4   OPERATION MANUAL FOR ARC/INFO

1   Introduction

1.1   Introduction

The ARC/INFO is GIS software based on topological data structure. This software is different in this point from GeoConcept used in IIMS. The user must understand what ARC/INFO is. The study team installed this software to make up for the weak point of GeoConcept in terms of topological data structure. ARC/INFO needs the same complete topological data structure as the CartaLinx in order to build a coverage. Although the user has to get familiar with the fundamental knowledge including GIS data such as polygon,

line and point, it is also important to understand the topology to manage GIS data properly. The present version 8.0 of ARC/INFO provides the user-friendly Graphic User Interface to ensure that the module is easy and simple to operate. All the tools are supported by the AML (ARC/INFO Macro Language), which is based on the command line in ARC/INFO. In addition to the former version of ARC/INFO supported by the command line, its present version provides the user-friendly interface supported by AML. ARC Tool is composed of several tools as shown in Fig.1.

Fig.1 ArcTools

(1) MapTools:
This tool is mainly used to manage the coverage, display module and plot module, which use some modules in ARC, as well as ARCPLOT and Info in the previous version of ARC/INFO.

(2) Edit Tools:
This tool is mainly used to manage the coverage and editing of the coverage, which use some modules in ARC, as well as ARCEDIT and Info in the previous version of ARC/INFO.

(3) Grid Tools:
This tool mainly supports the management of Grid data, which uses Grid and lattice command in the previous version of ARC/INFO. No license is needed to use it in IIMS. Command Tools: This command is used in the same operation style as described in the previous version of ARC/INFO.

(4) Command Tools:
This tool is the conventional module of ARC/INFO that is managed by the command line. A user must master this command before starting the development of the customizing method using AML.

(5) Land Records:
This tool mainly supports the management of the mapping of parcels or some other features based on the field observation data. It is supposed that this tool was newly added to this version.

This manual mainly describes the method of creating data for thematic maps though it is very hard to grasp all the modules of the software within a limited time.

1.2 Understanding of the topology and the coverage in ARC/INFO

(1) FEATURE CLASS
The ARC/INFO coverage consists of FEATURE CLASSES as shown in Fig1.2.1:
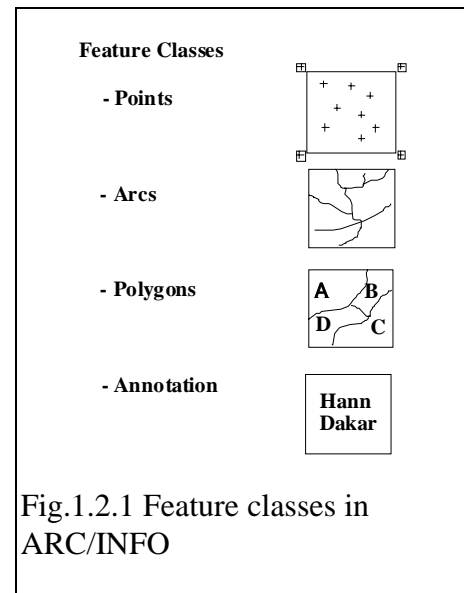
    Points
    ARCs
    Polygons
    Annotation

Each feature classes have the series of database records shown in the Fig 1.2.2.

Feature Classes

- Points

- Arcs

- Polygons

- Annotation

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Fig.1.2.1 Feature classes in ARC/INFO

```
                        COLUMN or ITEM

              AREA PERIMETER EXCOV# EXCOV-ID SYMBOL
FEATURE       3.25    1.60      1       0       0    RAW or R
              4.67    1.87      2       1       0
              8.09    2.05      3       2       0
              3.56    1.48      4       3       0
                                    ATTRIBUTE
```

Fig.1.2.2 Database record

(2) The concept of ARC/INFO
The coverage is defined as the map sheet to manage in ARC/INFO (see Fig.1.2.3) and consists of several kinds of features as follows:

1.Node: The start point and the end point of a Line and the cross point of Lines.
2.ARC: The Line or the Line of polygon.
3.Polygon:The closed figure surrounded to ARCs.
4.Label: The point feature at which a polygon user ID is attached to.
5.TIC: Registration points for the coverage domain. 4 points are required at least.
6.BND: The maximum and minimum ranges of the coordinates at which a figure exists.

Fig 1.2.3 Coverage and structure in ARC/INFO
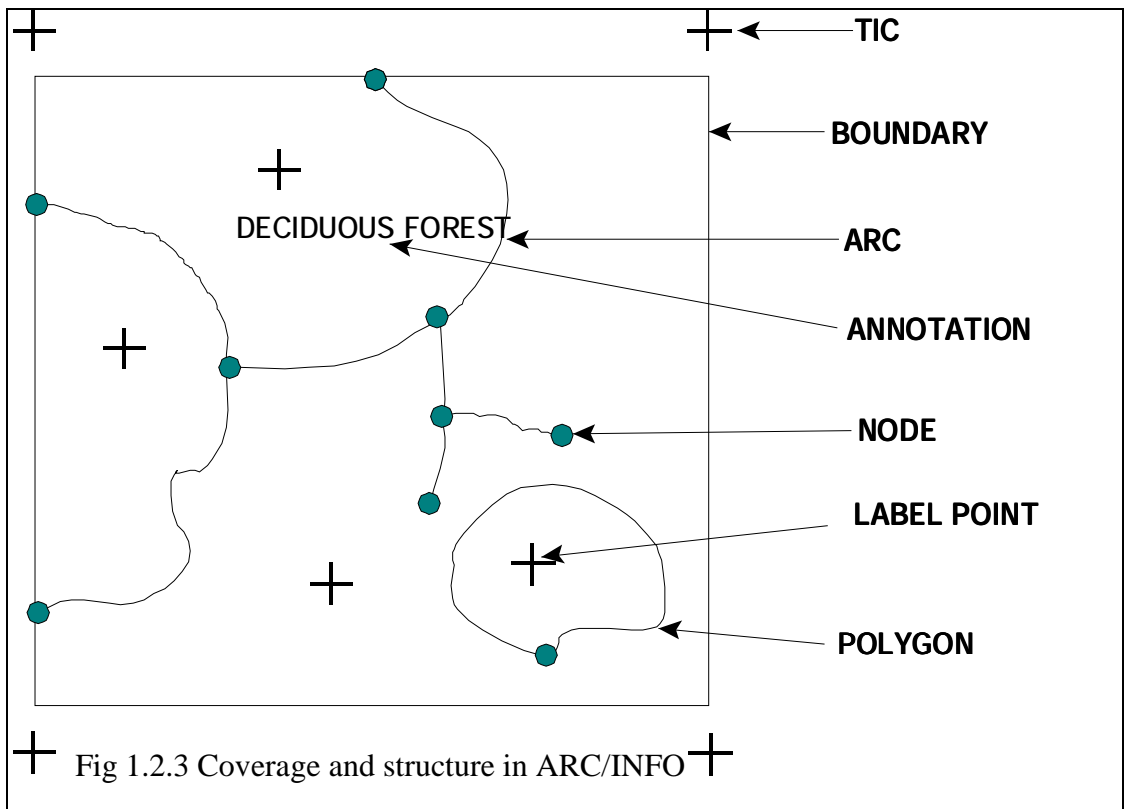
(3) Data structure of the coverage

The coverage is managed by the directory configuration consisting of tree structures as shown in Fig.1.2.4.

