000D-38	-0.1070D-02
11	0.00000D-38	-0.00000D-38	0.0000D-38	0.1268D-04	-0.1685D-03	-0.0000D-38	-0.1685D-03
12	0.00000D-38	-0.00000D-38	0.0000D-38	0.1013D-04	-0.0000D-38	0.1766D 02	0.1766D 02
13	0.00000D-38	-0.00000D-38	0.9141D 00	0.5916D-01	0.5020D 01	-0.0000D-38	0.5020D 01
TOTALS		0.0000D-38	0.1000D 01		0.4414D 01	-0.4414D 01	-0.1297D-12

DETAIL OF NODE		13	TEMPERATURE = -459.00	AREA = 0.89440 01			
			IR EMISSION = 1.0000	SOLAR EMISSION = 1.0000			
			ILUM = 0.00000-38	THETA = 0.90000 02			
THIS IS A CONSTANT		TEMPERATURE	NO	ASCRIPTFITFIR	Q COMP	Q COMP	TOTAL
NODE	CONDUCTANCE	Q COMP	F				
1	0.00000-38	-0.00000-38	0.59380-01	0.92900-01	-0.95280 02	-0.21050 03	-0.30580 03
2	0.00000-38	-0.00000-38	0.66190-01	0.94420-01	-0.91880 02	-0.22530 03	-0.31320 03
3	0.00000-38	-0.00000-38	0.72540-01	0.95450-01	-0.90310 02	-0.24170 03	-0.33200 03
4	0.00000-38	-0.00000-38	0.78280-01	0.96240-01	-0.89500 02	-0.25740 03	-0.34690 03
5	0.00000-38	-0.00000-38	0.62780-01	0.93080-01	-0.96990 02	-0.76790 02	-0.11380 03
6	0.00000-38	-0.00000-38	0.78140-01	0.95140-01	-0.87240 02	-0.66940 02	-0.94190 02
7	0.00000-38	-0.00000-38	0.85410-01	0.96560-01	-0.19810 02	-0.44480 02	-0.74290 02
8	0.00000-38	-0.00000-38	0.92620-01	0.97530-01	-0.14460 02	-0.42750 02	-0.57210 02
9	0.00000-38	-0.00000-38	0.97620-01	0.98190-01	-0.10730 02	-0.33240 02	-0.43970 02
10	0.00000-38	-0.00000-38	0.10110 00	0.98630-01	-0.81410 01	-0.26010 02	-0.34150 02
11	0.00000-38	-0.00000-38	0.10350 00	0.98940-01	-0.63230 01	-0.20630 02	-0.26950 02
12	0.00000-38	-0.00000-38	0.10520 00	0.99160-01	-0.50200 01	-0.16610 02	-0.21630 02
13	0.00000-38	0.00000-38	0.00000-38	0.77880 01	-0.00000-38	0.00000-38	0.00000-38
TOTALS		0.00000-38	0.10000 01		-0.49570 03	-0.12720 04	-0.17680 04

TAS I,	MAY 6, 1969 VERSION,	JAM X2777,	CASE NUMBER 4	
	TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY			
STEP RISE=Y,	STEP TREAD=X			
SAME AS CASE ONE BUT WITH DIFFERENT UNITS, (WATTS, CM, DEG C)				TITLE CARD
BOLTZ=	.5675938803510-11			DATA CARD
ABSCVN=	273.333333333			DATA CARD
SOLCON=	.1394309344			DATA CARD
NITER=	20			DATA CARD
CT(13)=	-272.777777777			DATA CARD
PRINT(10)=	1			DATA CARD
END OF CASE				CONTROL CARD

Table 4 (contd)

```

$NAMEZ
N      =      13,
BOLTZ  =      0.5675938835099998D-11,
SOLCON =      0.1394309344000000D 00,
RELTOL =      0.999999999999997D-05,
ABSCVN =      0.2733333333332999D 03,
NITER  =      20,
$ END
.....

TAS I,  MAY 6, 1969 VERSION,  JAH X2777, CASE NUMBER  4
TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
STEP RISER=Y, STEP TREAD=X
SAME AS CASE ONE BUT WITH DIFFERENT UNITS, (WATTS, CM, DEG C)

THE RESIDUES ARE
1 = 0.25660428D 01  2 = 0.25821159D 01  3 = 0.25903876D 01  4 = 0.25953416D 01  5 = -0.23339704D-01
6 = -0.14777369D-01  7 = -0.99680178D-02  8 = -0.69914229D-02  9 = -0.50692417D-02 10 = -0.37925260D-02
11 = -0.29181407D-02 12 = -0.23017583D-02 13 = -0.10822454D 02

THE TEMPERATURES ARE
1 = 0.41951386D 03  2 = 0.40802131D 03  3 = 0.40195046D 03  4 = 0.39826123D 03  5 = 0.23393305D 03
6 = 0.17931805D 03  7 = 0.12816060D 03  8 = 0.82275137D 02  9 = 0.42460079D 02 10 = 0.84488731D 01
11 = -0.20576123D 02 12 = -0.45450653D 02 13 = -0.27277778D 03

THE RESIDUES ARE
1 = 0.80456362D 00  2 = 0.80995493D 00  3 = 0.81272998D 00  4 = 0.81439213D 00  5 = -0.99326272D-02
6 = -0.65244674D-02  7 = -0.44822995D-02  8 = -0.31733512D-02  9 = -0.23129965D-02 10 = -0.17359201D-02
11 = -0.13383913D-02 12 = -0.10571246D-02 13 = -0.37688072D 01

THE TEMPERATURES ARE
1 = 0.38898651D 03  2 = 0.38013067D 03  3 = 0.37545171D 03  4 = 0.37260803D 03  5 = 0.25067735D 03
6 = 0.20935317D 03  7 = 0.17069722D 03  8 = 0.13604219D 03  9 = 0.10597798D 03 10 = 0.80298842D 02
11 = 0.58385620D 02 12 = 0.39606545D 02 13 = -0.27277778D 03

THE RESIDUES ARE
1 = 0.24734570D 00  2 = 0.24934938D 00  3 = 0.25038185D 00  4 = 0.25100064D 00  5 = -0.55456061D-02
6 = -0.38116918D-02  7 = -0.26747265D-02  8 = -0.19136553D-02  9 = -0.14029584D-02 10 = -0.10565801D-02
11 = -0.81641663D-03 12 = -0.64579734D-03 13 = -0.15379399D 01

THE TEMPERATURES ARE
1 = 0.22969292D 03  2 = 0.22250240D 03  3 = 0.21870103D 03  4 = 0.21638990D 03  5 = 0.12794442D 03
6 = 0.96112237D 02  7 = 0.66452862D 02  8 = 0.39902278D 02  9 = 0.16882801D 02 10 = -0.27732434D 01
11 = -0.19543892D 02 12 = -0.33914466D 02 13 = -0.27277778D 03

THE RESIDUES ARE
1 = 0.71423719D-01  2 = 0.72330693D-01  3 = 0.72800828D-01  4 = 0.73083539D-01  5 = -0.37401061D-02
6 = -0.26601230D-02  7 = -0.18949563D-02  8 = -0.13656432D-02  9 = -0.10051642D-02 10 = -0.75876931D-03
11 = -0.58716726D-03 12 = -0.46491763D-03 13 = -0.83488567D 00

THE TEMPERATURES ARE
1 = 0.11828552D 03  2 = 0.11167732D 03  3 = 0.10817662D 03  4 = 0.10604580D 03  5 = 0.46040202D 02
6 = 0.20322787D 02  7 = -0.34005724D 01  8 = -0.24557515D 02  9 = -0.42872174D 02 10 = -0.58498746D 02
11 = -0.71825708D 02 12 = -0.83242456D 02 13 = -0.27277778D 03

UNDRFLOW AT 24413 IN AC AND MQ.

THE RESIDUES ARE
1 = 0.16874122D-01  2 = 0.17357954D-01  3 = 0.17614785D-01  4 = 0.17771316D-01  5 = -0.21981908D-02
6 = -0.16068320D-02  7 = -0.11578381D-02  8 = -0.83895882D-03  9 = -0.61931416D-03 10 = -0.46830645D-03
11 = -0.36278820D-03 12 = -0.28746278D-03 13 = -0.61980222D 00

THE TEMPERATURES ARE
1 = 0.50790206D 02  2 = 0.43478185D 02  3 = 0.39580251D 02  4 = 0.37199013D 02  5 = 0.27239380D 01
6 = -0.20091721D 02  7 = -0.40779412D 02  8 = -0.59106841D 02  9 = -0.74928134D 02 10 = -0.88408587D 02
11 = -0.99896388D 02 12 = -0.10973298D 03 13 = -0.27277778D 03

UNDRFLOW AT 24413 IN AC AND MQ.

THE RESIDUES ARE
1 = 0.21207607D-02  2 = 0.23039280D-02  3 = 0.24079626D-02  4 = 0.24738629D-02  5 = -0.57651447D-03
6 = -0.44127360D-03  7 = -0.32335772D-03  8 = -0.23679899D-03  9 = -0.17562627D-03 10 = -0.13316920D-03
11 = -0.10334271D-03 12 = -0.81980487D-04 13 = -0.56495759D 00

THE TEMPERATURES ARE
1 = 0.23396617D 02  2 = 0.14625691D 02  3 = 0.98888744D 01  4 = 0.69726184D 01  5 = -0.97296983D 01
6 = -0.31948069D 02  7 = -0.51839129D 02  8 = -0.69370660D 02  9 = -0.84471961D 02 10 = -0.97324841D 02
11 = -0.10827112D 03 12 = -0.11764053D 03 13 = -0.27277778D 03

UNDRFLOW AT 24413 IN AC AND MQ.

THE RESIDUES ARE
1 = 0.47316018D-04  2 = 0.60190231D-04  3 = 0.68649971D-04  4 = 0.74482998D-04  5 = -0.19609358D-04
6 = -0.16572862D-04  7 = -0.12645058D-04  8 = -0.94101368D-05  9 = -0.70465938D-05 10 = -0.53732533D-05
11 = -0.41845825D-05 12 = -0.33274290D-05 13 = -0.55789621D 00

THE TEMPERATURES ARE
1 = 0.19120128D 02  2 = 0.96882246D 01  3 = 0.45415807D 01  4 = 0.13521124D 01  5 = -0.10668811D 02
6 = -0.32879871D 02  7 = -0.52723668D 02  8 = -0.70198368D 02  9 = -0.85245052D 02 10 = -0.98048993D 02
11 = -0.10895242D 03 12 = -0.11828459D 03 13 = -0.27277778D 03

UNDRFLOW AT 24413 IN AC AND MQ.

THE RESIDUES ARE
1 = 0.23378691D-07  2 = 0.424644981D-07  3 = 0.58972737D-07  4 = 0.72362081D-07  5 = -0.12978270D-07
6 = -0.13374330D-07  7 = -0.10948750D-07  8 = -0.84159177D-08  9 = -0.64120106D-08 10 = -0.49390433D-08
11 = -0.38709647D-08 12 = -0.30911260D-08 13 = -0.55772387D 00

THE TEMPERATURES ARE
1 = 0.19024488D 02  2 = 0.95559943D 01  3 = 0.43832405D 01  4 = 0.11748630D 01  5 = -0.10673872D 02
6 = -0.32885315D 02  7 = -0.52729014D 02  8 = -0.70203454D 02  9 = -0.85249844D 02 10 = -0.98053505D 02
11 = -0.10895668D 03 12 = -0.11828857D 03 13 = -0.27277778D 03

