DATA GENERATION USING GRAPHICS

FOR *P - 804*

RADIATIVE HEAT EXCHANGE CALCULATIONS

PROJECT WORK DONE AT

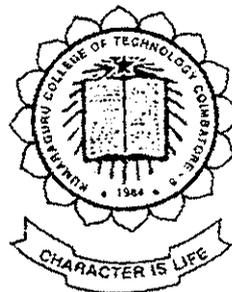## ISRO SATELLITE CENTRE(ISAC)

PROJECT REPORT

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE OF

MASTER OF COMPUTER APPLICATIONS

OF BHARATHIAR UNIVERSITY, COIMBATORE.

SUBMITTED BY

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Coimbatore-641006
MAY 2002

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

KUMARAGURU COLLEGE OF TECHNOLOGY

(Affiliated to the Bharathiar University)

CERTIFICATE

This is to certify that the project entitled

DATA GENERATION USING GRAPHICS
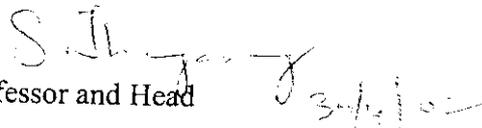
FOR

RADIATIVE HEAT EXCHANGE CALCULATIONS

Done By

K. NANTHAKUMAR, 9938m0639

Submitted in partial fulfillment of the requirements for the award of the degree of

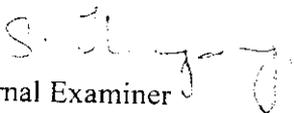## Master of Computer Applications of Bharathiar University.
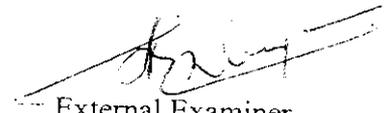
Professor and Head

Internal Guide

Submitted for the University Examination held on

Internal Examiner

External Examiner

CERTIFICATE

This is to certify that **Mr. K. Nanthakumar MCA, Kumaraguru college of Technology**, coimbatore undertook a project titled **"Data Generation Using Graphics For Radiative Heat Exchange Calculations "** in our organization from Jan 2002 to April 2002 and has successfully completed his assignment.

He worked on his project with extreme sense of ownership and dedication. During the above period his conduct and character were good.

GUIDE:

B. Thrinatha Reddy

(B.Thrinatha Reddy)
B. THRINATHA REDDY
ENGINEER
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BANGALORE – 560 017.

DECLARATION

DECLARATION

I here by declare that this Project work entitled " **DATA GENERATION USING GRAPHICS FOR RADIATIVE HEAT EXCHANGE CALCULATIONS**" submitted to **Bharathiar University** as the Project work of Master Of Computer Application Degree ,is a record of original work done by me under the supervision and guidance of Mr. B. Trinatha Reddy, Scientist, Thermal System Group, ISAC, Bangalore and Mr. S. Thangasamy, PhD, Head of the Department, Department of Computer Science, kumaraguru college of Technology, coimbatore and this project work has not found the basis of award of any Degree/ Diploma/Associateship/Felloship or Similar title to any Candidate of any University

Place: Coimbatore

Signature of the Student

(K. Nantha Kumar)

Date: 30/4/02

Counter Signed by

(Internal Guide)

Dr. S. Thangasamy, PhD,
Head of the Department,
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(External Guide)
Mr. B. Trinatha Reddy,
Scientist,
Thermal System Group,
ISRO Satellite center,
Bangalore.

ACKNOWLEDGEMENT

ACKNOWLEDGEMENT

The satisfaction that accompany the successful completion of any taste would be but incomplete without the mention of the people who made possible whose constant guidance and encouragement crowns all efforts with success.

I am extremely grateful to Dr. K. K. Padmanabhan, Principal , Kumaraguru College of Technology, coimbatore for permitting me to have a golden opportunity to serve the purpose of our education.

My sincere thanks to Dr. Thangasamy, Head of the Department of Computer Science and Engineering ,Kumaraguru College of Technology for providing me this opportunity to take up the project work .He has been a source of encouragement and inspiration throughout the curriculum.

I would like to express my sincere thanks to my internal guide Dr.Thangasamy ,Head of the Department of Computer Science and Engineering, Kumaraguru College Of Technology, Coimbatore, for his assistance and support in accomplishing my project .

I am grateful to Mr.Thirunatha Reddy, Scientist, INDIAN SATELLITE RESEARCH ORGANIZATION (ISRO), Bangalore, for those care, support and guidance, which helped me in the completion of this project.

SYNOPSIS

SYNOPSIS

The goal of this project is to find the Shape Factor for each and every surfaces of the satellite in the orbit. A satellite can be thought as a combination of different surfaces. The various surfaces includes **Trapezium, Rectangle, Disc, Cone, Truncated cone, Sphere.**

Radiation is the predominant mode of heat transfer between satellite surfaces. Computation of shape factor is one of the key step in estimating the heat transfer by radiation between surfaces.

The surface location and orientation is the input to the application. Any errors in preparing or keying the data, results in wrong estimate of the radiative heat exchange calculations between the surfaces.

A user friendly GUI is developed in **Visual Basic 6.0** which is used to get input from the user. From the input received, various surfaces are generated using **Turbo C 1.0,** which visually inspects the surfaces for errors. Finally the shape factor values are computed for the various surfaces generated. The calculated shape factor is the final output of the project and is stored in a file.

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INTRODUCTION

1. INTRODUCTION

1.1 PROJECT DESCRIPTION

This project work entitled **"Data Generation Using Graphics For Radiative Heat Exchange Calculations"** is an Calculation based application. A satellite can be thought as a combination of different surfaces. The surface includes are **Trapezium, Rectangle, Disc, Cone, Truncated cone, Sphere.**

Radiation is the predominant mode of heat transfer between surfaces while it is in orbit. Computation of shape factor is the key step in estimating heat transfer by radiation between surfaces.

Shape factor can be simply defined as "Fraction of energy emitted by surface and incident on the other surfaces".

To obtain the Shape Factor of the surface, the surface of satellite is divided into nodes. Further the nodes are divided into elemental areas in x, y axis, because the heat generated in each surface is not constant in all areas. Finally the Shape Factor is computed for each surfaces by adding the shape factor of each divided nodes.