Fig.1.2.4 Data structure and the coverage
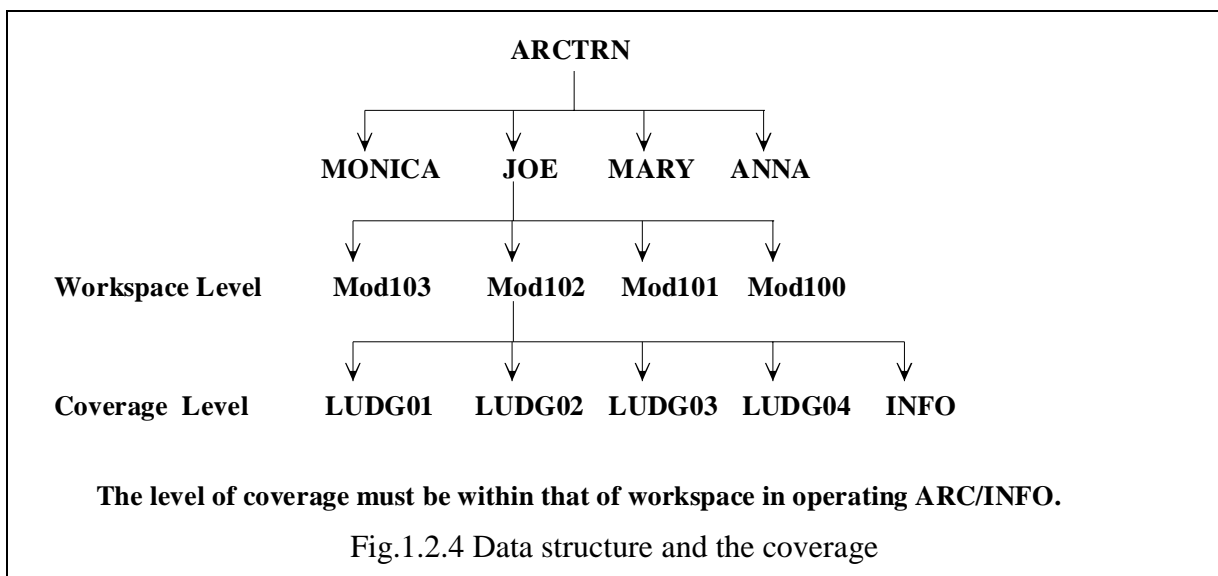
The relationship between Arc and Node:
  - Arc: A series of point which has X and Y coordinates.(See Fig.1.2.5)

  - Node: The start point and the end point of Arc. The intermediate point between the start point and the end point is so called as the Vertex. (See Fig.1.2.6)

Fig.1.2.5 Arc and Node

Fig.1.2.6 Node and Vertex
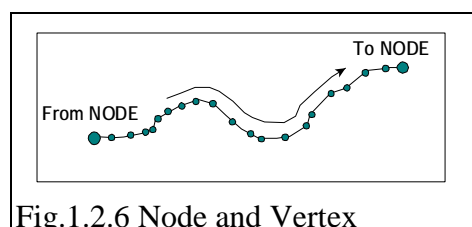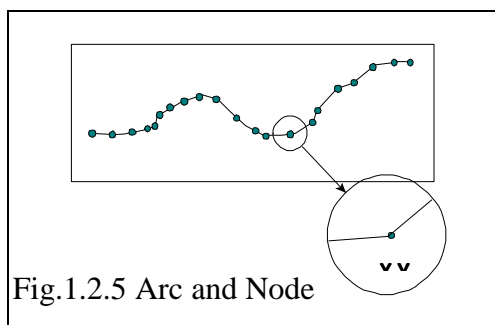
  - Topology means the spatial relation among figures.
    • Consequence
    • Connection

  -    The data structure of a complex figure is composed
     of that of a simple figure element.
    • Point (the simplest element)
    • ARC (A series of sequential points)
    • Area (A series of connected ARCs

  - The topology protects to create the meaningless coordinate data.
    • ARC is representative of linear feature in whole or part.
    • ARC forms the boundary or the part of thematic area such as polygon.

  -    The topology is defined as a relationship between the connectivity and neighborhood of a feature represented by ARCs, and the data is recorded in a number of lists of features.

    • Polygon topology is the list of the ARCs to form the boundary of a polygon.
    • ARC-Node topology is the list of the start point and the end point of ARC
    • ARC-Polygon topology is a list of the left side and the right side of polygon.
    • Node topology is the list of ARCs to be connected by Node.

(4)   Function of INFO

  - The figure feature is represented by the attribute of Point, Line and Polygon, and the attribute consists of the numeric of integer and float, character and etc. All the attribute data are stored in INFO.
  - INFO data file is a table of tabular data type.
  - Layout of file is shown below.
  - INFO handles the internal file and the external file.

The internal file:
    The file created by the user in the session of INFO is the internal file such as the lookup table and buffer table.

The external file:
    The file created by ARC is called external file and there are four files as follows:

- Coverage name .TIC
- Coverage name .BND
- Coverage name .PAT   or - Coverage name .AAT

    The external files can be accessed from INFO and are recorded under the directory of the coverage name.
    INFO Command in ARC manages the database in ARC/INFO.

2.   Command Line to Create the Coverage

In general, there are several steps to create the coverage in ARC/INFO.
    - Preparing the map for digitizing.
    - Digitizing the coverage.
    - Error-check of digitized figures and editing data.
    - Definition of features and creation of topology.
    - Linkage of database attribute to the coverage feature.
    - Error-check of attribute code and editing it.
      The next is the related modules in each step.

2.1   ADS (ARC Digitizing System)

Digitizing is mainly supported by the ADS using ARC command and ARCEDIT command. The main operation of ADS consists of the following steps:
    - Set up the map on digitizer board properly.
    - Set up the digitizing configuration:
            The registration of the control point of TIC consists of four points at least.
            The registration of map boundary (BND) requires two points at the left lower and the right upper.
    - Set up the digitizing environment
            The user manages the digitizing environment in the menu and functions including:
    - Add or delete the coordinate.
    - Display
    - Change window
    - Re-entry of map
    - Option:
            Tolerance distance set up the distance of tolerance.
             - WEED distance: Set up the distance between the vertexes on ARCs.
             - SNAP distance: Set up the distance between nodes to snap.
             - EDIT distance: Set up the distance to edit for ARC and Label.
    - Digitizing of ARC and Point / Label

2.2   ARCEDIT

ARCEDIT is a function of editing the coverage data in the first digitizing step in ARC/INFO.
    - Move and rotation of the coverage.
    - Editing of vertex and handling of attributes.
    - Ruber shooting
    - Handling of annotation data

2.3   Files Related to the Coverage

The coverage files are created by digitizing in ADS and ARCEDIT.
- TIC is the file to store the coordinates of the control point.
- BND is the file to store the coordinates of the boundary of the coverage.
- ARC is the file to store the coordinates of ARC.
- ARX is the file to store the indexes for ARC processing.
- LAB is the file to store the coordinates of the label point.
- LOG is the file to store the Log file for the coverage.

2.4   Building of the topology in the coverage

(1) BUILD
    BUILD command creates the topology of POLY, LINE, POINT in ARC/INFO:
    - Creates the topology against the coverage without error. Crossed ARC are
     not processed.
    - Creates the PAL file including the list of ARC surrounding each polygon.
    - Calculates the topological relationship of the left polygon and the right polygon in
      each ARC and writes the relation in the ARC file.
    - Makes the relation of polygon to attach the label number as the user ID at the step of
      digitizing.
    - Makes the internal relation number (#) against ARC such as left and right.
    - Calculates the area of polygon and the center of the geometry and the perimeter.
    - Creates and updates the attribute file.
    - POLY/POINT data is the coverage name .PAT.
    - LINE data is the coverage name .AAT.