```

Table 4 (contd)

TAS I, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 4
 TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
 STEP RISER=Y, STEP TREAD=X
 SAME AS CASE ONE BUT WITH DIFFERENT UNITS, (WATTS, CM, DEG C)

ENERGY PER UNIT TIME IN IS NEGATIVE AND ENERGY PER UNIT TIME OUT IS POSITIVE

DETAIL OF NODE 1 TEMPERATURE = 19.02 AREA = 0.10000 01
 IR EMITTANCE = 0.9000 SOLAR EMITTANCE = 0.1800
 ILUM = 0.10000 01 THETA = 0.000000-38
 NODE CONDUCTANCE Q COMP F ASCRIPFTFIR Q COMP Q COMP TOTAL
 1 0.00000-38 0.00000-38 0.00000-38 0.77630-02 -0.00000-38 0.12890 00 -0.13940 00
 2 0.00000-38 0.00000-38 0.00000-38 0.33010-02 0.16890-04 -0.00000-38 0.16890-04
 3 0.00000-38 0.00000-38 0.00000-38 0.17900-02 0.13790-04 -0.00000-38 0.13790-04
 4 0.00000-38 0.00000-38 0.00000-38 0.11350-02 0.10490-04 -0.00000-38 0.10490-04
 5 0.00000-38 0.00000-38 0.29290 00 0.23750 00 0.34320-02 -0.13340-01 -0.99100-02
 6 0.00000-38 0.00000-38 0.89070-01 0.72270-01 0.16260-02 -0.29410-02 -0.13160-02
 7 0.00000-38 0.00000-38 0.36890-01 0.29950-01 0.83940-03 -0.87500-03 -0.35590-04
 8 0.00000-38 0.00000-38 0.19590-01 0.15910-01 0.50610-03 -0.33620-03 0.17000-03
 9 0.00000-38 0.00000-38 0.12040-01 0.97840-02 0.33620-03 -0.15240-03 0.18380-03
 10 0.00000-38 0.00000-38 0.81300-02 0.66080-02 0.23860-03 -0.77770-04 0.16080-03
 11 0.00000-38 0.00000-38 0.58500-02 0.47560-02 0.17750-03 -0.43340-04 0.13420-03
 12 0.00000-38 0.00000-38 0.44100-02 0.35860-02 0.13690-03 -0.25880-04 0.11100-03
 13 0.00000-38 0.00000-38 0.53110 00 0.50560 00 0.20970-01 -0.00000-38 0.20970-01
 TOTALS 0.00000-38 0.10000 01 0.28300-01 -0.28300-01 0.23380-07

DETAIL OF NODE 2 TEMPERATURE = 9.56 AREA = 0.10000 01
 IR EMITTANCE = 0.9000 SOLAR EMITTANCE = 0.1800
 ILUM = 0.10000 01 THETA = 0.000000-38
 NODE CONDUCTANCE Q COMP F ASCRIPFTFIR Q COMP Q COMP TOTAL
 1 0.00000-38 -0.00000-38 0.00000-38 0.33010-02 -0.16890-04 -0.00000-38 -0.16890-04
 2 0.00000-38 0.00000-38 0.00000-38 0.24960-02 -0.00000-38 0.12350 00 0.12350 00
 3 0.00000-38 0.00000-38 0.00000-38 0.18030-02 0.46650-05 -0.00000-38 0.46650-05
 4 0.00000-38 0.00000-38 0.00000-38 0.13330-02 0.54920-05 -0.00000-38 0.54920-05
 5 0.00000-38 0.00000-38 0.89070-01 0.72270-01 0.67470-03 -0.40570-02 -0.33830-02
 6 0.00000-38 0.00000-38 0.11470 00 0.93030-01 0.16170-02 -0.37900-02 -0.21730-02
 7 0.00000-38 0.00000-38 0.74540-01 0.60430-01 0.13840-02 -0.17680-02 -0.38380-03
 8 0.00000-38 0.00000-38 0.47120-01 0.38200-01 0.10190-02 -0.80860-03 0.21090-03
 9 0.00000-38 0.00000-38 0.31440-01 0.25490-01 0.74550-03 -0.39790-03 0.34760-03
 10 0.00000-38 0.00000-38 0.22180-01 0.17980-01 0.55740-03 -0.21220-03 0.34520-03
 11 0.00000-38 0.00000-38 0.16380-01 0.13280-01 0.42780-03 -0.12140-03 0.30640-03
 12 0.00000-38 0.00000-38 0.12540-01 0.10170-01 0.33630-03 -0.73600-04 0.26270-03
 13 0.00000-38 0.00000-38 0.59200 00 0.56020 00 0.20360-01 -0.00000-38 0.20360-01
 TOTALS 0.00000-38 0.10000 01 0.27120-01 -0.27120-01 0.42460-07

DETAIL OF NODE 3 TEMPERATURE = 4.38 AREA = 0.10000 01
 IR EMITTANCE = 0.9000 SOLAR EMITTANCE = 0.1800
 ILUM = 0.10000 01 THETA = 0.000000-38
 NODE CONDUCTANCE Q COMP F ASCRIPFTFIR Q COMP Q COMP TOTAL
 1 0.00000-38 -0.00000-38 0.00000-38 0.17900-02 -0.13790-04 -0.00000-38 -0.13790-04
 2 0.00000-38 -0.00000-38 0.00000-38 0.18030-02 -0.46650-05 -0.00000-38 -0.46650-05
 3 0.00000-38 0.00000-38 0.00000-38 0.14910-02 -0.00000-38 0.12080 00 0.12080 00
 4 0.00000-38 0.00000-38 0.00000-38 0.11940-02 0.18310-05 -0.00000-38 0.18310-05
 5 0.00000-38 0.00000-38 0.36890-01 0.29960-01 0.20220-03 -0.16800-02 -0.14780-02
 6 0.00000-38 0.00000-38 0.74540-01 0.60430-01 0.89380-03 -0.24620-02 -0.15680-02
 7 0.00000-38 0.00000-38 0.70020-01 0.56750-01 0.11530-02 -0.16610-02 -0.50750-03
 8 0.00000-38 0.00000-38 0.54610-01 0.44260-01 0.10670-02 -0.93710-03 0.12960-03
 9 0.00000-38 0.00000-38 0.41040-01 0.33260-01 0.88680-03 -0.51940-03 0.36730-03
 10 0.00000-38 0.00000-38 0.31070-01 0.25180-01 0.71530-03 -0.29720-03 0.41810-03
 11 0.00000-38 0.00000-38 0.23990-01 0.19440-01 0.57590-03 -0.17770-03 0.39820-03
 12 0.00000-38 0.00000-38 0.18940-01 0.15350-01 0.46790-03 -0.11120-03 0.35680-03
 13 0.00000-38 0.00000-38 0.64890 00 0.60910 00 0.20560-01 -0.00000-38 0.20560-01
 TOTALS 0.00000-38 0.10000 01 0.26510-01 -0.26510-01 0.58970-07

DETAIL OF NODE 4 TEMPERATURE = 1.17 AREA = 0.10000 01
 IR EMITTANCE = 0.9000 SOLAR EMITTANCE = 0.1800
 ILUM = 0.10000 01 THETA = 0.000000-38
 NODE CONDUCTANCE Q COMP F ASCRIPFTFIR Q COMP Q COMP TOTAL
 1 0.00000-38 -0.00000-38 0.00000-38 0.11350-02 -0.10490-04 -0.00000-38 -0.10490-04
 2 0.00000-38 -0.00000-38 0.00000-38 0.13330-02 -0.54920-05 -0.00000-38 -0.54920-05
 3 0.00000-38 -0.00000-38 0.00000-38 0.11940-02 -0.18310-05 -0.00000-38 -0.18310-05
 4 0.00000-38 0.00000-38 0.00000-38 0.10080-02 -0.00000-38 0.11910 00 0.11910 00
 5 0.00000-38 0.00000-38 0.19590-01 0.15920-01 0.83010-04 -0.89240-03 -0.80940-03
 6 0.00000-38 0.00000-38 0.47120-01 0.38210-01 0.50650-03 -0.15560-02 -0.10500-02
 7 0.00000-38 0.00000-38 0.54610-01 0.44260-01 0.83160-03 -0.12950-02 -0.46370-03
 8 0.00000-38 0.00000-38 0.50250-01 0.40720-01 0.91900-03 -0.86230-03 0.56670-04
 9 0.00000-38 0.00000-38 0.42340-01 0.34310-01 0.86210-03 -0.53590-03 0.32620-03
 10 0.00000-38 0.00000-38 0.34640-01 0.28070-01 0.75430-03 -0.33140-03 0.42290-03
 11 0.00000-38 0.00000-38 0.28210-01 0.22860-01 0.64200-03 -0.20900-03 0.43300-03
 12 0.00000-38 0.00000-38 0.23110-01 0.18730-01 0.54210-03 -0.13560-03 0.40650-03
 13 0.00000-38 0.00000-38 0.70010 00 0.65230 00 0.21020-01 -0.00000-38 0.21020-01
 TOTALS 0.00000-38 0.10000 01 0.26140-01 -0.26140-01 0.72360-07

