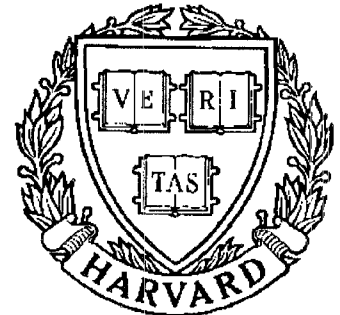


TECHNICAL RESEARCH REPORT



S Y S T E M S
R E S E A R C H
C E N T E R



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Implementation of an Integrated CAD and CAM System

by A.T. Chen and G.M. Zhang

The Implementation of an Integrated CAD and CAM System

Progress Report

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Abstract

This is a progress report on a joint research project between the University and the M. S. Willett, Inc. The research focus is on the integration of a CAD system and a CAM system currently being used at the Willett.

The development of CAD systems has revolutionized the process of preparing engineering designs and drawings. Likewise, CAM systems have significantly impacted the shop floor production process. Numerically controlled machines have improved accuracy and productivity in many applications. Integration of these two systems would tie the design phase of a project to the production process, and if done efficiently, could result in significant cost reduction and quality improvement.

In this project, two computer programs have been developed to automate NC code generation directly from a CAD file, either in DXF format or in IGES format. These two programs have been successful in identifying the important elements of an integrated CAD and CAM system. The initial results also indicated how the Willett could shorten the time of product development cycle, low the production cost, and improve the quality of end products.

This project has been supported by the Center for Manufacturing on the College Park campus.

The Implementation of an Integrated CAD and CAM system

Progress Report (January, 1991 to August, 1991)

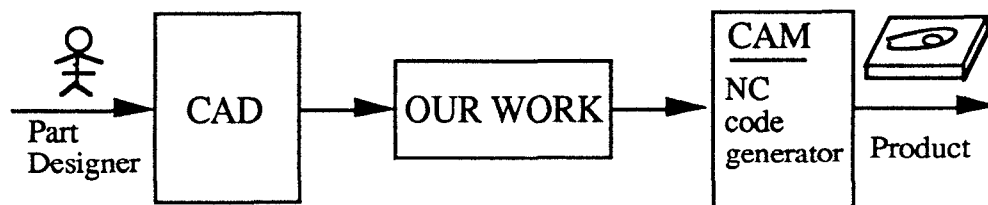
1. INTRODUCTION

The purpose of this report is to provide a summary of progress made to date, and to recommend further work that should be considered in this project. Additionally, the objectives of the project are reviewed with a discussion of the work remaining to be accomplished.

The development of computer-aided design (CAD) systems has revolutionized the process of preparing engineering designs and drawings. Both routine, repetitive designs and complex ones have seen preparation time substantially reduced. Improved productivity allows the designer to investigate options more thoroughly and to achieve better designs with less effort.

Likewise, computer-aided Manufacturing (CAM) systems have significantly impacted the shop floor production process. Numerically controlled machines have improved accuracy and productivity in many applications. CAM systems allow the input of a part design at a personal computer terminal and the creation of a command file to execute machining or other operations by equipment on the shop floor.

Integrating these two systems would tie the design phase of a project to the production process, and if done efficiently, could result in significant cost savings and quality improvement. A conceptual block diagram of an integrated system is presented on the following figure. A more detailed flow chart of such an integrated system is illustrated in Figure 1.



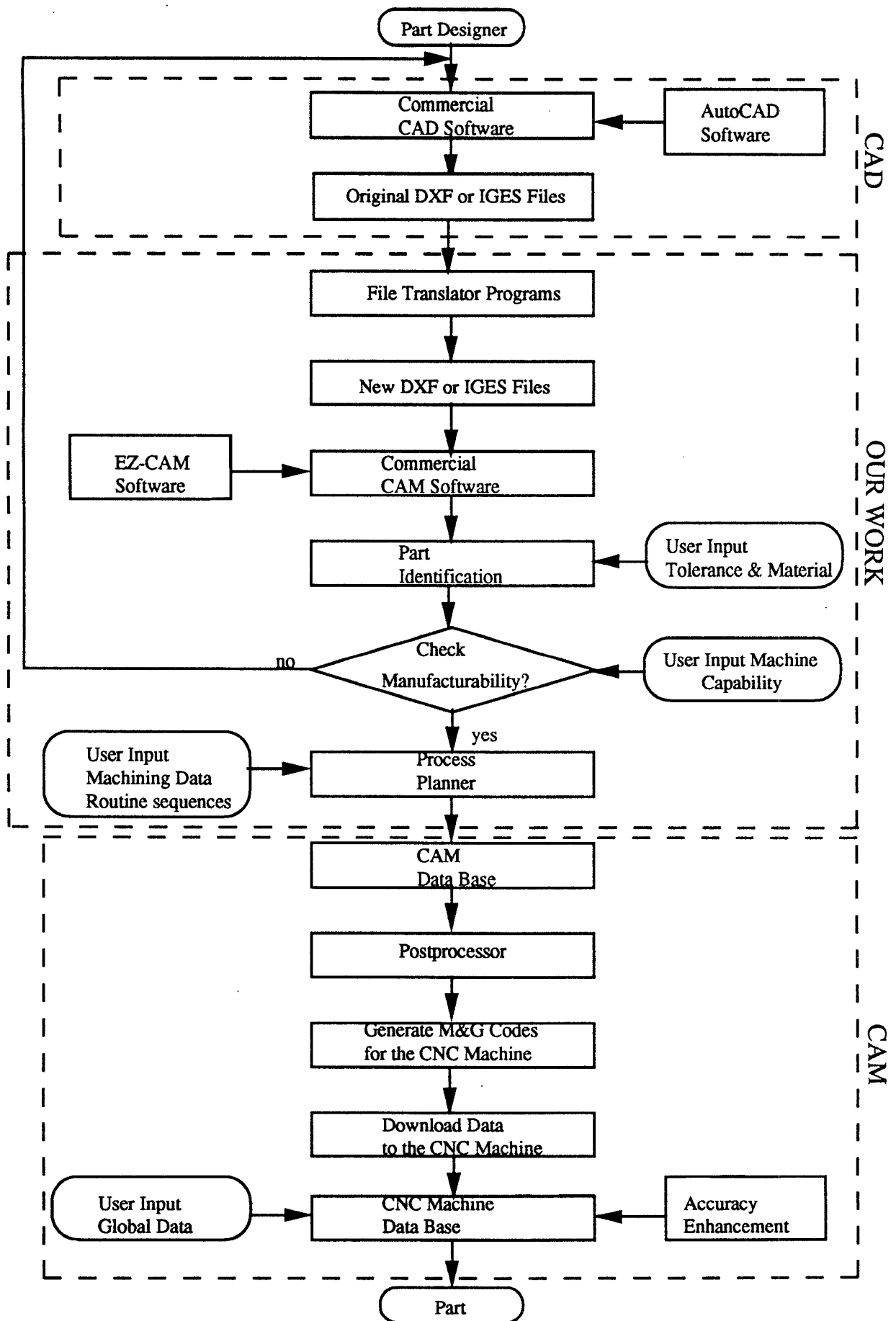


Figure 1. Integrated CAD/CAM System

In brief, the part designer uses a CAD system to perform the part design, passes the design either directly or through a translator to a CAM system, and uses the CAM system to create the NC codes and ultimately the desired part through machining.

Two software packages, AutoCAD, by Autodesk, Inc., and EZ-CAM, by Bridgeport Machines, Inc., are typical CAD and CAM systems, respectively, which will be employed for such an application in our work.

AutoCAD, the premier microcomputer CAD software system in the world today, is currently used in industries, colleges, and businesses around the world. These users understand the necessity of a customizable CAD system on the PC, not only for the immense cost saving, but for the versatility of the hardware and software supported in the PC environment.

EZ-CAM system, the IBM AT compatible CAM software system, is also widely used in industries. It has been developed into several software packages such as EZ-MILL, EZ-SURF, EZ-TURN, etc.. This is a CNC (Computer Numerical Control) support system with advanced software packages used to create and transfer programs to NC machines or machining centers.

The initial stage of this research is to develop a translator which can help the transfer of necessary design information from AutoCAD to EZ-CAM systems. A direct transfer would not work, since the AutoCAD drawings are typically general engineering drawings and have much more supplementary information than is required for the machining operation. Non-geometry items such as title blocks, bills of materials, centerlines, dashed lines, shading, weld symbols, text and dimension arrows help produce a clear design picture of a part, but confuse the part geometry needed for creating machine code. In other words, it seems to become very difficult to generate NC codes with little effort.

On the other hand, although AutoCAD system has the capabilities of creating different layers, line types, etc., EZ-CAM system was indistinguishable from the information if transferring AutoCAD files directly. For instance, EZ-CAM regards all lines as solid lines and treats all layers as the same layer. Therefore, the part designer might spend a lot of time removing those information which is not related to the generation of NC codes manually, either in AutoCAD or in EZ-CAM, before determining the tool path of the design part. Even some entities might not be removed through EZ-CAM software.

The primary accomplishment of this research was to develop computer programs to translate AutoCAD drawings into files easily utilized by EZ-CAM for the machining portion of the integrated CAD/CAM system. At the same time, recovering the needed data from reserved information and reorganizing the data structures of drawing files through computer programs are also the major objectives of this work.

2. BASIC METHODOLOGY

The basic approach taken in the project was to work through the elements of the integrated CAD/CAM system discussed in the introduction, and to determine what problems or barriers existed and should be addressed.

The drawing work was performed using AutoCAD version 10.0, and the tool path creation utilizing EZ-MILL was installed with EZ-CAM version IV. The hardware involved is of secondary importance to the software, since the software can run on many different systems. For our work, AutoCAD was installed on an IBM 486 personal computer, and EZ-CAM on a NEC 386 personal computer. EZ-CAM was tied into several milling machines in the Physics Instrument Shop; the one used for this work was a Bridgeport Series II CNC Milling, Drilling and Boring Machine with a Centurion V controller.

Both AutoCAD and EZ-CAM were relatively easy to use. AutoCAD is typical of CAD systems and can be learned by any skilled designer. EZ-CAM is menu-driven, and with some instruction and practice, parts could be created and tool paths generated rather quickly. EZ-CAM has the capability to accept two different kinds of files exported from AutoCAD. One is the DXF (Drawing Interchange) file and the other one is the IGES (Initial Graphics Exchange Specification) file.

It was found that a simple AutoCAD outline drawing imported to EZ-CAM remained clear and could be used to generate a tool path for the milling machine. However, AutoCAD has a variety of line weights and styles which enable a designer to identify part outlines, sections, centerlines and dimension lines. Therefore, a more complex yet typical drawing with dimensions, general notes, and non-geometric lines became cluttered with superfluous points and lines. Accurate tool path generation could become very difficult

since many of these extra points caused by non-geometry information lay close to needed geometry points, and the tool path generator may pick up the wrong point.

To alleviate this difficulty, it was decided to examine the AutoCAD file structure and determine whether the non-geometric information could be removed from the file before it was imported into EZ-CAM system. There are two approaches to handle this problem.

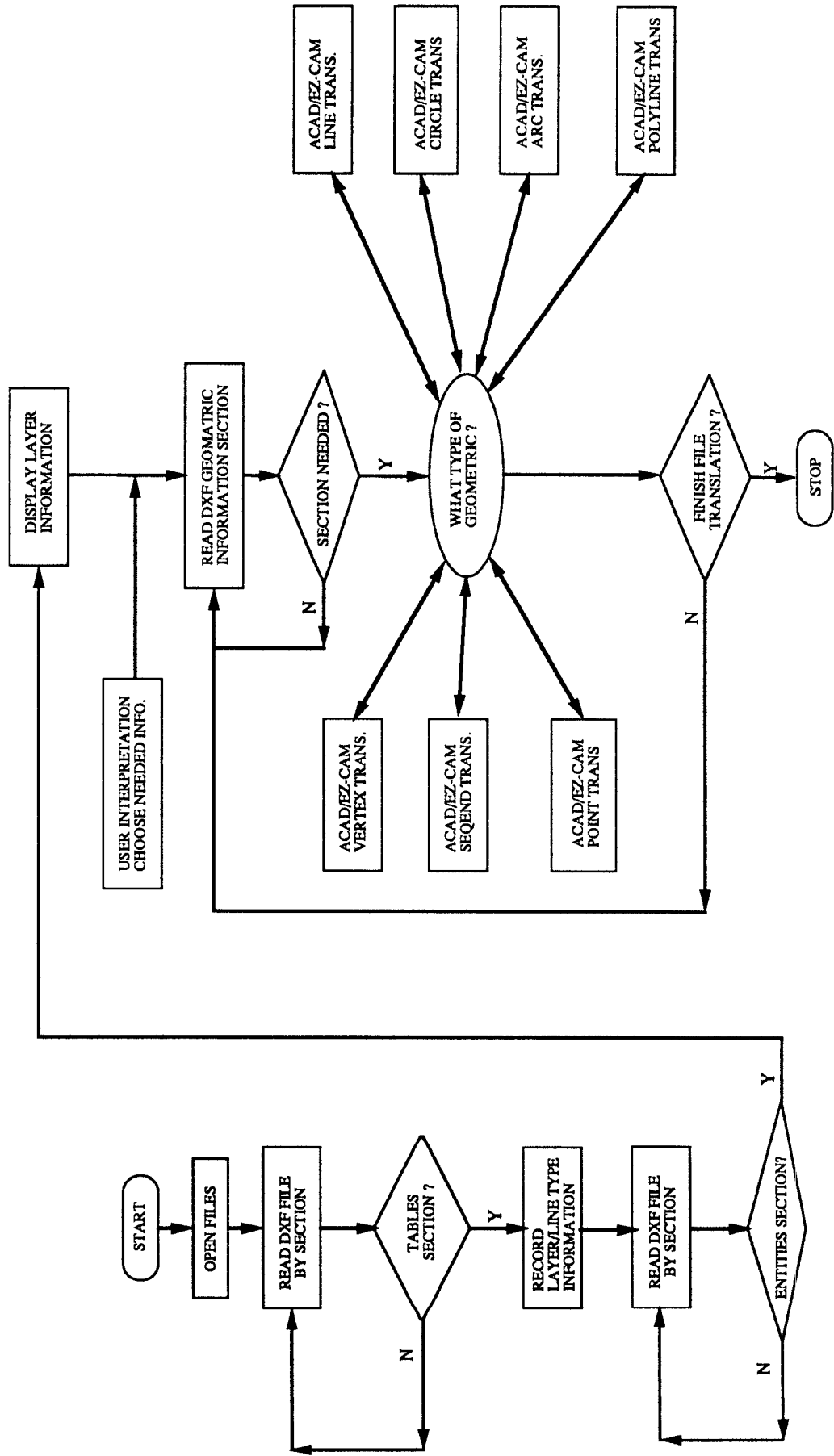
2.1 DXF Format Approach

The first communication takes place using DXF format. The DXF file, a standard ASCII text file, which can be obtained from AutoCAD software has four major sections. The first three sections are Header, Tables, and Blocks which provide definitions, layers, linetypes, dimensions, and text information transfer. The last section, Entities, is our interest as it provides the geometric information of the drawing to EZ-CAM.

By experimentation it was determined that if the first three sections of the DXF file were removed, the remained information in the Entities section would be satisfactory for EZ-CAM. The thrust of the project then became to develop a computer program which would take an AutoCAD DXF file, reorganize the data structure, remove the data which is not related to the NC code generation, and create a new DXF file suitable for import to the EZ-CAM system. The conceptual flow chart for this computer program is illustrated in Figure 2.

The program searches through the DXF file to record layer information and locate the Entities section. The program displays the layer information and requests the designer to select the desired layers in an interactive mode. Having selected the desired layers (presumably those with solid shape lines), the program searches through the Entities section, checks linetype for each entity, and extracts the needed geometry data. The geometry extracted includes all information describing points, lines, circles, arcs, polyline shapes, and vertices. This is deposited in a new DXF file which can then be imported into the EZ-CAM system. However, it was noticed that polyline entity has a little different from other entities. It includes all basic information except its linetype. In order to recover the needed data we must reserve all information, and check linetype from its vertex entity, then determine if it should be exported to the new file or not.

Figure 2.. FLOWCHART FOR AUTOCAD/EZ-CAM DXF FILE TRANSLATOR



An additional task required by the program was to determine and insert center points for circles in the new DXF file. It will help to define the center point of circle for NC code generation before importing the file. AutoCAD can draw circles without using a center point, and this causes a problem if the circles designate drilled holes. Without a center, EZ-CAM has no reference to locate the drill point unless the designer defines center points of circles through computer calculation before determining tool path. The computer program I identifies such circles, reserves the relevant information, and then provides the center points to those circles.

2.2 IGES Format Approach

The DXF format is not only file format which can be exported from AutoCAD software. Another format, called IGES format, can also be used. Likewise, EZ-CAM can also accept the IGES format files. IGES is a much more compact and standardized file format than DXF. The difference in file length is particularly noticeable as the drawing gets more complex.

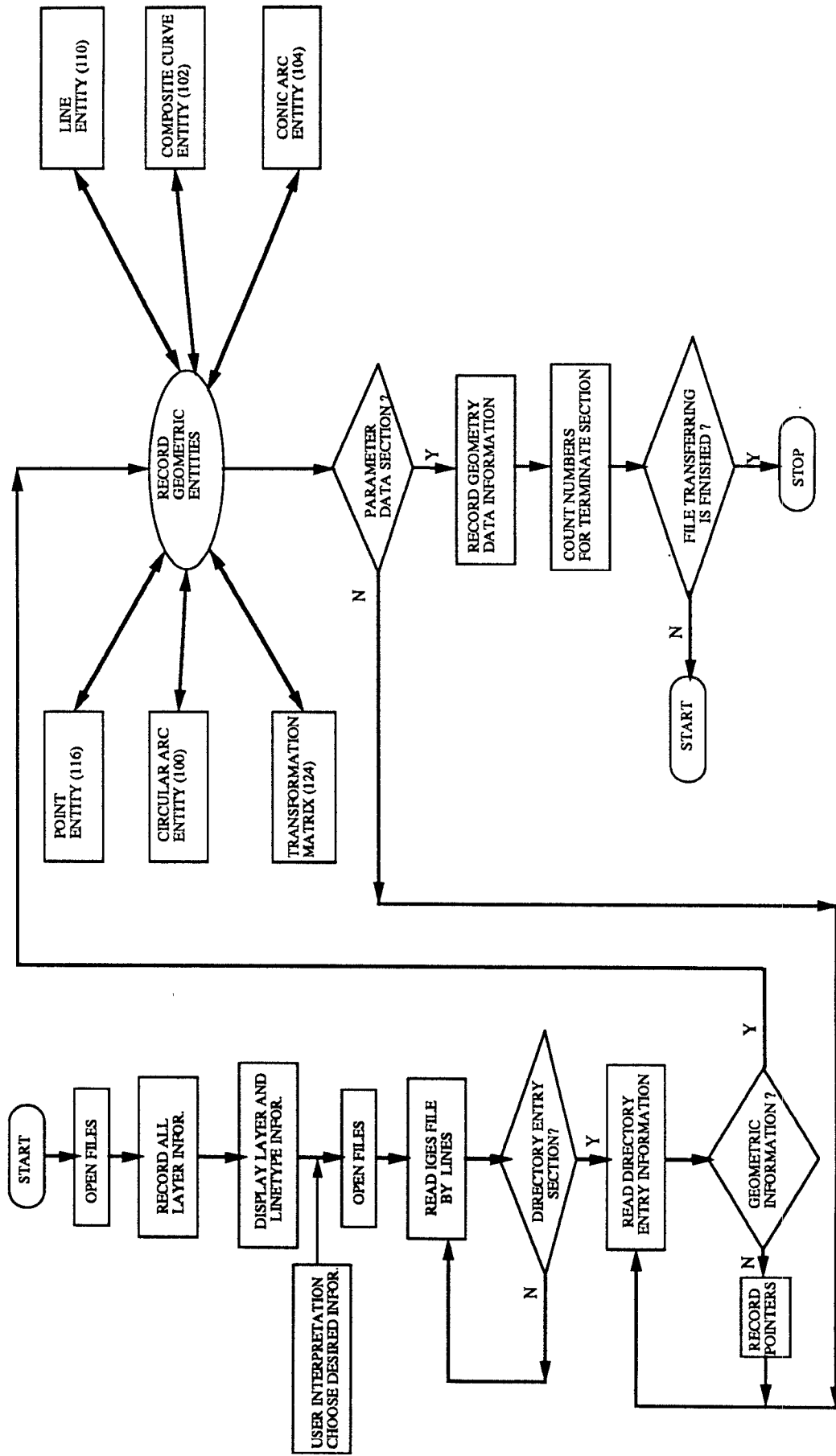
The IGES is a neutral data format which serves as a communication file to transfer data between CAD/CAM system. IGES is structured as a five section file. The first two sections- Start and Global- contain information about the system which the part was developed. The next two sections- Directory Entry and Parameter Data- are the major parts of interest to EZ-CAM, as they provide three entity types:

- (1) Geometry Entity (includes point, line, circle, arc, etc.)
- (2) Annotation Entity (includes dimension, centerline, label, etc.)
- (3) Structure Entity (includes standard and user defined associations, drawing relationships, etc.)