(2) CLEAN
    CLEAN command makes structural figures clean about Polygon or Line:
    - Makes the coverage clean about the coordinates.
    - Creates the topology of Polygon or Line.
    - Fuzzy tolerance is defined as the minimum route of vertexes of two ARCs, Nodes
       for the output coverage.
    - Dangle length manages to adjust, or to snap or delete the length of ARC against the
       overshooting or undershooting or duplication of ARCs. This tolerance limit is the
       minimum length of ARC.
    - CLEAN breaks ARC at the cross point of ARCs and put a Node at the break point of
      ARC.
    - Dangle length detects the overshooting ARC against both sides of polygon and
      identifies the dangle node. The default value is Zero.
    - Fuzzy tolerance

CLEAN command converges to one point from two or more points at which X and Y
distances are less than the Fuzzy distance.

2.5   Error-check in ADS and ARCEDIT

The following commands are supposed to check whether the coverage is acceptable or not.
  - Check the polygon label
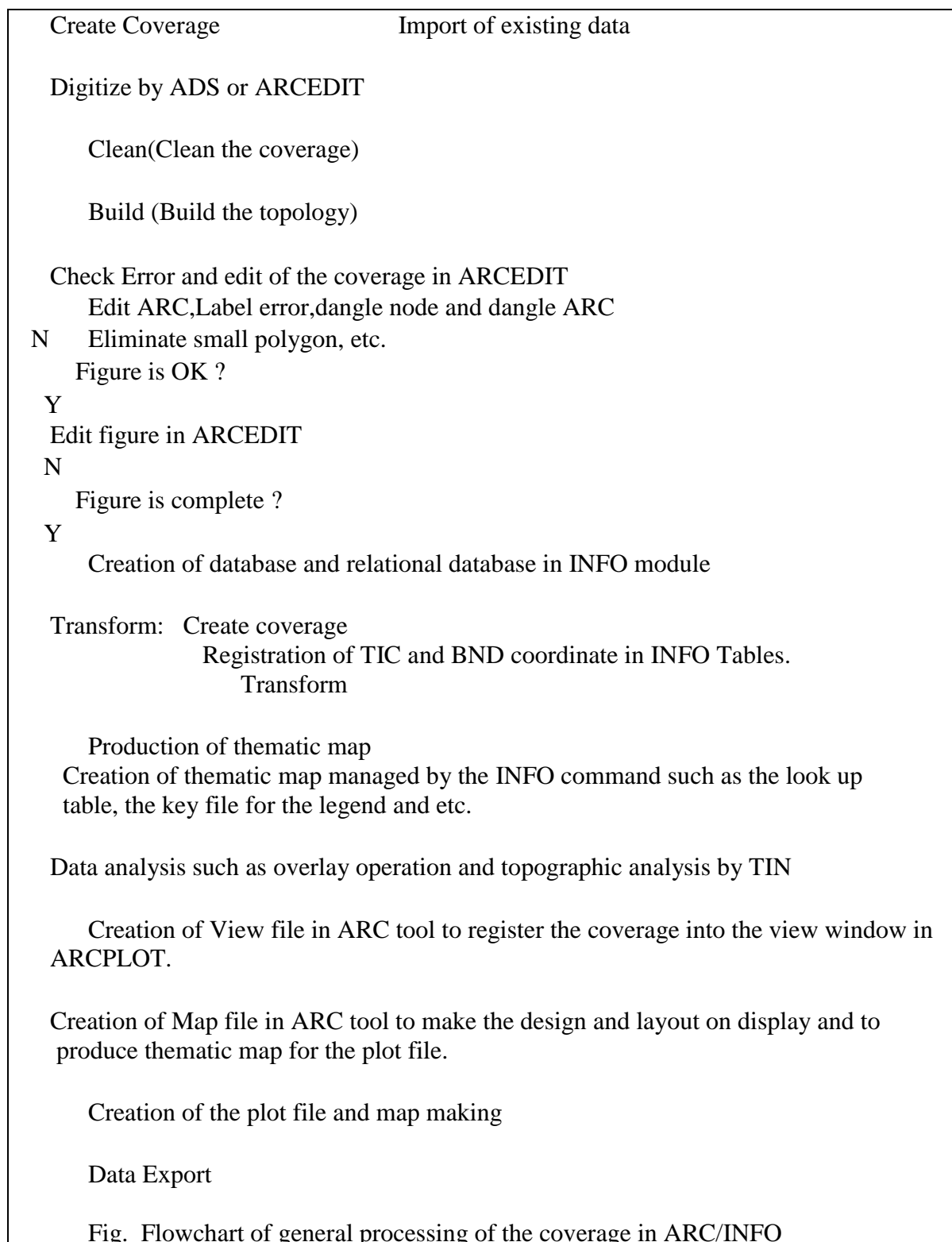 - Check the dangle node / pseudo node

2.6 Data Processing about Attributes in INFO

INFO and Tables in ARC command manage the database in ARC/INFO and the related database such as related data and lookup table data for legend, etc. The following command will be used: DEFINE, DIRECTORY, SELECT, ITEMS, LIST, REDEFINE, ADD, PURGE, ERASE, UPDATE, CALCULATE, MODIFY and ALTER, RESELECT, ASELECT and NSELECT, JOINITEM, ADDITEM, PULLITEMS, DROPITEM, IEDIT, and RELATE.

2.7 General Flow Chart to Process the Coverage

The following is the general flow chart to process the coverage from digitizing to the coverage:

General Processing of ARC/INFO in ARCTools

Create Coverage   Import of existing data

   Digitize by ADS or ARCEDIT

      Clean(Clean the coverage)

      Build (Build the topology)

   Check Error and edit of the coverage in ARCEDIT
         Edit ARC,Label error,dangle node and dangle ARC
   N   Eliminate small polygon, etc.
      Figure is OK ?
   Y
   Edit figure in ARCEDIT
   N
      Figure is complete ?
   Y
      Creation of database and relational database in INFO module

   Transform: Create coverage
                  Registration of TIC and BND coordinate in INFO Tables.
                    Transform

      Production of thematic map
   Creation of thematic map managed by the INFO command such as the look up
   table, the key file for the legend and etc.

   Data analysis such as overlay operation and topographic analysis by TIN

      Creation of View file in ARC tool to register the coverage into the view window in
   ARCPLOT.

   Creation of Map file in ARC tool to make the design and layout on display and to
    produce thematic map for the plot file.

      Creation of the plot file and map making

      Data Export

      Fig. Flowchart of general processing of the coverage in ARC/INFO

Memo random of Operation list for DIGITIZING in ARC/INFO

Digitizer command can start from command tool of ARC.
The operation of digitizing is as follows:
 - 1   Setup of Digitizer command from ARC
        - arc
        - &station dig   <= Setup the digitizer command
        - ads < Coverage name >
 - 2   Registration of TIC from the cursor on digitizer.
        - Click the TIC by mouse as follows:
        - Move the cursor at TIC, and enter 1 A <u>number of TIC.</u>
        - Continue to the end.
        - Enter 0 and A on cursor.
 - 3   Registration of BND

        Enter two points for the definition of
        map area:
        - Click the any number of button on the
          cursor at left down on map.
        - Click the any number of button on the cursor at right up on map.

16 button cursor			
1 A <u>number of TIC.</u>	===	ID_1
2 A <u>number of TIC.</u>	===	ID_2
3 A <u>number of TIC.</u>	===	ID_3
4 A <u>number of TIC.</u>	===	ID_4
0 A	===	END

 - 4   Reconfirmation of automatic correction
        Are duplicate ARCS permissible? <1:Yes 2:No>
        Enter 1 (yes) of the button number 1on the cursor.
 -5   Operation on the menu
        < Main menu>
        1) Add ARCS
        2) Remove ARCS
        3) Add Labels
        4) Remove Labels
        5) Draw Cover
        6) Define Window
        7) Add Tics
        8) Option
        9) Exit
        < Data Input >
        Change the active mode by clicking button 1 on the cursor.
        Move the cursor at the start point and click button 2.
        Enter button 1 to put a vertex and continue to trace by the click.
        At the end, enter button 2 on cursor.
        Continue to digitize feature.
        Enter button 9 to quit to digitize.
        When all digitizing steps finish, enter 9 in the main menu and save file and exit.
   -6   Clean and build
        At first, execute the Clean command and Build command to make a topology data in
        the coverage and to check the topological error in digitizing.
   -7   Check and edit the coverage in ARCEDIT to complete it.