Table 4 (contd)

```

DETAIL OF NODE 5  TEMPERATURE = -10.67          AREA = 0.10000 01
                   IR EMITTANCE = 0.9000          SOLAR EMITTANCE = 0.1800
                   ILUM          = 0.00000-38      THETA = 0.900000 02
                   Q COMP        F      ASCRIPFTFIR  Q COMP  Q COMP  TOTAL
NODE CONDUCTANCE
1  0.00000-38 -0.00000-38 0.29290 00 0.23750 00 -0.34320-02 -0.37760-01 -0.41190-01
2  0.00000-38 -0.00000-38 0.89070-01 0.72270-01 -0.67470-03 -0.11000-01 -0.11680-01
3  0.00000-38 -0.00000-38 0.36890-01 0.29960-01 -0.20220-03 -0.44550-02 -0.46570-02
4  0.00000-38 -0.00000-38 0.19590-01 0.19520-01 -0.83010-04 -0.23330-02 -0.24160-02
5  0.00000-38 0.00000-38 0.00000-38 0.77420-02 -0.00000-38 0.45550-01 0.45550-01
6  0.00000-38 0.00000-38 0.00000-38 0.32430-02 0.26080-04 -0.00000-38 0.26080-04
7  0.00000-38 0.00000-38 0.00000-38 0.17120-02 0.23230-04 -0.00000-38 0.23230-04
8  0.00000-38 0.00000-38 0.00000-38 0.10490-02 0.18210-04 -0.00000-38 0.18210-04
9  0.00000-38 0.00000-38 0.00000-38 0.70350-03 0.14010-04 -0.00000-38 0.14010-04
10 0.00000-38 0.00000-38 0.00000-38 0.50160-03 0.10860-04 -0.00000-38 0.10860-04
11 0.00000-38 0.00000-38 0.00000-38 0.37410-03 0.85560-05 -0.00000-38 0.85560-05
12 0.00000-38 0.00000-38 0.00000-38 0.28890-03 0.68570-05 -0.00000-38 0.68570-05
13 0.00000-38 0.00000-38 0.56160 00 0.52870 00 0.14280-01 -0.00000-38 0.14280-01
TOTALS 0.00000-38 0.10000 01 0.99990-02 -0.10000-01 -0.12980-07

```

```

DETAIL OF NODE 6  TEMPERATURE = -32.89          AREA = 0.10000 01
                   IR EMITTANCE = 0.9000          SOLAR EMITTANCE = 0.1800
                   ILUM          = 0.00000-38      THETA = 0.900000 02
                   Q COMP        F      ASCRIPFTFIR  Q COMP  Q COMP  TOTAL
NODE CONDUCTANCE
1  0.00000-38 -0.00000-38 0.89070-01 0.72270-01 -0.16260-02 -0.11480-01 -0.13110-01
2  0.00000-38 -0.00000-38 0.11470 00 0.93030-01 -0.16170-02 -0.14180-01 -0.15790-01
3  0.00000-38 -0.00000-38 0.74540-01 0.60430-01 -0.89380-03 -0.90020-02 -0.98960-02
4  0.00000-38 -0.00000-38 0.47120-01 0.38210-01 -0.50650-03 -0.56120-02 -0.61190-02
5  0.00000-38 -0.00000-38 0.00000-38 0.32430-02 -0.26080-04 -0.00000-38 -0.26080-04
6  0.00000-38 0.00000-38 0.00000-38 0.23420-02 -0.00000-38 0.33020-01 0.33020-01
7  0.00000-38 0.00000-38 0.00000-38 0.15920-02 0.88020-05 -0.00000-38 0.88020-05
8  0.00000-38 0.00000-38 0.00000-38 0.11020-02 0.10260-04 -0.00000-38 0.10260-04
9  0.00000-38 0.00000-38 0.00000-38 0.78930-03 0.93680-05 -0.00000-38 0.93680-05
10 0.00000-38 0.00000-38 0.00000-38 0.58520-03 0.79670-05 -0.00000-38 0.79670-05
11 0.00000-38 0.00000-38 0.00000-38 0.44740-03 0.66340-05 -0.00000-38 0.66340-05
12 0.00000-38 0.00000-38 0.00000-38 0.35130-03 0.55120-05 -0.00000-38 0.55120-05
13 0.00000-38 0.00000-38 0.67450 00 0.62560 00 0.11870-01 -0.00000-38 0.11870-01
TOTALS 0.00000-38 0.10000 01 0.72490-02 -0.72490-02 -0.13370-07

```

```

DETAIL OF NODE 7  TEMPERATURE = -52.73          AREA = 0.10000 01
                   IR EMITTANCE = 0.9000          SOLAR EMITTANCE = 0.1800
                   ILUM          = 0.00000-38      THETA = 0.900000 02
                   Q COMP        F      ASCRIPFTFIR  Q COMP  Q COMP  TOTAL
NODE CONDUCTANCE
1  0.00000-38 -0.00000-38 0.36890-01 0.29950-01 -0.83940-03 -0.47560-02 -0.55950-02
2  0.00000-38 -0.00000-38 0.74540-01 0.60430-01 -0.13840-02 -0.92090-02 -0.10590-01
3  0.00000-38 -0.00000-38 0.70020-01 0.56750-01 -0.11530-02 -0.84560-02 -0.96090-02
4  0.00000-38 -0.00000-38 0.54610-01 0.44260-01 -0.83160-03 -0.65040-02 -0.73360-02
5  0.00000-38 -0.00000-38 0.00000-38 0.17120-02 -0.23230-04 -0.00000-38 -0.23230-04
6  0.00000-38 -0.00000-38 0.00000-38 0.15920-02 -0.88020-05 -0.00000-38 -0.88020-05
7  0.00000-38 0.00000-38 0.00000-38 0.12000-02 -0.00000-38 0.23720-01 0.23720-01
8  0.00000-38 0.00000-38 0.00000-38 0.87580-03 0.33100-05 -0.00000-38 0.33100-05
9  0.00000-38 0.00000-38 0.00000-38 0.64640-03 0.40980-05 -0.00000-38 0.40980-05
10 0.00000-38 0.00000-38 0.00000-38 0.48800-03 0.39460-05 -0.00000-38 0.39460-05
11 0.00000-38 0.00000-38 0.00000-38 0.37750-03 0.35110-05 -0.00000-38 0.35110-05
12 0.00000-38 0.00000-38 0.00000-38 0.29880-03 0.30360-05 -0.00000-38 0.30360-05
13 0.00000-38 0.00000-38 0.76390 00 0.70140 00 0.94290-02 -0.00000-38 0.94290-02
TOTALS 0.00000-38 0.10000 01 0.52070-02 -0.52070-02 -0.10950-07

```

```

DETAIL OF NODE 8  TEMPERATURE = -70.20          AREA = 0.10000 01
                   IR EMITTANCE = 0.9000          SOLAR EMITTANCE = 0.1800
                   ILUM          = 0.00000-38      THETA = 0.900000 02
                   Q COMP        F      ASCRIPFTFIR  Q COMP  Q COMP  TOTAL
NODE CONDUCTANCE
1  0.00000-38 -0.00000-38 0.19590-01 0.15910-01 -0.50610-03 -0.25260-02 -0.30320-02
2  0.00000-38 -0.00000-38 0.47120-01 0.38200-01 -0.10190-02 -0.58210-02 -0.68410-02
3  0.00000-38 -0.00000-38 0.54610-01 0.44260-01 -0.10670-02 -0.65950-02 -0.76620-02
4  0.00000-38 -0.00000-38 0.50250-01 0.40720-01 -0.91900-03 -0.59850-02 -0.69040-02
5  0.00000-38 -0.00000-38 0.00000-38 0.10490-02 -0.18210-04 -0.00000-38 -0.18210-04
6  0.00000-38 -0.00000-38 0.00000-38 0.11020-02 -0.10260-04 -0.00000-38 -0.10260-04
7  0.00000-38 -0.00000-38 0.00000-38 0.87580-03 -0.33100-05 -0.00000-38 -0.33100-05
8  0.00000-38 0.00000-38 0.00000-38 0.65750-03 -0.00000-38 0.17160-01 0.17160-01
9  0.00000-38 0.00000-38 0.00000-38 0.49330-03 0.12630-05 -0.00000-38 0.12630-05
10 0.00000-38 0.00000-38 0.00000-38 0.37620-03 0.16200-05 -0.00000-38 0.16200-05
11 0.00000-38 0.00000-38 0.00000-38 0.29290-03 0.16170-05 -0.00000-38 0.16170-05
12 0.00000-38 0.00000-38 0.00000-38 0.23290-03 0.14860-05 -0.00000-38 0.14860-05
13 0.00000-38 0.00000-38 0.82840 00 0.75580 00 0.73040-02 -0.00000-38 0.73040-02
TOTALS 0.00000-38 0.10000 01 0.37670-02 -0.37670-02 -0.84160-08

```

```

DETAIL OF NODE 9  TEMPERATURE = -85.25          AREA = 0.10000 01
                   IR EMITTANCE = 0.9000          SOLAR EMITTANCE = 0.1800
                   ILUM          = 0.00000-38      THETA = 0.900000 02
                   Q COMP        F      ASCRIPFTFIR  Q COMP  Q COMP  TOTAL
NODE CONDUCTANCE
1  0.00000-38 -0.00000-38 0.12040-01 0.97840-02 -0.33620-03 -0.15520-02 -0.18880-02
2  0.00000-38 -0.00000-38 0.31440-01 0.25490-01 -0.74550-03 -0.38840-02 -0.46300-02
3  0.00000-38 -0.00000-38 0.41040-01 0.33260-01 -0.88680-03 -0.49560-02 -0.58430-02
4  0.00000-38 -0.00000-38 0.42340-01 0.34310-01 -0.86210-03 -0.50430-02 -0.59050-02
5  0.00000-38 -0.00000-38 0.00000-38 0.70350-03 -0.14010-04 -0.00000-38 -0.14010-04
6  0.00000-38 -0.00000-38 0.00000-38 0.78930-03 -0.93680-05 -0.00000-38 -0.93680-05
7  0.00000-38 -0.00000-38 0.00000-38 0.64640-03 -0.40980-05 -0.00000-38 -0.40980-05
8  0.00000-38 -0.00000-38 0.00000-38 0.49330-03 -0.12630-05 -0.00000-38 -0.12630-05
9  0.00000-38 0.00000-38 0.00000-38 0.37750-03 -0.35110-05 -0.00000-38 -0.35110-05
10 0.00000-38 0.00000-38 0.00000-38 0.28670-03 0.50040-06 -0.00000-38 0.50040-06
11 0.00000-38 0.00000-38 0.00000-38 0.22410-03 0.66300-06 -0.00000-38 0.66300-06
12 0.00000-38 0.00000-38 0.00000-38 0.17860-03 0.68270-06 -0.00000-38 0.68270-06
13 0.00000-38 0.00000-38 0.87310 00 0.79350 00 0.56360-02 -0.00000-38 0.56360-02
TOTALS 0.00000-38 0.10000 01 0.27780-02 -0.27780-02 -0.64120-08