The last section is Terminate section which acts as a bookkeeping record to check the number of records received and processed.

The IGES files are also coded in ASCII, with characters per record and appear logically as a card deck. However, it is still not ready for the generation of NC coding. Just as it mentioned in DXF format approach, it becomes necessary to create a computer program which would take an IGES file exported from AutoCAD, remove the undesired information for generating NC codes, and reorganize a new IGES file suitable for import to the EZ-CAM system. The conceptual flow chart for this computer program is shown in Figure 3.

Figure 3. FLOWCHART FOR AUTOCAD/EZ-CAM IGES FILE TRANSLATOR



Basically, the program searches through the IGES file to locate the Directory Entry section and record all layer information. It will display layers and linetypes for the designer selection and write only the desired information into a new IGES file. In order to remove undesired data easily from the Parameter Data section, this program records those pointers of non-geometric entities during searching through the Directory Entry section. Then, Parameter Data section will be investigated line by line to determine if reserving or dropping it according to the previous pointer records. On the other hand, to reorganize the sequential number of the data structure for each section and the record of total numbers for Terminate section, it is necessary to set up counters for each section taking count of each line being written in a new IGES file, which can then be loaded into EZ-CAM package.

3. ACCOMPLISHMENTS OF THE PROJECT

The development of the integrated CAD/CAM system involved both machine shop work and software development. The machine time was spent becoming familiar with the existing EZ-CAM system and in proving the project results; the softwares were developed to provide an important translator between AutoCAD and EZ-CAM.

3.1 Machine Shop Work

The machine shop portion of the project involved actual production of sample parts using the Bridgeport machine. One of the satisfying surprise of the research was the ease with which a machine code program could be created using software such as EZ-CAM. Rather than laboriously writing NC codes line by line, EZ-CAM allowed the relatively quick input of the part geometry and tool information, and then generated the tool path with its internal program. Further, the POST program converted the tool path and other specifications into the NC codes needed for the machine tool.

3.2 Software Development

3.2.1 Transferring the DXF file (Program I)

Having produced physical parts using the EZ-CAM software and the Bridgeport mill, the project shifted to develop the interface between AutoCAD and EZ-CAM. Using the

methodology discussed in the previous section, the computer program I was written and debugged for transferring the DXF file.

The shape used to make the initial sample part was then programmed using AutoCAD and the resulting design file passed through the computer program I. The DXF files of the sample part, before and after being reorganized by the translator, are included in the Appendix A. The modified file is clearly truncated, having had all non-geometric data removed and all center points of circles recovered. The part drawings for both files are shown in Figure 4 and Figure 5.

The file was imported to EZ-CAM and the tool path was generated. The POST program in EZ-CAM created the NC codes for the CNC machine. The NC codes are also included in the Appendix B. These codes were suitable for machining additional sample parts.

As a further exercise of the CAD/CAM system, a part was produced for a project team of the Computer-Aided Manufacturing class. Again starting from an AutoCAD drawing file, the computer program I was used to remove non-geometric information and EZ-CAM was used to generate NC codes. The codes were downloaded to the Bridgeport milling machine and a part was produced for the project team. This was a rather complex shape and the program handled it without difficulty. The part drawings, before and after running the program, are illustrated in Figure 6 and Figure 7. Both DXF files are also provided in the Appendix A.

In addition to the hard copy of program I provided in the Appendix C. A set of user instructions precedes the program printout in the Appendix C. This program is suitable for reorganizing AutoCAD DXF files prior to import into EZ-CAM.

3.2.2 Transferring the IGES file (Program II)

After transferring the DXF file successfully, the computer program II was then developed and debugged for transferring the IGES file in the same manner. The IGES file of the sample part drawing exported from AutoCAD passed through the program II. The new IGES file carried only geometry entities was obtained without difficulty and both part drawings can then be generated as shown in Figures 8 and 9. The IGES files of the sample part, before and after running program II, are attached in the Appendix A.

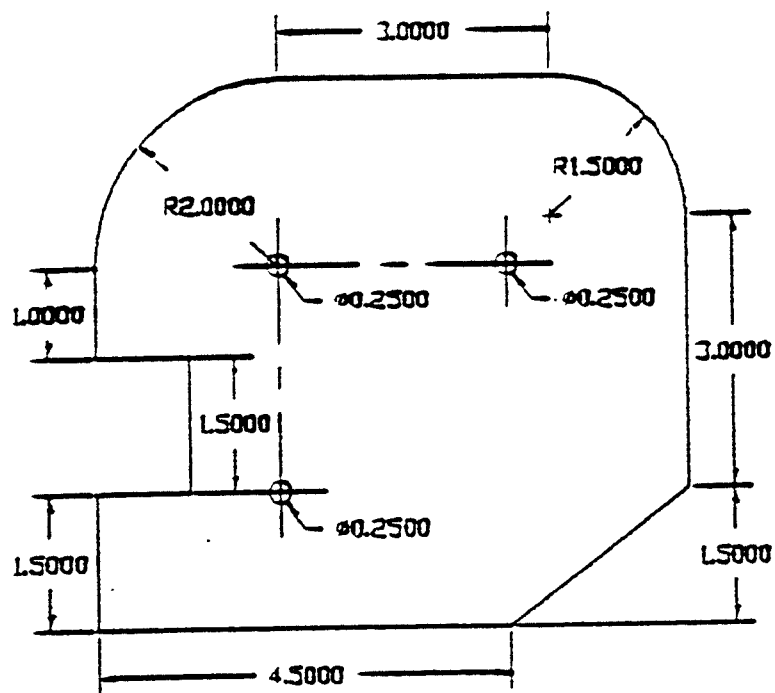


Figure 4.

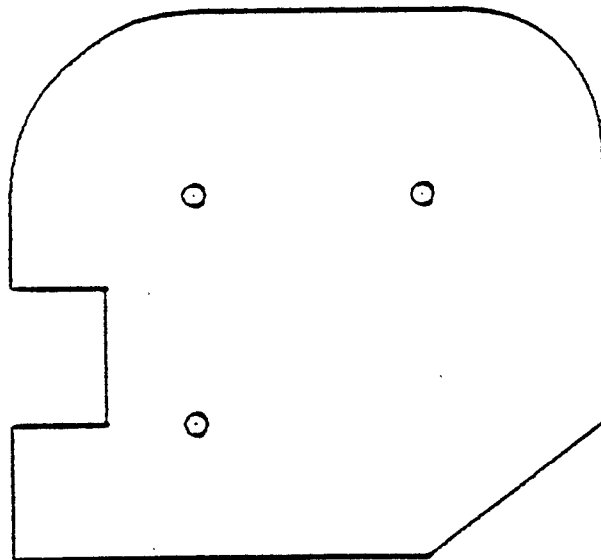


Figure 5.

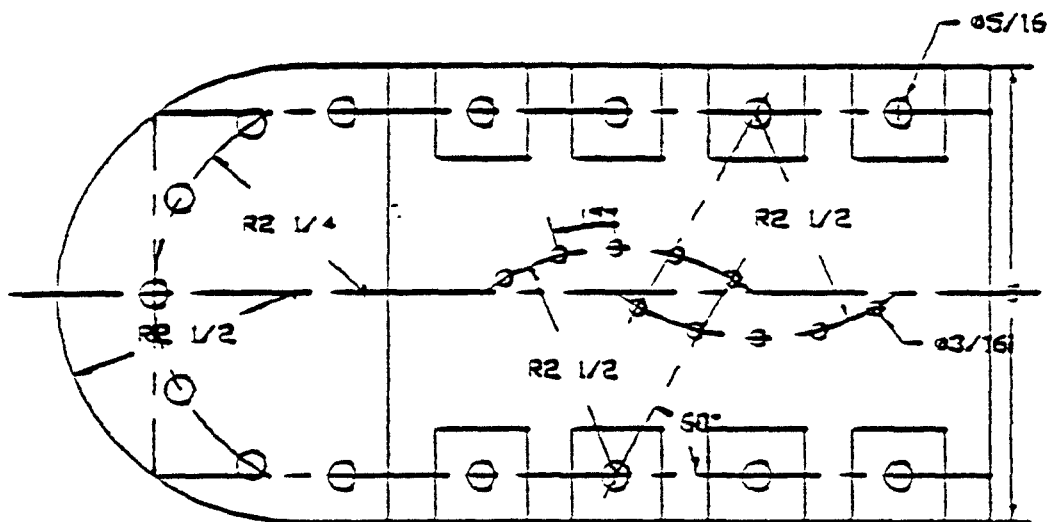


Figure 6.

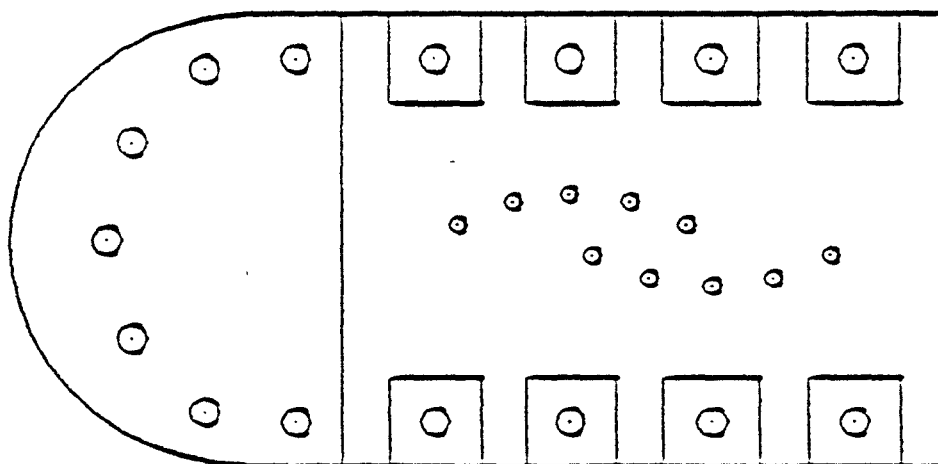


Figure 7.

To verify the program II, the rather complex shape was also used to be a further example and the modified IGES file had been removed all non-geometric data information just like before. The IGES files of the complex part, before and after running program II, are included in the Appendix A. Likewise, the part drawings were also illustrated in Figures 10 and 11.

After generating the geometry file, the procedure of creating the NC codes in EZ-CAM for the CNC machine is the same as the process of the DXF file discussed previously. The NC codes are now attached in the Appendix B. In addition to the hard copy of program II and a set of user instructions before the program printout also provided in the Appendix C. This program is suitable for reorganizing AutoCAD IGES files prior to import into EZ-CAM.

4. DISCUSSIONS

4.1 Program I (for DXF translation)

Standard practice for drafting with AutoCAD is to put different line styles, such as solid lines, dashed lines and dimension arrows, on different layers in the drawing. This segregates the part geometry from other descriptive data and helps organize the file. The program takes advantage of this practice in removing undesired lines. In running the program I, each layer is listed in an interactive process along with a description of the line style used in the layer. The layers to be eliminated are identified by the designer and removed by the program I. If the designer prepared the drawing with different line styles on the same layer, the program I would still have the capability of removing all undesired lines from the file. However, it might spend a little longer time to check all entities before sending them to the new file. Hence it is a better way to use same line style on the same layer while creating the part drawing in AutoCAD.

Another potential difficulty might be encountered if the AutoCAD draftsman uses the block feature in preparing the drawing. The block feature enables the draftsman to call on a standard or custom shape in a part library and place it repetitively at various locations in the drawing. Whenever the block is used the DXF file simply notes the location and identity of the block, but not all of its details. When the drawing is printed out the stops at each block insert point, calls up the detailed information from the library and plots it in the proper

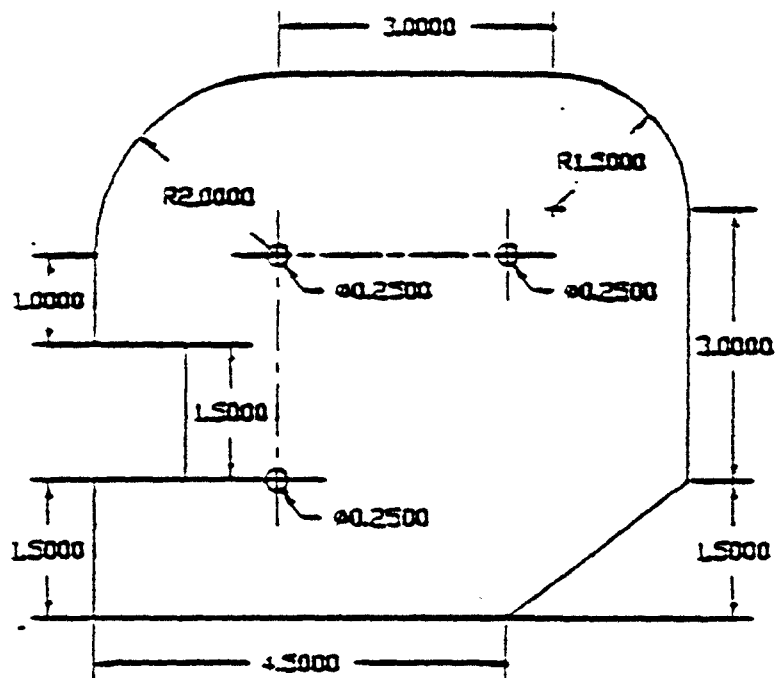


Figure 8.

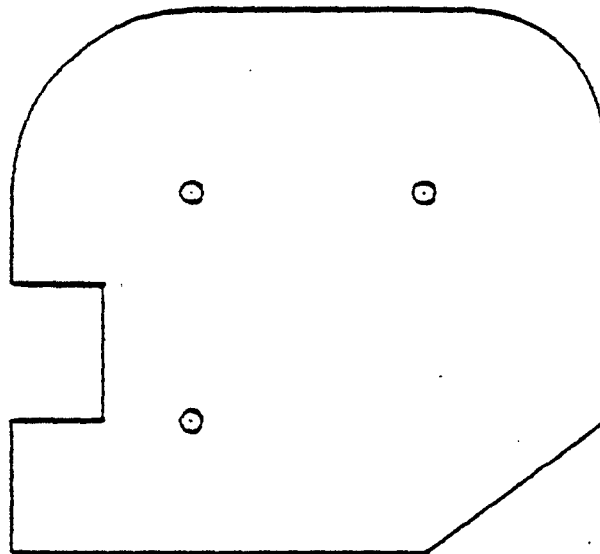


Figure 9 .

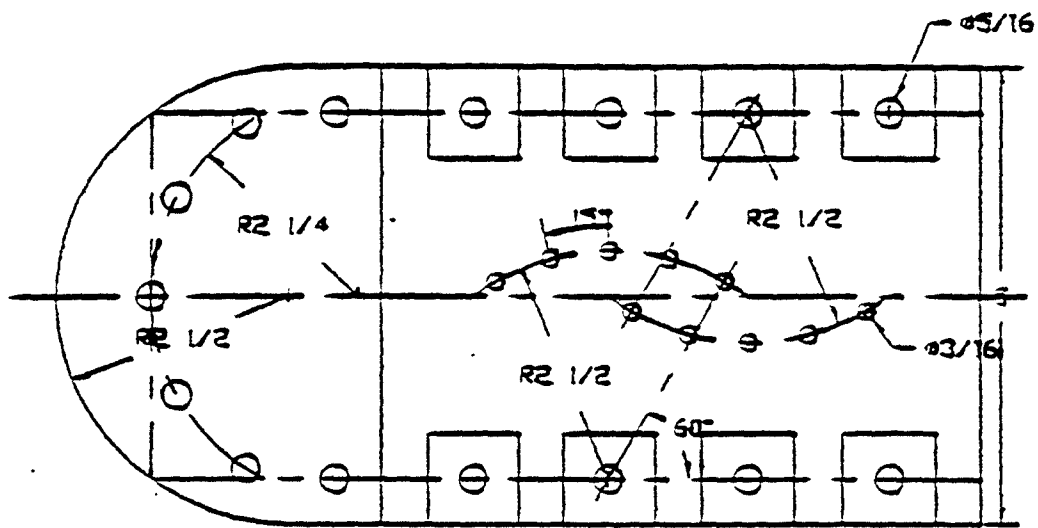


Figure 10.

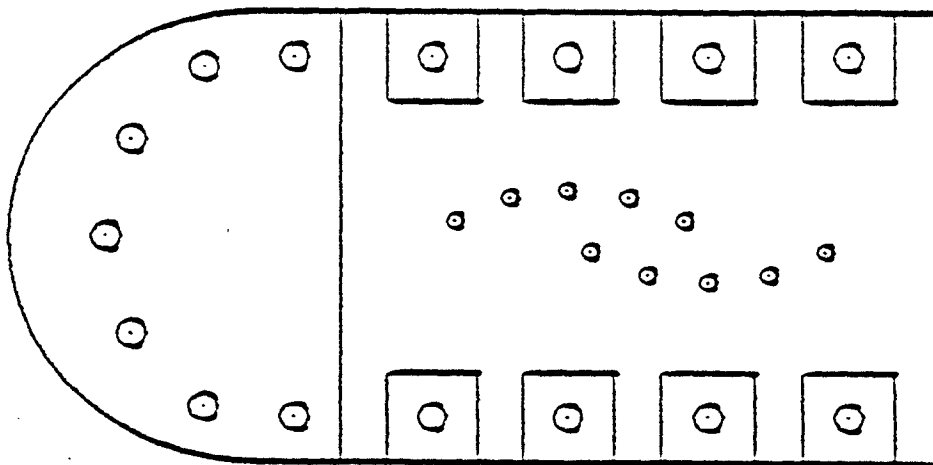


Figure 11.

position. The block is called upon as many times as is required for the particular drawing. For the time being the program does not cope with the block feature directly. However, an alternative LISP program can be used to handle this situation before running our program. This program enables to collect block information into a data base, and then retrieves those information to use them if the designers wish to explode block entities.

When the block is used, the LISP program would search through the whole drawings and identify each block. It displays block name for the designer and explodes it to normal entities if needed. However, the drawing with explosion would keep the same as the drawing with blocks, and the new drawing file with normal entities is suitable for file transfer without difficulty.

4.2 Program II (for IGES translation)

Because of the different structures between IGES file and DXF file, the non-geometric lines such as centerlines, dashed lines, etc. can easily be removed from the IGES file even the designer prepared the drawings on the same layer. The program II, however, would record the number names of the layers instead of the real layer names because the original IGES file only contains default layer name, 0, and creates a sequential number to be used if the new layer formed. Therefore, the program II would only provide the layer number listing for user selection. Additionally, the designers can also choose linetypes from the linetype listing during running this program. They will be required to input desired information when transferring IGES files at each time.

At present, this program would not take advantage of recovering the center point of a circle into a new IGES file due to the free format in the PARAMETER DATA section of IGES files. Therefore, the designer should provide center points, either in AutoCAD or in EZ-CAM, to those circles if the circles designate drilled holes. Comparing Figures 5 and 7 with Figures 9 and 11, you will understand that it makes no difference between those drawings if center points were provided before running the program.

The block feature is also used in the IGES file. It is only recorded the pointers of the entities, but not all of detail information. However, we can still obtain the same results if handling the blocks with explosion as discussed in the program I.