3. Map Tools

Map Tools is supported by commands of ARC, ARCPLOT and INFO Tables from command line. This tool manages the view to display the coverage, the map view to make a plot file, INFO to prepare for database, the relational database, the look up table for the color property and the key file for legend, etc.

3.1 ARC Tool

This tool manages all data of the coverage, Grid, TIN, Info and other relevant data in ARC/INFO. The tool is mainly supported by the ARC command, ARCPLOT command and INFO Tables command.
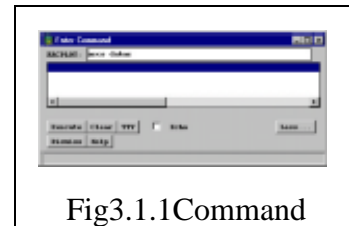
Fig3.1.1 Command

3.1.1 Command Tool

This tool is used to execute ARC/INFO commands as if the user were typing the command line. (See Fig.3.1.1.)

3.1.2 Workspace

This tool is used to move from one workspace to another. It is also necessary to move to a workspace to which the user has read/write access for editing or to find a set of coverage. (See Fig.3.1.2.)
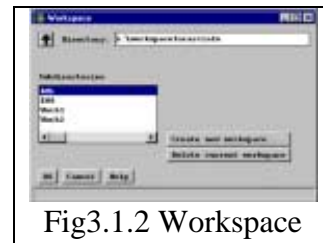
Fig3.1.2 Workspace

3.1.3 Manager

(1) Coverage MANAGER
This is the tool for browsing the file system to display coverage information and to perform coverage management operations including COPY, DESCRIBE, RENAME, KILL, etc. (See Fig.3.1.3.)
 - Feature types and sub-classes:
   This choice bar filters the contents of the coverage
   scroll list only by displaying the coverage of a
   specified type as follows:
    Line - Coverage with an ARC attribute table(AAT)
    Poly - Coverage with a polygon attribute table(PAT)
    Region - Coverage with region attribute table
        (PAT<region>)
    Point - Coverage with a Point attribute table (PAT)
    Route - Coverage with a Route Attribute table (RAT)
    Address - Coverage with an address file (ADD)
    Annotation - Coverage with annotation subclasses
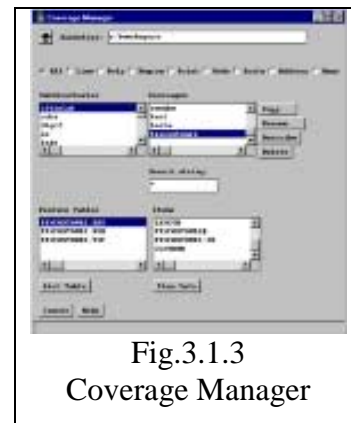   (TXT)
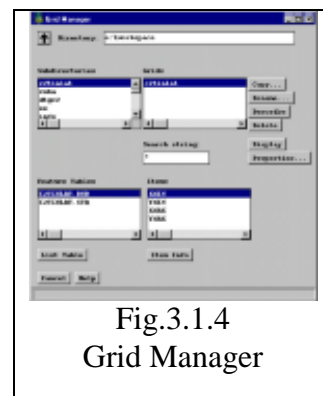

Fig.3.1.3
Coverage Manager

Fig.3.1.4
Grid Manager

(2) Grid

This is the tool for browsing the file system to display grids and grid information. The operation is the same as the coverage manager. (See Fig.3.1.4.)

(3) TIN MANAGER

This is the tool for browsing the file system to display TIN information. The operation is the same as the coverage manager. (See Fig.3.1.5.)
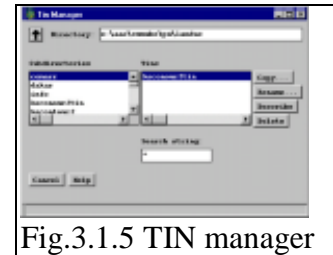

Fig.3.1.5 TIN manager

(4) INFO Tables

This is the tool for browsing the file system to display INFO file information. The operation is the same as the coverage manager. (See Fig.3.1.6.)

(5) Relate Environment

This tool is used to create, modify and delete relates of the coverage in the current relate environment. The current relate environment can be saved for future use and the previously saved environments can also be restored.

(6) Historical View Manager

This tool can generate ARCStorm historical views. (See Fig.3.1.7.)

| Fig.3.1.6 INFOTables Manager | Fig.3.1.7 Histrical View Manager | Fig.3.1.8 Workspace Manager |

(7) Workspace

Same as the mentioned before. (See Fig.3.1.8.)

(8) Defined Layer Manager

This is the tool for creating defined layers from a SDE data set or Shape files and to perform management operations including Describe, Remove, Save to File, etc. (See Fig.3.1.9.)
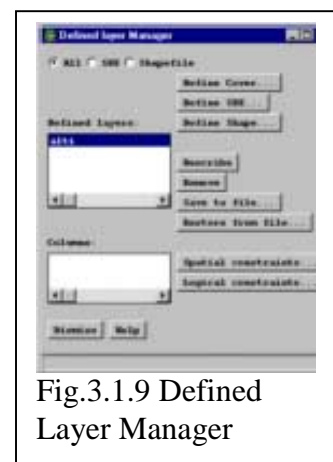

Fig.3.1.9 Defined Layer Manager

3.1.4 Data Viewer

The QuickDraw tool is used to perform rapid data display and query within the ARCPLOT or Grid subsystems. (See Fig.3.1.10.) Select one of Cover | Tin | Grid | Image.

3.1.5 Tool Browser

The Application picker is used to install user defined applications into ARCTools.

Fig.3.1.10 Data viewer

3.1.6 Application Browse

The applications are installed using the ATPREFS.AML tool.
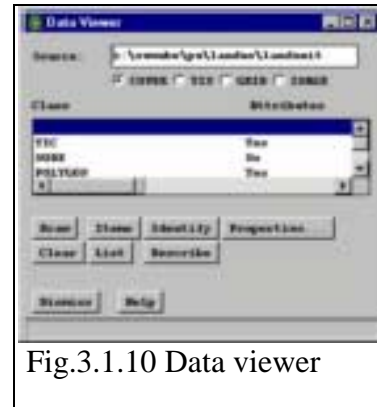
3.2 View Menu

View Menu manages the themes to display the coverage data, Grid, TIN and relevant data. This menu continues to the next Map Menu. The menu is mainly supported by ARC command, ARCPLOT command, INFO Tables and TIN command.