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THEORY AND FORMULATION:

If an elemental area is radiating to another elemental area then formula for shape factor is

$$\triangle F(1\text{-}2) = \frac{Cos(\theta 1) * Cos(\theta 2)}{\Pi \ (S*S)} * dA2 \qquad \ldots\ldots\ldots\ldots(1)$$

Where θ1, θ2 & S are shown in figure below
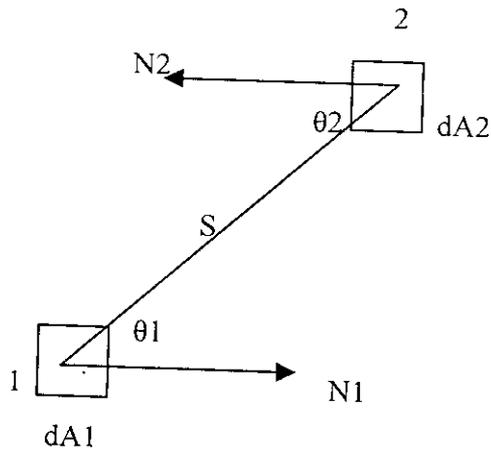
dA1 - Area of elemental area-1

dA2 - Area of elemental area-2

N1 - Normal to element - 1

N2 - Normal to element - 2

S - Distance between elements

When a surface A is radiating to the surface B, where B is further subdivided into a number of areas 1,2,3 ----etc.

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

A

B
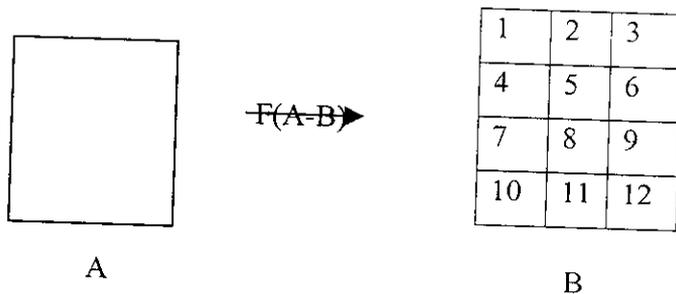
as shown in the figure above then

$$F(A-B) = F(A-1) + F(A-2) + F(A-3) + \ldots\ldots\ldots\ldots\ldots(2)$$

Suppose we consider surface A which is radiating to surface B is divided into a number of elemental areas 1,2,3 ...... etc, if the shape factor of each elemental area to B is known.

1	2	3
4	5	6
7	8	9

A

F(A-B)

B
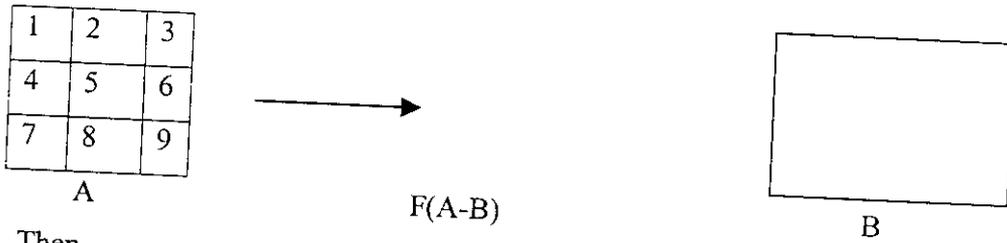
Then

$$A1\ F(1-B) + A2\ F(2-B) + A3\ F(3-B) + \ldots\ldots\ldots\ldots = A\ F(A-B)\ \ldots\ldots\ldots\ldots(3)$$

If the line joining the two points representing the elements cuts any other surface then radiation between the two elements is considered to be shaded by that surface and the shape factor between the two elements is zero.

If the line does not intersect any surface there is no shading. Consider two surfaces A and B, let A and B divided into a number of elemental areas.

Consider an element dA(1) on 'A' and another element dB(1) on 'B'
Now from equation ....(1)

$$FdA(1) - dB(1) = \frac{1}{\Pi}\ \frac{Cos(\theta1) * Cos(\theta2)}{(S*S)}\ dB(1) = DDS(1)\ (say)$$

Find shape factor of dA(1) with all the elements on B i.e......
Find DDS(2), DDS(3), ...etc

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From equation (2)

FdA(1)-B = **DDS(1) + DDS(2) + DDS(3)+........**

= **DS(1) (say)**

Let the product dA(1).DS(1)=dAds(1)

Consider anther element dA(2) on A. Adopt the same procedure and

Find dAds(2) similarly fine dAds(3), dAds(4) ....etc

Now from the equation ....(3)

A F(A-B) = dAds (1) + dAds(2) + dAds(3)+........

F(A-B) = **dAds(i) / A**

1.2 ORGANIZATION PROFILE

The India Space Research organization is the primary agency charged with the responsibility laid down by the space commission and department of space, govt of India. For executing research and development programs and schemes of the department of space.

Over the years this organization is playing a pivotal role in the nation's development and achievement in the field of space research. The main activities in this organization are carrying research in the field of space and developing space crafts and satellites for multiple users such as communication, weather forecasting, remote sensing nation wide telecast, resource survey and management, meteorological services and other such activities.

Department of space, government of India is the department responsible for the execution of the activity in the space science through the ISRO. The DOS/ISRO head quarters is located in Bangalore providing overall direction to the technical, scientific and administrative functioning of eight centers as described below.

VSSC : Vikram Sarabai Space Center, Trivandruam.

Engaged in design and development of scientific satellite launching technology.

SHAR : Sriharikota Range, Sriharikota

It is the main operational base of ISRO fully equipped with sophisticated launching pad facilities.

ISAC : ISRO Satellite Centre, Bangalore.

Engaged in design and development of communication, remote sensing and other satellite activities.

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SPAC :   Space Application Centre, Ahmedabad.

It is ISRO's main application R&D centre with activities in telecommunication and developing of payloads for spacefcrafts.

LPSC :   Liquid Propulsion System Centre, Mahendragiri.

Engaged in launching vehicles propultion systems, engine testing.

ISTRAC :   ISRO Telemetry Tracking and Command Network, Bangalore.

Providing ground support for the launching vehicle and satellite machine of ISRO.

NRSA :   National Remote Sensing Agency, Hyderabad.

It is engaged in developing and utilizing modern remote sensing techniques and providing traning and other operational supports.

MCF :   Master Control Facility, Hassan.

It is the ground for monitoring and control of INSAT spacecrafts.