```

Table 4 (contd)

```

DETAIL OF NODE 10  TEMPERATURE = -98.05          AREA = 0.10000 01
                   IR EMITTANCE = 0.9000          SOLAR EMITTANCE = 0.1800
                   ILUM          = 0.00000-38      THETA = 0.900000 02
                   Q COMP        F      ASCRIPFTTIR  Q COMP  Q COMP  TOTAL
NODE CONDUCTANCE  Q COMP        F      ASCRIPFTTIR  Q COMP  Q COMP  TOTAL
1  0.00000-38 -0.00000-38  0.81300-02  0.66080-02 -0.23860-03 -0.10480-02 -0.12870-02
2  0.00000-38 -0.00000-38  0.22180-01  0.17980-01 -0.55740-03 -0.27400-02 -0.32980-02
3  0.00000-38 -0.00000-38  0.31070-01  0.25180-01 -0.71530-03 -0.37520-02 -0.44680-02
4  0.00000-38 -0.00000-38  0.34640-01  0.28070-01 -0.75430-03 -0.41260-02 -0.48800-02
5  0.00000-38 -0.00000-38  0.00000-38  0.50160-03 -0.10860-04 -0.00000-38 -0.10860-04
6  0.00000-38 -0.00000-38  0.00000-38  0.58520-03 -0.79670-05 -0.00000-38 -0.79670-05
7  0.00000-38 -0.00000-38  0.00000-38  0.48800-03 -0.39460-05 -0.00000-38 -0.39460-05
8  0.00000-38 -0.00000-38  0.00000-38  0.37620-03 -0.16200-05 -0.00000-38 -0.16200-05
9  0.00000-38 -0.00000-38  0.00000-38  0.28670-03 -0.50040-06 -0.00000-38 -0.50040-06
10 0.00000-38 -0.00000-38  0.00000-38  0.22070-03 -0.00000-38  0.95660-02  0.95660-02
11 0.00000-38 -0.00000-38  0.00000-38  0.17290-03  0.20990-06 -0.00000-38  0.20990-06
12 0.00000-38 -0.00000-38  0.00000-38  0.13800-03  0.28680-06 -0.00000-38  0.28680-06
13 0.00000-38 -0.00000-38  0.90400 00  0.81940 00  0.43900-02 -0.00000-38  0.43900-02
TOTALS          0.00000-38  0.10000 01          0.21000-02 -0.21000-02 -0.49390-08

```

```

DETAIL OF NODE 11  TEMPERATURE = -108.96          AREA = 0.10000 01
                   IR EMITTANCE = 0.9000          SOLAR EMITTANCE = 0.1800
                   ILUM          = 0.00000-38      THETA = 0.900000 02
                   Q COMP        F      ASCRIPFTTIR  Q COMP  Q COMP  TOTAL
NODE CONDUCTANCE  Q COMP        F      ASCRIPFTTIR  Q COMP  Q COMP  TOTAL
1  0.00000-38 -0.00000-38  0.58500-02  0.47560-02 -0.17750-03 -0.75420-03 -0.93170-03
2  0.00000-38 -0.00000-38  0.16380-01  0.13280-01 -0.42780-03 -0.20240-02 -0.24510-02
3  0.00000-38 -0.00000-38  0.23990-01  0.19440-01 -0.57590-03 -0.28970-02 -0.34730-02
4  0.00000-38 -0.00000-38  0.28210-01  0.22860-01 -0.64200-03 -0.33600-02 -0.40020-02
5  0.00000-38 -0.00000-38  0.00000-38  0.37410-03 -0.85560-05 -0.00000-38 -0.85560-05
6  0.00000-38 -0.00000-38  0.00000-38  0.44740-03 -0.66340-05 -0.00000-38 -0.66340-05
7  0.00000-38 -0.00000-38  0.00000-38  0.37750-03 -0.35110-05 -0.00000-38 -0.35110-05
8  0.00000-38 -0.00000-38  0.00000-38  0.29290-03 -0.16170-05 -0.00000-38 -0.16170-05
9  0.00000-38 -0.00000-38  0.00000-38  0.22410-03 -0.66300-06 -0.00000-38 -0.66300-06
10 0.00000-38 -0.00000-38  0.00000-38  0.17290-03 -0.20990-06 -0.00000-38 -0.20990-06
11 0.00000-38 -0.00000-38  0.00000-38  0.13570-03 -0.00000-38  0.74090-02  0.74090-02
12 0.00000-38 -0.00000-38  0.00000-38  0.10840-03  0.93650-07 -0.00000-38  0.93650-07
13 0.00000-38 -0.00000-38  0.92560 00  0.83750 00  0.34710-02 -0.00000-38  0.34710-02
TOTALS          0.00000-38  0.10000 01          0.16260-02 -0.16260-02 -0.38710-08

```

```

DETAIL OF NODE 12  TEMPERATURE = -118.29          AREA = 0.10000 01
                   IR EMITTANCE = 0.9000          SOLAR EMITTANCE = 0.1800
                   ILUM          = 0.00000-38      THETA = 0.900000 02
                   Q COMP        F      ASCRIPFTTIR  Q COMP  Q COMP  TOTAL
NODE CONDUCTANCE  Q COMP        F      ASCRIPFTTIR  Q COMP  Q COMP  TOTAL
1  0.00000-38 -0.00000-38  0.44100-02  0.35860-02 -0.13690-03 -0.56860-03 -0.70550-03
2  0.00000-38 -0.00000-38  0.12540-01  0.10170-01 -0.33630-03 -0.15490-02 -0.18850-02
3  0.00000-38 -0.00000-38  0.18940-01  0.15350-01 -0.46790-03 -0.22870-02 -0.27550-02
4  0.00000-38 -0.00000-38  0.23110-01  0.18730-01 -0.54210-03 -0.27520-02 -0.32950-02
5  0.00000-38 -0.00000-38  0.00000-38  0.28890-03 -0.68570-05 -0.00000-38 -0.68570-05
6  0.00000-38 -0.00000-38  0.00000-38  0.35130-03 -0.55120-05 -0.00000-38 -0.55120-05
7  0.00000-38 -0.00000-38  0.00000-38  0.29880-03 -0.30360-05 -0.00000-38 -0.30360-05
8  0.00000-38 -0.00000-38  0.00000-38  0.23290-03 -0.14860-05 -0.00000-38 -0.14860-05
9  0.00000-38 -0.00000-38  0.00000-38  0.17860-03 -0.68270-06 -0.00000-38 -0.68270-06
10 0.00000-38 -0.00000-38  0.00000-38  0.13800-03 -0.28680-06 -0.00000-38 -0.28680-06
11 0.00000-38 -0.00000-38  0.00000-38  0.10840-03 -0.93650-07 -0.00000-38 -0.93650-07
12 0.00000-38 -0.00000-38  0.00000-38  0.86680-04 -0.00000-38 -0.58690-02 -0.58690-02
13 0.00000-38 -0.00000-38  0.94100 00  0.85050 00  0.27900-02 -0.00000-38  0.27900-02
TOTALS          0.00000-38  0.10000 01          0.12880-02 -0.12880-02 -0.30910-08

```

```

DETAIL OF NODE 13  TEMPERATURE = -272.78          AREA = 0.89440 01
                   IR EMITTANCE = 1.0000          SOLAR EMITTANCE = 1.0000
                   ILUM          = 0.00000-38      THETA = 0.900000 02
                   THIS IS A CONSTANT TEMPERATURE NODE
                   Q COMP        F      ASCRIPFTTIR  Q COMP  Q COMP  TOTAL
NODE CONDUCTANCE  Q COMP        F      ASCRIPFTTIR  Q COMP  Q COMP  TOTAL
1  0.00000-38 -0.00000-38  0.59380-01  0.50560 00 -0.20970-01 -0.68480-01 -0.89440-01
2  0.00000-38 -0.00000-38  0.66190-01  0.56020 00 -0.20360-01 -0.73130-01 -0.93500-01
3  0.00000-38 -0.00000-38  0.72550-01  0.60910 00 -0.20560-01 -0.78370-01 -0.98930-01
4  0.00000-38 -0.00000-38  0.78280-01  0.65230 00 -0.21020-01 -0.83390-01 -0.10440 00
5  0.00000-38 -0.00000-38  0.62780-01  0.52870 00 -0.14280-01 -0.25580-01 -0.39860-01
6  0.00000-38 -0.00000-38  0.75410-01  0.62560 00 -0.11870-01 -0.22280-01 -0.34150-01
7  0.00000-38 -0.00000-38  0.85410-01  0.70140 00 -0.94290-02 -0.18120-01 -0.27550-01
8  0.00000-38 -0.00000-38  0.92620-01  0.75580 00 -0.73040-02 -0.14220-01 -0.21520-01
9  0.00000-38 -0.00000-38  0.97620-01  0.79350 00 -0.56360-02 -0.11050-01 -0.16690-01
10 0.00000-38 -0.00000-38  0.10110 00  0.81940 00 -0.43900-02 -0.86480-02 -0.13040-01
11 0.00000-38 -0.00000-38  0.10350 00  0.83750 00 -0.34710-02 -0.68570-02 -0.10330-01
12 0.00000-38 -0.00000-38  0.10520 00  0.85050 00 -0.27900-02 -0.55230-02 -0.83120-02
13 0.00000-38 -0.00000-38  0.00000-38  0.70470 00 -0.00000-38  0.00000-38  0.00000-38
TOTALS          0.00000-38  0.10000 01          -0.14210 00 -0.41560 00 -0.55770 00

```

TAS I, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBER 5
 TEMPERATURE DISTRIBUTION OF AN L-SHAPE STEP CAVITY
 STEP RISER=Y, STEP TREAD=X
 END OF PROBLEM

CONTROL CARD

Appendix
Source Program Listing for TAS I

SJOB JAH,5693000,52400-0,38132,A IC 5,9000 TAS I HULTBERG
 SASSIGN SYSCK1
 SASSIGN SYSUT6
 SASSIGN SYSUT9
 SIBJOB TAS I GO,DLOGIC,MAP,FILES,SOURCE,ALTIO
 SIBFTC 1000JA

C JOHN A. HULTBERG
 C JET PROPULSION LABORATORY
 C 4800 OAK GROVE DRIVE
 C PASADENA, CALIFORNIA 91103

C PHONE (213) 354-2777

C LOGICAL TAPE UNIT 5 IS USED FOR INPUT
 C LOGICAL TAPE UNIT 6 IS USED FOR OUTPUT
 C LOGICAL TAPE UNIT 3 IS USED AS A SCRATCH TAPE
 C LOGICAL TAPE UNIT 9 IS USED AS A SCRATCH TAPE
 C LOGICAL TAPE UNIT 13 IS USED AS A SCRATCH TAPE
 C LOGICAL TAPE UNIT 14 IS USED AS A SCRATCH TAPE