3.2.1 New
This is the tool for registration of a new theme and the management coverage on display. (See Fig.3.2.1.)

This tool is used to create, edit, draw and delete themes within a view. Themes are a collection of geographic features contained in a single coverage, Grid, TIN or image for which the user can specify drawing instructions. A view is used to manage the display of a set of themes in ARCTools. The theme manager allows you to define a series

Fig.3.2.1 New view

of themes in the view, specify each theme's drawing properties and to draw the themes.
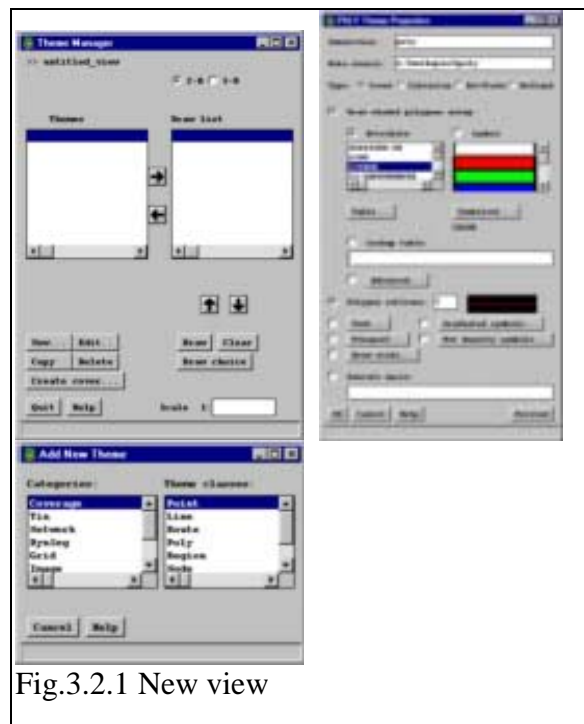
The theme manager contains two scroll lists. The left list is a collection of themes that make up the view. The right list is the set of themes to be drawn. The theme manager performs the following operations:
   - Add new theme to a view.
   - Edit the theme properties and drawing legend.
   - Copy a theme.
   - Delete a theme.
   - Create a coverage from selected theme features.

- Specify which themes to draw in the view.
- Record the theme drawing list in the view.
- Draw all themes in the view.
- Draw selected themes in the view.
- Toggle from 2-D to 3-D drawing mode.

3.2.2   Open

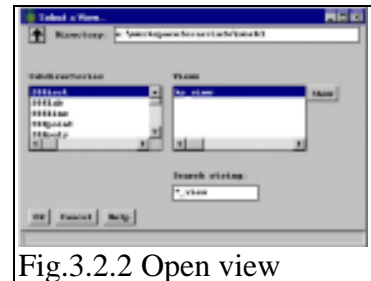Open the existing view file, view for the management of data in ARC/INFO. (See Fig.3.2.2.)

Fig.3.2.2 Open view

3.2.3   Open Workspace

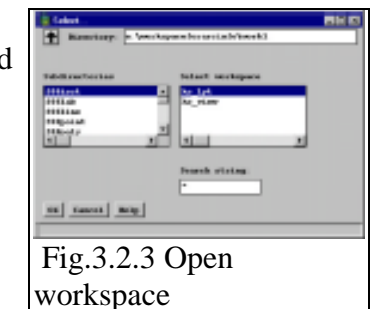This tool displays workspaces in the current directory and allows the user to browse the file system. (See Fig.3.2.3.)

3.2.4   Save

This command saves view file.

Fig.3.2.3 Open workspace

3.2.5.Save as

This command saves view file as another file name. (See Fig.3.2.4.)

3.2.6   Save as macro

This command saves view file as AML file. (See Fig.3.2.4.)
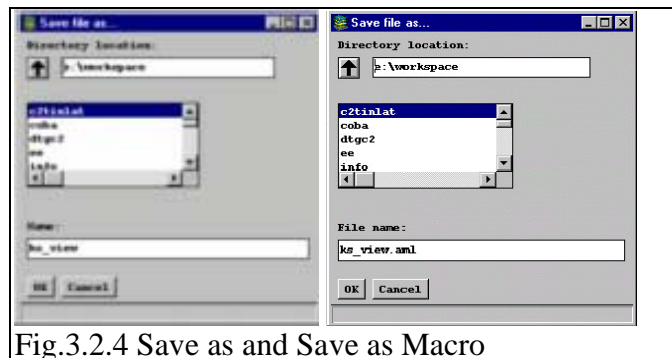
3.2.7   Pan/Zoom

Fig.3.2.4 Save as and Save as Macro

This command manages view including pan of view and zoom of view on display: VIEW, PAN/ZOOM, ZOOM IN/OUT, MAPEXTEND, PAN FO MAP EXTEND, DISPLAY ALL. (See Fig.3.2.5.)
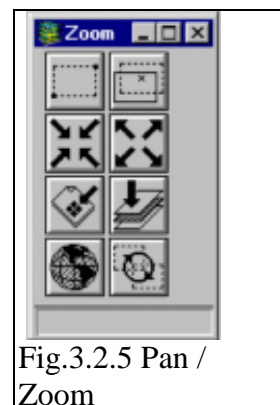
3.2.8   Tools

Not available in this mode.

3.2.9   Productivity Tools

Fig.3.2.5 Pan / Zoom

This module is also limited because of requiring an additional license of ARC/INFO. It is used to select and execute a number of productivity tools. These tools are organized in 5 classes:

    Analysis   - Tools to be used within either MapTools or GridTools
    Grid   - Tools for GRID analysis within GridTools

Network   - Network analysis tools for use in MapTools
Geocoding - Tools related to geocoding
Other   - Tools that do not fall within one of the above classes.

3.2.10 Load surface

This command loads surface file such as TIN or Lattice for 3D views.
This tool is aimed at allowing the user to incorporate a surface within the view and enabling display and query operations in 3-D perspective. Views will be drawn in 3-D after having loaded a surface with this tool and making sure that the '3-D' button on the Theme Manager has been pressed.
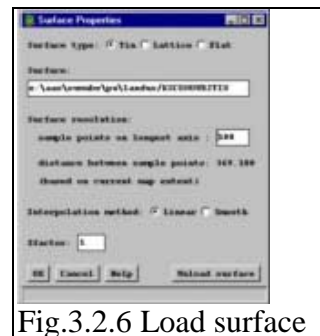

Fig.3.2.6 Load surface

The coverage should be 3D. (See Fig.3.2.6.)

3.2.11 Orient Camera

This tool is used to define the 3D-view environment such as basic positioning of the camera and the target, and the orientation of camera azimuth, camera altitude, etc.

Only the 3D coverage is available.

3.2.12 Property

This is the property of the coverage including general information of the coverage and properties of color table list. (See Fig.3.2.7.)

Fig.3.2.7 Property

3.3   Map Menu

Map menu manages the design of layout and property control of the coverage for map plot, and is supported by ARCPLOT command.

3.3.1   New Registration of Map window.

This command selects the directory of template layouts that are in the sub-directories. An icon is displayed below the scroll lists to illustrate the "look" of the currently selected layout template. (See Fig.3.3.1.)
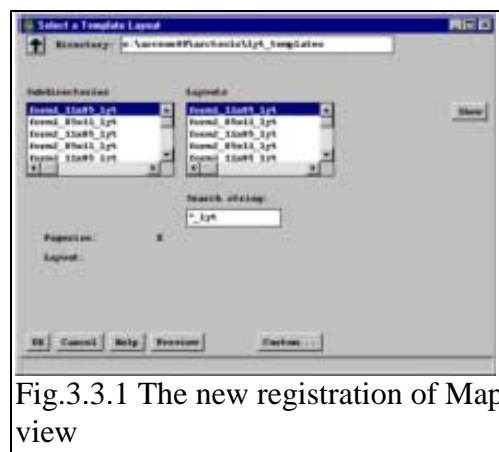

Fig.3.3.1 The new registration of Map view

3.3.2 Open

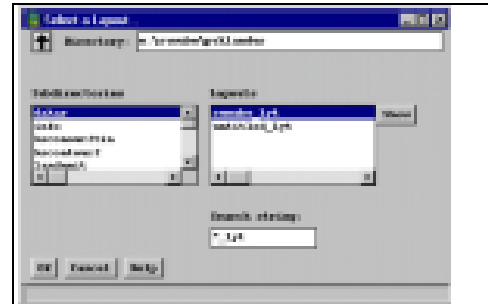This command selects the existing Map file to open for a map layout. (See Fig.3.3.2.)