5. APPLICATION

In order to verify the capabilities of handling the different drawings through our programs. The part design shown in Figure 12. was created by Willett company and used as a practical example. Although the drawing contains five layers, the layer name 5 included geometry entities is only layer related to NC code generation after checking output drawings. The output drawing illustrated in Figure 13. was generated using the new DXF file after running the program I.

After importing such a new file into EZ-CAM, the designer may determine tool path, tool information, and machining specifications. It is further postprocessed to obtain NC codes on EZ-CAM system. The part was then manufactured by downloading the codes on the CNC machine with a Centurion V controller. The NC codes were also included in the Appendix B. This example was successfully illustrated the necessity of such an integrated CAD/CAM system.

6. CONCLUSIONS AND RECOMMENDATIONS

The project in its initial stage was successful in identifying the important elements of an integrated CAD and CAM system, and in evaluating barriers to implementing such a system using commercial software. The barriers were addressed and eliminated to a large extent, and a functioning system was satisfactorily demonstrated. Therefore, this work will help the company to shorten the development time, lower the costs, and improve quality for the final products if done efficiently. Further work could improve the system and such areas are recommended below.

The project illustrates the importance of tying the elements of a computerized design and manufacturing system together in an efficient manner. AutoCAD on its own is a highly productive design tool, and has gained wide acceptance in the drafting room. Many, however, continue to focus on hard copy paper drawings as the final product of the draftsman, and only use CAD systems to prepare those drawings more quickly. Likewise, CAM applications often start programming machine operations from paper drawings and concentrate on the machine command process.

Technical drawing of a mechanical part, showing top, side, and cross-sectional views with dimensions and tolerances.

Top View Dimensions:

- Overall width: 3.25
- Overall length: 2.500
- Distance from left edge to first hole center: 1.250
- Distance between hole centers: 1.50
- Distance from last hole center to right edge: 1.50
- Distance from left edge to first hole center: .38
- Distance between hole centers: .14 TYP
- Distance from last hole center to right edge: .31
- Distance from last hole center to right edge: .16

Side View Dimensions:

- Overall height: 1.57
- Distance from bottom to top of first hole: .31
- Distance from bottom to top of last hole: .50

Cross-sectional View Dimensions:

- Overall width: 1.57
- Distance from bottom to top of first hole: .31
- Distance from bottom to top of last hole: .50

Feature Callouts:

- 3/4" THRU 4 PLS (Pointing to the holes)
- 5" TYP (Pointing to the holes)
- R TYP (Pointing to the rounded corners)

Surface Finish:

- Surface finish symbol: $\sqrt{\text{ }}$.005

[illegible]

Figure 12.

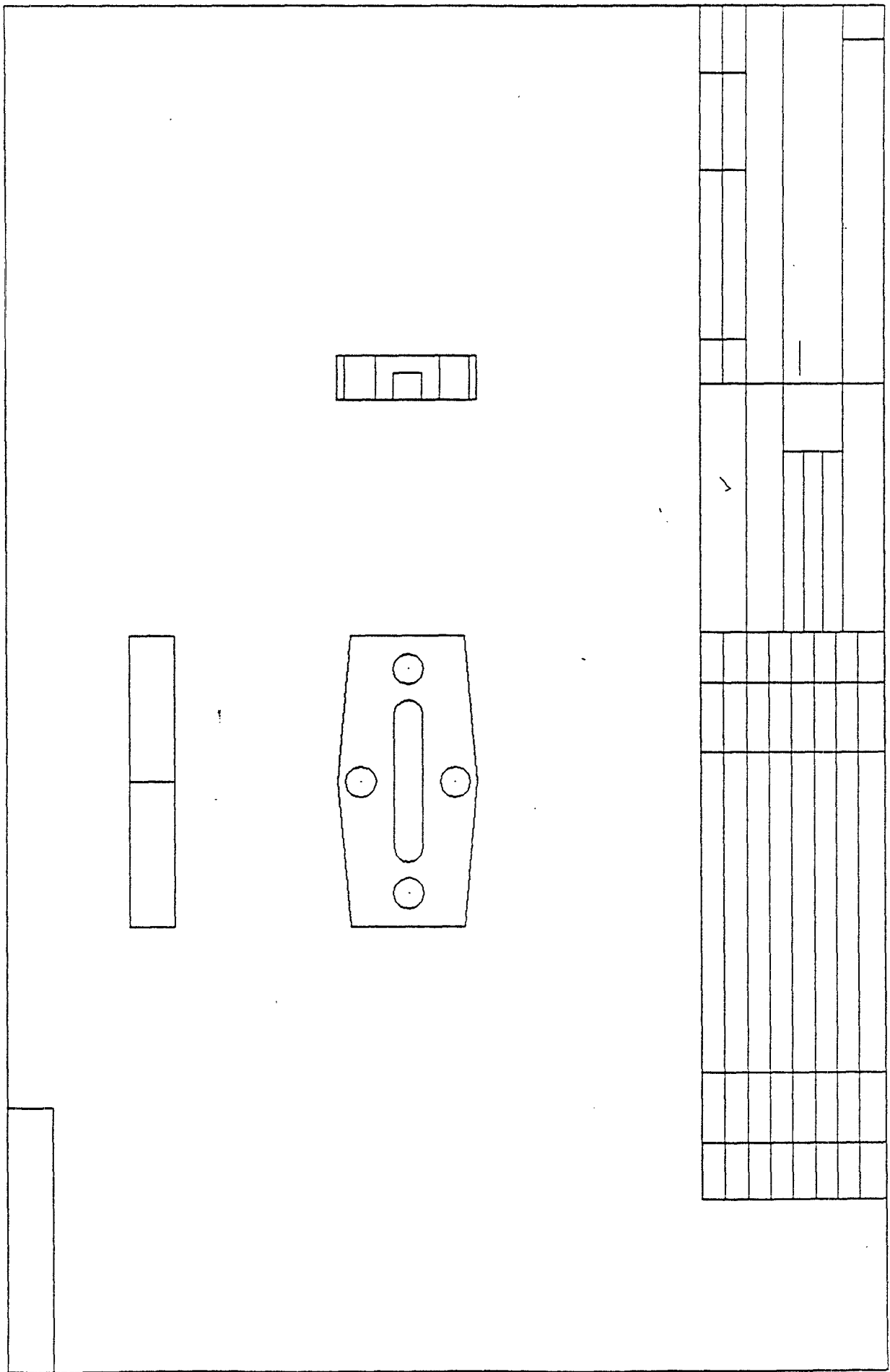


Figure 13.

What the system designer needs to do is to link the designer with the machinist through the computer. The CAD system and the CAM system, while both similar, have been developed and exploited for different purposes. The weak link in the communication today is the paper drawing that is transmitted from the designer to the machinist.

This project has shown that while the transfer can be made directly through computer files, there are problems which impede this communication. The DXF and IGES files created by AutoCAD are not clearly understood by EZ-CAM, excess lines and points confuse the machinist in programming the tool path. The computer programs developed by this project eliminate some of the problems in communication, but it must be admitted that this can be considered a band-aid cure for what needs a broader solution.

Another potential work is to develop an expert system instead of using interactive mode to input necessary information for machining the parts in a CAM system. This system might be included part identification, manufacturability checking, and intelligent process planning. It will be able to generate machining specifications and provide tool information automatically after loading the drawing files. Therefore, the advanced file format called PDES (Product Data Exchange Specifications) will be investigated if any relation between IGES/DXF and PDES files.

The program developer, as they work on an AutoCAD or an EZ-CAM system, must begin to consider the full potential application of their computer programs. The further major work should be placed on making those programs as general as possible, not only for AutoCAD and EZ-CAM systems but for any other CAD and CAM systems. The goal from the start should be to generate design data which can flow smoothly and without filtering or translation from the designer to the machine tool. As this begins to occur, we will truly see an integrated manufacturing system.

7. ACKNOWLEDGEMENTS AND COMMUNICATIONS WITH OTHERS

We would like to thank Dr. W. L. Fourney, the acting chairman of the Center of Manufacturing, for providing financial support, which has made this research a reality.

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We would like to thank Dr. Thomas R. Kramer, researcher at Factory Automation Systems Division of Center for Manufacturing Engineering at NIST, for his time, suggestions, and encouragement. Also, he brought into some new concepts to broaden our vision of this research.

We would also like to thank Mr. Kai Wang and Mr. Ken Walker for their support during the entire project.

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APPENDICES

APPENDIX A

DXF and IGES files

DXF file for a sample part
before running program I

0	70	9.	70	9	9	40
SECTION	0	SDIMEXO	1	SDIMTOPL	SADNITS	0.0064117731
2	9	40	9	70	70	9
HEADER	SMIRTEXT	0.0625	SDIMSEL	0	0	SUSRTIMER
9	70	9	70	9	9	70
SACADVER	1	SDIMDLT	0	SDIMTVP	SANPREC	1
1	9	40	9	40	70	9
AC1006	SDRAGMODE	0.38	SDIMSEL	0.0	0	SANGBASE
9	70	9	70	9	9	50
SINSBASE	2	SDIMRND	0	SDIMTEX	SMENU	0.0
10	9	40	9	70	1	9
0.0	SLSSCALE	0.0	SDIMTAD	0	acad	SANGDIR
20	40	9	70	9	9	70
0.0	1.0	SDIMDLT	0	SDIMSOXD	ELEVATION	0
30	9	40	9	70	40	9
0.0	SOSMODE	0.0	SDIMZIN	0	0.0	SPMODE
9	70	9	70	9	9	70
SECTION	0	SDIMEXE	0	SDIMSAH	THICKNESS	0
10	9	40	9	70	40	9
1.125	SATMODE	0.18	SDIMBLK	0	0.0	SPDSIZE
20	70	9	1	9	9	40
1.32	1	SDIMTVP	9	SDIMBLK	SLMCHCK	0.0
9	9	40	9	1	70	9
SEKTRAX	STEKSIZE	0.0	SDIMASO	9	0	SPLINEWID
10	40	9	70	SDIMBLK2	9	40
11.83882	0.2	SDIMTVP	1	1	\$ELIPMODE	0.0
20	9	40	9	1	70	9
8.68	STRACEWID	0.0	SDIMSHO	9	1	SCORDS
9	40	9	70	9	9	70
SLIMIN	0.05	SDIMTVP	0	SIGNITS	SCHAMPERA	0
10	9	40	9	70	40	9
0.0	STEKSTYLE	0.18	SDIMPOST	2	0.0	SSPLFRAME
20	7	9	1	9	9	70
0.0	STANDARD	SDIMCEN	9	SLOPREC	SCHAMPERB	0
9	9	40	9	70	40	9
SLIMMAX	SCSLAYER	0.09	SDIMAPOST	4	0.0	SSPLINETYPE
10	8	9	1	9	9	70
12.0	CENTER	SDIMTSZ	9	SAXISMODE	SSXPOLY	6
20	9	40	9	70	70	9
9.0	SCSLTYPE	0.0	SDIMALT	1	0	SSPLINESEGS
9	6	9	70	9	9	70
SORTHOMODE	BYLAYER	SDIMTOL	0	SAXISUNIT	STDCREATE	8
70	9	70	9	10	40	9
0	SCECOLOR	0	SDIMALT2	0.0	2448344.1538446760	SATTDIA
9	62	9	70	20	9	70
SEGENMODE	256	SDIMLIN	2	0.0	STDUPDATE	0
70	9	70	9	9	40	9
1	SDIMSCALE	0	SDIMALT3	SSKETCHINC	2448389.5470222221	SATIREQ
9	40	9	40	40	9	70
SPILLMODE	1.0	SDIMTCH	25.4	0.1	STDINDWG	1
70	9	70	9	9	40	9
1	SDIMASZ	1	SDIMLFAC	SPILLETRAD	0.0064117731	SHANDLING
9	40	9	40	40	9	70
SQTEXTMODE	0.18	SDIMTOR	1.0	0.0	STDUSRTIMER	0

0	70	9.	70	9	9	40
SECTION	0	SDIMEKO	1	SDIMTOPL	SAUNITS	0.0064137731
2	9	40	9	70	70	9
HEADER	SMIRRTXT	0.0625	SDIMSE1	0	0	SUSRTIMER
9	70	9	70	9	9	70
SACADVER	1	SDIMDLT	0	SDIMTVP	SAUPREC	1
1	9	40	9	40	70	9
AC1006	SDRAGMODE	0.38	SDIMSE2	0.0	0	SANGBASE
9	70	9	70	9	9	50
SINSBASE	2	SDIMRND	0	SDIMTEX	SHENU	0.0
10	9	40	9	70	1	9
0.0	SITSSCALE	0.0	SDIMTAD	0	acad	SANGDIR
20	40	9	70	9	9	70
0.0	1.0	SDIMBLE	0	SDIMSOXD	ELEVATION	0
30	9	40	9	70	40	9
0.0	SQSMODE	0.0	SDIMZIN	0	0.0	SPMODE
9	70	9	70	9	9	70
SECTMIN	0	SDIMEKE	0	SDIMSAH	STHICKNESS	0
10	9	40	9	70	40	9
1.125	SATTMODE	0.18	SDIMBLK	0	0.0	SPDSIZE
20	70	9	1	9	9	40
1.32	1	SDIMTP	9	SDIMBLK1	SLIMCHECK	0.0
9	9	40	9	1	70	9
SECTMAX	STEXTSIZE	0.0	SDIMASO	9	0	SPLINEWID
10	40	9	70	9	9	40
11.83882	0.2	SDIMTM	1	SDIMBLK2	SHLIPMODE	0.0
20	9	40	9	1	70	9
8.68	STRACEWID	0.0	SDIMSHO	9	1	SCORDS
9	40	9	70	9	9	70
SLDMMIN	0.05	SDIMTXT	0	SLUNITS	SCHAMFERA	0
10	9	40	9	70	40	9
0.0	STEXTSTYLE	0.18	SDIMPOST	2	0.0	SSPLFRAME
20	7	9	1	9	9	70
0.0	STANDARD	SDIMCEN	9	SLUPREC	SCHAMFERB	0
9	9	40	9	70	40	9
SLIMMAX	SCILAYER	0.09	SDIMAPOST	4	0.0	SSPLINETYPE
10	8	9	1	9	9	70
12.0	CENTER	SDIMTSZ	9	SAXISMODE	SSKPOLY	6
20	9	40	9	70	70	9
9.0	SCELTYPE	0.0	SDIMALT	1	0	SSPLINESEGS
9	6	9	70	9	9	70
SORTHOMODE	BYLAYER	SDIMTOL	0	SAXISUNIT	STDCREATE	8
70	9	70	9	10	40	9
0	SCECOLOR	0	SDIMALTD	0.0	2448344.1538446760	SATTDIA
9	62	9	70	20	9	70
SREGENMODE	256	SDIMLIN	2	0.0	STDUPDATE	0
70	9	70	9	9	40	9
1	SDIMSCALE	0	SDIMALTF	SSKETCHINC	2448389.5470222221	SATTREQ
9	40	9	40	40	9	70
SFILLMODE	1.0	SDIMTHH	25.4	0.1	STDINDWG	1
70	9	70	9	9	40	9
1	SDIMASZ	1	SDIMLFAC	SFILLETRAD	0.0064137731	SHANOLING
9	40	9	40	40	9	70
SQTEXTMODE	0.18	SDIMTOH	1.0	0.0	STDUSRTIMER	0

9	30	2	44	73	2	2
\$HANDSEED	0.0	VPORT	0.0	4	STYLE	BLOCKS
5	9	70	50	40	70	0
0	SUSERI1	2	0.0	2.0	1	BLOCK
9	70	0	51	49	0	8
SSURFTAB1	0	VPORT	0.0	1.25	STYLE	0
70	9	2	71	49	2	2
6	SUSERI2	*ACTIVE	0	-0.25	STANDARD	*DO
SSURFTAB2	70	70	72	49	70	70
70	9	0	100	0.25	64	65
9	9	10	73	49	40	10
SSURFTAB2	70	0.0	1	-0.25	0.0	0.0
6	SUSERI3	20	74	0	41	20
SSURFTYPE	9	0.0	75	1	1.0	0.0
70	70	11	76	1	50	30
9	SUSERI4	1.0	77	1	0.0	0.0
SSURFV	70	21	78	0	71	0
70	9	1.0	0	3	0	LINE
6	SUSERI5	12	0	LAYER	42	8
SSURFV	70	7.360658	78	0	0.2	0
9	9	5.331017	0	2	3	6
SSURFV	70	13	0	LAYER	4	BYBLOCK
6	SUSERR1	0.0	ENDTAB	0	4	62
SFLATLAND	40	23	0	70	0	0
70	0.0	0.0	TABLE	64	ENDTAB	10
0	9	14	2	62	0	4.0
9	SUSERR2	0.5	LTYPE	7	TABLE	20
SUCSNAME	40	24	70	6	2	8.0625
2	0.0	0.5	2	CONTINUOUS	VIEW	30
9	9	15	0	0	70	0.0
SUCSORG	SUSERR3	0.0	LTYPE	LAYER	0	11
10	40	25	2	2	0	4.0
0.0	0.0	0.0	CONTINUOUS	DEPOINTS	ENDTAB	21
20	9	16	70	70	0	8.68
0.0	SUSERR4	0.0	64	64	0	31
30	40	26	3	62	TABLE	0.0
0.0	0.0	0.0	Solid line	-7	2	0
9	9	36	72	6	UCS	LINE
SUSERR5	40	17	65	CONTINUOUS	70	8
0.0	0.0	0.0	73	0	0	0
10	9	27	40	LAYER	0	6
1.0	SWORLDVIEW	0.0	0.0	2	ENDTAB	BYBLOCK
20	70	37	0	CENTER	0	62
0.0	1	0.0	LTYPE	64	TABLE	0
30	0	40	2	62	2	10
0.0	ENDSEC	10.662035	CENTER	7	DWGMR	7.0
9	0	41	70	6	70	20
SUCSYDIR	SECTION	1.380723	64	CENTER	0	8.0625
10	2	42	3	0	0	30
0.0	TABES	50.0	72	ENDTAB	ENDTAB	0.0
20	0	43	72	0	ENDSEC	11
1.0	TABLE	0.0	65	TABLE	0	7.0
					SECTION	21
						8.68

31	30	8	20	30	62	23	6
0.0	0.0	0	8.5	0.0	0	6.0	BYBLOCK
0	11	6	30	11	10	33	62
LINE	4.18	BYBLOCK	0.0	1.32	1.53	0.0	0
8	21	62	0	21	20	0	10
0	8.53	0	ENDBLK	6.0	5.18	TEXT	1.5
6	11	10	8	31	30	8	20
BYBLOCK	0.0	5.11	0	0.0	0.0	0	6.0
62	12	20	0	0	11	6	30
0	4.0	8.41	BLOCK	LINE	1.47	BYBLOCK	0.0
10	22	30	8	8	21	62	0
4.18	8.5	0.0	0	0	5.18	0	ENDBLK
20	32	40	2	6	31	10	8
8.5	0.0	0.18	*D1	BYBLOCK	0.0	1.14	0
30	13	1	70	62	12	20	0
0.0	4.0	3.0000	65	0	1.5	5.41	BLOCK
11	23	0	10	10	22	30	8
4.93	8.5	POINT	0.0	1.5	5.0	0.0	0
21	33	8	20	20	32	40	2
8.5	0.0	DEPOINTS	0.0	5.18	0.0	0.18	*D2
31	0	6	30	30	13	1	70
0.0	SOLID	BYBLOCK	0.0	0.0	1.5	1.0000	65
0	8	62	0	11	23	0	10
LINE	0	0	LINE	1.5	5.0	POINT	0.0
8	6	10	8	21	33	8	20
0	BYBLOCK	4.0	0	5.23	0.0	DEPOINTS	0.0
6	62	20	6	31	0	6	30
BYBLOCK	0	8.0	BYBLOCK	0.0	SOLID	BYBLOCK	0.0
62	10	30	62	0	8	62	0
0	6.82	0.0	0	LINE	0	0	LINE
10	20	0	10	8	6	10	8
6.82	8.47	POINT	1.9375	0	BYBLOCK	2.0	0
20	30	8	20	6	62	20	6
8.5	0.0	DEPOINTS	5.0	BYBLOCK	0	5.0	BYBLOCK
30	11	6	30	62	10	30	62
0.0	6.82	BYBLOCK	0.0	0	1.53	0.0	0
11	21	62	11	10	20	0	10
6.07	8.53	0	1.32	1.5	5.82	POINT	3.0625
21	31	10	21	20	30	8	20
8.5	0.0	7.0	5.0	5.82	0.0	DEPOINTS	5.0
11	12	20	31	30	11	6	30
0.0	7.0	8.0	0.0	0.0	1.47	BYBLOCK	0.0
0	22	30	0	11	21	62	11
SOLID	8.5	0.0	LINE	1.5	5.82	0	3.68
8	32	0	8	21	31	10	21
0	0.0	POINT	0	5.77	0.0	2.0	5.0
6	13	8	6	31	12	20	31
BYBLOCK	7.0	DEPOINTS	BYBLOCK	0.0	1.5	6.0	0.0
62	23	6	62	0	22	30	0
0	8.5	BYBLOCK	0	SOLID	6.0	0.0	LINE
10	33	62	10	8	32	0	8
4.18	0.0	0	1.9375	0	0.0	POINT	0
20	0	10	20	6	13	8	6
8.47	TEXT	7.0	6.0	BYBLOCK	1.5	DEPOINTS	BYBLOCK