ISRO SATELLITE CENTRE(ISAC):

Started in 1972 the ISRO satellite centre which had initiated the Indian Scientific Satellite Projects(ISSP) for the realization Aryabhatta, has today grown in to the nations premier center for R&D in satellite technology.

ISAC has so for successfully designed and executed several satellite projects of ISRO, namely Aryabhatta, Bhaskara 1 & 11, the three satellites of Rohini series, Apple. SCROSS 1 & 11, C and C1 IRS1A, 1B and INSAT2A,2B,2C,2D,2E. ISAC located in bangalore caries out all functional R&D tasks and infrastructure facility establishment and maintenance with overall staff strength of 3500 members.

The ISAC centre is organized in mechanical systems area. Electronic systems area, control and machine area and special projects area. The center also had independent groups. The groups are Program Planning and Evaluation Group(PPEG), Systems Reliability Group(SRG), Computer Information Group(CIG).

Thermal System Group (TSG):

Thermal System Group(TSG) is one of the largest groups of the satellite center involved in thermal design and analysis, fabrication and testing groups. The group is responsible for the design and development of suitable thermal control system(TCS) various materials are used in a spacecraft.

The performance of thermal control system crucially depends upon the thermal behavior of the materials and elements of TCS. The measurement and characterization of the thermos-physical and optical properties are fundamental for the under standing of thermal behavior of materials employed in TCS.

TSG has a full-fledged design/analysis division (TDAD), which specializes in thermal analysis/design of the spacecraft and its sub-systems. TDAD employs several integrated imported software tools. How ever an attempt to evolve an integrated tool for its in-house thermal analysis codes is being made. The software development reported here in forms a part of this integration effort.

SYSTEM STUDY AND ANALYSIS

2. SYSTEM STUDY AND ANALYSIS

2.1 EXISTING SYSTEM

The existing system was developed in FORTRAN 70 language. In this system inputs are stored manually in a notepad. This takes lot of time for entering the inputs and inspecting the errors. Dynamic memory management is not supported in FORTARN 70.

2.2 PROPOSED SYSTEM

The objective of the proposed system is to find the shape factor for each and every surface in the satellite. The proposed system should automate the factors and facilitate effective shape factor calculation and view a graphical output along with the final value of shape factor.

The user interface is developed in Visual Basic 6.0 by using this, user can give the proper input with the help of Graphical User Interface(GUI). If there is any erroneous data at the time of input it prompts the error. Due to this the user can immediately rectify the error before execution of the program.

The processing of the input is done in 'Turbo C'. The inputs entered in Visual Basic is stored in a text file which serves as a data store. 'C ' graphics process the inputs from the text file and generates various surfaces. From the generated surfaces, the shape factor is calculated for each and every surfaces.

2.3 USER CHARACTERSTICS

The user of the system should be well versed in windows platform. The user should have complete knowledge about the satellites and the various surfaces used by it. He should be aware of the various orientations and locations of the surfaces. Once the surfaces are displayed, the user should be capable of inspecting those orientations and locations. He has the responsibility to check for errors and to correct them.

PROGRAMMING ENVIRONMENT

Version : Turbo C 1.0

Operating System : DOS

3.2 SOFTWARE REQUIREMENTS

Features of Visual Basic

Visual basic provides a graphical environment in which you visually design the forms and controls that become the buildings blocks of your applications. Visual Basic support many useful tools that will help you be more productive.

These includes, but are not limited to projects, forms, class objects, templates, custom controls, add-ins, and database managers. You can these tools together to create complete applications in months, weeks, or even days producing an application using another language can take much longer.

Version 6 of Visual Basic is specifically designed to utilize the Internet. It comes with several controls that allow you to create Web-based applications called ActiveX executables. These work just like stand-alone Visual Basic applications, but they are accessed through the Microsoft Internet Explorer4 Web Browser.

Using this new style of application you can revise your existing Visual Basic applications and distribute them through the Internet. New to Visual Basic 6 are the ISAPI Application and Dynamic HTML project templates. These templates provides you with a frame work to develop server-side components as well as "smart" Web pages and applications.

Visual Basic continues to sport the Explorer–style development environment, modeled after Windows Explore. This makes it easy for a computer user to jump right into creating applications with Visual Basic. Almost all the objects and tools on the screen can be manipulated through a right click. You can set properties, add controls and even view context-sensitive help with this single action.

Features of C

The increasing popularity of C is probably due to its many desirable qualities. It is a robust language whose rich set of built –in functions and operators can be used to write any complex program.

The C complier combines the capabilities on an assembly language with the features of a high-level language and therefore it is well suited for writing both system software and business packages. In fact, menu of the C compilers available in the market are written in C.

Programs written in C are efficient and fast. This is due to its variety of data types and powerful operators. It is many times faster than BASIC. There are only 32 keywords and its strength lies in its built-in functions. Several standard functions are available which can be used for developing programs.

C is highly portable. This means that C programs written for one computer can be run on another with little or no modification. Portability is important if we plan to use a new computer with a different operating system.

C language is well suited for structured programming, thus requiring the user to think of a problem in terms of function modules or blocks. A proper collection of these modules would make a complete program. This modular structure makes program debugging, testing and maintenance easier.

Another important feature of is its ability to extend itself. A C program is basically a collection of functions that are supported by the C library. We can continuously add our own functions to the C library. With the availability of large functions, the programming tasks become simple.

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SYSTEM DESIGN AND DEVELOPMENT

4. SYSTEM DESIGN AND DEVELOPMENT

4.1 INPUT DESIGN

Input design is the part of the overall system design that requires very careful attention and is the most expensive phase. If data going into the system is incorrect then processing and output will magnify these errors. Objectives during input design are as follows:

➢ Produce cost effective method of input.

➢ Achieve high – level of accuracy.

➢ Ensure that the input is free of ambiguity.

Several stages of our input design are:

➢ Data Recording

➢ Transfer of data to input form

➢ Data verification

➢ Transmitting data to computer

➢ Data correction

The input design involves converting the user-originated inputs into a computer – based format. The aim of the input design is to make the data entry easier, logical and error free. It helps us to filter errors in the input data that otherwise entered into the database might have brought in a lot of inconsistency.

During application development, care has been taken to make our system extremely user-friendly and organize our screens such that the possibilities of making errors are minimized.

List of all possible values, list box, check box, radio buttons etc. are provided to the user for selection the inputs. This makes the system less prone to errors as the input texts are to be selected rather than to be typed in by the users.