3.3.3 Save

Save map file.

Fig 3.3.2 Open existing map file

3.3.4 Save as

Save map file as another file name. (See Fig.3.3.3.)

3.3.5 Save as macro

Save map file as AML file.

3.3.6 Save as Template

Fig.3.3.3 Save as

3.3.7 Create metafile

This tool is used to create a metafile by selection out of options of Meta File Format such as EMF, WMF, GRA, ESP, AI, CGMC, CGMT, CGMB, Color hcbc (cc), Hgg12 (hp2) and RTL(rtl). It is used to convert the map layout currently opened to a metafile format. The converted file will be written into your current workspace, using the name of your layout followed by an extension as explained below. (See Fig.3.3.4.)

Fig.3.3.4 Create metafile

3.3.8 Plotting

Plotting is done by selecting a printer and paper. The IIMS uses Windows NT as the platform so that it is necessary to select Printing on NT.

Creating a plot of your map layout is a two-step process. First, generate a metafile, and then you may send it to a selected output device.

Send the metafile to an output device
  Step 1: Use the file browser to select the target metafile and press OK.
  Step 2: Press the Submit plot… button.

The Print menu will be displayed. The File input field displays the metafile to be plotted.
  Step 3: Press the Print... button to select an output device.

A Print menu will be displayed with a list of Printer names currently available on your system.
  Step 4: Highlight the desired output device from the scroll list.

Select the appropriate print queue.

Step 5: Dismiss the menu when it is no longer active.

Additional plotting tools can be found under the Map pull-down: Rotate plot… The Rotate plot tool rotates an ARC/INFO graphic file counterclockwise 90 degrees. (See Fig.3.3.5.)
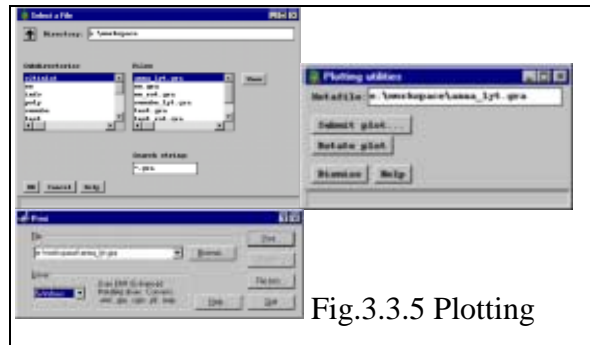

Fig.3.3.5 Plotting

3.3.9 Page Setup

This command is used to select the layout's page size, orientation and page units.
The scroll list contains the most common page sizes: A, B, C, D and E. Other sizes can be specified by entering the dimensions in the fields above the list. The number on the left corresponds to the width (x-axis) and the one on the right to the height (y-axis). (See Fig.3.3.6.)
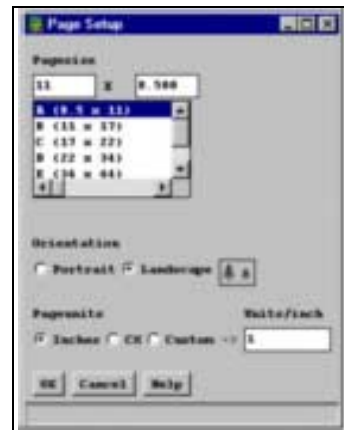
3.3.10 Snap to Grid

This command is used to snap map objects to a definable grid. To snap the objects, move them to the closest grid point. (See Fig.3.3.7.)

Fig.3.3.6 Page Setup

3.3.11 Layout property

This tool allows you to set various properties for the current layout, including when it was created, by whom, what the default symbol sets are (including north arrows), whether or not to display a border at the current page size and comments. (See Fig.3.3.8.)

Shadeset is the name of the default shadeset file to be used during the layout session.

Lineset is the name of the default lineset file to be used during the layout session.

Fig.3.3.7 Snap to Grid

Markerset is the name of the default markerset file to be used during the layout session.

North arrows is the name of the default markerset file to be used for symbolizing north arrows during the layout session.

Fig.3.3.8 Layer Property

4.   Edit Tools

Edit tools is supported by ARCEDIT command and INFO Tables command to manage the editing of GIS data.

ARCEDIT consists of several types of module to create and edit the coverage. These modules provide the useful functions to complete the topological GIS data as follows:
- To check the topological error;
- To edit the above error in any feature class such as polygon, ARC, Point or Labels.
- To provide an user-friendly interface by manual operation and by batch processing.
- To manage the attribute as the property of a feature that INFO Tables supports.

4.1   NEW: Creation of the new coverage

This tool is used to create a new coverage and features. The coverage creation process differs depending upon coordinate input devices, and whether a source coverage is used or not.

4.1.2   Open

This command is used to select a coverage for editing and a feature class to edit.

4.1.3   Save

This is used to specify the name of a new object as which the current edit object can be saved.

4.1.4   Save as

Same as 4.1.3

4.1.5   Table: new

This tool is used to create a new INFO table file with defined items. Enter a new INFO table name and items to create for INFO data. Define item names, types, widths, output widths and decimal places (if item type is F or N), and place them in the "Create items" scroll list. This command is the same as to define items in INFO Tables.

4.1.6   Table: open

Used to select an INFO table file for editing. Note that you cannot edit $$TEMP files and feature attribute tables (.AAT, .PAT, etc.). To edit an INFO Table select one in the "Tables" scroll list.
This command is the same as to select and edit commands in INFO Tables.

4.1.7   Table: save

Save INFO file.

4.1.8   Table: save as

Save as INFO file.

4.2   Edit

4.2.1   Change Edit feature

Used to select an edit coverage and feature class for editing.
Available edit covers is to specify which edit coverage you wish to
edit by selecting it with the left mouse button. Available features is
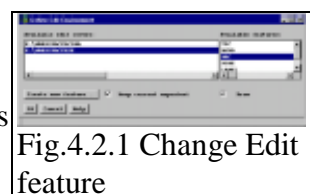to specify which edit feature. (See Fig.4.2.1.)

Fig.4.2.1 Change Edit feature

4.2.2   Feature Edit menu

Use to edit ARC and Node features in the current edit coverage. This menu contains all graphic operations available to edit the ARCs in coverage, to add new ARCs, and to correct ARC digitizing errors. Node editing operations include the capabilities to add and delete Nodes (i.e. split and unsplit ARCs) and to move Nodes. This menu is used to access AAT and NAT records for editing. Edit operations are grouped by the type of editing. ARC and Node editing operations are performed on one or more selected features.

The edit process is:
  1. Select features using [Graphic selection] or [Attribute selection] to highlight them.
  2. Press the desired edit button to edit the highlighted features.
     Any edit operation that has been performed since the last "Save" can be undone using the [OOPS] button.
 - Add:
     Add new ARCs. Use the 2 key to start and end each ARC (i.e. to specify the Nodes) and the 1 key to enter vertices. Other operations can be performed using additional keys.
 - Delete:
     Delete highlighted ARCs.
 - Copy:
     Copy highlighted ARCs by specifying a from location and a to location after pressing [Copy].
 - Copy parallel:
     Copy the highlighted ARC to a specified location from its current location to create line parallel to the selected ARC with the same shape. Only one ARC can be selected for this operation.
 - Move:
     Move highlighted ARCs by specifying a from location and a to location after pressing [Move].
 - Move parallel:
     Move the highlighted ARC to a specified location from its current location to create a line parallel to the selected ARC with the same shape. Only one ARC can be selected for this operation.

- Rotate:
> Rotate highlighted ARCs. First, specify the pivot point and then the angle of rotation after pressing [Rotate]. User can set the Rotate angle under [Edit Env].

- Rotate and Snap:
> This command activates the Rotate and Snap tool. The tool contains a series of selections that allow the user to move, rotate, and snap ARCs and Nodes within the edit coverage.