62	0	22	30	0	11	21	62
10	0	3.5	0.0	LINE	1.5	3.32	0
1.0625	0	32	0	8	21	31	10
20	0	0.0	POINT	0	1.02	0.0	2.0
1.5	6	13	8	6	31	12	20
30	BYBLOCK	1.5	DEPOINTS	BYBLOCK	0.0	1.5	1.5
0.0	62	23	6	62	0	22	30
11	0	3.5	BYBLOCK	0	SOLID	3.5	0.0
1.68	10	33	62	10	8	32	0
21	3.53	0	0	1.9375	0	0.0	POINT
3.5	20	TEXT	10	20	6	13	8
11	4.82	8	3.5	3.5	BYBLOCK	1.5	DEPOINTS
30	30	0	20	30	62	23	6
0.0	0.0	0	3.5	0.0	0	3.5	BYBLOCK
0	11	6	30	11	10	33	62
LINE	3.47	BYBLOCK	0.0	1.32	1.53	0.0	0
8	21	62	0	21	20	0	10
0	4.82	0	ENDBLK	3.5	2.18	TEXT	1.5
6	31	10	8	31	30	8	20
BYBLOCK	0.0	3.125	0	0.0	0.0	0	3.5
62	12	20	0	0	11	6	30
0	1.5	4.16	BLOCK	LINE	1.47	BYBLOCK	0.0
10	22	0.0	8	8	21	62	0
1.5	5.0	0.0	0	0	2.18	0	ENDBLK
20	32	40	2	6	31	10	8
4.82	0.0	0.18	*D3	BYBLOCK	0.0	1.125	0
30	13	1	70	62	12	20	0
0.0	3.5	1.5000	65	0	1.5	2.66	BLOCK
11	23	0	10	10	22	30	8
1.5	5.0	POINT	0.0	1.5	2.0	0.0	0
21	33	8	20	20	32	40	2
4.52	0.0	DEPOINTS	0.0	2.18	0.0	0.18	*D4
31	0	6	30	30	13	1	70
0.0	SOLID	BYBLOCK	0.0	0.0	1.5	1.5000	65
0	8	62	0	11	23	0	10
LINE	0	0	LINE	1.5	2.0	POINT	0.0
8	6	10	8	21	33	8	20
0	BYBLOCK	3.0	0	2.48	0.0	DEPOINTS	0.0
6	62	20	6	31	0	6	30
BYBLOCK	0	5.0	BYBLOCK	0	SOLID	BYBLOCK	0.0
62	10	30	62	0	8	62	0
0	3.53	0.0	0	LINE	0	0	LINE
10	20	0	10	8	6	10	8
1.5	1.68	POINT	1.9375	0	BYBLOCK	2.0	0
20	30	8	20	6	62	20	6
1.68	0.0	DEPOINTS	2.0	BYBLOCK	0	2.0	BYBLOCK
30	11	6	30	62	10	30	62
0.0	3.47	BYBLOCK	0.0	0	1.53	0.0	0
11	21	62	11	10	20	0	10
1.5	1.68	0	1.32	1.5	3.32	POINT	8.5625
21	31	10	21	20	30	8	20
1.98	0.0	3.0	2.0	1.32	0.0	DEPOINTS	6.5
11	12	20	31	30	11	6	30
0.0	3.5	3.5	0.0	0.0	1.47	BYBLOCK	0.0

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11
9.18
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LINE
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BYBLOCK
62
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9.0
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30
0.0
11
9.0
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5.27
31
0.0
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LINE
8
0
6
BYBLOCK
62
0

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8	21	33	8	20	33	11	0
0	3.02	0.0	DEPOINTS	0.0	0.0	7.09	ENDBLK
6	11	0	6	10	0	21	8
BYBLOCK	0.0	SOLID	BYBLOCK	0.0	LINE	6.5	0
62	0	8	62	0	8	11	0
0	LINE	0	0	LINE	0	0.0	BLCK
10	8	6	10	8	6	0	8
8.5625	0	BYBLOCK	8.5	0	BYBLOCK	LINE	0
20	6	62	20	6	62	8	2
1.5	BYBLOCK	0	1.5	BYBLOCK	0	0	*DB
30	62	10	30	62	10	6	70
0.0	0	9.03	0.0	0	7.0	BYBLOCK	65
11	10	20	0	10	20	62	10
9.18	9.0	2.18	POINT	7.933381	6.5	0	0.0
21	20	30	8	20	30	10	20
1.5	2.18	0.0	DEPOINTS	7.433381	0.0	7.0	0.0
31	30	11	6	30	11	20	30
0.0	0.0	8.97	BYBLOCK	0.0	7.215551	6.41	0.0
0	11	21	62	11	21	30	0
LINE	9.0	2.18	0	7.845109	6.715551	0.0	LINE
8	21	31	10	21	31	11	8
0	2.48	0.0	6.5	7.345109	0.0	7.0	0
6	31	12	20	31	0	21	6
BYBLOCK	0.0	9.0	2.0	0.0	TEXT	6.59	BYBLOCK
62	0	22	30	0	8	31	62
0	SOLID	2.0	0.0	SOLID	0	0.0	0
10	8	32	0	8	6	0	10
6.5625	0	0.0	POINT	0	BYBLOCK	POINT	2.619596
20	6	13	8	6	62	8	20
2.0	BYBLOCK	9.0	DEPOINTS	BYBLOCK	0	DEPOINTS	7.186122
30	62	23	6	62	10	6	30
0.0	0	2.0	BYBLOCK	0	7.06533	BYBLOCK	0.0
11	10	33	62	10	20	62	11
9.18	9.03	0.0	0	7.912168	6.94033	0	2.784397
21	20	0	10	20	30	10	21
2.0	1.32	TEXT	9.0	7.454594	0.0	8.06066	7.044515
31	30	8	20	30	40	20	31
0.0	0.0	0	2.0	0.0	0.18	7.56066	0.0
0	11	6	30	11	1	30	0
LINE	8.97	BYBLOCK	0.0	7.954594	R1.5000	0.0	SOLID
8	21	62	0	21	0	0	8
0	1.32	0	ENDBLK	7.412168	LINE	POINT	0
6	31	10	8	31	8	8	6
BYBLOCK	0.0	8.625	0	0.0	0	DEPOINTS	BYBLOCK
62	12	20	0	12	6	6	62
0	9.0	2.66	BLCK	8.06066	BYBLOCK	BYBLOCK	0
10	22	30	8	22	62	62	10
9.0	1.5	0.0	0	7.56066	0	0	2.600045
20	32	40	2	32	10	10	20
3.32	0.0	0.18	*D7	0.0	6.91	7.0	7.163368
30	13	1	70	13	20	20	30
0.0	9.0	1.5000	65	8.06066	6.5	6.5	0.0
11	23	0	10	23	30	30	11
9.0	1.5	POINT	0.0	7.56066	0.0	0.0	2.639148

21	0	0	8	6	0	10	20
7.208876	LINE	POINT	0	BYBLOCK	POINT	4.178013	5.606177
11	8	8	6	62	8	20	30
0.0	0	DEPOINTS	BYBLOCK	10	DEPOINTS	5.752338	0.0
12	6	6	62	20	6	30	11
2.483073	BYBLOCK	BYBLOCK	0	7.135727	BYBLOCK	0.0	4.463069
22	62	62	10	5.511002	62	11	21
7.303431	0	0	6.698076	30	0	4.283069	5.606177
32	10	10	20	0.0	10	21	31
0.0	3.91	4.0	5.766139	40	6.571064	5.606177	0.0
13	20	20	30	0.18	20	31	0
2.483073	6.0	6.0	0.0	1	5.897165	0.0	TEXT
23	30	30	11	**1290.2500	30	0	8
7.303431	0.0	0.0	6.648715	0	0.0	SOLID	0
33	11	0	21	LINE	0	8	6
0.0	4.09	ENDBLK	5.732028	8	POINT	0	BYBLOCK
0	21	8	31	0	8	6	62
LINE	6.0	0	0.0	6	DEPOINTS	BYBLOCK	0
8	31	0	12	BYBLOCK	6	62	10
0	0.0	BLOCK	6.571064	62	62	0	4.643069
6	0	8	22	10	0	10	20
BYBLOCK	LINE	0	5.897165	6.41	10	4.202373	5.516177
62	8	2	32	20	6.428936	20	30
0	0	*D13	0.0	6.0	20	5.769847	0.0
10	6	70	13	30	6.102835	30	40
4.0	BYBLOCK	65	23	0.0	30	0.0	0.18
20	62	10	5.897165	11	0.0	11	1
6.0	0	0.0	33	6.59	0	4.153652	**1290.2500
30	10	20	0.0	21	ENDBLK	21	0
0.0	4.0	0.0	0	6.0	5.734828	0.0	LINE
11	20	30	LINE	31	8	31	8
3.698675	5.91	0.0	8	0.0	0	12	0
21	30	0	0	0	BLOCK	4.072956	6
6.258915	0.0	LINE	6	0	8	22	BYBLOCK
31	11	8	BYBLOCK	LINE	0	5.898499	62
0.0	4.0	0	62	8	2	32	0
0	21	6	10	0	*D14	13	10
TEXT	6.09	BYBLOCK	6.775727	6	70	0.0	3.91
8	31	62	20	BYBLOCK	65	13	20
0	0.0	0	5.601002	62	10	23	6.0
6	0	10	0.0	10	0.0	5.898499	30
BYBLOCK	POINT	6.673395	11	6.5	20	33	0.0
62	8	20	21	5.91	0.0	0	11
0	DEPOINTS	5.749083	31	30	0.0	LINE	4.09
10	6	30	6.955727	11	0	8	21
2.761536	BYBLOCK	0.0	5.601002	6.0	0	6	6.0
20	62	11	0.0	21	LINE	0	31
6.561715	0	6.775727	31	6.5	8	BYBLOCK	0.0
30	10	21	0	21	0	62	8
0.0	2.483073	5.601002	TEXT	6.09	6	0	0
40	20	31	8	31	BYBLOCK	10	6
0.18	7.303431	0.0	0	0.0	62	4.283069	BYBLOCK
1	30	0	SOLID	0	0		
R2.0000	0.0	SOLID	0				

62	10	23	30	30	11	0	10
0	0.0	3.395693	0.0	0.0	3.0	LINE	7.0
10	20	13	11	21	8	8	20
4.0	0.0	0.0	4.09	0	5.0	0	8.5
20	30	0	21	ENDBLK	31	10	30
5.91	0.0	LINE	3.5	8	0.0	4.0	0.0
30	0	8	31	0	0	20	11
0.0	LINE	0	0.0	ENDSEC	LINE	8.0	5.5
11	8	6	0	0	8	30	21
4.0	0	BYBLOCK	LINE	SECTION	0	0.0	8.5
21	6	62	8	2	10	11	31
6.09	BYBLOCK	0	0	ENTITIES	3.0	7.0	0.0
31	62	10	6	0	20	21	13
0.0	0	4.267272	BYBLOCK	LINE	5.0	8.0	4.0
0	10	20	62	8	30	31	23
POINT	4.168078	3.095289	0	0	0.0	0.0	8.0
8	20	30	10	10	11	0	33
DEFPPOINTS	3.245491	0.0	4.0	2.0	2.0	ARC	0.0
6	30	11	20	20	21	8	14
BYBLOCK	0.0	4.447272	3.41	2.0	5.0	0	7.0
62	11	21	30	30	31	10	24
0	4.267272	3.095289	0.0	0.0	0.0	7.0	8.0
10	21	31	11	11	0	20	34
4.072956	3.095289	0.0	4.0	2.0	LINE	6.5	0.0
20	31	0	21	21	8	30	0
5.898499	0.0	TEXT	3.59	3.5	0	0.0	DIMENSION
30	0	8	31	31	10	40	8
0.0	SOLID	0	0.0	0.0	2.0	1.5	0
0	8	6	0	0	20	50	2
POINT	0	BYBLOCK	POINT	LINE	5.0	0.0	*D1
8	6	62	8	8	30	51	10
DEFPPOINTS	BYBLOCK	0	DEFPPOINTS	0	0.0	90.0	1.5
6	62	10	6	10	11	0	20
BYBLOCK	0	4.627272	BYBLOCK	2.0	2.0	LINE	6.0
62	10	20	62	20	21	8	30
0	4.193112	3.005289	0	1.5	6.0	0	0.0
10	20	30	10	30	31	10	11
3.927044	3.262024	0.0	4.068885	0.0	0.0	8.5	1.5
20	30	40	20	11	0	20	21
6.101501	0.0	0.18	3.395693	1.0	ARC	6.5	5.5
30	11	1	30	21	8	30	31
0.0	4.143045	31290.2500	0.0	3.5	0	0.0	0.0
0	21	0	0	31	10	11	13
ENDBLK	3.228959	LINE	POINT	0.0	4.0	8.5	2.0
8	31	8	8	0	20	21	23
0	0.0	0	DEFPPOINTS	LINE	6.0	3.5	5.0
0	12	6	6	8	30	31	33
BLCK	4.068885	BYBLOCK	BYBLOCK	0	0.0	0.0	0.0
8	22	62	62	10	40	0	14
0	3.395693	0	0	3.0	2.0	DIMENSION	2.0
2	32	10	10	20	50	8	24
*D15	0.0	3.91	3.931115	3.5	90.0	0	6.0
70	13	20	20	30	51	2	34
65	4.068885	3.5	3.604307	0.0	180.0	*D0	0.0

50
90.0
0
DIMENSION
8
0
2
*D2
10
3.5
20
3.5
30
0.0
11
3.5
21
4.25
31
0.0
13
3.0
23
5.0
33
0.0
14
1.0
24
3.5
34
0.0
50
90.0
0
DIMENSION
8
0
2
*D3
10
1.5
20
3.5
30
0.0
11
1.5
21
2.75
31
0.0
13
2.0

23
2.0
33
0.0
14
2.0
24
3.5
34
0.0
50
90.0
0
DIMENSION
8
0
2
*D4
10
9.0
20
3.5
30
0.0
11
5.0
33
0.0
14
9.0
21
5.0
31
0.0
13
8.5
23
6.5
33
0.0
14
8.5
24
3.5
34
0.0
50
90.0
0
LINE
8
0
10
8.5
20
3.5
30
0.0

11
6.5
21
2.0
31
0.0
0
LINE
8
0
10
6.5
20
2.0
30
0.0
11
2.0
21
2.0
31
0.0
0
DIMENSION
8
0
2
*D5
10
6.5
20
1.5
30
0.0
11
4.25
21
1.5
31
0.0
13
2.0
23
2.0
33
0.0
14
6.5
24
2.0
34
0.0
50
0
DIMENSION

8
0
2
*D6
10
9.0
20
2.0
30
0.0
11
9.0
21
2.75
31
0.0
13
8.5
23
3.5
33
0.0
14
6.5
24
2.0
34
0.0
50
90.0
0
DIMENSION
8
0
2
*D7
10
7.0
6.5
30
0.0
11
7.53033
21
7.03033
31
0.0
70
15
4
8.06066
25
7.56066

35
0.0
0
DIMENSION
8
0
2
*D8
10
4.0
20
6.0
30
0.0
11
3.241536
21
6.651715
31
0.0
70
15
4
2.483073
25
7.303431
35
0.0
0
CIRCLE
8
0
10
6.5
20
6.0
30
0.0
40
0.125
0
CIRCLE
8
0
10
4.0
20
6.0
30
0.0
40
0.125
0
CIRCLE

8
0
10
4.0
20
3.5
30
0.0
40
0.125
0
DIMENSION
8
0
2
*D13
10
6.428936
20
6.102835
30
0.0
11
7.630727
21
5.601002
31
0.0
70
15
3
6.571064
25
5.897165
35
0.0
40
0.026627
0
DIMENSION
8
0
2
*D14
10
3.927044
20
6.101501
30
0.0
11
5.138069
21
5.606177

11
0.0
70
3
15
4.072956
25
5.898499
35
0.0
40
0.032825
0
DIMENSION
8
0
2
*D15
10
3.931115
20
3.604307
30
0.0
11
5.122272
21
3.095289
31
0.0
70
15
3
4.068885
25
3.395693
35
0.0
40
0.004549
0
LINE
8
CENTER

31
0.0
0
LINE
8
CENTER
10
4.0
20
6.5
30
0.0
11
4.0
21
3.0
31
0.0
0
LINE
8
CENTER
10
3.5
20
6.0
30
0.0
11
7.0
21
6.0
31
0.0
0
LINE
8
CENTER
10
1.5
20
3.5
30
0.0
11
4.5
21
3.5
31
0.0
0
ENDSEC
0
EOF

DXF file for a sample part
after running program I

0	8	30	31	8
SECTION	0	0	0	0
2	10	11	0	10
ENTITIES	3	7	LINE	4
0	20	21	8	20
LINE	5	8	0	6
8	30	31	10	30
0	0	0	6.5	0
10	11	0	20	0
2	2	ARC	2	CIRCLE
20	21	8	30	8
2	5	0	0	0
30	31	10	11	10
0	0	7	2	4
11	0	20	21	20
2	LINE	6.5	2	3.5
21	8	30	31	30
3.5	0	0	0	0
31	10	40	0	40
0	2	1.5	CIRCLE	.125
0	20	50	8	0
LINE	5	0	0	POINT
8	30	51	10	8
0	0	90	6.5	0
10	11	0	20	10
2	2	LINE	6	4
20	21	8	30	20
3.5	6	0	0	3.5
30	31	10	40	30
0	0	8.5	.125	0
11	0	20	0	0
3	ARC	6.5	POINT	ENDSEC
21	8	30	8	0
3.5	0	0	0	EOF
31	10	11	10	
0	4	8.5	6.5	
0	20	21	20	
LINE	6	3.5	6	
8	30	31	30	
0	0	0	0	
10	40	0	0	
3	2	LINE	CIRCLE	
20	50	8	8	
3.5	90	0	0	
30	51	10	10	
0	180	8.5	4	
11	0	20	20	
3	LINE	3.5	6	
21	8	30	30	
5	0	0	0	
31	10	11	40	
0	4	6.5	.125	
0	20	21	0	
LINE	8	2	POINT	