C DOUBLE PRECISION F,FA,C,AMAT,BMAT,SMAT,ESOL,P,A,QNET,QTOTAL,
 1ALPHA,ILUM,T,TF,THETA,L,CT,TSTART,EIR,U2,DUFFER,
 1TNOTSP,DETIR,QIR,QIRT,GNTOT,BOLTZ,RELTOL,ABSCVN,QSOL,QCT,QSOLT,
 1SOLCON,QC,FT,DUMMY
 C INTEGER BDCDCT,BDTICT
 C INTEGER FAUSED
 C INTEGER CARD
 C COMMON F
 C DIMENSION NTITLE (72,10)
 C DIMENSION F (80,80)
 C DIMENSION FA (80,80)
 C DIMENSION C (80,80)
 C DIMENSION AMAT (80,80)
 C DIMENSION BMAT (80,80)
 C DIMENSION SMAT (80,80)
 C EQUIVALENCE (F,FA)
 C EQUIVALENCE (F,C)
 C EQUIVALENCE (F,AMAT)
 C EQUIVALENCE (F,BMAT)
 C EQUIVALENCE (F,SMAT)
 C DIMENSION ESOL (80)
 C DIMENSION P (80)
 C DIMENSION A (80)
 C DIMENSION QNET (80)
 C DIMENSION QTOTAL (80)
 C DIMENSION ALPHA (80)
 C DIMENSION ILUM (80)
 C DIMENSION T (80)
 C DIMENSION TF (80)
 C DIMENSION THETA (80)
 C DIMENSION L (80)
 C DIMENSION CT (80)
 C DIMENSION TSTART (80)
 C DIMENSION EIR (80)
 C INTEGER S1
 C DIMENSION S1 (240)
 C DIMENSION S2 (80)
 C DIMENSION BUFFER (240)
 C EQUIVALENCE (BUFFER,S1)
 C DIMENSION CARD (80)

C INTEGER PRINT
 C DIMENSION PRINT (50)

C NAMELIST /INPUT/N,BOLTZ,SOLCON,FA,C,A,EIR,ESOL,ILUM,THETA,CT,P,F,R
 1ELTOL,TNOTSP,ABSCVN,TSTART,FAUSED,PRINT,DUMMY,NITER

C NAMELIST /NAME2/N,BOLTZ,SOLCON,RELTOL,ABSCVN,NITER

C NDIM=80
 C NEOBD=0
 99 CALL EDITA (NEOBD,BDCDCT,CARD,NTITLS,BDTICT,NCASE,NTITLE)

C SET INITIAL VALUES

C BOLTZ = .1714D-08
 C SOLCON=442.D0
 C RELTOL=.00001D0
 C ABSCVN=460.D0
 C NITER=15
 C TNOTSP=68.D0
 C DO 101 I=1,NDIM
 C A(I)=0.D0
 C EIR(I)=0.D0
 C ESOL(I)=0.D0
 C P(I)=0.D0
 C ILUM(I)=1.D0
 C THETA(I)=90.D0
 C L(I)=0.D0
 C CT(I)=-500.D0
 C TSTART(I)=-500.D0
 101 QNET(I)=0.D0

C DO 98 I=1,40
 C 98 PRINT(I)=0

C REWIND 13
 C READ (13,INPUT)

NX2=N*2
 NX3=N*3
 C MAKE ILUM ZERO FOR THETA EQUAL TO OR GREATER THAN 90 DEGREES
 C DO 105 I=1,N
 C IF (DABS(THETA(I)).GE.90.D0) ILUM(I)=0.D0
 105 CONTINUE

C REWIND 14
 C DO 107 I=1,N
 C WRITE (14) (BUFFER(J),J=1,NX3)
 107 CONTINUE

C IF (PRINT(10).EQ.1) WRITE (6,NAME2)

C CALL CEDIT (NDIM,N,CARD,NCASE,NTITLS,NTITLE,
 1PRINT(11),
 1 60H(/54H THE SYMMETRIC CONDUCTION MATRIX IS))

C CALL WRIT14 (NDIM,C,N,NX2,NX3,1,BUFFER)

C CALL FEDIT (NDIM,N,A,CARD,NCASE,NTITLS,NTITLE,

1PRINT(12),
 1 60H(/54H THE SYMMETRIC FA MATRIX IS),
 1PRINT(13),
 1 60H(/54H THE F MATRIX IS))

C CALL WRIT14 (NDIM,F,N,NX2,NX3,2,BUFFER)
 C SELECT THE PROPER TEMPERATURES

DO 120 I=1,N
 IF (CT(I).GE.0.D0) GO TO 116
 IF (CT(I)+499.D0).GT.0.D0) GO TO 116
 IF (NCASE.GT.1) GO TO 120
 112 IF (TSTART(I).GT.0.D0) GO TO 114
 IF ((TSTART(I)+499.D0).GT.0.D0) GO TO 114
 C FLOW TO THIS POINT INDICATES A TEMPERATURE NOT SPECIFIED
 C TF(I)=TNOTSP
 C GO TO 118
 114 TF(I)=TSTART(I)
 C GO TO 118
 116 TF(I)=CT(I)
 118 T(I)=TF(I)+ABSCVN
 120 CONTINUE

C IF ((PRINT(14)+PRINT(15)+PRINT(16)+PRINT(17)
 1 +PRINT(18)+PRINT(19)+PRINT(20)).NE.0)
 1CALL TITLE (NCASE,NTITLS,NTITLE)

C IF (PRINT(14).EQ.1)
 1CALL VECPR (NDIM,A ,N,
 1 60H(/54H THE AREAS ARE))

C IF (PRINT(15).EQ.1)
 1CALL VECPR (NDIM,EIR ,N,
 1 60H(/54H THE IR EMITTANCES ARE))

C IF (PRINT(16).EQ.1)
 1CALL VECPR (NDIM,ESOL ,N,
 1 60H(/54H THE SOLAR EMITTANCES ARE))

C IF (PRINT(17).EQ.1)
 1CALL VECPR (NDIM,ILUM ,N,
 1 60H(/54H THE ILLUMINATIONS ARE))

C IF (PRINT(18).EQ.1)
 1CALL VECPR (NDIM,THETA ,N,
 1 60H(/54H THE ANGLES THETA TO THE SUN ARE))

C IF (PRINT(19).EQ.1)
 1CALL VECPR (NDIM,CT ,N,
 1 60H(/54H THE CONSTANT TEMPERATURE NODES ARE))

C IF (PRINT(20).EQ.1)
 1CALL VECPR (NDIM,P ,N,
 1 60H(/54H THE POWERS ARE))

C COMPUTE THE EXCITATION VECTOR
 C DO 199 I=1,N
 199 L(I)=SOLCON*ILUM(I)*(1.D0-ESOL(I))*DCOS(.01745329D0*THETA(I))

C CALL RADIOS (NDIM,F,N,ESOL,L,DETIR,S1,S2, NCASE,NTITLS,NTITLE,
 1PRINT(21),
 1 60H(/54H THE EXCITATION VECTOR IS),

1PRINT(22),
 1 60H(/54H THE SOLAR TRANSFER MATRIX BEFORE INVERSION IS),
 1PRINT(23),
 1 60H(/54H THE SOLAR TRANSFER MATRIX AFTER INVERSION IS),