- More ARC editing:
> This command presents the More ARC Editing menu. The menu contains extra ARC editing functions.

- Edit Nodes:
Split:
> Split an ARC by adding a Node at the specified location. Only one ARC can be selected in this operation.

Unsplit:
> Combine highlighted ARCs sharing a pseudo Node by removing the Node. By default, the ARCs must have the same User-ID. Use Unsplit item under [Edit Env] to specify a different item or set Unsplit item to NONE.

Move Nodes:
> Move Node locations.
> ARCs do not have to be highlighted before this operation. Nodes to be moved are selected after pressing [Move Nodes].

- Error correction:
> Correct undershoots
> Extend the endpoints of highlighted ARCs to snap into an existing ARC. (Hint: Select dangling ARCs by pressing the [More] button on the Feature Selection tool.)

- Correct overshoots
> Intersect dangling ARCs if they overlap other ARCs and delete the excess segments that fall within a specified distance.

- Intersect overlaps
> Split highlighted ARCs at their intersections if they overlap.

- Snap
> Snaps ARCs to other ARCs. The snap feature for your edit coverage must be set to ARC. The user can set this with [Edit Env].

- Attributes Table Mngr:
> Display the feature attribute table manager for ARCs or Nodes.

- Table editor:
> Display the feature attribute table editing tool for ARCs or Nodes.

- ARC | Node
> Specify which feature attribute table is active when the table manager and editor are called up.

- Other: Get from cover:
> Copy ARCs into the current edit coverage from the coverage you specify after pressing [Get from cover].

- Put to cover:
> Copy highlighted ARCs as the name of the coverage you specify after pressing [Put to cover].

- Edit Env:
> Set ARC/Node editing tolerances and properties.

 - Oops:

Undo the last edit operation.

4.3   Tools

4.3.1   Command Tools

This is the command line of ARCEDIT on command windows.

4.3.2   Snap Environment

Fig.4.3.1 Snap environment

This tool is used to set up one or more snap coverages for a specified edit coverage and feature, and specify the order in which the snap coverage features are seARChed. (See Fig.4.3.1.)
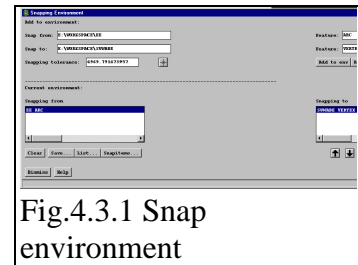
4.3.3   Edge match

Used to align features on the edges of coverages to append coverage. (See Fig.4.3.2.)

Fig.4.3.2 Edge match

4.3.4   Transfer

This command is used to copy the attributes, coordinates or both from features in the source cover to features in the current edit coverage. To transfer attributes, both the transfer and edit features must possess feature attributes. To transfer coordinates, the transfer and edit features must be the same. (See Fig.4.3.3.)
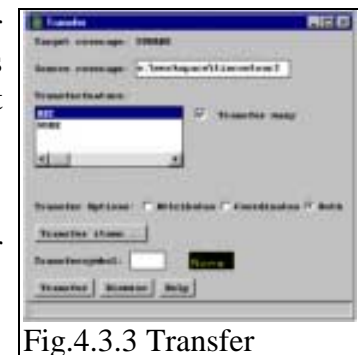

Fig.4.3.3 Transfer

Target coverage:
Displays the current edit coverage that the attributes or coordinates will be transferred to.

Source Coverage:
Specifies the coverage to use as the source of the transfer features. To obtain a scroll list of coverages available, click the right button in the input field.

Transfer feature:
Displays the features available in the source coverage. Select the feature in the list to use as the source for the transfer operation.

4.3.5   Topology

This tool is used to update the polygon topology and the polygon attribute table (PAT) without correcting coordinate errors. (See Fig.4.3.4.)

This command builds a polygon topology using the selected features. The Build command can be undone by pressing the [OOPS] button in the Edit Polygons menu.
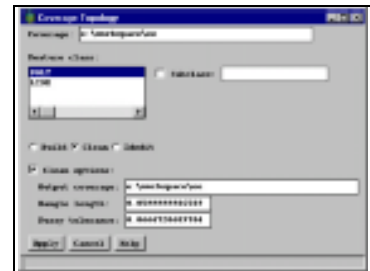
4.3.6 Clean

This command is used to generate a polygon topology by editing and correcting geometric coordinate errors, assembling ARCs into polygons, and rebuilding the polygon attribute table (PAT). (See Fig.4.3.4).

Fig.4.3.4 Build Polygon and Clean

Specify a fuzzy tolerance, and ARC vertices that fall within the fuzzy tolerance will be removed when the coverage is cleaned.

Specify a dangle tolerance, and the initial value is the default for the current edit coverage. Dangling ARCs that fall within the dangle tolerance will be removed when the coverage is cleaned.

4.3.7 Unit Calculator

The Unit Conversion Tool is used to convert numbers between different measurement systems. For example, you may want to know how many meters are equivalent to 5 miles; which might be used in a buffer computation. (See Fig.4.3.5.)

Fig.4.3.5 Unit calculator

4.3.8 Error plot

This command creates an ARC/INFO graphics file from a coverage. The Feature drawing options allow tic, ARC, Node and label features to be drawn with feature identifiers. The default setting is no User-IDs. (See Fig.4.3.6.)

4.4 Display
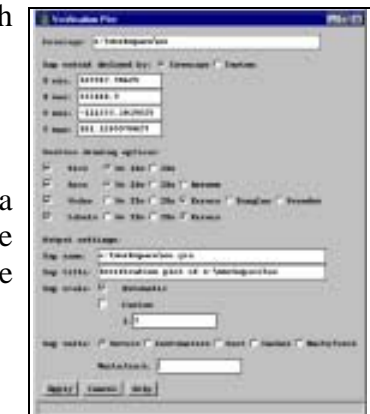
4.4.1 Draw

This command is used to draw a coverage on the window.

Fig.4.3.6 Error plot

4.4.2 Draw selected

Selected object shows as a yellow line only and is displayed on the window.

4.4.3 Clear

Selected object will be cleared.

4.4.4 Draw environment General

The user can manage the drawing environment of ARCEDIT to display a coverage on the window. Select features such as ARC, Node, Label, Tic, LINK, Annotation, Polygon, Region and Section Route Group. Draw option is on by selecting options such as IDs, Arrows, intersection and symbols. The user selects the desired options to display a coverage on the window. (See Fig.4.4.1.)
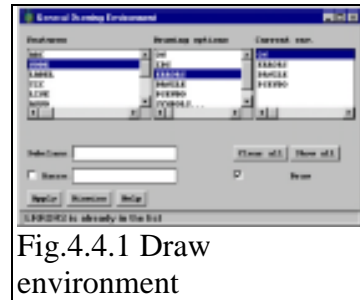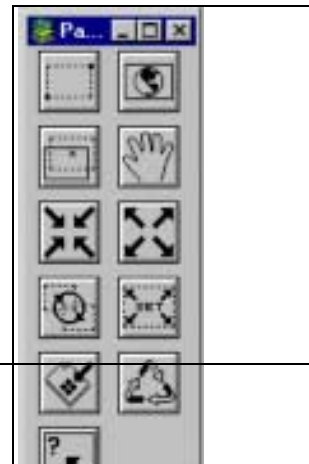
Fig.4.4.1 Draw environment

4.4.5 Back Object Environment

Choice of the background coverage

4.4.6 Pan/Zoom

Pan and zooming of the coverage such as zooming, zoom-out, pan display all. (See Fig.4.4.2.)