DXF file for a complex part
before running program I

0	70	9	70	9	9	40	9
SECTION	0	SDIMEXO	1	SDIMTOFL	SAUNITS	0.0118561343	\$HANDSEED
2	9	40	9	70	70	9	5
HEADER	SMIRRTEXT	0.0625	SDIMSEL	0	0	SUSRTIMER	0
9	70	9	70	9	9	70	9
SACADVER	1	SDIMDLI	0	SDIMTVP	SAUPREC	1	\$SURFTAB1
1	9	40	9	40	70	9	70
AC1006	SDRAGMODE	0.38	SDIMSE2	0.0	0	SANGBASE	6
9	70	9	70	9	9	50	\$SURFTAB2
SINSBASE	2	SDIMRND	0	SDIMTIX	SMENU	0.0	70
10	9	40	9	70	1	9	6
0.0	SLTSCALE	0.0	SDIMTAB	0	acad	SANGDIR	\$SURFTYPE
20	40	9	70	9	9	70	70
0.0	1.0	SDIMDLE	0	SDIMSOXD	SELEVATION	0	6
30	9	40	9	70	40	9	9
0.0	SOSMODE	0.0	SDIMZIN	0	0.0	SPDMODE	\$SURFU
9	70	9	70	9	9	70	70
SEXTMIN	0	SDIMEKE	0	SDIMSAH	STHICNESS	0	6
10	9	40	9	70	40	9	9
0.5	SATTHODE	0.18	SDIMBLK	0	0.0	SPOSIZE	\$SURFV
20	70	9	1	9	9	40	70
2.0	1	SDIMTP	9	SDIMBLK1	SLIMCHECK	0.0	6
9	9	40	9	1	70	9	9
SEXTMAX	STEXTSIZE	0.0	SDIMASO	9	0	SPLNEWID	\$FLATLAND
10	40	9	70	9	9	40	70
11.580695	0.2	SDIMTH	1	SDIMBLK2	SBLIPMODE	0.0	0
20	9	40	9	1	70	9	9
7.572295	STRACEWID	0.0	SDIMSHO	9	1	SCOODS	SUCSHAME
9	40	9	70	9	9	70	2
SLIMMIN	0.05	SDIMEXT	0	SLUNITS	SCHAMPERA	0	9
10	9	40	9	70	40	9	SUCSORG
0.0	STEXTSTYLE	0.18	SDIMPOST	2	0.0	SSPLFRAME	10
20	7	9	1	9	9	70	0.0
0.0	STANDARD	SDIMGEN	9	SLUPREC	SCHAMFERB	0	20
9	9	40	9	70	0.0	9	0.0
SLIMMAX	SCLAYER	0.09	SDIMAPOST	4	9	SSPLINETYPE	30
10	8	9	1	9	9	70	0.0
12.0	CENTER	SDIMTSZ	9	SAXISMODE	SSKPOLY	6	9
20	9	40	9	70	70	9	SSPLINESECS
9.0	SCELTYPE	0.0	SDIMALT	1	0	70	9
9	6	9	70	9	9	8	SUCSXDIR
SORTHOMODE	CENTER	SDIMTOL	0	SAXISUNIT	STDCREATE	9	1.0
70	9	70	9	10	40	SAITDIA	20
0	SCECOLOR	0	SDIMALTD	0.0	2448375.8933859952	70	0.0
9	62	9	70	20	9	9	30
SREGENMODE	256	SDIMLIN	2	0.0	STDOPDATE	9	0.0
70	9	70	9	9	40	SAITREQ	9
1	SDIMSCALE	0	SDIMALTF	SSKETCHING	2448429.4913415508	70	SUCSYDIR
9	40	9	40	40	9	1	10
SFILLMODE	1.0	SDIMTH	25.4	0.1	STDINDWG	9	0.0
70	9	70	9	9	40	SHANDLING	20
1	SDIMASZ	1	SDIMLFAC	SFILLETRAD	0.0118561343	70	1.0
9	40	9	40	40	9	0	
SQTEXTMODE	0.18	SDIMTOH	1.0	0.0	STDSRTIMER		

30	2	44	73	2	2	50	31
0.0	VPORT	0.0	40	STYLE	BLOCKS	45.92362	0.0
9	70	50	2.0	70	0	51	12
SUSERI1	2	0.0	49	1	BLOCK	47.956736	7.428964
70	0	51	1.25	0	8	0	22
0	VPORT	0.0	49	STYLE	0	SOLID	3.242987
9	2	71	-0.25	2	6	8	32
SUSERI2	*ACTIVE	0	49	STANDARD	CENTER	0	0.0
70	70	100	0.25	70	2	6	13
0	0	73	49	64	*00	BYBLOCK	7.428964
9	10	1	-0.25	40	70	62	23
SUSERI3	0.0	74	0	0.0	65	0	3.242987
70	20	1	ENDTAB	41	10	10	13
0	0.0	75	0	1.0	0.0	7.809211	0.0
9	11	1	TABLE	50	20	20	0
SUSERI4	1.0	76	2	0.0	0.0	2.67586	TEXT
70	21	1	LAYER	71	30	30	8
0	1.0	77	70	0	0.0	0.0	0
9	12	0	0	42	0	11	6
SUSERI5	6.213253	78	0	0.2	ARC	7.86888	BYBLOCK
70	22	0	LAYER	3	8	21	62
0	4.5	0	2	4	0	2.682154	0
9	13	0	0	0	6	31	10
SUSERR1	0.0	ENDTAB	70	0	BYBLOCK	0.0	7.712255
40	23	0	64	0	62	12	20
0.0	0.0	TABLE	62	ENDTAB	0	7.857928	2.978261
9	14	2	7	0	10	22	30
SUSERR2	0.25	LTYPE	6	TABLE	7.0	2.5	0.0
40	24	70	CONTINUOUS	2	20	32	40
0.0	0.25	0	0	VIEW	2.5	0.0	0.18
9	15	2	LAYER	70	30	13	1
SUSERR3	0.0	LTYPE	2	0	0.0	7.857928	6081127
40	25	2	DEFPPOINTS	0	40	23	0
0.0	0.0	CONTINUOUS	70	ENDTAB	0.857928	2.5	POINT
9	16	70	64	0	50	33	8
SUSERR4	0.0	3	62	TABLE	12.043264	0.0	DEFPPOINTS
40	26	64	-7	2	51	0	6
0.0	0.0	Solid line	6	UCS	21.837093	SOLID	BYBLOCK
9	36	72	CONTINUOUS	70	0	8	62
SUSERR5	1.0	65	0	0	ARC	0	0
40	17	73	LAYER	0	8	6	10
0.0	0.0	0	2	ENDTAB	0	BYBLOCK	6.854701
9	27	40	CENTER	0	6	62	20
SWORLDVIEW	0.0	0.0	70	TABLE	BYBLOCK	0	2.248134
70	37	0	64	2	62	10	30
1	0.0	LTYPE	62	DWGNGR	0	7.556904	0.0
0	40	2	7	70	10	20	0
ENDSEC	9.0	CENTER	6	0	7.0	1.112867	POINT
0	41	70	CENTER	0	20	30	8
SECTION	1.380723	64	0	ENDTAB	2.5	0.0	DEFPPOINTS
2	42	3	ENDTAB	0	30	11	6
TABLES	50.0	72	0	ENDSEC	0.0	7.59219	BYBLOCK
0	43	65	TABLE	0	40	21	62
TABLE	0.0			SECTION	0.857928	1.161395	0

10	30	0	21	8	11	1	30
8.378173	0.0	LINE	2.5	0	1.324278	R2 1/2	0.0
20	0	8	31	6	21	0	0
4.887066	LINE	0	0.0	CONTINUOUS	1.694063	LINE	POINT
30	8	6	0	0	31	8	8
0.0	0	BYBLOCK	LINE	BLOCK	0.0	0	DEPOINTS
0	6	62	8	8	12	6	6
POINT	BYBLOCK	0	0	0	1.167092	BYBLOCK	BYBLOCK
8	62	10	6	6	22	62	62
DEPOINTS	0	7.0	BYBLOCK	CONTINUOUS	1.601367	0	0
6	10	20	62	2	32	10	10
BYBLOCK	6.100149	2.5	0	*D2	0.0	1.41	1.5
62	20	30	10	70	13	20	20
0	4.63838	0.0	7.0	65	1.167092	4.5	4.5
10	30	11	20	10	23	30	30
2.0	0.0	6.689369	2.41	0.0	1.601367	0.0	0.0
20	11	21	30	20	33	11	0
2.5	6.340963	3.238174	0.0	0.0	0.0	3.59	ENDBLK
30	21	31	11	30	0	21	8
0.0	4.066115	0.0	7.0	0.0	LINE	4.5	0
0	11	0	21	0	8	11	6
POINT	0.0	TEXT	2.59	LINE	0	0.0	CONTINUOUS
8	0	8	31	8	6	0	0
DEPOINTS	SOLID	0	0.0	0	BYBLOCK	LINE	BLOCK
6	8	6	0	6	62	8	8
BYBLOCK	0	BYBLOCK	POINT	BYBLOCK	0	0	0
62	6	62	8	62	10	6	6
0	BYBLOCK	0	DEPOINTS	0	3.5	BYBLOCK	CONTINUOUS
10	62	10	6	10	20	62	2
11.0	0	6.035166	BYBLOCK	1.335062	4.5	0	*D3
20	10	20	62	20	30	10	70
2.5	6.072497	1.562144	0	3.666068	0.0	1.5	65
30	20	30	10	30	11	20	10
0.0	4.626744	0.0	6.030333	0.0	2.889308	4.41	0.0
0	30	40	20	11	21	30	20
ENDBLK	0.0	0.18	4.804288	1.777785	4.264762	0.0	0.0
8	11	30	0.0	21	31	11	30
0	6.1278	0	0.0	3.836605	0.0	1.5	0.0
6	21	R2 1/2	0	31	0	21	0
CENTER	4.650016	0	POINT	0.0	TEXT	4.59	LINE
0	31	8	8	0	8	31	8
BLOCK	0.0	0	DEPOINTS	SOLID	0	0.0	0
8	12	6	6	8	6	0	6
0	6.030333	BYBLOCK	BYBLOCK	0	BYBLOCK	POINT	BYBLOCK
6	22	62	62	6	62	8	62
CONTINUOUS	4.804288	0	0	BYBLOCK	0	DEPOINTS	0
2	32	10	10	62	10	6	10
*D1	0.0	6.91	7.0	0	1.853546	BYBLOCK	2.741292
70	13	20	20	10	20	62	20
65	6.030333	2.5	2.5	1.145845	1.960683	0	5.917286
10	23	30	30	20	30	10	30
0.0	4.804288	0.0	0.0	1.638073	0.0	1.167092	0.0
20	33	11	0	30	40	20	11
0.0	0.0	7.09	ENDBLK	0.0	0.18	1.601367	2.998963

21
5.675229
31
0.0
0
SOLID
8
0
6
BYBLOCK
62
10
2.720751
20
5.895421
30
0.0
11
2.761832
21
5.939151
31
0.0
12
2.6101
22
6.040528
32
0.0
13
2.6101
23
6.040528
33
0.0
0
LINE
8
0
6
BYBLOCK
62
10
4.25
20
4.5
30
0.0
11
3.861137
21
4.865299

31
0.0
0
TEXT
8
0
6
BYBLOCK
62
10
2.95005
20
5.180264
30
0.0
40
0.18
1
R2 1/4
0
LINE
8
0
6
BYBLOCK
62
10
4.16
20
4.5
30
0.0
11
4.34
21
4.5
31
0.0
0
LINE
8
0
6
BYBLOCK
62
10
4.25
20
4.41
30
0.0

11
4.25
21
4.59
31
0.0
0
POINT
8
6
DEPOINTS
6
BYBLOCK
62
10
2.6101
20
6.040528
30
0.0
0
POINT
8
6
DEPOINTS
6
BYBLOCK
62
10
4.25
20
4.5
30
0.0
0
ENDBLK
8
0
6
CONTINUOUS
0
BLOCK
8
0
6
CONTINUOUS
2
*D4
70
65
10
0.0
20
0.0

30
0.0
0
LINE
8
0
6
BYBLOCK
62
10
11.0625
20
7.0
30
0.0
11
11.41165
21
7.0
31
0.0
0
LINE
8
0
6
BYBLOCK
62
10
11.0625
20
2.0
30
0.0
11
11.41165
21
2.0
31
0.0
0
LINE
8
0
6
BYBLOCK
62
10
11.23165
20
20
32
6.82

30
0.0
11
11.23165
21
4.77
31
0.0
0
LINE
8
0
6
BYBLOCK
62
10
11.23165
20
2.18
30
0.0
11
11.23165
21
4.23
31
0.0
0
SOLID
8
0
6
BYBLOCK
62
10
11.26165
20
6.82
30
0.0
11
11.20165
21
6.82
31
0.0
12
11.23165
22
7.0
32
0.0

13
11.23165
23
7.0
33
0.0
0
SOLID
8
0
6
BYBLOCK
62
10
11.26165
20
2.18
30
0.0
11
11.20165
21
2.18
31
0.0
12
11.23165
22
2.0
32
0.0
13
11.23165
23
2.0
33
0.0
0
TEXT
8
0
6
BYBLOCK
62
10
11.17165
20
4.41
30
0.0
40
0.18

1
5
0
POINT
8
6
DEPOINTS
6
BYBLOCK
62
10
11.0
20
7.0
30
0.0
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POINT
8
6
DEPOINTS
6
BYBLOCK
62
10
11.0
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2.0
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POINT
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6
DEPOINTS
6
BYBLOCK
62
10
11.23165
20
2.0
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0.0
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ENDBLK
8
0
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CONTINUOUS
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BLOCK
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0

6
CONTINUOUS
2
*D5
70
65
10
0.0
20
0.0
30
0.0
0
LINE
8
0
6
BYBLOCK
62
10
9.394463
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4.359361
30
0.0
11
9.154694
21
4.933178
31
0.0
0
SOLID
8
0
6
BYBLOCK
62
10
9.422144
20
4.370927
30
0.0
11
9.366782
21
4.347795
31
0.0
12
9.463861

22
4.19327
32
0.0
13
9.463861
23
4.19327
33
0.0
0
LINE
8
0
6
BYBLOCK
62
10
8.5
20
6.5
30
0.0
11
8.80916
21
5.76009
31
0.0
0
TEXT
8
0
6
BYBLOCK
62
10
8.501931
20
5.256638
30
0.0
40
0.18
1
R2 1/2
0
LINE
8
0
6
BYBLOCK

62 0
10
8.41
20
6.5
10
0.0
11
8.59
21
6.5
31
0.0
0
LINE
8
0
6
BYBLOCK
62
0
10
8.5
20
6.41
30
0.0
11
8.5
21
6.59
31
0.0
0
POINT
8
DEPOINTS
6
BYBLOCK
62
0
10
9.463861
20
4.193277
30
0.0
0
POINT
8
DEPOINTS
6
BYBLOCK

62 0
10
8.5
20
6.5
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0.0
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ENDBLK
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CONTINUOUS
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BLOCK
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CENTER
2
*D6
70
65
10
0.0
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0.0
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11
0.0
ARC
8
0
6
BYBLOCK
62
0
10
7.0
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2.5
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2.764543
50
93.731201
31
101.268799
0
LINE
8
0

0
6
BYBLOCK
62
0
10
6.237896
20
5.34421
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0.0
11
6.336776
21
4.975185
31
0.0
0
LINE
8
0
6
BYBLOCK
62
0
10
7.0
20
5.444543
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0.0
11
7.0
21
5.0625
31
0.0
0
SOLID
8
0
6
BYBLOCK
62
0
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6.821072
20
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6.819119
21

5.288667
31
0.0
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7.0
22
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32
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13
7.0
23
5.264543
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0.0
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SOLID
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BYBLOCK
62
0
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6.466592
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6.452958
21
5.240461
31
0.0
12
6.284484
22
5.170343
32
0.0
13
6.284484
23
5.170343
33
0.0
0
TEXT
8
0
6
BYBLOCK
62
0
10
6.604297
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5.26087
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0.0
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0.18
1
1544127
0
POINT
8
DEPOINTS
6
BYBLOCK
62
0
10
6.352952
20
4.914815
30
0.0
0
POINT
8
DEPOINTS
6
BYBLOCK
62
0
10
7.0
20
2.5
30
0.0
0
POINT
8
DEPOINTS
6
BYBLOCK
62
0
10
7.0
20
2.5
30
0.0
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POINT
8
DEPOINTS
6
BYBLOCK
62
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10
7.0
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5.0
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0.0
0
ENDBLK
8
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6
CENTER
0
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BLOCK
8
0
6
CENTER
2
*D7
70
65
10
0.0
20
0.0
30
0.0
0
LINE
8
0
6
BYBLOCK
62
0
10
10.137638
20
6.80679
30
0.0
11
10.440695
21
7.482295
31
0.0
0
SOLID
8
0
6
BYBLOCK
62
0
10
10.110266
20
6.81907
30
0.0
11
10.165009
21
6.79451
31
0.0
12
10.063958
22
6.64256
32
0.0
13
10.063958
23
6.64256
33
0.0
0
LINE
8
0
6
BYBLOCK
62
0
10
10.440695
20
7.482295
30
0.0
11
10.620695
21
7.482295
31
0.0
0

TEXT
8
0
6
BYBLOCK
62
0
10
10.800695
20
7.392295
30
0.0
40
0.18
1
441295/16
0
0
LINE
8
0
6
BYBLOCK
62
0
10
9.91
20
6.5
30
0.0
11
10.09
21
6.5
31
0.0
0
LINE
8
0
6
BYBLOCK
62
0
10
10.0
20
6.41
30
0.0
11
10.0
21
0.0
0
POINT
8
0.0
0
POINT
8
DEPOINTS
6
BYBLOCK
62
0
10
9.93604
20
6.35744
30
0.0
0
ENDBLK
8
0
6
CENTER
0
0
BLOCK
8
0
6
CENTER
2
*D8
70
65
10
0.0
20
0.0
30
0.0
11
0.0
21
0.0
31
0.0
0

LINE	0	0.0	CENTER	270.0	9.5	9.0	LINE	2.0	2.0
8	6	0	0	0	20	21	8	30	31
0	BYBLOCK	LINE	ENDSEC	LINE	6.0	6.0	0	0.0	0.0
6	62	8	0	8	10	31	10	11	0
BYBLOCK	0	0	SECTION	0	0.0	0.0	5.0	10.5	LINE
62	10	6	2	10	11	0	20	21	8
0	10.036033	BYBLOCK	ENTITIES	3.5	9.5	LINE	6.0	1.0	0
10	20	62	0	20	21	8	30	11	10
9.910815	1.940904	0	LINE	2.0	7.0	0	0.0	0.0	9.0
20	30	10	8	30	31	10	11	C	20
4.113402	0.0	9.75	0	0.0	0.0	6.5	5.0	LINE	3.0
30	11	20	10	11	0	20	21	8	30
0.0	10.216033	4.244936	11.0	11.0	LINE	6.0	7.0	0	0.0
11	21	30	20	21	8	30	31	10	11
10.036033	3.940904	0.0	2.0	2.0	0	0.0	0.0	10.5	8.0
21	31	11	30	31	10	11	0	20	21
3.940904	0.0	9.75	0.0	0.0	8.0	6.5	LINE	3.0	3.0
31	0	21	11	0	20	21	8	30	31
0.0	TEXT	4.424936	11.0	LINE	6.0	7.0	0	0.0	0.0
0	8	31	21	8	30	31	10	11	0
SOLID	0	0.0	7.0	0	0.0	0.0	6.0	9.5	LINE
8	6	0	31	10	11	0	20	21	8
0	BYBLOCK	POINT	0.0	10.5	8.0	LINE	6.0	3.0	0
6	62	8	0	20	21	8	30	31	10
BYBLOCK	0	DEPOINTS	LINE	7.0	7.0	0	0.0	0.0	9.0
62	10	6	8	30	31	10	11	0	20
0	10.396033	BYBLOCK	0	0.0	0.0	7.5	5.0	LINE	2.0
10	20	62	10	11	0	20	21	8	30
9.935092	1.850904	0	11.0	10.5	LINE	6.0	6.0	0	0.0
20	30	10	20	21	8	30	31	10	11
4.131025	0.0	9.805074	7.0	6.0	0	0.0	0.0	9.5	9.0
30	40	20	30	31	10	11	0	20	21
0.0	0.18	4.259068	0.0	0.0	9.0	6.5	LINE	3.0	3.0
11	1	30	11	0	20	21	8	30	31
9.886537	*1293/16	0.0	3.5	LINE	6.0	6.0	0	0.0	0.0
21	0	0	21	8	30	31	10	11	0
4.095778	LINE	POINT	7.0	0	0.0	0.0	6.0	9.5	LINE
31	8	8	31	10	11	0	20	21	8
0.0	0	DEPOINTS	0.0	10.5	8.0	LINE	7.0	2.0	0
12	6	6	0	20	21	8	30	31	10
9.805074	BYBLOCK	BYBLOCK	ARC	6.0	6.0	0	0.0	0.0	6.5
22	62	62	8	30	31	10	11	0	20
4.259068	0	0	0	0.0	0.0	7.5	6.0	LINE	3.0
32	10	10	10	11	0	20	21	8	30
0.0	9.66	9.694926	3.5	9.5	LINE	7.0	6.0	0	0.0
13	20	20	20	21	8	30	31	10	11
9.805074	4.334936	4.410805	4.5	6.0	0	0.0	0.0	8.0	6.5
23	30	30	30	31	10	11	0	20	21
4.259068	0.0	0.0	0.0	0.0	9.0	7.5	LINE	3.0	2.0
13	11	0	40	0	20	21	8	30	31
0.0	9.84	ENDBLK	2.5	LINE	7.0	6.0	0	0.0	0.0
0	21	8	50	8	30	31	10	11	0
LINE	4.334936	0	90.0	0	0.0	0.0	10.5	8.0	LINE
8	31	6	51	10	11	0	20	21	8