After the wrong entries such as primary key duplication, letters in numeric data, wrong data format, range exceed have been provided error messages in the application. Upon this, a well-documented instruction set and navigation maps are also provided for the non-frequent and first-time users to familiarize them with our web site.

DATA PREPARATION:

➤ The surfaces are to be numbered in serial order starting from 1.

➤ The nodes are to be numbered in serial order starting from 1. First all the trapezium data is given out followed by rectangle, disc, cone, Truncated cone and Sphere. The last serial number equals the total number of nodes.

➤ The secondary reference frames associated with each surface are to be established as explained while defining surfaces.

➤ A primary reference frame is to be established which generally will be a secondary reference frame associated with one of the surfaces.

The data is to be supplied as follows:

NFIG	–	Number of surfaces
NTRN	–	Number of trapezium nodes.
NREN	–	Number of rectangular nodes.
NSIDN	–	Number of disc nodes.
NYTN	–	Number of Truncated nodes
NSPN	–	Number of spherical nodes.
NCON	–	Number of conical nodes.
NNIS, NNIE	-	Starting and ending node numbers of the set of the nodes from which shape factor is to be found. In program variable I will have values from NNIE.

Data For Surfaces:

FIGTYP(I) Type of the I surface. This is to be given in quotes as shown below.

'TRAP' For a trapezoidal surface.

'RECT' For a rectangular surface.

'DISC' For a disc surface.

'CYLI' For a cylindrical surface.

'CONE' For a conical surface.

'SPHE' For a spherical surface.

OXF[I], OYF[I], OZF[I] X,Y,Z co-ordinates in the primary reference frame of the origin of the secondary reference frame associated with I surface.

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PSIF[I],PHIF[I],THETF[I] Euler angles θ, ψ, ϕ of the secondary reference frame associated with the I surface to specify the orientation of the I surface with respect to the primary reference frame.

DIMF[I][J] To specify the dimensions of the I surface which is to be given as follows.

SURFACE	DIMF[I][1]	DIMF[I][2]	DIMF[I][3]	DIMF[I][4]
TRAPEZIUM	H	L1	L2	L3
RECTANGLE	X	Y	0	0
DISC	R1	R2	ϕ	0
TRUNCATED CONE	H1	H2	R1	R2
CONE	H	ϕ	0	R
SPHERE	θ1	θ2	ϕ	R

The above parameters are explained while defining surfaces. The angles are to be given in degrees.

NODE DATA

SIDE[I] To specify whether the I node is inside or outside the surface to be given in quotes as

'IN' for inside surface

· 'OUT' for outside surface.

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FIGN[I]   The serial number of the surface on which the I node lies.

DIMN[I][J]   To specify the dimensions of the I node. Data is to be supplied as
                 given below.

SURFACE	DIMF[I][1]	DIMF[I][2]	DIMF[I][3]	DIMF[I][4]
TRAPEZIUM	H1	H2	L1	L2
RECTANGLE	X1	X2	Y1	Y2
DISC	R1	R2	φ1	θ2
TRUNCATED CONE	H1	H2	φ1	φ2
CONE	H1	H2	φ1	φ2
SPHERE	θ1	θ2	φ1	φ2

The above parameters are explained while defining nodes. Angles are to be given in
degrees.

DIMTRN[I][K]   These are the two extra data needed to define a trapezium node .

DIMTRN[I][1]   L3 of the I node if it is a trapezium.

DUNTRN[I][2]   L4 of the I trapezium node

NDIV1[I]   Number of divisions into which the I node is to be divided in
                 height direction for a cylindrical or conical node, in   direction for
                 spherical node, in radial direction for disc node, along the 'Y ' axis
                 for trapezium or rectangular node.

NDIV2[I] Number of division in the other direction into which the I node is to be divided.

NIDIV[I] Number indicating the way in which I node is divided into elements in height direction. '0' is to be given for uniform division and 1 for first and last elements in height direction to have smaller areas.

NIDVRX[I] Number indicating the way in which I node is divided into elements in X direction. This is required only when the I node is a rectangular node. For trapezoidal node neither NIDIV[I] nor NIDVRX[I] is to be given.

SHADING DATA

I Serial number of a surface.

J Serial number of another surface.

NUMSF Number of surfaces those may come between I and J

NOSF Serial numbers of the surfaces those may come between I and J

If no shading data is given the shape factors will be found assuming there is no shading due to any other surface.

PARAMETERS FOR DIMENSIONAL ARRAYS

Values to the following parameters are to be assigned as shown below for dimensioning arrays.

DFG	Number of figures
DNN	Total number of nodes
DPL	Total number of nodes

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DCY	Number of truncated cone + conical nodes
DSP	Number of spherical nodes
TRA	Number of trapezoidal nodes
DNNR	Total number of trapezoidal + rectangular nodes
DNND	Number of disc nodes
DVRT1	Maximum number of divisions for trapezoidal and rectangular nodes along 'Y' axis
DVRT2	Maximum number of division for trapezoidal and rectangular nodes along 'X' axis
DVD1	Maximum number of divisions in the radial direction for disc nodes
DVD2	Maximum number of divisions for disc nodes in circumferential direction
DVCC1	Maximum number of divisions in height direction for truncated cone and conical nodes
DVCC2	Maximum number of divisions in the circumferential direction for truncated cone and conical nodes
DVSP1	Maximum number of divisions in θ direction for spherical nodes
DVSP2	Maximum number of divisions in ϕ direction for spherical nodes

4.2 OUTPUT DESIGN

Outputs from the computer systems are required primarily to communicate results of processing to users (including machine-based system) they are also used to provide 'Hard Copy ' of the results for the later consultation.

Various types of output required by most systems are external output whose destination is outside.

Internal output whose destination is within the organization which requires careful design. Interactive output which involve user in communication with the computer.

Name given to each data item should be record and its characteristics described clearly in standard form.

- Whether alphabetic or numeric
- Number of characters
- Position of decimal points

OUTPUT SPECIFICATION

System Analyst has two specific objectives at this stage:

- To interpret the results of the computer part of the system to users in a form which they can understand and which meets their requirements.
- To communicate the output design specification to programmers in a way, which is ambiguous, comprehensive and capable of being translated in to programming language.

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Satellite Surfaces:

The various surfaces that are generated in the application are:

1. Trapezium.
2. Rectangle.
3. Disc.
4. Truncated Cone.
5. Cone.
6. Sphere.

The surfaces which are generated above are in Local Reference Frame. The Local Reference Frame should be transformed into Global Reference Frame by applying the Transformation Matrix.

