INTERFACING A COMMERCIALLY AVAILABLE DRAFTING PACKAGE TO USE
RESULTS OBTAINED BY OTHER PROGRAMS AND PACKAGES

by

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Abstract

Presentation of Scientific data has taken a different dimension over the years, as computers churn out enormous amounts of data, which has to be presented in various forms such as graphs charts etc. in reports. Very often it is easier to use standard packages available in the market to get the job done efficiently.

AutoCAD™ is a popular drafting package which is used widely in design offices. However, it has a limitation when it comes to transfer large amounts of data from other programs and packages as no direct command is available to access data.

This paper attempts to give standard subroutines which can be used to form Data Exchange Files which can later be accessed through AutoCAD. An example application is also discussed to illustrate the technique.

1.0 Introduction

Engineers and scientists use computers for various scientific applications and later try to plot the results in graphs etc. to express the trends better. One way of getting a graph on paper is to use a plotter or a printer whose operating commands may vary from manufacturer to manufacturer. It is difficult to use various fonts and styles for presentation as programming is tedious. It may also involve time for debugging the software that is written for that application.

Thus it is easier to use commercially available software to complete the work faster. These software allow the user to grow with them as each new upgrade will make available more powerful features to the user while he doesn't do any thing himself. They have the additional advantage of being able to interact with other major commercial packages. Application packages like Lotus 1-2-3™, and Havard Graphics™ have their own graphing facilities but have limitations of their own. Very often designers like to interact with the drafting tool they are employing, and it is necessary to locate such a drafting package and exploit the available features to the users full advantage.

2.0 AutoCAD as a drafting tool

AutoCAD is a popular drafting package which offers 80% of the facilities available on a mainframe CAD system at less than 20% of the cost on a personal computer and has become the defacto industry standard of the IBM family of personal computers and compatibles over the years. It boasts of various fonts and styles along with other useful features which can be useful in a drawing office of an Engineering organisation. This has already been taken advantage of, as some engineering design packages provide the drawing interface via AutoCAD for drafting. This package can also export and import data to other CAD systems and desktop publishers. It is also easy to find personnel trained in AutoCAD than other drafting packages and hence will pose lesser problems to recruit and train staff.

3.0 Limitation of AutoCAD

The main limitation of AutoCAD is its inability to accept data directly from another commercial program or a data file, and it is tedious to give data manually through the keyboard when the amount of data involved is large. However, the program allows the formation of Data eXchange Format (DXF) which are mainly provided to transfer data to and from other CAD packages (micro and main frame systems).

4.0 DXF files

These files consist of different parts and can be separated into distinct sections some of which occur repeatedly with each curve or data point. The numbering of these subroutines are deliberately made over 5000 to allow the main program to be incorporated within lines 1-5000.

5.0 Preparation of DXF files to be used on Version 2.18

Appendix A gives details of the subroutines which can be used with AutoCAD version 2.18 or later. Version 2.18 is to be the last version which does not require a hard disk or math co-processor and can be run from a modest system having only 2/360KB floppy disk drives.

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The first part consists of the Header Section which has flags indicating the start of the DXF file. The program should consist of a line accessing subroutine 5000 which is the start of the header section.

The second section is the start of the polyline which has to be given at the start of each curve. The polyline can have any number of points which will form the curve. The plot is obtained as a polyline instead of a normal straight line as a straight line will only connect the points with a straight line. The polyline allows the user to do curve fitting to obtain the best fitting curve of the specified points. To access the starting part of the polyline the program should consist of a line referring to subroutine 9000.

The next section consists of flags which will be accompanying all data entries. The values X2 and Y2 are the ordinates of the specified data point, and the parent program should endeavour to determine the values of X2 and Y2 by the necessary computations. This subroutine is repeated for all data points in the polyline. The main program should consist of a line referring to subroutine 9100 to access this segment.

After giving all data points in the polyline it is necessary to complete the polyline. The end of polyline subroutine completes the polyline by issuing the necessary flags. The main program should have the line referring to subroutine 9200 to issue the flags necessary to complete the polyline.

If the user has to plot another curve he can access subroutine 9000 again to start the polyline, issue point X with coordinates X2, Y2 through subroutine 9100 and finally complete the polyline through subroutine 9200.

After all necessary curves had been input, the operation has to be brought to an end. This is done by the last subroutine which issues the necessary flags. The main program should have a line to access subroutine 9300.

These operations will form the DXF file which is often large. Hence, it is advisable to use a hard disk and also make sure that there is enough space to hold the DXF file, if the curves are going to consist of a large number of points. The hard disk should also have enough space for the final drawing file along with the temporary files during operation. However, a floppy based system is adequate for smaller applications.

6.0 Using DXF files

The DXF files are accessed by the dxfin command from AutoCAD. The name of the DXF file is given and the computer pauses for some time to generate the image. These files will be rejected even if a small error is found in one line. The program allows very little help to determine the cause of the errors. Thus it is not advisable to write a DXF file from the first principles but to modify existing files suitably. Version 2.18 requires that the dxfin command can be used only on a new file. Thus the data transfer should take place immediately after a new file has been created. However, this requirement is relaxed for later versions.