0	0.0	6.5	CIRCLE	0.15625	5.75	0.09375	3.024562	CENTER
10	11	30	8	0	20	0	20	10
7.5	5.0	0.0	0	CIRCLE	4.665064	CIRCLE	6.387009	11.0
20	21	40	10	8	30	8	30	20
1.0	1.0	0.15625	10.0	0	0.0	0	0.0	6.5
30	31	0	20	10	40	10	40	30
0.0	0.0	CIRCLE	2.5	20	0.09375	7.25	0.15625	0.0
11	0	8	30	2.5	0	20	0	11
6.5	LINE	0	0.0	CIRCLE	4.334936	CIRCLE	CIRCLE	2.0
21	8	10	40	8	30	8	8	21
3.0	0	5.5	0.15625	0.0	0	0.0	0	6.5
31	10	20	0	40	10	40	10	31
0.0	6.0	6.5	LINE	0.15625	8.25	0.09375	3.024562	0.0
0	20	30	8	0	20	0	20	0
LINE	2.0	0.0	0	CIRCLE	4.665064	CIRCLE	2.612991	LINE
8	30	40	10	8	30	8	30	8
0	0.0	0.15625	4.5	0	0.0	0	0.0	CENTER
10	11	0	20	10	40	10	40	6
7.5	6.0	CIRCLE	7.0	2.0	0.09375	7.852952	0.15625	CENTER
20	21	8	30	20	0	20	0	10
2.0	1.0	0	0.0	4.5	CIRCLE	4.085185	CIRCLE	2.0
30	31	10	11	30	8	30	8	20
0.0	0.0	5.5	4.5	0.0	0	0.0	0	2.5
11	0	20	21	40	10	40	10	30
7.5	CIRCLE	2.5	7.0	0.15625	7.647048	0.09375	2.272661	0.0
21	8	30	31	0	20	0	20	11
3.0	0	0.0	0.0	CIRCLE	4.914815	CIRCLE	3.426393	11.0
11	10	40	0	8	30	8	30	21
0.0	10.0	0.15625	LINE	0	0.0	0	0.0	2.5
0	20	0	8	10	40	10	40	31
LINE	6.5	CIRCLE	0	7.0	0.09375	8.5	0.15625	0.0
8	30	8	10	20	0	20	0	0
0	0.0	0	4.5	5.0	CIRCLE	4.0	LINE	ARC
10	40	10	20	30	8	30	8	8
5.0	0.15625	7.0	7.0	0.0	0	0.0	CENTER	CENTER
20	0	20	30	40	10	40	6	6
3.0	CIRCLE	2.5	0.0	0.09375	9.147048	0.09375	CENTER	CENTER
30	8	30	11	0	20	0	10	10
0.0	0	0.0	4.5	CIRCLE	4.085185	CIRCLE	0.5	7.0
11	10	40	21	8	30	8	20	20
5.0	8.5	0.15625	2.0	0	0.0	0	4.5	2.5
21	20	0	31	10	40	10	30	30
2.0	6.5	CIRCLE	0	6.352952	0.09375	2.272661	0.0	0.0
31	30	8	0	20	0	20	11	40
0.0	0.0	0	CIRCLE	4.914815	CIRCLE	5.573607	11.5	2.5
0	40	10	8	30	8	30	21	50
LINE	0.15625	8.5	0	0.0	0	0.0	4.5	53.130102
8	0	20	10	40	10	40	31	51
0	CIRCLE	2.5	4.0	0.09375	9.75	0.15625	0.0	126.869898
10	8	30	20	0	20	0	0	0
6.0	0	0.0	6.5	CIRCLE	4.334936	CIRCLE	LINE	ARC
20	10	40	30	8	30	8	8	8
3.0	7.0	0.15625	0.0	0	0.0	0	CENTER	CENTER
30	20	0	40	10	40	10	6	6

CENTER	CENTER	7.712255	4	0.0	0.0	DIMENSION	4.259068
10	10	26	15	13	11	8	35
8.5	6.854701	2.978261	1.167092	11.0	7.142173	0	0.0
20	20	36	25	23	21	6	40
6.5	2.248334	0.0	3.601367	7.0	4.148175	CENTER	0.193155
30	30	0	35	33	31	2	0
0.0	0.0	DIMENSION	0.0	0.0	0.0	*D7	ENDSEC
40	11	8	0	14	0	10	0
2.5	8.378173	0	DIMENSION	11.0	DIMENSION	9.936042	EOF
50	21	6	8	24	8	20	
233.130102	4.887066	CONTINUOUS	0	2.0	0	6.35744	
51	31	2	6	34	6	30	
306.869898	0.0	*D1	CONTINUOUS	0.0	CENTER	0.0	
0	0	10	2	50	2	11	
LINE	DIMENSION	7.0	*D3	90.0	*D6	11.190695	
8	8	20	10	0	10	21	
CENTER	0	2.5	4.25	DIMENSION	7.0	7.482295	
6	6	30	20	8	20	31	
CENTER	CENTER	0.0	4.5	0	5.0	0.0	
10	2	11	30	6	30	70	
2.0	*D0	6.515166	0.0	CONTINUOUS	0.0	3	
20	10	21	11	2	11	15	
6.5	11.0	3.652144	1.43005	*D5	6.784297	10.063958	
30	20	31	21	10	21	25	
0.0	2.5	0.0	5.270264	8.5	5.35087	6.64256	
11	30	70	31	20	31	35	
2.0	0.0	4	0.0	6.5	0.0	0.0	
21	11	15	70	30	70	40	
2.5	7.907255	6.030333	4	0.0	130	0.920373	
31	21	25	15	11	13	0	
0.0	3.068261	4.804288	2.6101	8.981931	6.352952	DIMENSION	
0	31	35	25	21	23	8	
ARC	0.0	0.0	6.040528	5.346638	4.914815	0	
8	70	0	35	31	33	6	
CENTER	130	DIMENSION	0.0	0.0	0.0	CENTER	
6	13	8	0	70	14	2	
CENTER	6.854701	0	DIMENSION	4	7.0	*D8	
10	23	6	8	15	24	10	
4.25	2.248334	CONTINUOUS	0	9.463861	2.5	9.694926	
20	33	2	6	25	34	20	
4.5	0.0	*D2	CONTINUOUS	4.193277	0.0	4.410805	
30	14	10	2	35	15	30	
0.0	8.378173	3.5	*D4	0.0	7.0	0.0	
40	24	20	10	0	25	11	
2.25	4.887066	4.5	11.23165	LINE	2.5	10.786033	
50	34	30	20	8	35	21	
117.266044	0.0	0.0	2.0	CENTER	0.0	1.940904	
51	15	11	30	6	16	31	
242.733956	2.0	2.333546	0.0	CENTER	6.626022	0.0	
0	25	21	11	10	26	70	
LINE	2.5	4.050683	11.23165	8.623897	5.23913	3	
8	35	11	21	20	36	15	
CENTER	0.0	0.0	4.5	6.714596	0.0	9.805074	
6	16	70	31	30	0	25	

DXF file for a complex part
after running program I

0	8	30	31	10	11	0	20	21	0
SECTION	0	0	0	5	10.5	LINE	1	3	POINT
2	10	11	0	20	21	8	30	31	8
ENTITIES	3.5	9.5	LINE	6	3	0	0	0	0
0	20	21	8	30	31	10	11	0	10
LINE	2	7	0	0	0	9	6.5	LINE	8.5
8	30	31	10	11	0	20	21	8	20
0	0	0	6.5	5	LINE	3	3	0	6.5
10	11	0	20	21	8	30	31	10	30
11	11	LINE	6	7	0	0	0	6	0
20	21	8	30	31	10	11	0	20	0
2	2	0	0	0	10.5	8	LINE	2	CIRCLE
30	31	10	11	0	20	21	8	30	8
0	0	8	6.5	LINE	3	3	0	0	0
11	0	20	21	8	30	31	10	11	10
11	LINE	6	7	0	0	0	7.5	6	7
21	8	30	31	10	11	0	20	21	20
7	0	0	0	6	9.5	LINE	2	3	6.5
31	10	11	0	20	21	8	10	31	30
0	10.5	8	LINE	6	3	0	0	0	0
LINE	7	7	0	0	31	10	11	0	40
8	30	31	10	11	0	9	7.5	CIRCLE	.15625
0	0	0	7.5	5	LINE	2	3	8	0
10	11	0	20	21	8	30	31	10	POINT
11	10.5	LINE	6	6	0	0	0	10	8
20	21	8	30	31	10	11	0	10	0
7	6	0	0	0	9.5	9	LINE	6.5	10
30	31	10	11	0	20	21	8	30	7
0	0	9	6.5	LINE	3	3	0	0	20
11	0	20	21	8	30	31	10	40	6.5
3.5	LINE	6	6	0	0	0	5	.15625	30
21	8	30	31	10	11	0	20	0	0
7	0	0	0	6	9.5	LINE	3	POINT	CIRCLE
31	10	11	0	20	21	8	30	8	8
0	10.5	8	LINE	7	2	0	0	0	0
ARC	6	6	0	0	31	10	11	10	10
8	30	31	10	11	0	6.5	5	10	5.5
0	0	0	7.5	6	LINE	3	21	20	20
10	11	0	20	21	8	30	31	6.5	6.5
3.5	9.5	LINE	7	6	0	0	0	30	30
20	21	8	30	31	10	11	0	0	0
4.5	6	0	0	0	8	6.5	LINE	0	40
30	31	10	11	0	20	21	8	CIRCLE	.15625
0	0	9	7.5	LINE	3	2	0	8	0
40	0	20	21	8	30	31	10	0	POINT
2.5	LINE	7	6	0	0	0	6	10	8
50	8	30	31	10	11	0	20	8.5	0
90	0	0	0	10.5	8	11	3	20	10
51	10	11	0	20	21	8	30	6.5	5.5
270	9.5	9	LINE	2	2	0	0	30	20
0	20	21	8	30	31	10	11	40	6.5
LINE	6	6	0	0	0	7.5	5	.15625	30

```

      8
0
      10
2.2726
      20
3.4263
      30
0
      0
ENDSEC
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EOF

```

IGES file for a sample part
before running program II

```

IGES file generated from an AutoCAD drawing by the IGES          S00000001
translator from Autodesk, Inc., translator version IGESOUT-3.01. S00000002
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	141P00000081
	143P00000082
	145P00000083
	145P00000084
	147P00000085

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149P00000087
149P00000088
151P00000089
153P00000090
155P00000091
157P00000092
159P00000093
T00000001

IGES file for a sample part
after running program II

```

IGES file generated from an AutoCAD drawing by the IGES          S00000001
translator from Autodesk, Inc., translator version IGESOUT-3.01. S00000002
,,10Ha:\3\tony9,14HA:\3\TONY9.IGS,15HAUTO-CAD-10 c10a,12HIGESOUT-3.01,32,G00000001
38,6,99,15,10Ha:\3\tony9,1.0,1,4HINCH,32767,1.2767D1,13H910622.155430, G00000002
1.0D-8,1.1838820390136D1,6HThroop,14HAutodesk, Inc.,4,0; G00000003
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    L10      1      1      1      1      D00000002
    L10      2      1      1      1      00000000D00000003
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    L10      4      1      1      1      00000000D00000007
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    L10      1      1      1      1      D00000022
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    L00     13      1      1      1      0      00000000D00000025
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    L00     14      1      1      1      0      00000000D00000027
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L10,3.0,5.0,0.0,2.0,5.0,0.0;          7P00000004
L10,2.0,5.0,0.0,2.0,6.0,0.0;          9P00000005
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S00000002G00000003D00000028P00000014 T00000001