The Transformation Matrix is calculated by using Euler angles which includes θ, ψ, φ
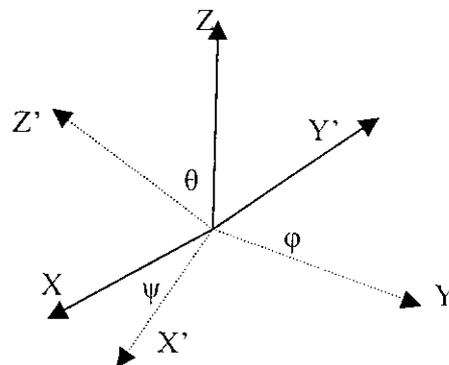
Where X, Y, Z   - Primary Reference Frame

Where X', Y', Z' - Secondary Reference Frame

Where θ, ψ, φ - Euler angles.

The Transformation matrix to transform from X', Y', Z' to X, Y, Z is

$$
\begin{bmatrix}
\cos\varphi\cos\psi - \sin\varphi\cos\theta\sin\psi & -\sin\varphi\cos\psi - \cos\varphi\cos\theta\sin\psi & \sin\theta\sin\varphi \\
\sin\varphi\cos\theta\cos\psi + \cos\theta\sin\psi & \cos\varphi\cos\theta\cos\psi - \sin\varphi\sin\psi & -\sin\theta\sin\varphi \\
\sin\varphi\sin\theta & \cos\varphi\sin\theta & \cos\theta
\end{bmatrix}
$$

Projection of Surfaces:

Each surface is projected by using above transformation matrix. The various projections are:

1. Based on XY axis (front view)
2. Based on YZ axis (side view)
3. Based on XZ axis (top view)

Projection is done by suppressing the axis which is facing us.

4.3 PROCESS DESIGN
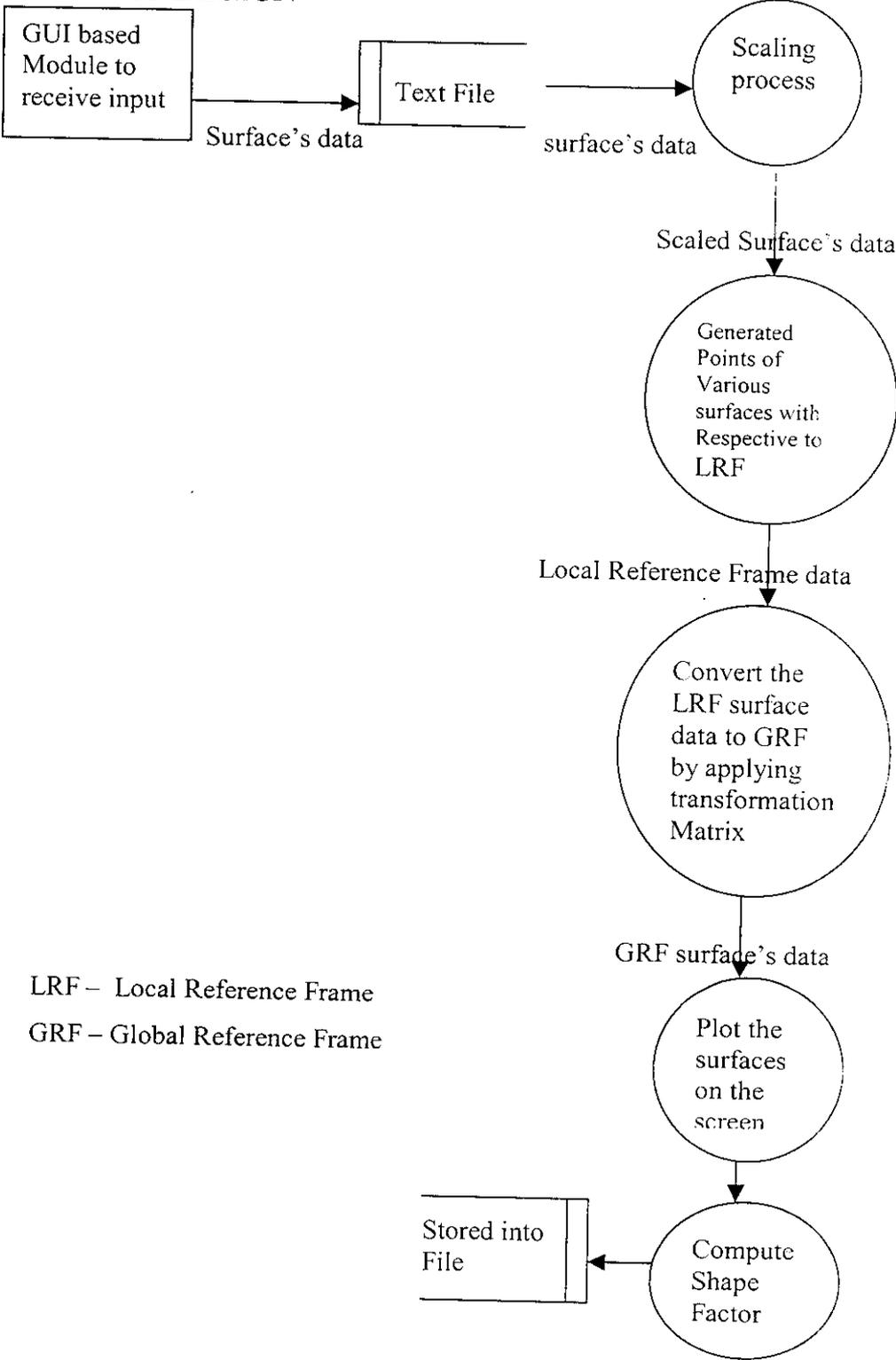
GUI based Module to receive input

Surface's data

Text File

surface's data

Scaling process

Scaled Surface's data

Generated Points of Various surfaces with Respective to LRF

Local Reference Frame data

Convert the LRF surface data to GRF by applying transformation Matrix

GRF surface's data

LRF – Local Reference Frame

GRF – Global Reference Frame

Plot the surfaces on the screen

Stored into File

Compute Shape Factor

SYSTEM IMPLEMENTATION
AND TESTING

5. SYSTEM IMPLEMENTATION AND TESTING

5.1 SYSTEM IMPLEMENTATION:

Implementation is the stage of the project when the theoretical design is turned into a working system. At this stage the main workload, the upheaval and the major impact on the existing practice shifts of the user department. If the implementation stage is not carefully planned and controlled. It can cause chaos. Thus it can be considered to be the most crucial stage in achieving a new successful system and in giving the users confidence that the new system will work and be effective.