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1PRINT(24),
1 60H(54H THE RESPONSE VECTOR IS
C
C RESTORE THE F MATRIX
CALL READ14 (NDIM,F,N,NX2,NX3,2,BUFFER)
C
DO 210 I=1,N
QNET(I)=-A(I)*SOLCON*ILUM(I)*DCOS(0.01745329D0*THETA(I))
DO 210 J=1,N
IF (I.EQ.J) QSOL=(1.D0-F(I,J))*A(I)*L(J)
IF (I.NE.J) QSOL=-F(I,J)*A(I)*L(J)
210 QNET(I)=QNET(I)+QSOL
C
IF (PRINT(25).EQ.1)
1CALL VECPR1 (NDIM,QNET ,N,
1 60H(54H THE SOLAR QNET VECTOR IS
C
CALL SCRPTF (NDIM,F,N,EIR,A,BOLTZ,
1DETIR,S1,S2,NX2,NX3,BUFFER, NCASE,NTITLS,NTITLE,
1PRINT(26),
1 60H(54H STEP 1 OF THE SCRIPT F MATRIX IS
1PRINT(27),
1 60H(54H STEP 2 OF THE SCRIPT F MATRIX IS
1PRINT(28),
1 60H(54H STEP 3 OF THE SCRIPT F MATRIX IS
1PRINT(29),
1 60H(54H THE SCRIPT F MATRIX IS
1PRINT(30),
1 60H(54H THE AREA SCRIPT F MATRIX IS
1PRINT(31),
1 60H(54H THE BOLTZ TIMES THE AREA SCRIPT F MATRIX IS
C
CALL TITLE (NCASE,NTITLS,NTITLE)
C
DO 509 INDEX=1,NITER
REWIND 14
C
IF (INDEX.EQ.1) GO TO 499
CALL DINVRT (NDIM,SMAT ,N,ALPHA,1,DETIR,S1,S2)
DO 508 I=1,N
TF(I)=ALPHA(I)-ABSCVN
508 T(I)=ALPHA(I)
C
499 IEND=1
DO 500 I=1,N
DO 500 J=1,N
500 SMAT(I,J)=0.D0
C
DO 501 I=1,N
501 ALPHA(I)=P(I)-DABS(QNET(I))
C
DO 503 I=1,N
IF (CT(I).LT.(-499.D0)) GO TO 503
DO 502 J=1,N
502 SMAT(I,J)=0.D0
SMAT(I,I)=1.D0
ALPHA(I)=CT(I)+ABSCVN
C
503 CONTINUE
C
DO 510 I=1,N
READ (14) (BUFFER(J),J=1,NX3)
DO 504 J=1,N
IF (CT(I).GT.(-499.D0)) GO TO 504
IF (I.EQ.J) GO TO 504
J3=J+NX2
ADD TO DIAGONAL ELEMENT
SMAT(I,I)=SMAT(I,I)-BUFFER(J)-BOLTZ*BUFFER(J3)*4.D0*(T(I)**3)
C
ADD TO OFF DIAGONAL ELEMENT
C
ADD TO POWER TERM
SMAT(I,J)= BUFFER(J)+BOLTZ*BUFFER(J3)*4.D0*(T(J)**3)
ALPHA(I)=ALPHA(I)-BOLTZ*BUFFER(J3)*3.D0*(T(I)**4)-(T(J)**4)
504 CONTINUE
C
C COMPUTE AND PRINT UNBALANCE
C
QTOTAL(I)=P(I)-DABS(QNET(I))
DO 506 J=1,N
J3=J+NX2
IF ((DABS(BUFFER(J))+DABS(BUFFER(J3)))*GT.0.D0) GO TO 506
GO TO 506
505 QC=BUFFER (J)*((T(I) )-(T(J) ))
QIR=BUFFER(J3)*((T(I)**4)-(T(J)**4))*BOLTZ
QTOTAL(I)=QTOTAL(I)+QC+QIR
506 CONTINUE
C
IS THE RESIDUE IN TOLERANCE
IF (CT(I).GT.(-499.D0)) GO TO 510
IF (DABS(QTOTAL(I)).GT.RELTOL) IEND=0
510 CONTINUE
C
507 CALL VECPR1 (NDIM,QTOTAL,N,
1 60H(54H THE RESIDUES ARE
C
CALL VECPR1 (NDIM,TF ,N,
1 60H(54H THE TEMPERATURES ARE
C
IF (IEND.EQ.1) GO TO 300
509 CONTINUE
8900 FORMAT (///30H ITERATIONS DID NOT CONVERGE )
WRITE (6,8900)
C
9000 FORMAT (/ 91H0 ENERGY PER UNIT TIME IN IS NEGATIVE AND ENERGY PE
IR UNIT TIME OUT IS POSITIVE )
9100 FORMAT ( /// 16H DETAIL OF NODE,I4,15H TEMPERATURE = ,F8.2,3X,
120H AREA =,D11.4)
9200 FORMAT ( 20X, 15H IR EMISSANCE =,F7.4,4X,
120H SOLAR EMITTANCE =,F7.4)
9300 FORMAT ( 20X, 15H ILUM =,D11.4 ,
120H THETA =,D12.5)
9400 FORMAT ( 40H THIS IS A CONSTANT TEMPERATURE NODE )
9500 FORMAT ( 110H NODE CONDUCTANCE Q COMP F ASCTPTF
11R Q COMP Q COMP TOTAL /)
9550 FORMAT (56X,12HDIRECT SOLAR,2D12.4)
9600 FORMAT (18,2D12.4,D12.4,4D12.4)
9700 FORMAT (8H POWER,72X,D12.4)
C
9800 FORMAT (8H TOTALS,12X,2D12.4,12X,D12.4, 2D12.4)
C
300 CALL TITLE (NCASE,NTITLS,NTITLE)
REWIND 14
WRITE (6,9000)
DO 306 I=1,N
WRITE (6,9100) I,TF(I),A(I)
WRITE (6,9200) EIR(I),ESOL(I)
WRITE (6,9300) ILUM(I),THETA(I)
IF (CT(I).GT.-499.D0) WRITE (6,9400)
WRITE (6,9500)
QCT=0.D0
FT=0.D0
QIRT=0.D0
QSOLT =-A(I)*SOLCON*ILUM(I)*DCOS(0.01745329D0*THETA(I))
QTOTAL(I)=QSOLT
IF (DABS(QSOLT).GT.0.D0) WRITE (6,9550) QSOLT,QSOLT
READ (14) (BUFFER(J),J=1,NX3)
DO 304 J=1,N
J2=J+N
J3=J+NX2
QC =BUFFER(J)*((T(I) )-(T(J) ))
QIR=BUFFER(J3)*((T(I)**4)-(T(J)**4))*BOLTZ
IF (I.EQ.J) QSOL=(1.D0-BUFFER(J2))*A(I)*L(J)
IF (I.NE.J) QSOL=-BUFFER(J2)*A(I)*L(J)
QCT=QCT+QC
FT=FT+BUFFER(J2)
QIRT=QIRT+QIR
QSOLT=QSOLT+QSOL
QNTOT= QC+QIR+QSOL
QTOTAL(I)=QTOTAL(I)+QNTOT
IF ((DABS(BUFFER(J))+DABS(QC)+DABS(BUFFER(J2))+DABS(BUFFER(J3))
1+DABS(QIR)+DABS(QSOL)+DABS(QNTOT))*GT.0.D0)
1WRITE (6,9600) J,BUFFER(J),QC,BUFFER(J2),BUFFER(J3),QIR,QSOL,QNTOT
304 CONTINUE
IF (DABS(P(I)).GT.0.D0) WRITE (6,9700) P(I)
QTOTAL(I)=QTOTAL(I)+P(I)
305 WRITE (6,9800) QCT,FT,QIRT,QSOLT,QTOTAL(I)
306 CONTINUE
GO TO 99
END
SIBFTC 10000B
SUBROUTINE TITLE (NCASE,NTITLS,NTITLE)
DIMENSION NTITLE (72,10)
1000 FORMAT (57H1 TAS I, MAY 6, 1969 VERSION, JAH X2777, CASE NUMBE
1R ,I2)
1001 FORMAT (72A1)
WRITE (6,1000) NCASE
IF (NTITLS.NE.0) WRITE (6,1001) ((NTITLE(I,J),I=1,72),J=1,NTITLS)
RETURN
END
SIBFTC 10000C
SUBROUTINE CEDIT (NDIM,N,CARD,NCASE,NTITLS,NTITLE,PRT1,FMT1)
DOUBLE PRECISION C,DUMMY
INTEGER CARD,ALPHA,ALPHAA,ALPHAB,ALPHAC
COMMON C
DIMENSION NTITLE (72,10)
DIMENSION FMT1(24)
INTEGER PRT1
DIMENSION C(80,80)
DIMENSION CARD(80)
DIMENSION ALPHAA(2)
DIMENSION ALPHAB(1)
DIMENSION ALPHAC(4)
DATA ALPHAA/1HC,1HT/
DATA ALPHAB/1HC/
DATA ALPHAC/1HS,1HE,1HN,1HD/
NAMELIST /INPUT/C,DUMMY
C
REWIND 3
REWIND 13
REWIND 14
C
WRITE $INPUT ON SCRATCH TAPE 3
1001 FORMAT (20H $INPUT DUMMY=1.D0,,80X)
WRITE (3,1001)
C
READ A CARD IMAGE FROM THE INPUT SCRATCH TAPE
1002 FORMAT (8U,1)
1 READ (13,1002) CARD
C
TEST FOR CT

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      CALL MATCH (CARD,ALPHA,2,I,J)
      GO TO (5,2),J
      GO TO 1
C
      TEST FOR C
      CALL MATCH (CARD,ALPHA,1,I,J)
      GO TO (6,3),J
      WRITE (3,1002) CARD
      GO TO 1
C
      TEST FOR $END
      CALL MATCH (CARD,ALPHA,4,I,J)
      GO TO (7,1),J
      WRITE (3,1002) CARD
C
      FLOW TO THIS POINT INDICATES ALL CARD IMAGES HAVE BEEN PROCESSED
C
      ZERO THE C MATRIX
      DO 4 I=1,N
      DO 4 J=1,N
      C(I,J)=0.D0
C
      REWIND 3
      READ (3,INPUT)
C
      CALL MATPOS (NDIM,C,N)
      CALL MATSYM (NDIM,C,N)
      PRINT C MATRIX IF REQUESTED
      IF (PRT1.EQ.1) CALL MATPRT (NDIM,C,N,NCASE,NTITLS,NTITLE,FM11)
      RETURN
      END
$IBFTC 10000D
      SUBROUTINE MATCH(CARD,NAME,NAMDIM,K,L)
      INTEGER CARD,BLANK
      DIMENSION CARD(80)
      DIMENSION NAME(NAMDIM)
      DATA BLANK/1H /
C
      L=1
      J=1
C
      DO 1 I=1,72
      K=1
      SKIP BLANKS
      IF (CARD(I).EQ.BLANK) GO TO 1
      LOOK FOR COLUMN MATCH
      IF (CARD(I).NE.NAME(J)) GO TO 2
      FLOW TO THIS POINT INDICATES A SUCCESSFUL COLUMN MATCH
      MAKE A SUCCESSFUL RETURN IF THE ENTIRE NAME HAS BEEN SCANNED
      IF (J.EQ.NAMDIM) RETURN
      INCREMENT THE NAME COLUMN INDEX BY ONE
      J=J+1
      1 CONTINUE
      FLOW TO THIS POINT INDICATES AN UNSUCCESSFUL COLUMN MATCH
      L=2
      RETURN
      END
$IBFTC 10000E
      SUBROUTINE EDITA (NEOBD,BDCDCT,CARD,NTITLS,BDTICT,NCASE,NTITLE)
      INTEGER BDCDCT,BDTICT
      INTEGER CARD,ALPHA
      DIMENSION NTITLE (72,10)
      DIMENSION CARD(80)
      DIMENSION ALPHA (35)
      DIMENSION NAMEA(14)
      DIMENSION NAMEB(9)
      DIMENSION NAMEC(12)
      DIMENSION NAMEG(6)
      DATA ALPHA/1HA,1HB,1HC,1HD,1HE,1HF,1HG,1HH,1HI,1HJ,1HK,1HL,1HM,1HN
      1,1HO,1HP,1HQ,1HR,1HS,1HT,1HU,1HV,1HW,1HX,1HY,1HZ,1H ,1H(,1H),1H,,1
      1H+,1H*,1H$,1H$/
      DATA NAMEA/1HE,1HN,1HD,1HO,1HF,1HB,1HA,1HS,1HI,1HC,1HD,1HA,1HT,1HA
      1/
      DATA NAMEB/1HE,1HN,1HD,1HO,1HF,1HC,1HA,1HS,1HE/
      DATA NAMEC/1HE,1HN,1HD,1HO,1HF,1HP,1HR,1HO,1HB,1HL,1HE,1HM/
      DATA NAMEE/1HC/
      DATA NAMEF/1HT/
      DATA NAMEG/1HS,1HI,1HN,1HP,1HU,1HT/
C
      REWIND THE INPUT SCRATCH TAPE
      1 REWIND 13
C
      IS THIS A NEW PROBLEM
      IF (NEOBD) EQUALS ZERO IT IS A NEW PROBLEM
      IF (NEOBD.EQ.0) GO TO 9
      IF THIS IS A CASE SPACE OUT THE SCRATCH INPUT TAPE
      1000 FORMAT (80A1)
      DO 8 I=1,BDCDCT
      8 READ (13,1000) CARD
      NTITLS=BDTICT
C
      INCREASE THE CASE NUMBER BY ONE
      6 NCASE=NCASE+1
      CALL TITLE (NCASE,NTITLS,NTITLE)
      GO TO 10
      9 NCASE=0
      NTITLS=0
      BDCDCT=1
      BDTICT=0
C
      WRITE $INPUT ON THE INPUT SCRATCH TAPE
      1002 FORMAT (20H $INPUT DUMMY=1,D0,80X)
      WRITE (13,1002)
      CALL TITLE (NCASE,NTITLS,NTITLE)