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IGES file for a complex part
before running program II

```

IGES file generated from an AutoCAD drawing by the IGES      S00000001
translator from Autodesk, Inc., translator version IGESOUT-3.01. S00000002
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110      2      1      1      00000000D00000003
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100      3      1      1      00000000D00000005
100      1      1      1      D00000006
110      4      1      1      00000000D00000007
110      1      1      1      D00000008
110      5      1      1      00000000D00000009
110      1      1      1      D00000010
110      6      1      1      00000000D00000011
110      1      1      1      D00000012
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110      1      1      1      D00000014
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110      1      1      1      D00000020
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110      1      1      1      D00000022
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110      1      1      1      D00000026
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110      1      1      1      D00000036
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110			1			D0000048
110			1			00000000D0000049
110	25	1	1			D0000050
110			1			00000000D0000051
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110			1			00000000D0000055
110	28	1	1			D0000056
110			1			00000000D0000057
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100			1			00000000D0000059
100	30	1	1		0	D0000060
100			1			00000000D0000061
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IGES file for a complex part
after running program II

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IGES file generated from an AutoCAD drawing by the IGES          S00000001
translator from Autodesk, Inc., translator version IGESOUT-3.01. S00000002
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110			1			D0000054
110	28	1	1		00000000	D0000055
110			1			D0000056
100	29	1	1	0	00000000	D0000057
100			1			D0000058
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100			1			D0000060
100	31	1	1	0	00000000	D0000061
100			1			D0000062
100	32	1	1	0	00000000	D0000063
100			1			D0000064
100	33	1	1	0	00000000	D0000065
100			1			D0000066
100	34	1	1	0	00000000	D0000067
100			1			D0000068
100	35	1	1	0	00000000	D0000069
100			1			D0000070
100	36	1	1	0	00000000	D0000071
100			1			D0000072
110	37	1	1		00000000	D0000073
110			1			D0000074
110	38	1	1		00000000	D0000075
110			1			D0000076
100	39	1	1	0	00000000	D0000077
100			1			D0000078
100	40	1	1	0	00000000	D0000079
100			1			D0000080
100	41	1	1	0	00000000	D0000081
100			1			D0000082
100	42	1	1	0	00000000	D0000083
100			1			D0000084
100	43	1	1	0	00000000	D0000085
100			2			D0000086
100	45	1	1	0	00000000	D0000087
100			2			D0000088
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100			2			D0000090
100	49	1	1	0	00000000	D0000091
100			2			D0000092
100	51	1	1	0	00000000	D0000093
100			2			D0000094
100	53	1	1	0	00000000	D0000095

100			2			D0000096
100	55	1	1		0	00000000D0000097
100			2			D0000098
100	57	1	1		0	00000000D0000099
100			2			D0000100
100	59	1	1		0	00000000D0000101
100			1			D0000102
100	60	1	1		0	00000000D0000103
100			2			D0000104
100	62	1	1		0	00000000D0000105
100			2			D0000106
100	64	1	1		0	00000000D0000107
100			2			D0000108
100	66	1	1		0	00000000D0000109
100			2			D0000110
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100,0.0,3.5,4.5,3.5,7.0,3.5,2.0;						5P00000003
110,3.5,2.0,0.0,11.0,2.0,0.0;						7P00000004
110,1.05D1,7.0,0.0,1.05D1,6.0,0.0;						9P00000005
110,1.05D1,6.0,0.0,9.5,6.0,0.0;						11P00000006
110,9.5,6.0,0.0,9.5,7.0,0.0;						13P00000007
110,8.0,6.0,0.0,8.0,7.0,0.0;						15P00000008
110,9.0,6.0,0.0,8.0,6.0,0.0;						17P00000009
110,9.0,7.0,0.0,9.0,6.0,0.0;						19P00000010
110,6.5,6.0,0.0,6.5,7.0,0.0;						21P00000011
110,7.5,6.0,0.0,6.5,6.0,0.0;						23P00000012
110,7.5,7.0,0.0,7.5,6.0,0.0;						25P00000013
110,5.0,6.0,0.0,5.0,7.0,0.0;						27P00000014
110,6.0,6.0,0.0,5.0,6.0,0.0;						29P00000015
110,6.0,7.0,0.0,6.0,6.0,0.0;						31P00000016
110,1.05D1,2.0,0.0,1.05D1,3.0,0.0;						33P00000017
110,1.05D1,3.0,0.0,9.5,3.0,0.0;						35P00000018
110,9.5,3.0,0.0,9.5,2.0,0.0;						37P00000019
110,8.0,3.0,0.0,8.0,2.0,0.0;						39P00000020
110,9.0,3.0,0.0,8.0,3.0,0.0;						41P00000021
110,9.0,2.0,0.0,9.0,3.0,0.0;						43P00000022
110,6.5,3.0,0.0,6.5,2.0,0.0;						45P00000023
110,7.5,3.0,0.0,6.5,3.0,0.0;						47P00000024
110,7.5,2.0,0.0,7.5,3.0,0.0;						49P00000025
110,5.0,3.0,0.0,5.0,2.0,0.0;						51P00000026
110,6.0,3.0,0.0,5.0,3.0,0.0;						53P00000027
110,6.0,2.0,0.0,6.0,3.0,0.0;						55P00000028
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100,0.0,8.5,6.5,8.65625,6.5,8.65625,6.5;						59P00000030
100,0.0,7.0,6.5,7.15625,6.5,7.15625,6.5;						61P00000031
100,0.0,5.5,6.5,5.65625,6.5,5.65625,6.5;						63P00000032
100,0.0,5.5,2.5,5.65625,2.5,5.65625,2.5;						65P00000033
100,0.0,7.0,2.5,7.15625,2.5,7.15625,2.5;						67P00000034
100,0.0,8.5,2.5,8.65625,2.5,8.65625,2.5;						69P00000035

100,0.0,10.0,2.5,1.015625D1,2.5,1.015625D1,2.5;	71P0000036
110,4.5,7.0,0.0,4.5,7.0,0.0;	73P0000037
110,4.5,7.0,0.0,4.5,2.0,0.0;	75P0000038
100,0.0,4.0,6.5,4.15625,6.5,4.15625,6.5;	77P0000039
100,0.0,4.0,2.5,4.15625,2.5,4.15625,2.5;	79P0000040
100,0.0,2.0,4.5,2.15625,4.5,2.15625,4.5;	81P0000041
100,0.0,7.0,5.0,7.09375,5.0,7.09375,5.0;	83P0000042
100,0.0,6.3529523872437D0,4.9148145657227D0,6.4467023872437D0,	85P0000043
4.9148145657227D0,6.4467023872437D0,4.9148145657227D0;	85P0000044
100,0.0,5.75,4.6650635094611D0,5.84375,4.6650635094611D0,	87P0000045
5.84375,4.6650635094611D0;	87P0000046
100,0.0,8.25,4.6650635094611D0,8.34375,4.6650635094611D0,	89P0000047
8.34375,4.6650635094611D0;	89P0000048
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4.9148145657227D0,7.7407976127563D0,4.9148145657227D0;	91P0000050
100,0.0,9.1470476127563D0,4.0851854342773D0,9.2407976127563D0,	93P0000051
4.0851854342773D0,9.2407976127563D0,4.0851854342773D0;	93P0000052
100,0.0,9.75,4.3349364905389D0,9.84375,4.3349364905389D0,	95P0000053
9.84375,4.3349364905389D0;	95P0000054
100,0.0,7.25,4.3349364905389D0,7.34375,4.3349364905389D0,	97P0000055
7.34375,4.3349364905389D0;	97P0000056
100,0.0,7.8529523872437D0,4.0851854342773D0,7.9467023872437D0,	99P0000057
4.0851854342773D0,7.9467023872437D0,4.0851854342773D0;	99P0000058
100,0.0,8.5,4.0,8.59375,4.0,8.59375,4.0;	101P0000059
100,0.0,2.2726614965106D0,5.5736072105841D0,2.4289114965106D0,	103P0000060
5.5736072105841D0,2.4289114965106D0,5.5736072105841D0;	103P0000061
100,0.0,3.0245621712162D0,6.3870087778772D0,3.1808121712162D0,	105P0000062
6.3870087778772D0,3.1808121712162D0,6.3870087778772D0;	105P0000063
100,0.0,3.0245621712162D0,2.6129912221228D0,3.1808121712162D0,	107P0000064
2.6129912221228D0,3.1808121712162D0,2.6129912221228D0;	107P0000065
100,0.0,2.2726614965106D0,3.4263927894159D0,2.4289114965106D0,	109P0000066
3.4263927894159D0,2.4289114965106D0,3.4263927894159D0;	109P0000067
S0000002G0000003D00000110P0000067	T0000001

APPENDIX B

NC Codes

NC codes for the sample part (3-APR-91)

N2G0G17G20G40G49G80G90G98
N3G54X0Y0
N4G0G90X0Y0
N1T1M6
N6X-0.125Y0S2000M3
N7G43Z1.0H1M7
/N8G4F15
N9Z0.05
N10G1Y0.1Z-0.1F2.0
N11Y0F5.0
N12Y0.375
N13G2X0Y0.5I0.125J0
N14G1X0.125
N15Y0.625
N16X0
N17G2X-0.125Y0.75I0J0.125
N18G1Y1.0
N19G2X0.5Y1.625I0.625J0
N20G1X1.125
N21G2X1.625Y1.125I0J-0.5
N22G1Y0.375
N23G2X1.5884Y0.2866I-0.125J0
N24G1X1.2134Y-0.0884
N25G2X1.125Y-0.125I-0.0884J0.0884
N26G1X0
N27G2X-0.125Y0I0J0.125
N28G0Z1.0
N29G0G54G40G90X0.5Y0.375
N30Z0.05
N31G81X0.5Y0.375Z-0.1R0.05F2.0
N32G80
N33G0Z1.0
N34G40X0.5Y1.0
N35Z0.05
N36G81X0.5Y1.0Z-0.1R0.05F2.0
N37G80
N38G0Z1.0
N39G40X1.125Y1.0
N40Z0.05
N41G81X1.125Y1.0Z-0.1R0.05F2.0
N42G80
N43G0Z1.0
N44G40M9
N45G00Z0H0
N46G90X0Y0
N47G0G40G49G80G90
N48M30
%

NC codes for the complex part (30-APR-91)

N2G0G17G20G40G49G80G90G98
N3G54X0Y0
N4G0G90X0Y0
N1T1M6
N6X5.5Y0.75S2000M3
N7G43Z1.0H1M7
/N8G4F15
N9Z0.05
N10G1X5.45Z-0.15F2.0
N11X5.5F10.0
N12X1.75
N13G2X1.75Y3.75I0J1.5
N14G1X5.5
N15G2X5.75Y3.5I0J-0.25
N16G1Y1.0
N17G2X5.5Y0.75I-0.25J0
N18G0Z1.0
N19G0G54G40G90X1.375Y2.25
N20Z0.05
N21G1X1.3814Y2.2996Z-0.1F2.0
N22X1.375Y2.25F10.0
N23X1.4Y2.4436
N24G3X1.4Y2.0564I0.35J-0.1936
N25G1Y2.4436
N26X1.7Y2.9482
N27G3X1.7Y1.5518I0.05J-0.6982
N28G1Y2.9482
N29X2.0Y3.25
N30X1.75
N31G3X1.75Y1.25I0J-1.0
N32G1X2.0
N33Y3.25
N34G0Z1.0
N35G40M9
N36G00H0Z0M9
N37G0G54G40G90X0Y0
N2T2M6
N39X2.875Y2.3325S1500M3
N40G43Z1.0H2M7
/N41G4P15
N42Z0.05
N43G83X2.875Y2.3325Z-0.15Q0.05R0.05F2.0
N44G80
N45G0Z1.0
N46G40X3.1765Y2.4574
N47Z0.05
N48G83X3.1765Y2.4574Z-0.15Q0.05R0.05F2.0
N49G80
N50G0Z1.0
N51G40X3.5Y2.5

N52Z0.05
N53G83X3.5Y2.5Z-0.15Q0.05R0.05F2.0
N54G80
N55G0Z1.0
N56G40X3.8235Y2.4574
N57Z0.05
N58G83X3.8235Y2.4574Z-0.15Q0.05R0.05F2.0
N59G80
N60G0Z1.0
N61G40X4.125Y2.3325
N62Z0.05
N63G83X4.125Y2.3325Z-0.15Q0.05R0.05F2.0
N64G80
N65G0Z1.0
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N67Z0.05
N68G83X3.625Y2.1675Z-0.15Q0.05R0.05F2.0
N69G80
N70G0Z1.0
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N72Z0.05
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N74G80
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N82Z0.05
N83G83X4.5735Y2.0426Z-0.15Q0.05R0.05F2.0
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N87Z0.05
N88G83X4.875Y2.1675Z-0.15Q0.05R0.05F2.0
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N92G00H0Z0M9
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N3T3M6
N95X5.0625Y1.0S2000M3
N96G43Z1.0H3M7
/N97G4P15
N98Z0.05
N99G1Y1.05Z-0.1F2.0
N100Y1.0F10.0
N101Y1.3125
N102X4.9375
N103Y1.0

N104G2X4.75Y0.8125I-0.1875J0
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N106G2X4.3125Y1.0I0J0.1875
N107G1Y1.3125
N108X4.1875
N109Y1.0
N110G2X4.0Y0.8125I-0.1875J0
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N112G2X3.5625Y1.0I0J0.1875
N113G1Y1.3125
N114X3.4375
N115Y1.0
N116G2X3.25Y0.8125I-0.1875J0
N117G1X3.0
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N120X2.6875
N121Y1.0
N122G2X2.5Y0.8125I-0.1875J0
N123G1X2.25
N124G2X2.0625Y1.0I0J0.1875
N125G1Y3.5
N126G2X2.25Y3.6875I0.1875J0
N127G1X2.5
N128G2X2.6875Y3.5I0J-0.1875
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N130X2.8125
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N132G2X3.0Y3.6875I0.1875J0
N133G1X3.25
N134G2X3.4375Y3.5I0J-0.1875
N135G1Y3.1875
N136X3.5625
N137Y3.5
N138G2X3.75Y3.6875I0.1875J0
N139G1X4.0
N140G2X4.1875Y3.5I0J-0.1875
N141G1Y3.1875
N142X4.3125
N143Y3.5
N144G2X4.5Y3.6875I0.1875J0
N145G1X4.75
N146G2X4.9375Y3.5I0J-0.1875
N147G1Y3.1875
N148X5.0625
N149Y3.5
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N151G40M9
N152G00H0Z0M9
N153G0G54G40G90X0Y0
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N163Z0.05
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N169G81X1.1363Y2.7868Z-0.15R0.05F2.0
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N189G81X2.0Y1.25Z-0.15R0.05F2.0
N190G80
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N193Z0.05
N194G81X2.75Y1.25Z-0.15R0.05F2.0
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N197G40X3.5Y1.25
N198Z0.05
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N200G80
N201G0Z1.0
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N203Z0.05
N204G81X4.25Y1.25Z-0.15R0.05F2.0
N205G80
N206G0Z1.0
N207G40X5.0Y1.25

N208Z0.05
N209G81X5.0Y1.25Z-0.15R0.05F2.0
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N212G40X5.0Y3.25
N213Z0.05
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N215G80
N216G0Z1.0
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N218Z0.05
N219G81X4.25Y3.25Z-0.15R0.05F2.0
N220G80
N221G0Z1.0
N222G40X3.5Y3.25
N223Z0.05
N224G81X3.5Y3.25Z-0.15R0.05F2.0
N225G80
N226G0Z1.0
N227G40X2.75Y3.25
N228Z0.05
N229G81X2.75Y3.25Z-0.15R0.05F2.0
N230G80
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N232G40M9
N233G00Z0H0
N234G90X0Y0
N235G0G40G49G80G90
N236M30
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NC codes for the company part (20-AUG-91)

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N7G43Z0.5H2M7
/N8G4F15
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N10G83X5.5252Y5.6873Z-0.5Q0.167R0.05F5.0
N11G80
N12G0Z0.5
N13G40X6.7752Y6.2186
N14Z0.05
N15G83X6.7752Y6.2186Z-0.5Q0.167R0.05F5.0
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N41G3X6.0252Y5.6861I0J-0.0012
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N45Z-0.105
N46G1Y5.6861Z-0.31F5.0
N47Y5.6873
N48Y5.6861
N49G3X7.5252Y5.6886I0J0.0012
N50G1X6.0252
N51G3X6.0252Y5.6861I0J-0.0012

N52G1X7.5252
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N54G0G54G40G90X4.9952Y5.0444
N55Z0.05
N56G1Y5.1444Z-0.25F5.0
N57Y5.0444
N58Y6.3303
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N60G1X6.7616Y6.6268
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N63G2X8.5552Y6.3303I-0.0135J-0.1544
N64G1Y5.0444
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N67G2X6.7616Y4.7478I-0.0135J0.1544
N68G1X5.1366Y4.89
N69G2X4.9952Y5.0444I0.0135J0.1544
N70G0Z0.5
N71G40M9
N72G00Z0H0
N73G90X0Y0
N74G0G40G49G80G90
N75M30
%

APPENDIX C

File Translator Programs I and II

CAD/CAM File Translator Program I
User Instructions
(for DXF file translation)

- (1) Load CAD/CAM program I into BASIC system.
- (2) Run program I.
- (3) When prompted, enter name of AutoCAD DXF file to be Transferred, and name of new DXF file which will be created.
- (4) Answer questions regarding AutoCAD layers as prompted.
- (5) Final output is a new DXF file which can be import into EZ-MILL for tool path programming and part production.

```

10 REM PROGRAM I
20 REM *****
30 REM ** This program is to translate an original DXF file which is **
   ** generated from AutoCAD system into a new DXF file which is **
   ** used to EZ-CAM system for the necessity of automated machining. **
40 REM *****
50 REM
60 REM Defining lengths of array variables
70 REM
80 DIM FLAG(50),PFLAG(50),FLAG1(50),V(50),PV(50),P(50),P$(50),PP(50),X(50),
   XS(50),XX(50),Y(50),YS(50),YY(50),LAYN$(50),LINTP$(50),LAY$(50)
90 CLOSE #1,#2:CLS:KEY OFF:WIDTH 40
100 REM
110 REM Initializing array variables
120 REM
130 FOR Q=1 TO 50:PFLAG(Q)=0:PV(Q)=0:P(Q)=0:P$(Q)="":PP(Q)=0 : NEXT Q
140 SCREEN 0,1 : COLOR 12,0,0
150 LOCATE 8,2
160 REM
170 REM Reading input DXF file and writing output DXF file
180 REM
190 LINE INPUT "Input DXF file name: ";INFILES$
200 LINE INPUT "Output DXF file name: ";OUTFILES$
210 IF OUTFILES$=INFILES$ OR OUTFILES$="" THEN PRINT "":PRINT "*** Choose the
   different file name from the input file name. ***" : PRINT "":GOTO 200
220 IF OUTFILES$=TEMPOUT$ THEN PRINT "":PRINT "Do you wish to use the same output
   file name as before?(Y/N)" ELSE GOTO 260
230 ANS2$=INKEY$:IF ANS2$="" GOTO 230
240 IF ANS2$="N" OR ANS2$="n" THEN PRINT "":GOTO 200
250 IF ANS2$="Y" OR ANS2$="y" THEN GOTO 260 ELSE GOTO 220
260 OPEN "I" , #1,INFILES$+".DXF"
270 OPEN "O" , #2,OUTFILES$+".DXF"
280 I=1
290 INPUT #1, INFOR$:IF INFOR$="ENTITIES" THEN I=I+1:GOTO 370
300 IF INFOR$<>"LAYER" THEN GOTO 290
310 INPUT #1,INFOR1$:INPUT #1,INFOR2$:IF INFOR1$<>"2" THEN GOTO 290
320 LAYN$(I)=INFOR2$
330 INPUT #1,TEMP1$:INPUT #1,TEMP2$
340 IF TEMP1$="6" THEN GOTO 350 ELSEIF TEMP1$="0" THEN GOTO 360 ELSE GOTO 330
350 LINTP$(I)=TEMP2$
360 I=I+1:GOTO 290
370 CLS:COLOR 10:WIDTH 80:LOCATE 8
380 REM
390 REM Listing all layer information for user selection
400 REM
410 PRINT "*****"
420 PRINT"*";:COLOR 13:PRINT" LAYERnumber LAYERname LINetype
   ";;:COLOR 10:PRINT TAB(65);"*"
430 FOR J=1 TO I:PRINT "":;:COLOR 15:PRINT TAB(9);J;;:COLOR 10:PRINT TAB(23);
   LAYN$(J);:PRINT TAB(42);LINTP$(J);:PRINT TAB(55);"LINE";:PRINT TAB(65);"":
   NEXT J
440 PRINT "*****"
450 COLOR 12
460 REM
470 REM Choosing layers which users need for generating DXF file of geometry
480 REM
490 INPUT "How many layers do you want";NUM
500 FOR K=1 TO NUM
510 PRINT ""
520 PRINT "Enter the LAYERnumber of the No. ";K;:LINE INPUT "layer which you
   want:";NO$:NO=VAL(NO$):LAY$(K)=LAYN$(NO)
530 NEXT K
540 PRINT ""
550 PRINT "Are you sure your choices(Y/N)"
560 ANS$=INKEY$:IF ANS$="" GOTO 560
570 IF ANS$="N" OR ANS$="n" GOTO 370

```

```

580 IF ANS$="Y" OR ANS$="y" THEN GOSUB 870 ELSE GOTO 550
590 POLYLINE=0:VERTEX=0
600 INPUT #1,CH$
610 IF CH$="LINE" THEN G=12:GOSUB 5000:GOTO 600
620 IF CH$="CIRCLE" THEN G=8:GOSUB 5000:GOTO 600
630 IF CH$="ARC" THEN G=12:GOSUB 5000:GOTO 600
640 IF CH$="POINT" THEN G=6:GOSUB 5000:GOTO 600
650 IF CH$="INSERT" THEN G=6:GOSUB 5130:GOTO 590
660 IF CH$="SHAPE" THEN G=6:GOSUB 5130:GOTO 590
670 IF CH$="SOLID" THEN G=24:GOSUB 5130:GOTO 590
680 IF CH$="TRACE" THEN G=24:GOSUB 5130:GOTO 590
690 IF CH$="POLYLINE" THEN GOSUB 9000:GOTO 600
700 IF CH$="VERTEX" THEN G=6:GOSUB 5000:POLYLINE=0:GOTO 600
710 IF CH$="SEQEND" AND VERTEX=1 THEN G=0:GOSUB 5000:VERTEX=0:GOTO 600
720 IF CH$="EOF" THEN GOSUB 5530:CLS:WIDTH 40:LOCATE 8,2:PRINT "File
transferring is finished":COLOR 10:GOTO 770
730 GOTO 600
740 REM
750 REM Asking users for transferring another DXF file
760 REM
770 LOCATE 10,1:PRINT "Transferring another DXF files?(Y/N)"
780 ANS1$=INKEY$:IF ANS1$="" GOTO 780
790 IF ANS1$="Y" OR ANS1$="y" THEN TEMPOUT$=OUTFILE$:GOTO 90
800 IF ANS1$="N" OR ANS1$="n" THEN GOTO 810 ELSE GOTO 770
810 WIDTH 80
820 REM
830 REM Closing input and output files
840 REM
850 CLOSE #1,#2
860 END
870 REM
880 REM Print start section
890 REM
900 PRINT #2,USING "###";0
910 PRINT #2, "SECTION"
920 PRINT #2,USING "###";2
930 PRINT #2, "ENTITIES"
940 RETURN
5000 REM
5010 REM Getting Entity Information
5020 REM
5030 INPUT #1,L
5040 INPUT #1,L$
5050 FOR N1=1 TO NUM
5060 IF L$=LAY$(N1) THEN GOTO 5090
5070 NEXT N1
5080 GOTO 5520
5090 II=1
5100 INPUT #1,X(II)
5110 IF X(II)=0 THEN II=II-1:GOTO 5190
5120 IF X(II)<10 OR X(II)=999 THEN LINE INPUT #1,X$(II) ELSE 5140
5130 IF X(II)=6 AND X$(II)<>"CONTINUOUS" THEN RETURN ELSE FLAG(II)=1:GOTO 5180
5140 IF X(II)>=38 AND X(II)<=49 THEN INPUT #1,XX(II):FLAG(II)=2:GOTO 5180
5150 IF X(II)>=50 AND X(II)<=59 THEN INPUT #1,XX(II):FLAG(II)=2:GOTO 5180
5160 IF X(II)>=60 AND X(II)<=79 THEN INPUT #1,XX(II):FLAG(II)=3:GOTO 5180
5170 V(1)=X(II):II=II-1:GOTO 5190
5180 II=II+1:GOTO 5100
5190 IF POLYLINE=1 THEN GOSUB 9310
5200 PRINT #2,USING "###";0:PRINT #2,CH$
5210 PRINT #2,USING "###";L:PRINT #2,L$
5220 IF X(II+1)=0 AND X(II)=0 THEN RETURN
5230 FOR JJ=1 TO II
5240 PRINT #2, USING "###";X(JJ)
5250 ON FLAG(JJ) GOTO 5260,5270,5280
5260 PRINT #2,X$(JJ):GOTO 5290
5270 WRITE #2,XX(JJ):GOTO 5290

```

```

5280 PRINT #2,USING "#####";XX(JJ)
5290 NEXT JJ
5300 IF X(II+1)=0 THEN RETURN
5310 FOR Q=2 TO G:INPUT #1,V(Q):NEXT Q
5320 FOR Q=1 TO G
5330 IF (Q\2)*2<>Q THEN PRINT #2,USING "###";V(Q) ELSE WRITE #2,V(Q)
5340 NEXT Q
5350 KK=1
5360 INPUT #1,Y(KK)
5370 IF Y(KK)=0 THEN KK=KK-1:GOTO 5430
5380 IF Y(KK)>=60 AND Y(KK)<=79 THEN INPUT #1,YY(KK):FLAG1(KK)=3:GOTO 5420
5390 IF Y(KK)>=38 AND Y(KK)<=49 THEN INPUT #1,YY(KK):FLAG1(KK)=2:GOTO 5420
5400 IF Y(KK)>=50 AND Y(KK)<=59 THEN INPUT #1,YY(KK):FLAG1(KK)=2:GOTO 5420
5410 IF Y(KK)<10 THEN INPUT #1,Y$(KK):FLAG1(KK)=1:GOTO 5420
5420 KK=KK+1:GOTO 5360
5430 FOR JJ1=1 TO KK
5440 PRINT #2, USING "###";Y(JJ1)
5450 ON FLAG1(JJ1) GOTO 5460,5470,5480
5460 PRINT #2,Y$(JJ1):GOTO 5490
5470 WRITE #2,YY(JJ1):GOTO 5490
5480 PRINT #2,USING "#####";YY(JJ1)
5490 NEXT JJ1
5500 IF CH$="CIRCLE" THEN GOSUB 5610
5510 IF CH$="VERTEX" THEN VERTEX=1
5520 RETURN
5530 REM
5540 REM Print end section
5550 REM
5560 PRINT #2,USING "###";0
5570 PRINT #2, "ENDSEC"
5580 PRINT #2,USING "###";0
5590 PRINT #2, "EOF"
5600 RETURN
5610 REM
5620 REM Printing a center point of a circle
5630 REM
5640 PRINT #2,USING "###";0:PRINT #2,"POINT"
5650 PRINT #2,USING "###";L:PRINT #2,L$
5660 FOR JJ=1 TO II
5670 PRINT #2, USING "###";X(JJ)
5680 ON FLAG(JJ) GOTO 5690,5700,5710
5690 PRINT #2,X$(JJ):GOTO 5720
5700 WRITE #2,XX(JJ):GOTO 5720
5710 PRINT #2,USING "#####";XX(JJ)
5720 NEXT JJ
5730 FOR Q=1 TO 6
5740 IF (Q\2)*2<>Q THEN PRINT #2,USING "###";V(Q) ELSE WRITE #2,V(Q)
5750 NEXT Q
5760 RETURN
9000 REM
9010 REM Reserving POLYLINE Entity Information
9020 REM
9030 INPUT #1,P
9040 INPUT #1,P$
9050 FOR N1=1 TO NUM
9060 IF P$=LAY$(N1) THEN GOTO 9090
9070 NEXT N1
9080 GOTO 9290
9090 PII=1
9100 INPUT #1,P(PII)
9110 IF P(PII)=0 THEN PII=PII-1:GOTO 9190
9120 IF P(PII)<10 OR P(PII)=999 THEN LINE INPUT #1,P$(PII) ELSE 9140
9130 IF P(PII)=6 AND P$(PII)<>"CONTINUOUS" THEN 9140 ELSE PFLAG(PII)=1:
GOTO 9180
9140 IF P(PII)>=38 AND P(PII)<=49 THEN INPUT #1,PP(PII):PFLAG(PII)=2:GOTO 9180
9150 IF P(PII)>=50 AND P(PII)<=59 THEN INPUT #1,PP(PII):PFLAG(PII)=2:GOTO 9180

```