Implementation involves careful planning, investigation of the current system and its constraints on implementation, design of methods to achieve the changeover, training of staff in the changeover procedures and evaluation of changeover methods. The first task is implementation planning. i.e., deciding on the methods and time scale to be adopted.

Once the planning has been completed, the major effort in the computer department is to ensure that the programs in the system are working properly. At the same time the user department must concentrate on training user staff. When the staff has been trained, a full system test can be carried out, involving both the computer and clerical procedures.

Education involves creating the right atmosphere and motivation the user. Staff education section should encourage participation from all sides.

CODING:

Conversion of design specification into source code in the software product developed includes the usage of set of factors given below:

1) **Structured Coding Techniques:**

   ➤ Single Entry, Single Exit Constructs.

   ➤ Efficiency Considerations

2) **Coding styles:**

   ➤ Use of few standards, agreed upon control constructs

   ➤ Use of User defined data types.

In the code sheet, the code written for particular event of the selected object will get executed if the control acquires the object. For example, control passes through the code written in the keycode event of the object, say Text Box, if the key press action takes place in the corresponding Text Box on the screen. This implies that the data variables and functions written for that object are encapsulsted to it. Hence the security for the execution of code holds goods. Also comments have been included in the coding when the part of the program needs to specify the remarks.

3) **Documentation Guidelines:**

   ➤ Supporting documents such as requirement specifications, design documents, test plans and maintenance reports have been included. Thus

documents are the result of systematic development and maintenance of software.

➢ Program until completion notebook has been maintained on the due date of the module's completion. Also remarks are entered which are then referred in further coding.

4) Internal documentation:

This consists of a standard prologue for each program init with the commenting conventions in it. The factors that are used in the commenting conventions are as follows.

➤ The needs are attached to block of code that perform major data manipulations perform Exception Handling.

➤ The needs for embedding the comments are mininmized

➤ Blank lines, border and indentation to highlight the comments have been used

➤ Comments and code are written in such a way that they agree with each other and with the requirements and design specifications.

5.2 SYSTEM TESTING

Software testing can be looked upon as one among the many processes. This is the last opportunity to correct any possible flaws in the developed system. Software testing includes selection test and test data that have more probability of finding errors.

System is the stage of implementation that is aimed at ensuring that the system works accurately and efficiently before live operation commences. In principle, system proving is an on-going activity throughout the project.

The logical design and the physical design should be thoroughly and continually examined on paper to ensure that they will work when implemented. Thus the system test in implementation should be a confirmation that all is correct and an opportunity to show the users that the system works.

The first step in system testing is to develop a plan that tests all the aspects of the system. Completeness, correctness, reliability and maintainability of the software are to be tested for the best quality assurance – an assurance that the performance.

System testing is the most useful practical process of executing a program with explicit intention of finding errors that make the program fail. The following phases were developed.

Test plan:

This document describes the plan for testing the shape factor computation and it's GUI software. All major testing activities are specified here.

Test Units:

In this project I perform two levels of testing Unit Testing and System Testing. The basic units to be tested are:

➤ Modules and object of Database

> Modules and object operations to Forms and Menus

The testing for these different units will be done independently

Features to be tested:

a) All the functional features specified in the requirements document will be tested.

b) Performance testing will be done to

> Increase system speed.

> Decrease saving time response.

> Decrease the time taken for Request and Response from the server.

Approach for Testing:

For unit testing, structural testing based on statement, branch and path coverage criteria will be used as per need in the modules and operations. The goal is to achieve branch and path coverage of more than 95%. The focus is on the invalid and valid cases boundary value and special cases.

Test Deliverables:

The following documents are required(besides this test plan):

a. Unit Report for each unit.

b. Test Case specification for System Testing.

c. The report for System Testing.

d. Error Report

The test case specification for system testing has to he submitted for review testing commences.

Unit Test Report:

Here I present the test report for major modules and operations., the goal of testing is to achieve over 95% branch or path coverage.

Drivers and Stubs:

Because I use bottom-up approach for testing, there is need of writing Stubs. Drivers well suited for bottom-up approach. The general Driver for major modules and operation is shown below.

procedure Insert_Submitt()

Local Variables:

Test Case   : Integer

/* This is the module to be unit tested */

/* It validates all major modules to be tested */

Begin /* Driver */

Get test case and set it to TestCase.

/* As per requirements call these modules or operations

for Unit Test only one module appear below. For Integration more than it can be have */

Call Module1

Call Module2

:

If not error then Print Expected Output or Message

Else Print Error Message or Error

End If

End.

Test Case Specifications For System Testing:

Here I specify all test cases that are used for system testing. First, the different conditions that need to be tested, along with the test cases used for testing those conditions and expected outputs are given. The test cases have been selected using the functional approach. The goal is to test the different functional requirements, as specified in the requirement document, Test cases have been selected for both valid and invalid inputs.

SI.NO	Test Case	Condition Being Checked	Expected Output
1.	ISRO ******(password)	Authorization Usage	Main Menu

2.   ISRO   Authorization Access   Message:
******(password)   Unauthorized user

Black Box Testing:

This is conducted at the software interface. This test though is designed to uncover errors, is used to demonstrate that software functions are operational, input is properly accepted and outputs are produced correctly and that integrity of external information is maintained. Black box testing attempts to find errors in the following categories.

➢   Incorrect or missing functions.

➢   Interfaces errors.

➢   Errors in data structure/external database access.

➢   Performance and termination errors.

Accordingly, all the inputs to each if the modules were checked and like wise all the outputs were tested to meet requirements of the system under development.

White Box Testing:

White box testing of software is predicated on close examination of procedural details. Logical paths through the software are tested by providing test cases that exercise specific tests of conditions and/or loops. White Box testing attempts to gurantee that all independent paths within a module have been exercised at least once.

Thus the different units that were tested were put together to see its functionality and flow of data from module to module.

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5.3 REFINEMENT BASED ON FEEDBACK

Proper unit testing had been underwent to check that the changes made to the system as a result of feedback after testing, have not affected the modules of the system

CONCLUSION

6. CONCLUSION

This project "Data Generation Using Graphics For Radiative Heat Exchange Calculations" provides solution for the satellite using the surfaces like Trapezium, Rectangle, Disc, Cone, Truncated Cone, Sphere.