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C      READ AN INPUT CARD FROM THE INPUT TAPE
C
      10 READ (5,1000) CARD
C
      TEST FOR $INPUT
      CALL MATCH(CARD,NAMEG,5,I,J)
      GO TO (50,900),J
      FLOW TO THIS POINT INDICATES A $INPUT CARD
      1003 FORMAT (1H ,80A1,20H DATA CARD )
      50 WRITE (6,1003) CARD
C
      BLANK THE $INPUT
      CARD(I )=ALPHA(27)
      CARD(I-1)=ALPHA(27)
      CARD(I-2)=ALPHA(27)
      CARD(I-3)=ALPHA(27)
      CARD(I-4)=ALPHA(27)
      CARD(I-5)=ALPHA(27)
C
      TEST FOR C
      900 IF (CARD(1).NE.NAMEE) GO TO 910
      FLOW TO THIS POINT INDICATES A COMMENT CARD
      1004 FORMAT (1H ,80A1,20H COMMENT CARD )
      200 WRITE (6,1004) CARD
      GO TO 10
C
      TEST FOR T
      910 IF (CARD(1).NE.NAMEF) GO TO 400
      FLOW TO THIS POINT INDICATES A TITLE CARD
      IF THE TITLE ARRAY IS FULL, PRINT THE TITLE CARD AS A COMMENT CARD
      300 IF (NTITLS.EQ.10) GO TO 200
      1005 FORMAT (1H ,80A1,20H TITLE CARD )
      WRITE (6,1005) CARD
C
      INCREASE THE BASIC DATA TITLE COUNTER BY ONE
      IF (NEOBD.EQ.0) BDTICT=BDTICT+1
      INCREASE THE TITLE COUNTER (NTITLS) BY ONE
      NTITLS=NTITLS+1
      BLANK THE FIRST CHARACTER FOR LATER PRINTOUT
      CARD(01)=ALPHA(27)
      LOAD INTO THE TITLE ARRAY (NTITLE)
      DO 310 I=1,72
      310 NTITLE(I,NTITLS)= CARD(I)
      GO TO 10
C
      IS THIS AN END OF BASIC DATA CARD
      400 CALL MATCH(CARD,NAMEA,14,I,J)
      GO TO (51,410),J
      WRITE IT ON THE OUTPUT TAPE
      1006 FORMAT (1H ,80A1,20H CONTROL CARD )
      51 WRITE (6,1006) CARD
C
      SET NEOBD NOT EQUAL TO ZERO TO SHOW THAT AN END OF BASIC DATA
      CARD HAS BEEN READ
      NEOBD=1
      GO TO 6
C
      IS THIS AN END OF CASE CARD
      410 CALL MATCH(CARD,NAMEB,9,I,J)
      GO TO (52,420),J
      WRITE IT ON THE OUTPUT TAPE
      52 WRITE (6,1006) CARD
C
      WRITE THE DUMMY CARD IMAGE ON THE INPUT SCRATCH TAPE
      1007 FORMAT (5H $END,75X)
      WRITE (13,1007)
      RETURN
C
      IS THIS AN END OF PROBLEM CARD
      420 CALL MATCH(CARD,NAMEC,12,I,J)
      GO TO (53,425),J
      WRITE IT ON THE OUTPUT TAPE
      53 WRITE (6,1006) CARD
C
      WRITE THE DUMMY CARD IMAGE ON THE INPUT SCRATCH TAPE
      WRITE (13,1007)
      IF (NEOBD.EQ.0) RETURN
      NEOBD=0
      GO TO 1
C
      TEST FOR BLANK
      425 IF (CARD(1).NE.ALPHA(27)) GO TO 430
      FLOW TO THIS POINT INDICATES A DATA CARD
      WRITE (6,1003) CARD
      BLANK IDENTIFICATION
      DO 110 I=72,80
      110 CARD(I)=ALPHA(27)
C
      SEARCH FOR THE LAST CHARACTER STARTING IN COL 72
      DO 122 J=1,72
C
      REVERSE THE INDEX
      I=73-J
C
      TEST FOR BLANK, FLOW TO NEXT COLUMN IF PRESENT
      IF (CARD(I).NE.ALPHA(27)) GO TO 120
      GO TO 122
C
      TEST FOR COMMA
      120 IF (CARD(I).NE.ALPHA(30)) GO TO 121

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C      GO TO 124
C      TEST FOR DOLLAR SIGN, REPLACE WITH A COMMA IF PRESENT
121 IF (CARD(1).NE.ALPHA(35)) GO TO 123
    CARD(1)=ALPHA(30)
    GO TO 124
C
122 CONTINUE
C      FLOW TO THIS POINT INDICATES A BLANK CARD
    GO TO 124
C      FLOW TO THIS POINT INDICATES A COMMA IS NOT PRESENT, INSERT ONE
123 CARD(I+1)=ALPHA(20)
C
C
124 WRITE (13,1000) CARD
C      COUNT THE CARDS FOR A POSSIBLE CASE RUN
C      INCREASE THE BASIC DATA CARD COUNT BY ONE
    IF (INEODD.EQ.0) BDCDCT=BDCDCT+1
    GO TO 10
C
C      FLOW TO THIS POINT INDICATES A CARD ERROR
1001 FORMAT (1H,80A1,20H CARD ERROR )
C      430 WRITE (6,1001) CARD
C      WRITE THE DUMMY CARD IMAGE ON THE INPUT SCRATCH TAPE
    WRITE (13,1007)
    RETURN
    END
$IBFTC 10000F

SUBROUTINE RADIOS (NDIM,F,N,E,X,R,DETERM,S1,S2,
  INCASE,NTITLS,NTITLE,PRT1,FMT1,PRT2,FMT2,PRT3,FMT3,PRT4,FMT4)
  DOUBLE PRECISION F,X,R,S2,E,DETERM
  DIMENSION F(80,80)
  DIMENSION X(80)
  DIMENSION R(80)
  INTEGER S1
  DIMENSION S1 (240)
  DIMENSION S2 (80)
  DIMENSION E (80)
  DIMENSION NTITLE (72,10)
  DIMENSION FMT1(24)
  DIMENSION FMT2(24)
  DIMENSION FMT3(24)
  DIMENSION FMT4(24)
  INTEGER PRT1,PRT2,PRT3,PRT4

C
C      PRINT THE EXCITATION VECTOR IF REQUESTED
    IF (PRT1.EQ.0) GO TO 1
    CALL TITLE (NCASE,NTITLS,NTITLE)
    CALL VECPR (NDIM,X,N,FMT1)
  1 DO 4 I=1,N
    DO 3 J=1,N
  3 F(I,J)=-(1.D0-E(I))*F(I,J)
  4 F(I,I)=1.D0+F(I,I)
C
C      PRINT THE TRANSFER MATRIX BEFORE INVERSION IF REQUESTED
    IF (PRT2.EQ.1) CALL MATPRT (NDIM,F,N,NCASE,NTITLS,NTITLE,FMT2)
C
C      DO 6 I=1,N
  6 R(I)=X(I)
C
C      CALL DINVRT (NDIM,F,N,R,1,DETERM,S1,S2)
C
C      PRINT THE TRANSFER MATRIX AFTER INVERSION IF REQUESTED
    IF (PRT3.EQ.1) CALL MATPRT (NDIM,F,N,NCASE,NTITLS,NTITLE,FMT3)
C
C      PRINT THE RESPONSE VECTOR IF REQUESTED
    IF (PRT4.EQ.0) RETURN
    CALL TITLE (NCASE,NTITLS,NTITLE)
    CALL VECPR (NDIM,R,N,FMT4)
C
    RETURN
    END
$IBFTC 10000G
SUBROUTINE MATSYM (NDIM,F,N)
  DOUBLE PRECISION F
  DIMENSION F(NDIM,NDIM)
9001 FORMAT (15HMATRIX ELEMENT,13,1H,,13,19H AND MATRIX ELEMENT,13,1H,
  1,13,12H BOTH DEFINED)
  DO 6 I=1,N
  DO 6 J=1,N
    IF (J.LE.I) GO TO 6
    IF (DABS(F(I,J)).GT.0.D0) GO TO 1
    GO TO 5
  1 IF (DABS(F(J,I)).GT.0.D0) GO TO 2
    GO TO 3
  2 WRITE (6,9001) I,J,J,1
  3 F(J,I)=F(I,J)
    GO TO 6
  5 F(I,J)=F(J,I)
  6 CONTINUE
  RETURN
  END
$IBFTC 10000H
SUBROUTINE MATPOS (NDIM,A,N)
  DOUBLE PRECISION A
  DIMENSION A(NDIM,NDIM)
9001 FORMAT (15HMATRIX ELEMENT,13,1H,,13,19H IS NEGATIVE, IT HAS BEEN
  1MADE POSITIVE)
  DO 1 I=1,N
  DO 1 J=1,N
    IF ((A(I,J)).GE.(0.D0)) GO TO 1
    WRITE (6,9001) I,J
    A(I,J)=DABS(A(I,J))
  1 CONTINUE
  RETURN
  END
$IBFTC 10000I
SUBROUTINE SCRPTF (NDIM,F,N,E,A,BOLTZ,DETERM,S1,S2,NX2,NX3,BUFFER,
  1 NCASE,NTITLS,NTITLE,PRT1,FMT1,PRT2,FMT2,PRT3,FMT3,PRT4,FMT4,
  1PRT5,FMT5,PRT6,FMT6)
  DOUBLE PRECISION F,E,A,BOLTZ,DETERM,S2,BUFFER
  DIMENSION NTITLE (72,10)
  DIMENSION F(80,80)
  DIMENSION E (80)
  DIMENSION A (80)
  INTEGER S1
  DIMENSION S1 (240)
  DIMENSION S2 (80)
  DIMENSION BUFFER(240)
  DIMENSION FMT1(24)
  DIMENSION FMT2(24)
  DIMENSION FMT3(24)
  DIMENSION FMT4(24)
  DIMENSION FMT5(24)
  DIMENSION FMT6(24)
  INTEGER PRT1,PRT2,PRT3,PRT4,PRT5,PRT6