```

9160 IF P(PII)>=60 AND P(PII)<=79 THEN INPUT #1,PP(PII):PFLAG(PII)=3:GOTO 9180
9170 PV(1)=P(PII):PII=PII-1:GOTO 9190
9180 PII=PII+1:GOTO 9100
9190 IF P(PII+1)=0 THEN RETURN
9200 FOR Q=2 TO 6:INPUT #1,PV(Q):NEXT Q
9210 KK=1
9220 INPUT #1,Y(KK)
9230 IF Y(KK)=0 THEN KK=KK-1:GOTO 9290
9240 IF Y(KK)>=60 AND Y(KK)<=79 THEN INPUT #1,YY(KK):FLAG1(KK)=3:GOTO 9280
9250 IF Y(KK)>=38 AND Y(KK)<=49 THEN INPUT #1,YY(KK):FLAG1(KK)=2:GOTO 9280
9260 IF Y(KK)>=50 AND Y(KK)<=59 THEN INPUT #1,YY(KK):FLAG1(KK)=2:GOTO 9280
9270 IF Y(KK)<10 THEN INPUT #1,Y$(KK):FLAG1(KK)=1:GOTO 9280
9280 KK=KK+1:GOTO 9220
9290 POLYLINE=1
9300 RETURN
9310 REM
9320 REM Printing POLYLINE Entity Information
9330 REM
9340 PRINT #2,USING "###";0:PRINT #2,"POLYLINE"
9350 PRINT #2,USING "###";P:PRINT #2,P$
9360 FOR JJ=1 TO PII
9370 PRINT #2,USING "###";P(JJ)
9380 ON PFLAG(JJ) GOTO 9390,9400,9410
9390 PRINT #2,P$(JJ):GOTO 9420
9400 WRITE #2,PP(JJ):GOTO 9420
9410 PRINT #2,USING "#####";PP(JJ)
9420 NEXT JJ
9430 FOR Q=1 TO 6
9440 IF (Q\2)*2<>Q THEN PRINT #2,USING "###";PV(Q) ELSE WRITE #2,PV(Q)
9450 NEXT Q
9460 FOR JJ1=1 TO KK
9470 PRINT #2,USING "###";Y(JJ1)
9480 ON FLAG1(JJ1) GOTO 9490,9500,9510
9490 PRINT #2,Y$(JJ1):GOTO 9520
9500 WRITE #2,YY(JJ1):GOTO 9520
9510 PRINT #2,USING "#####";YY(JJ1)
9520 NEXT JJ1
9530 RETURN

```

CAD/CAM File Translator Program II
User Instructions
(for IGES file translation)

- (1) Load CAD/CAM program II into BASIC system.
- (2) Run program II.
- (3) When prompted, enter name of AutoCAD IGES file to be Transferred, and name of new IGES file which will be created.
- (4) Answer questions regarding AutoCAD layers and linetypes as prompted.
- (5) Final output is a new IGES file which can be import into EZ-MILL for tool path programming and part production.

```

10 REM PROGRAM II
20 REM *****
30 REM ** This program is to translate an original IGES file which is **
   ** generated from AutoCAD system into a new IGES file which is **
   ** used to EZ-CAM system for the necessity of automated machining. **
40 REM *****
50 REM
60 REM Defining lengths of array variables
70 REM
80 DIM SS(30),GS(30),DS(2500),PS(2500),DES(2500),DE(2500),PTR(2500),LEVEL(30),
   LAY(30),LTYPE$(10),LTYPE(10)
90 CLOSE #1,#2:CLS:KEY OFF:WIDTH 40
100 REM
110 REM Initializing array variables
120 REM
130 FOR Q=1 TO 10
140 LTYPE$(Q)="" : LTYPE(Q)=0
150 NEXT Q
160 FOR Q=1 TO 30
170 SS(Q)="" : GS(Q)="" : LEVEL(Q)=0 : LAY(Q)=0
180 NEXT Q
190 FOR Q=1 TO 2500
200 DS(Q)="" : PS(Q)="" : DES(Q)="" : DE(Q)=0 : PTR(Q)=0
210 NEXT Q
220 SCREEN 0,1:COLOR 12,0,0
230 LOCATE 7,2
240 REM
250 REM Reading input IGES file and writing output IGES file
260 REM
270 PRINT "":LINE INPUT "Input IGES file name: ";INFILE$
280 LINE INPUT "Output IGES file name: ";OUTFILE$
290 IF INFILE$="" THEN 270
300 IF OUTFILE$=INFILE$ OR OUTFILE$="" THEN PRINT "":PRINT "**** Choose the
   different file name from the INPUT file name. ****":PRINT "":GOTO 280
310 IF OUTFILE$=TEMPOUT$ THEN PRINT "":PRINT "Do you wish to use the same OUTPUT
   file name as before?(Y/N)" ELSE 350
320 ANS2$=INKEY$:IF ANS2$="" THEN 320
330 IF ANS2$="N" OR ANS2$="n" THEN PRINT"":GOTO 280
340 IF ANS2$="Y" OR ANS2$="y" THEN 350 ELSE 300
350 OPEN "I" ,#1,INFILE$+".IGS"
360 OPEN "O" ,#2,OUTFILE$+".IGS"
370 GOSUB 8000
380 GOSUB 9000
390 OPEN "I" ,#1,INFILE$+".IGS"
400 I1=1:I2=1:I3=1:I4=1
410 REM
420 REM Start Section information
430 REM
440 SS(I1)=INPUT$(82,#1)
450 CH1$=MID$(SS(I1),73,1)
460 IF CH1$<>"S" THEN GS(I2)=SS(I1):GOTO 560
470 PRINT #2,LEFT$(SS(I1),73);
480 IF I1>=100 THEN PRINT #2,"0000":PRINT #2,USING "###";I1:GOTO 510
490 IF I1>=10 THEN PRINT #2,"00000":PRINT #2,USING "###";I1:GOTO 510
500 PRINT #2,"0000000":PRINT #2,USING "#";I1;
510 PRINT #2,RIGHT$(SS(I1),2);:SS(I1)=""
520 I1=I1+1:GOTO 440
530 REM
540 REM Global Section information
550 REM
560 IF CH1$<>"G" THEN DS(I3)=GS(I2):GOTO 690
570 PRINT #2,LEFT$(GS(I2),73);
580 IF I2>=100 THEN PRINT #2,"0000":PRINT #2,USING "###";I2:GOTO 610
590 IF I2>=10 THEN PRINT #2,"00000":PRINT #2,USING "###";I2:GOTO 610
600 PRINT #2,"0000000":PRINT #2,USING "#";I2;
610 PRINT #2,RIGHT$(GS(I2),2);:GS(I2)=""

```

```

620 I2=I2+1
630 G$(I2)=INPUT$(82,#1)
640 CH1$=MID$(G$(I2),73,1)
650 GOTO 560
660 REM
670 REM Directory Entry(DE) Section information
680 REM
690 K=1
700 TEMP1=1:TEMP2=0
710 IF CH1$<>"D" THEN P$(I4)=D$(I3):GOTO 1330
720 FLAG=1
730 FOR J=1 TO 8
740 J1=(J-1)*8+1
750 D$(J)=MID$(D$(I3),J1,8)
760 DE(J)=VAL(D$(J))
770 NEXT J
780 DE(10)=VAL(MID$(D$(I3),74,7))
790 IF DE(1)>200 THEN FLAG=0:PTR(K)=DE(10):K=K+1:GOTO 1050
800 IF DE(1)=106 THEN 1040
810 FOR N1=1 TO NUM
820 IF DE(5)=LAY(N1) THEN 850
830 NEXT N1
840 FLAG=0:PTR(K)=DE(10):K=K+1:GOTO 1050
850 IF LINETYPES="ALL" THEN 900
860 FOR N2=1 TO NUM1
870 IF DE(4)=LTYPE(N2) THEN 900
880 NEXT N2
890 FLAG=0:PTR(K)=DE(10):K=K+1:GOTO 1050
900 DE(2)=TEMP1+TEMP2
910 REM
920 REM Print the first line for DE section
930 REM
940 PRINT #2,LEFT$(D$(I3),8);
950 PRINT #2,USING "#####";DE(2);
960 PRINT #2,MID$(D$(I3),17,57);
970 IF I3>=1000 THEN PRINT #2,"000";:PRINT #2,USING "####";I3;:GOTO 1010
980 IF I3>=100 THEN PRINT #2,"0000";:PRINT #2,USING "####";I3;:GOTO 1010
990 IF I3>=10 THEN PRINT #2,"00000";:PRINT #2,USING "###";I3;:GOTO 1010
1000 PRINT #2,"000000";:PRINT #2,USING "#";I3;
1010 PRINT #2,RIGHT$(D$(I3),2);:D$(I3)="
1020 TEMP1=DE(2)
1030 IF DE(1)=106 THEN I3=I3-1:GOTO 1190
1040 I3=I3+1
1050 D$(I3)=INPUT$(82,#1)
1060 IF FLAG=0 THEN 1270
1070 FOR J=14 TO 15
1080 J2=(J-11)*8+1
1090 D$(J)=MID$(D$(I3),J2,8)
1100 DE(J)=VAL(D$(J))
1110 NEXT J
1120 IF DE(1)<>106 THEN 1190
1130 IF DE(15)>=20 AND DE(15)<=63 THEN 1140 ELSE I3=I3-1:GOTO 810
1140 FLAG=0:PTR(K)=DE(10):K=K+1
1150 I3=I3-1:GOTO 1270
1160 REM
1170 REM Print the second line for the DE section
1180 REM
1190 PRINT #2,LEFT$(D$(I3),73);
1200 IF I3>=1000 THEN PRINT #2,"000";:PRINT #2,USING "####";I3;:GOTO 1240
1210 IF I3>=100 THEN PRINT #2,"0000";:PRINT #2,USING "####";I3;:GOTO 1240
1220 IF I3>=10 THEN PRINT #2,"00000";:PRINT #2,USING "###";I3;:GOTO 1240
1230 PRINT #2,"000000";:PRINT #2,USING "#";I3;
1240 PRINT #2,RIGHT$(D$(I3),2);:D$(I3)="
1250 TEMP2=DE(14)
1260 I3=I3+1
1270 D$(I3)=INPUT$(82,#1)

```

```

1280 CH1$=MID$(DS(I3),73,1)
1290 GOTO 710
1300 REM
1310 REM Parameter Data(PD) Section information
1320 REM
1330 INDEX=1:TEMP3=0
1340 IF CH1$<>"P" THEN 1680
1350 PD1$=LEFT$(P$(I4),3)
1360 PD1=VAL(PD1$)
1370 PD2$=MID$(P$(I4),66,7)
1380 PD2=VAL(PD2$)
1390 REM
1400 REM Checking if the number is the same as one of those pointers which were
      erased in DE section
1410 REM
1420 FOR L=1 TO K-1
1430 IF PD2=PTR(L) THEN INDEX=INDEX-2:GOTO 1590
1440 NEXT L
1450 IF PD2<>TEMP3 THEN 1500
1460 INDEX=INDEX-2
1470 REM
1480 REM Print the parameter data line
1490 REM
1500 PRINT #2,LEFT$(P$(I4),65);
1510 PRINT #2,USING "#####";INDEX;
1520 PRINT #2,CH1$;
1530 IF I4>=1000 THEN PRINT #2,"000";:PRINT #2,USING "####";I4;:GOTO 1570
1540 IF I4>=100 THEN PRINT #2,"0000";:PRINT #2,USING "####";I4;:GOTO 1570
1550 IF I4>=10 THEN PRINT #2,"00000";:PRINT #2,USING "###";I4;:GOTO 1570
1560 PRINT #2,"000000";:PRINT #2,USING "#";I4;
1570 PRINT #2,RIGHT$(P$(I4),2);:P$(I4)=" "
1580 I4=I4+1
1590 TEMP3=PD2
1600 INDEX=INDEX+2
1610 P$(I4)=INPUT$(82,#1)
1620 CH1$=MID$(P$(I4),73,1)
1630 GOTO 1340
1640 REM
1650 REM Terminate Section information
1660 REM
1670 IF (I1-1)>=1000 THEN PRINT #2,"S000";:PRINT #2,USING "####";I1-1;:
      GOTO 1710
1680 IF (I1-1)>=100 THEN PRINT #2,"S0000";:PRINT #2,USING "####";I1-1;:GOTO 1710
1690 IF (I1-1)>=10 THEN PRINT #2,"S00000";:PRINT #2,USING "##";I1-1;:GOTO 1710
1700 PRINT #2,"S000000";:PRINT #2,USING "#";I1-1;
1710 IF (I2-1)>=1000 THEN PRINT #2,"G000";:PRINT #2,USING "####";I2-1;:
      GOTO 1750
1720 IF (I2-1)>=100 THEN PRINT #2,"G0000";:PRINT #2,USING "####";I2-1;:GOTO 1750
1730 IF (I2-1)>=10 THEN PRINT #2,"G00000";:PRINT #2,USING "##";I2-1;:GOTO 1750
1740 PRINT #2,"G000000";:PRINT #2,USING "#";I2-1;
1750 IF (I3-1)>=1000 THEN PRINT #2,"D000";:PRINT #2,USING "####";I3-1;:
      GOTO 1790
1760 IF (I3-1)>=100 THEN PRINT #2,"D0000";:PRINT #2,USING "####";I3-1;:GOTO 1790
1770 IF (I3-1)>=10 THEN PRINT #2,"D00000";:PRINT #2,USING "##";I3-1;:GOTO 1790
1780 PRINT #2,"D000000";:PRINT #2,USING "#";I3-1;
1790 IF (I4-1)>=1000 THEN PRINT #2,"P000";:PRINT #2,USING "####";I4-1;:
      GOTO 1830
1800 IF (I4-1)>=100 THEN PRINT #2,"P0000";:PRINT #2,USING "####";I4-1;:GOTO 1830
1810 IF (I4-1)>=10 THEN PRINT #2,"P00000";:PRINT #2,USING "##";I4-1;:GOTO 1830
1820 PRINT #2,"P000000";:PRINT #2,USING "#";I4-1;
1830 PRINT #2,TAB(73);"T00000001"
1840 CLS:WIDTH 40:LOCATE 8,2:PRINT "File transferring is finished":COLOR 10
1850 REM
1860 REM Asking users for transferring another IGES file
1870 REM
1880 PRINT "":PRINT "Transferring another IGES files?(Y/N)"

```

```

1890 ANS3$=INKEY$:IF ANS3$="" THEN 1890
1900 IF ANS3$="Y" OR ANS3$="y" THEN TEMPOUT$=OUTFILE$:GOTO 90
1910 IF ANS3$="N" OR ANS3$="n" THEN 1920 ELSE 1880
1920 CLOSE #1,#2 : WIDTH 80 : COLOR 10
1930 END
8000 REM
8010 REM Subroutine for LAYER selection
8020 REM
8030 JJ1=1
8040 L$=INPUT$ (82,#1)
8050 LCH$=MID$(L$,73,1)
8060 IF LCH$="S" THEN 8040
8070 IF LCH$="G" THEN 8040
8080 IF LCH$="P" THEN 8220
8090 LN=VAL(MID$(L$,74,7))
8100 IF (LN\2)*2=LN THEN 8040
8110 L1$=MID$(L$,25,8)
8120 L2$=MID$(L$,33,8)
8130 L1=VAL(L1$)
8140 L2=VAL(L2$)
8150 LEVEL(1)=0
8160 FOR JJ=1 TO JJ1
8170 IF L2=LEVEL(JJ) THEN 8040
8180 NEXT JJ
8190 JJ1=JJ1+1
8200 LEVEL(JJ)=L2
8210 GOTO 8040
8220 CLOSE #1
8230 CLS:COLOR 15:WIDTH 80:LOCATE 8
8240 REM
8250 REM Listing all layer information for user selection
8260 REM
8270 PRINT TAB(5);"LAYER Information Listing":COLOR 10
8280 PRINT "*****"
8290 PRINT"*";:COLOR 13:PRINT"    LAYERname    ";:COLOR 10:PRINT TAB(65);"*"
8300 FOR JJJ=1 TO JJ1:PRINT " ";:COLOR 15:PRINT TAB(8);LEVEL(JJJ);:COLOR 10:
PRINT TAB(20);"LAYER";:PRINT TAB(65);"*":NEXT JJJ
8310 PRINT "*****"
8320 COLOR 12
8330 REM
8340 REM Choosing layers which users need for generating IGES file of geometry
8350 REM
8360 INPUT "How many layers do you want";NUM
8370 FOR KK=1 TO NUM
8380 PRINT ""
8390 COLOR 15:PRINT "Enter the LAYERname of the NO.";KK;:LINE INPUT "layer which
you want:";NO$:NO=VAL(NO$):LAY(KK)=NO
8400 NEXT KK
8410 PRINT ""
8420 COLOR 12:PRINT "Are you sure your choices(Y/N)"
8430 ANS$=INKEY$:IF ANS$="" GOTO 8430
8440 IF ANS$="N" OR ANS$="n" GOTO 8230
8450 IF ANS$="Y" OR ANS$="y" THEN 8460 ELSE GOTO 8420
8460 RETURN
9000 REM
9010 REM Subroutine for LINetype selection
9020 REM
9030 CLS:COLOR 15:WIDTH 80:LOCATE 8
9040 REM
9050 REM Listing all LINetype information for user selection
9060 REM
9070 LTYPE$(1)="Solid":LTYPE$(2)="Dashed":LTYPE$(3)="Phantom"
9080 LTYPE$(4)="Centerline":LTYPE$(5)="Dotted"
9090 PRINT TAB(5);"LINetype Information Listing":COLOR 10
9100 PRINT "*****"
9110 PRINT"*";:COLOR 13:PRINT"    Number    LINetype    ";:COLOR 10:

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PRINT TAB(65);""
9120 FOR JJJJ=1 TO 5:PRINT "*****";COLOR 15:PRINT TAB(6);JJJJ;:COLOR 10:
PRINT TAB(16);LTYPE$(JJJJ);:COLOR 15:PRINT TAB(30);"LINE";:COLOR 10:
PRINT TAB(65);"";NEXT JJJJ
9130 PRINT "*****"
9140 COLOR 12
9150 REM
9160 REM Choosing LINetypes which users need for generating IGES file of
geometry
9170 REM
9180 PRINT "Do you wish to choose all LINetypes(Y/N) "
9190 ANS$=INKEY$:IF ANS$="" GOTO 9190
9200 IF ANS$="N" OR ANS$="n" GOTO 9220
9210 IF ANS$="Y" OR ANS$="y" THEN LINETYPE$="ALL":GOTO 9270 ELSE GOTO 9180
9220 PRINT "":INPUT "How many LINetypes do you want";NUM1
9230 FOR KKK=1 TO NUM1
9240 PRINT " "
9250 COLOR 15:PRINT "Enter the Number of the NO.";KKK;:LINE INPUT "LINetype
which you want:";NO1$:NO1=VAL(NO1$):LTYPE(KKK)=NO1
9260 NEXT KKK
9270 PRINT " "
9280 COLOR 12:PRINT "Are you sure your choices(Y/N) "
9290 ANS$=INKEY$:IF ANS$="" GOTO 9290
9300 IF ANS$="N" OR ANS$="n" GOTO 9030
9310 IF ANS$="Y" OR ANS$="y" THEN 9320 ELSE GOTO 9280
9320 RETURN

```