The GUI based application provides a user friendly environment to the users. The user has to operate his part according to the requirements of the application.

Since the project is developed in 'C', there is a better dynamic memory management which surpasses the demerits of FORTRAN 70.

SCOPE FOR FUTURE DEVELOPMENT

7. FUTURE ENHANCEMENTS

This project is suited for the satellite using surfaces like Trapezium, Rectangle, Disc, Cone, Truncated cone, Sphere. Surfaces used in satellite may differ from each other. This application is enhanced with adopting future requirements.

In future the satellite may be in need of using surfaces like Circle, Triangle, Cube etc. The application is capable of generating surfaces and compute shape factor for any type bof surfaces.

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   - Author   :   Richard Fairley
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APPENDIX
SAMPLE INPUTS

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APPENDIX
SAMPLE OUTPUTS

RECTANGLE

PROJECTION ON XY AXIS

PROJECTION ON XZ AXIS

PROJECTION ON YZ AXIS

TRAPEZIUM

PROJECTION ON XY AXIS
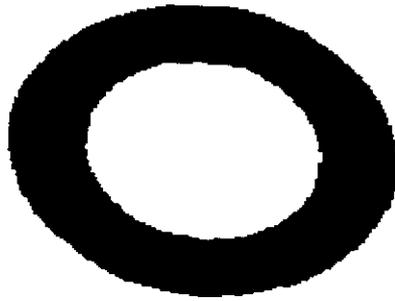
PROJECTION ON XZ AXIS

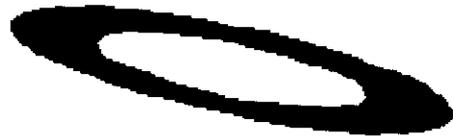PROJECTION ON YZ AXIS

DISC

PROJECTION ON XY AXIS

PROJECTION ON XZ AXIS

PROJECTION ON YZ AXIS

PROJECTION ON XY AXIS

PROJECTION ON XZ AXIS
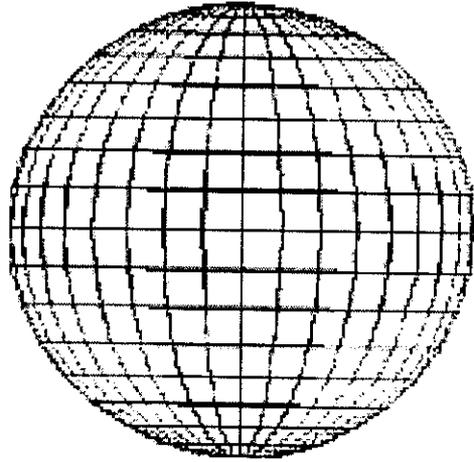
Enter ur choice2

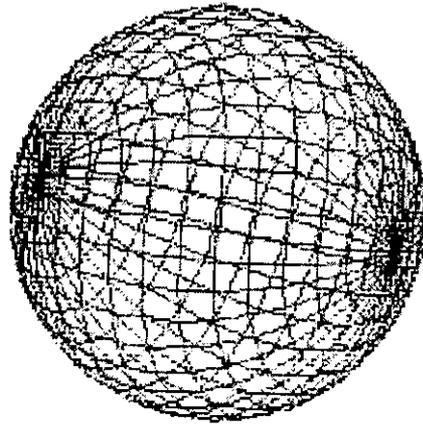**PROJECTION ON YZ AXIS**

TRUNCATED CONE

PROJECTION ON XY AXIS

PROJECTION ON XZ AXIS

PROJECTION ON YZ AXIS

SPHERE

PROJECTION ON XY AXIS
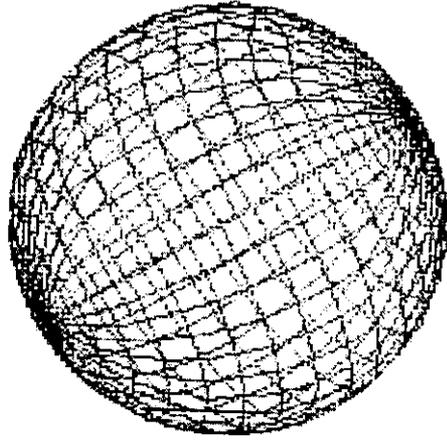
PROJECTION ON XZ AXIS