C
C      DO 2 I=1,N
  DO 1 J=1,N
  1 F(I,J)=-(1.D0-E(I))*F(I,J)
  2 F(I,I)=1.D0+F(I,I)
C
C      PRINT THE MATRIX BEFORE INVERSION IF REQUESTED
    IF (PRT1.EQ.1) CALL MATPRT (NDIM,F,N,NCASE,NTITLS,NTITLE,FMT1)
C
  3 CALL DINVRT (NDIM,F,N,E,DETERM,S1,S2)
C
C      IF (PRT2.EQ.1) CALL MATPRT (NDIM,F,N,NCASE,NTITLS,NTITLE,FMT2)
C
C      THE F MATRIX IS STORED BY ROWS ON TAPE 14
    REWIND 14
    REWIND 9
C
  5 DO 6 I=1,N
C
C      READ A ROW OF THE F MATRIX FROM SCRATCH TAPE 14
    READ (14) (BUFFER(J),J=1,NX3)
C
C      PERFORM THE ELEMENT SUM AND WRITE IT BY ROWS ON TAPE 9
  DO 7 J=1,N
  S2(J)=0.D0
  DO 7 K=1,N
    K2=K+N
    S2(J)=S2(J)+BUFFER(K2)*F(K,J)
  7 CONTINUE
  WRITE (9) (S2(J),J=1,N)
  8 CONTINUE
  REWIND 9
  DO 100 I=1,N
    READ (9) (S2(J),J=1,N)
    DO 100 J=1,N
      F(I,J)=S2(J)
  100 CONTINUE
C
C      IF (PRT3.EQ.1) CALL MATPRT (NDIM,F,N,NCASE,NTITLS,NTITLE,FMT3)
C
  10 DO 11 I=1,N
  DO 11 J=1,N
  11 F(I,J)=E(I)*E(J)*F(I,J)
C
C      IF (PRT4.EQ.1) CALL MATPRT (NDIM,F,N,NCASE,NTITLS,NTITLE,FMT4)
C
  13 DO 14 I=1,N
  DO 14 J=1,N
  14 F(I,J)=A(I)*F(I,J)
C
C      IF (PRT5.EQ.1) CALL MATPRT (NDIM,F,N,NCASE,NTITLS,NTITLE,FMT5)
C
C      CALL WRIT14 (NDIM,F,N,NX2,NX3,3,BUFFER)
C
  16 DO 17 I=1,N
  DO 17 J=1,N
  17 F(I,J)=BOLTZ*F(I,J)
    IF (PRT6.EQ.1) CALL MATPRT (NDIM,F,N,NCASE,NTITLS,NTITLE,FMT6)
    RETURN
    END
$IBFTC 10000J
SUBROUTINE FEDIT (NDIM,N,A,CARD,NCASE,NTITLS,NTITLE,
  1PRT1,FMT1,PRT2,FMT2)
  INTEGER ALPHA,ALPHA,ALPHAC,ALPHAD,CARD
  DOUBLE PRECISION F,FA,A,DUMMY
  DIMENSION A(80)

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COMMON F
DIMENSION F (80,80)
DIMENSION FA (80,80)
EQUIVALENCE (F,FA)
INTEGER FAUSED
DIMENSION NTITLE (72,10)
DIMENSION FMT1(24)
DIMENSION FMT2(24)
INTEGER PRT1,PRT2
DIMENSION ALPHAA(2)
DIMENSION ALPHAB(1)
DIMENSION ALPHAC(6)
DIMENSION ALPHAD(4)
DATA ALPHAA/1HF,1HA/
DATA ALPHAB/1HF/
DATA ALPHAC/1HF,1HA,1HU,1HS,1HE,1HD/

DATA ALPHAD/1HS,1HE,1HN,1HD/
DIMENSION CARD(80)

C
C
C NAMELIST /INPUT/F,FA,FAUSED,DUMMY
C
C
C REWIND 3
C REWIND 13
C REWIND 14
C
C
C WRITE $INPUT ON SCRATCH TAPE 3
C 1001 FORMAT (20H $INPUT DUMMY=1.D0,,80X)
C WRITE (3,1001)
C
C
C READ A CARD IMAGE FROM THE INPUT SCRATCH TAPE
C 1002 FORMAT (80A1)
C 1 READ (13,1002) CARD
C
C
C TEST FOR FA
C CALL MATCH (CARD,ALPHAA,2,I,J)
C GO TO (10,2),J
C 10 WRITE (3,1002) CARD
C
C
C TEST FOR F
C 2 CALL MATCH (CARD,ALPHAB,1,I,J)
C GO TO (11,3),J
C 11 WRITE (3,1002) CARD
C
C
C TEST FOR FAUSED
C 3 CALL MATCH (CARD,ALPHAC,6,I,J)
C GO TO (12,4),J
C 12 WRITE (3,1002) CARD
C
C
C TEST FOR SEND
C 4 CALL MATCH (CARD,ALPHAD,4,I,J)
C GO TO (13,1),J
C 13 WRITE (3,1002) CARD
C
C
C FLOW TO THIS POINT INDICATES ALL CARD IMAGES HAVE BEEN PROCESSED
C
C
C FAUSED=0
C ZERO THE F MATRIX
C DO 5 I=1,N
C DO 5 J=1,N
C 5 F(I,J)=0.D0
C
C
C REWIND 3
C READ (3,INPUT)
C
C
C IF (FAUSED.EQ.1) GO TO 7
C CALL MATPOS (NDIM,F,N)
C DO 6 I=1,N
C DO 6 J=1,N
C 6 FA(I,J)=A(I)*F(I,J)
C 7 CALL MATPOS (NDIM,FA,N)
C CALL MATSYM (NDIM,FA,N)
C
C
C PRINT FA MATRIX IF REQUESTED
C IF (PRT1.EQ.1) CALL MATPRT (NDIM,FA,N,NCASE,NTITLS,NTITLE,FMT1)
C
C
C CONVERT FA MATRIX TO F MATRIX
C DO 14 I=1,N
C
C
C IF (DABS(A(I)).GT.0.D0) GO TO 8
C GO TO 14
C 8 DO 9 J=1,N
C 9 F(I,J)= FA(I,J)/A(I)
C 14 CONTINUE
C
C
C PRINT F MATRIX IF REQUESTED
C IF (PRT2.EQ.1) CALL MATPRT (NDIM,F,N,NCASE,NTITLS,NTITLE,FMT2)
C
C
C RETURN
C END
C
C $IBFTC 10000K
C SUBROUTINE WRIT14 (NDIM,MATRIX,N,NX2,NX3,MATNO,BUFFER)
C DOUBLE PRECISION MATRIX,BUFFER
C DIMENSION MATRIX (80,80)
C DIMENSION BUFFER(240)
C
C REWIND 9
C
C REWIND 14
C DO 7 I=1,N
C READ (14) (BUFFER(J),J=1,NX3)
C GO TO (1,2,3),MATNO
C
C 1 DO 4 J=1,N
C 4 BUFFER(J)=MATRIX(I,J)
C GO TO 65
C
C
C 2 DO 5 J=1,N
C J2=J+N
C 5 BUFFER(J2)=MATRIX(I,J)
C GO TO 65
C
C
C 3 DO 6 J=1,N
C J3=J+NX2
C 6 BUFFER(J3)=MATRIX(I,J)
C
C
C 65 WRITE (9) (BUFFER(J),J=1,NX3)
C 7 CONTINUE
C
C
C REWIND 9
C REWIND 14
C DO 8 I=1,N
C READ (9) (BUFFER(J),J=1,NX3)
C WRITE (14) (BUFFER(J),J=1,NX3)
C 8 CONTINUE
C RETURN
C END
C
C $IBFTC 10000L
C SUBROUTINE READ14 (NDIM,MATRIX,N,NX2,NX3,MATNO,BUFFER)
C DOUBLE PRECISION MATRIX,BUFFER
C DIMENSION MATRIX (80,80)
C DIMENSION BUFFER(240)
C
C
C REWIND 14
C DO 7 I=1,N
C READ (14) (BUFFER(J),J=1,NX3)
C GO TO (1,2,3),MATNO
C
C 1 DO 4 J=1,N
C 4 MATRIX(I,J)=BUFFER(J)
C GO TO 7
C 2 DO 5 J=1,N
C
C
C J2=J+N
C 5 MATRIX(I,J)=BUFFER(J2)
C GO TO 7
C 3 DO 6 J=1,N
C J3=J+NX2
C 6 MATRIX(I,J)=BUFFER(J3)
C 7 CONTINUE
C RETURN
C END
C
C $IBFTC 10000M
C SUBROUTINE VECPR1 (NDIM,A,N,FMTT)
C DOUBLE PRECISION A
C DIMENSION A(NDIM)
C DIMENSION FMTT(24)
C WRITE (6,FMTT)
C DO 3 J=1,N,5
C K=J
C KK=J+4
C IF (KK.LE.N) GO TO 3
C KK=N
C 1001 FORMAT (1H I4,2H = D16.8,
C 1 I4,2H = D16.8,
C 1 I4,2H = D16.8,
C 1 I4,2H = D16.8,
C 1 I4,2H = D16.8)
C 3 WRITE (6,1001) (K,A(K),K=J,KK)
C RETURN
C END
C
C $IBFTC 10000N
C SUBROUTINE MATPRT (NDIM,A,N,NCASE,NTITLS,NTITLE,FMTT)
C DOUBLE PRECISION A
C REAL NTITLE
C DIMENSION NTITLE (72,10)
C DIMENSION A(NDIM,NDIM)
C DIMENSION FMTT(24)
C CALL TITLE (NCASE,NTITLS,NTITLE)
C WRITE (6,FMTT)
C DO 3 J=1,N
C 1000 FORMAT (6H0 ROW,I3)
C WRITE (6,1000)J
C DO 3 J=1,N,5
C K=J
C KK=J+4
C IF (KK.LE.N) GO TO 3
C KK=N
C 1001 FORMAT (1H I4,2H = D16.8,
C 1 I4,2H = D16.8,
C 1 I4,2H = D16.8,
C 1 I4,2H = D16.8,
C 1 I4,2H = D16.8)
C 3 WRITE (6,1001) (K,A(I,K),K=J,KK)
C RETURN
C END
C
C $IBFTC 10000O
C SUBROUTINE DINVRT (NDIM,A,NORDER,B,MORDER,DETERM,S1,S2)
C DOUBLE PRECISION A,B,DETERM,S2,AMAX,T,SWAP

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Nomenclature

A	area	L	radiosity or flux density streaming away from a surface
EIR, ϵ	infrared emittance	P	power or electrical dissipation
$ESOL, \alpha$	solar emittance, equal to the solar absorptance	Q	radiant flux
F	form factor	$SOLCON, S$	solar constant
$\mathcal{G}$	total radiation conductance, including multiple reflections	T	temperature
θ	angle from the normal of a surface to the sun	ρ	reflectance equal to 1 minus the emittance
G	radiant flux per unit area on a surface	σ	Stefan-Boltzmann constant

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