7.0 Example Application

Appendix B illustrates an application using DXF files. The new code BS8100 does not give a column chart for Grade 20 concrete and steel of strength 410 N/mm². The lines 30-50 request the strengths of concrete, steel and the d/h ratio. Line 55 requests the name of the input file. The full path name should be given with the extension dxf to send the DXF file to a place other than the default directory. After verifying these values as correct in line 60 the DXF file is opened in line 70.

The subroutine 5000 gives the header section flags and subroutine 9000 issues the polyline starting flags. Line 84 gives the starting point 200,200 through subroutine 9100. Subroutine 180 deals with the computation of data point X(X2,Y2), the details of which are omitted in this program for clarity. After completing the necessary calculations (line 100), the program issues the end of polyline flags via subroutine 9200 in line 110. The plot is repeated for reinforcement percentages up to 8% (line 123). If the percentage of reinforcement considered is more than 8% the subroutine 9300 is used to give the end of operation flags. Otherwise the plot is repeated from line 90 (subroutine 9000). A sample plot is annexed for reference in Appendix C.

This briefly explains an application using DXF files. This example requires a hard disk as a large amount of data is involved. The program execution time can be reduced considerably by using a BASIC compiler or a Quick compiler while creating the DXF file.

8.0 Conclusions

This paper gives details of the Data eXchange (DXF) Format files available in AutoCAD which can be utilised as a subroutine of any BASIC program to prepare the data for graphing later. The subroutines have been prepared for AutoCAD version 2.18 which does not require a hard disk. This enhances the flexibility of the subroutines as these can be used on subsequent releases after Version 2.18. Once converted to an AutoCAD file the data can be manipulated in any desirable way, using standard features available in AutoCAD.

This technique can be modified to include 3-D plotting which will be a useful feature in a CAD package (Release 10 and later). If necessary useful features such as text and styles can be incorporated in the DXF file itself and can be used in AutoCAD.
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10.0 References

3. BS 8110 - Structural use of concrete
APPENDIX A
Subroutines for AutoCAD Version 2.18 or later

5000 REM HEADER SECTION
5010 PRINT #1, "0"
5020 PRINT #1, "SECTION"
5030 PRINT #1, "2"
5040 PRINT #1, "ENTITIES"
5050 RETURN

9000 REM POLYLINK STARTS
9010 PRINT #1, "0"
9020 PRINT #1, "POLYLINE"
9030 PRINT #1, "8"
9040 PRINT #1, "0"
9050 PRINT #1, "66"
9060 PRINT #1, "1"
9070 RETURN

9100 REM POINT X2,Y2
9110 PRINT #1, "0"
9120 PRINT #1, "VERTEX"
9130 PRINT #1, "8"

9140 PRINT #1, "0"
9150 PRINT #1, "10"
9160 PRINT #1, "X2"
9170 PRINT #1, "20"
9180 PRINT #1, "Y2"
9190 RETURN

9200 REM END OF POLYLINE
9210 PRINT #1, "0"
9220 PRINT #1, "SEQEND"
9230 PRINT #1, "8"
9240 PRINT #1, "0"
9250 RETURN

9300 REM END OF OPERATION
9310 PRINT #1, "0"
9320 PRINT #1, "ENDSEC"
9330 PRINT #1, "0"
9340 PRINT #1, "EOF"
9350 RETURN

APPENDIX B
Illustrated program of an application

05 REM This program illustrates the fundamentals of preparing a DXF file using a BASIC program. Only the main steps are included to explain clearly.
10 REM CHARTS FOR COLUMNS- BS 8110. for AutoCAD vers 2.18.
20 READ N,B,H
25 DATA 1500,.3,.3
30 COLOR 7,1,3:CLS:FK=0
32 INPUT"What is the characteristic strength of the concrete (N/mm^2) ":FK:IF FK=0 THEN FK=20
40 FY=0:INPUT"What is the characteristic strength of the steel (N/mm^2) ":FY:IF FY=0 THEN FY=410
50 INPUT"What is the value of d/h chosen ":G:D1=H*(1-G):D=D1
55 XX$:="":INPUT "What is the name of the file ":XX$
60 Y$="":PRINT"Are these values correct? type Y/N"
62 Y$=INPUT$(1):IF Y$="N" OR Y$="N" THEN 30
70 P=0:Z2=0:OPEN "O",1,XX$:REM XX$ is the name of the DXF file.
80 GOSUB 5000:REM Header Section
82 X2=200:Y2=200:GOSUB 9000:REM Polyline Starts
84 GOSUB 9100:REM Point X2,Y2
86 GOTO 100
90 GOSUB 9000:REM Polyline Starts
100 GOSUB 180:REM Subroutine to calculate point X(X2,Y2)
110 GOSUB 9200:REM Polyline Ends
120 P=P+.01:Z2=Z2+1
123 IF Z2>=9 THEN 130 ELSE 90
130 GOSUB 9300:REM End of operation
170 CLS:CLOSE:END
180 REM Subroutine for calculation starts from this line.
DESIGN CHARTS FOR COLUMNS - BS 8110

FCU = 20
FY = 410
D/H = .90