PROJECTION ON YZ AXIS

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I=              5AREA=   282655.200000
I=              6AREA=   282655.200000
I=              7AREA=    66630.520000
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13	.0582	14	.0445	15	.0281	16	.0232	17	.0281	18	.0445
19	.0462	20	.0575	21	.0109	22	.0057	23	.0059	24	.0325
25	.0136	26	.0110	27	.0347	28	.0081	29	.0048	30	.3496
31	.0059	32	.0057	33	.0109	34	.0110	35	.0136	36	.0325
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25	.0072	26	.0077	27	.0049	28	.0025	29	.0025	30	.1277
31	.0070	32	.0053	33	.0070	34	.0270	35	.0230	36	.0270
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    19   .0629   20   .1328   21   .0515   22   .0497   23   .0515   24   .0319
    25   .0274   26   .0319   27   .0086   28   .0065   29   .0086   30   .1328
    31   .0029   32   .0029   33   .0054   34   .0086   35   .0080   36   .0145
    37   .0061   38   .0052   39   .0090   40   .0508
SUM OF SHAPE FACTORS=        1.006185
SHAPE FACTORS FROM      19
     1   .0162    2   .0201    3   .0447    4   .1223    5   .0447    6   .0201
     7   .0025    8   .0033    9   .0087   10   .0468   11   .0087   12   .0033
    13   .0136   14   .0168   15   .0355   16   .0728   17   .0355   18   .0168
    19   .0000   20   .0978   21   .0090   22   .0075   23   .0130   24   .0131
    25   .0111   26   .0196   27   .0090   28   .0075   29   .0130   30   .1044
    31   .0130   32   .0075   33   .0090   34   .0196   35   .0111   36   .0131
    37   .0130   38   .0075   39   .0090   40   .0978
SUM OF SHAPE FACTORS=        1.037843
SHAPE FACTORS FROM      20
     1   .0201    2   .0162    3   .0201    4   .0447    5   .1223    6   .0447
     7   .0033    8   .0025    9   .0033   10   .0087   11   .0468   12   .0087
    13   .0168   14   .0136   15   .0168   16   .0355   17   .0728   18   .0355
    19   .0978   20   .0000   21   .0047   22   .0054   23   .0162   24   .0073
    25   .0087   26   .0257   27   .0047   28   .0054   29   .0162   30   .1029
    31   .0112   32   .0078   33   .0112   34   .0163   35   .0113   36   .0163
    37   .0112   38   .0078   39   .0112   40   .1029
SUM OF SHAPE FACTORS=        1.034382
SHAPE FACTORS FROM      21
     1   .0338    2   .0264    3   .0193    4   .0175    5   .0183    6   .0216
     7   .0327    8   .0023    9   .0011   10   .0010   11   .0015   12   .1109
    13   .0727   14   .0128   15   .0069   16   .0068   17   .0132   18   .1219
    19   .0796   20   .0416   21   .0000   22   .0000   23   .0000   24   .0000
    25   .0000   26   .0000   27   .0000   28   .0000   29   .0000   30   .1434
    31   .0109   32   .0107   33   .0226   34   .0126   35   .0119   36   .0238
    37   .0066   38   .0056   39   .0101   40   .0993
SUM OF SHAPE FACTORS=     9.997292E-01
SHAPE FACTORS FROM      22
     1   .0269    2   .0228    3   .0205    4   .0228    5   .0269    6   .0248
     7   .0050    8   .0016    9   .0012   10   .0016   11   .0050   12   .1121
```

13	.0329	14	.0104	15	.0077	16	.0104	17	.0329	18	.1788
19	.1006	20	.0724	21	.0000	22	.0000	23	.0000	24	.0000
25	.0000	26	.0000	27	.0000	28	.0000	29	.0000	30	.0724
31	.0112	32	.0095	33	.0163	34	.0132	35	.0109	36	.0181
37	.0071	38	.0055	39	.0086	40	.1047				

SUM OF SHAPE FACTORS=   9.946557E-01
SHAPE FACTORS FROM   23

1	.0183	2	.0175	3	.0193	4	.0264	5	.0333	6	.0216
7	.0015	8	.0010	9	.0011	10	.0023	11	.0327	12	.1109
13	.0132	14	.0068	15	.0069	16	.0128	17	.0727	18	.1219
19	.1149	20	.1434	21	.0000	22	.0000	23	.0000	24	.0000
25	.0000	26	.0000	27	.0000	28	.0000	29	.0000	30	.0416
31	.0100	32	.0074	33	.0109	34	.0119	35	.0087	36	.0126
37	.0067	38	.0047	39	.0066	40	.0993				

SUM OF SHAPE FACTORS=   9.996461E-01
SHAPE FACTORS FROM   24

1	.0755	2	.0311	3	.0190	4	.0180	5	.0255	6	.0628
7	.0148	8	.0053	9	.0029	10	.0026	11	.0030	12	.0053
13	.0604	14	.0258	15	.0161	16	.0153	17	.0224	18	.0567
19	.0873	20	.0484	21	.0000	22	.0000	23	.0000	24	.0000
25	.0000	26	.0000	27	.0000	28	.0000	29	.0000	30	.1707
31	.0095	32	.0089	33	.0178	34	.0144	35	.0140	36	.0294
37	.0095	38	.0089	39	.0178	40	.1081				

SUM OF SHAPE FACTORS=   1.007441
SHAPE FACTORS FROM   25

1	.0481	2	.0255	3	.0207	4	.0255	5	.0481	6	.0814
7	.0067	8	.0038	9	.0031	10	.0038	11	.0067	12	.0066
13	.0413	14	.0217	15	.0176	16	.0217	17	.0413	18	.0739
19	.1121	20	.0880	21	.0000	22	.0000	23	.0000	24	.0000
25	.0000	26	.0000	27	.0000	28	.0000	29	.0000	30	.0880
31	.0099	32	.0082	33	.0136	34	.0148	35	.0125	36	.0213
37	.0099	38	.0082	39	.0136	40	.1141				

SUM OF SHAPE FACTORS=   1.011509
SHAPE FACTORS FROM   26

1	.0255	2	.0180	3	.0190	4	.0311	5	.0755	6	.0628
7	.0030	8	.0026	9	.0029	10	.0053	11	.0148	12	.0053
13	.0224	14	.0153	15	.0161	16	.0258	17	.0604	18	.0567
19	.1304	20	.1707	21	.0000	22	.0000	23	.0000	24	.0000
25	.0000	26	.0000	27	.0000	28	.0000	29	.0000	30	.0484
31	.0089	32	.0065	33	.0095	34	.0131	35	.0097	36	.0144
37	.0089	38	.0065	39	.0095	40	.1081				

SUM OF SHAPE FACTORS=   1.007338
SHAPE FACTORS FROM   27

1	.1074	2	.0152	3	.0080	4	.0078	5	.0148	6	.2370
7	.0061	8	.0051	9	.0034	10	.0029	11	.0025	12	.0012
13	.0275	14	.0213	15	.0158	16	.0145	17	.0158	18	.0203
19	.0796	20	.0416	21	.0000	22	.0000	23	.0000	24	.0000
25	.0000	26	.0000	27	.0000	28	.0000	29	.0000	30	.1434
31	.0066	32	.0056	33	.0101	34	.0126	35	.0119	36	.0238
37	.0109	38	.0107	39	.0226	40	.0993				

SUM OF SHAPE FACTORS=   1.005616
SHAPE FACTORS FROM   28

1	.0380	2	.0120	3	.0089	4	.0120	5	.0380	6	.3033
7	.0041	8	.0040	9	.0036	10	.0040	11	.0041	12	.0014
13	.0228	14	.0188	15	.0170	16	.0188	17	.0228	18	.0232
19	.1006	20	.0724	21	.0000	22	.0000	23	.0000	24	.0000
25	.0000	26	.0000	27	.0000	28	.0000	29	.0000	30	.0724
31	.0071	32	.0055	33	.0086	34	.0132	35	.0109	36	.0181

DEFINITIONS:

Shape Factor:

Fraction of energy emitted by surface incident on the other surfaces.

Radiation:

Energy emitted by the objects or surfaces.

Node:

A portion which is divided from the surface.

Elemental area:

A small portion which is divided from the node in X, Y direction.

ACRONYMS:

LRF – Local Reference Frame.

GRF – Global Reference Frame.