4.4.7 Change symbol set

See Fig.4.4.3.
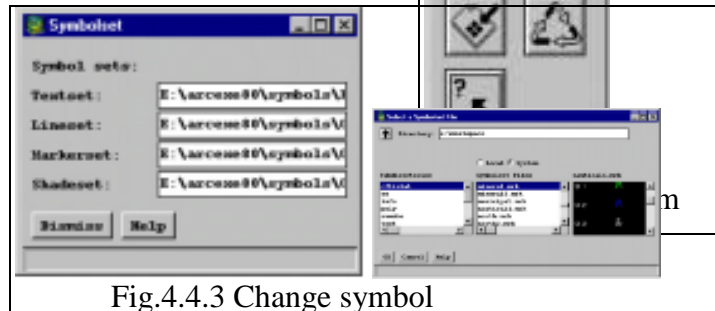
Fig.4.4.3 Change symbol

Text set   Setup for the properties of text on display

Line set   Set up for the properties of line data on display.

Markerset   Set up for properties of symbol and others on display, called Marker file.

Shadeset   Setup for properties of color table and polygon on display, called Shade file.

4.4.8 Quick Plot

This command allows you to create a quick output (1040 graphics file) on the edit canvas. Select a plot file and properties of paper. (See Fig.4.4.4.)

4.4.9 Current status

This command displays the present coverage status on the window. (See Fig.4.4.5.)

Fig.4.4.4 Quick plot

Fig.4.4.5 Current status

Memo random Editing by ARCEDIT

The procedures to edit feature is as follows:

-1 Open the coverage.

-2 Select Edit feature from TIC, ANNO, ARC, NODE, LABEL and POLYGON.
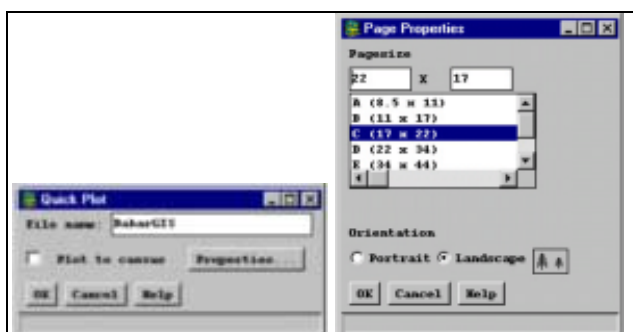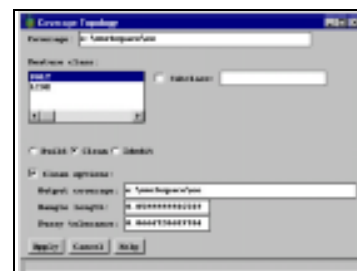   The user must select the edit feature for editing data, considering the data condition
   timely.

-3 Check the draw environment.
   Select the drawing option for display:
   It is supposed to check ARC on; Node on; Node error on; Label on; Label Error.
   The user must set up the draw environment for editing timely.

-4 Set up the Edit feature.
      Check EDIT environment as follow:
      - Node snap tolerance: Set up distance by clicking the icon and enter two points on
                              the window.
      - ARCSnap tolerance: Set up distance by clicking the icon and enter two points on
                            the window.
      - Intersection: Check on.

-5 Editing work
-5.1 Add ARC in the same way as Add TIC, Add BND, Add Label
      - Click the icon of Add ARC.
      - Click the button 2 from the keyboard or the digitizer button at the start Node.
      - Click the left button of the mouse or enter 1 from the keyboard or enter the
        digitizer button 1 to put a vertex.
      - Continue to trace up to the last step.
      - Enter 2 from the keyboard or enter 2 from the digitizer button.
      - Enter 9 from the keyboard or click the digitizer button to quit.

-5.2 Del ARC same as Del TIC, Del BND, Del Label
      - Click the icon of Del ARC.
      - Click the left button or enter 2 to select ARC.
      - Enter 9 from the keyboard.
      - Click the select icon and select the object by the left click of the mouse to
        continue to select.
      - Enter 9 from the keyboard to end the selection.
      - Click the icon of Del ARC.

-5.3 Move V same as Move TIC, Move BND, Move Label
      - Select ARC and enter 9 from the keyboard.
      - Click the icon of MoveV
      - Select a vertex to move by clicking the left button of the mouse.
      - Enter 4 from the keyboard.
      - Click the point to move the vertex.
      - Enter 9 from the keyboard.

- 5.4 AddVin the same way as Add TIC, Add BND, Add Label
  - Select ARC and enter 9 from the keyboard.
  - Click the icon of AddV
  - Click the point to add a vertex by clicking the left button of the mouse.
  - Continue to click to add a vertex.
  - Enter 9 from the keyboard to quit.

- 5.5 DelV in the same way as Del TIC, Del BND, Del Label
  - Select ARC and enter 9 from the keyboard.
  - Click the icon of AddV
  - Click the point to delete a vertex by clicking the left button of the mouse.
  - Enter 4 from the keyboard.
  - Continue to click to delete a vertex.
  - Enter 9 from keyboard to quit.

-6 After all the editing steps finish, save the coverage.

-7 Process to Clean and Build to check the topology and to complete the coverage.

-8 Check the coverage in ARCedit again to repeat this process to complete.

5.   INFO command

INFO and Tables in ARC commands manage the database in ARC/INFO.

-1   DEFINE command defines the data file structure called scheme, and its data record is written in INFO data file. This creates the new format of INFO file including:
- Definition of item from keyboard.
- Effective item type
  - D defines date.
  - C defines character in the same way as text data.
  - N defines numeric.
  - I defines integer.
  - B defines binary integer (two bytes or four bytes).
  - F defines binary float integer (four bytes or eight bytes).

-2   Directory or dir command from the keyboard makes a list of INFO data file.

-3   SELECT Command
This command selects records in the active INFO file to manage to display data, to edit and to update the data.

-4   ITEMS command makes a list of the definition of item in INFO file.

-5   LIST command displays the contents of selected INFO file.

-6   REDEFINE command defines the existing INFO file to divide or to combine the existing defined items. REDEFINE can not be used for the B or F type of item.

-7   ADD command adds the record to the defined scheme. Before this operation, use select command for this scheme. There is a choice by manual operation from the keyboard or by importing of record file by editor.

-8   PURGE command deletes the queried record from data file.

-9   ERASE command deletes the INFO file.

-10 UPDATE command changes the value of each item in the selected record of data file, which data unit is based on one record.

-11 CALCULATE command calculates the value for the selected or related data file.
Select the target record at first by the select command and its condition.
Enter the statement for CALCULATE. The blank is needed in each item and condition.

-12 Modify and Alter
There are two commands to change the scheme in INFO database.
- In case of no record data, MODIFY or ALTER command are available.
- In case of existing record, ALTER command is available.
  ALTER has more functions than MODIFY, but it can not change the length of items.

-13 RESELECT and ASELECT and NSELECT

There are three commands to query INFO database as follows:
- RESELECT command selects the record to satisfy any condition and combination of data set to extract the same as the statement in SQL language. The following is the command line:

      SELECT CFTR04.CODE
       RESELECT LANDUSE = 20 or LANDUSE = 30

- NSELECT command selects the opposite record against the current records.
- ASELECT command adds the record that satisfies the additional condition to the selected one.

-14 Link command between the coverage and INFO
- JOINITEM command joins the two INFO files through the relate item as the key field.

-15 The link between the coverage and INFO
- ADDITEM command adds the new item to the existing INFO file.
- PULLITEMS command copies items in the existing INFO file to another file.
- DROPITEM command removes the unnecessary items in the existing INFO file.
- IEDIT must be operated when user ID is modified in INFO.
- RELATE command defines the relation among data files. This environment is saved as the configuration file in ARCPLOT and ARCEDIT.

6.   Utilities

6.1   Transform

The coverage can transform any map coordinates. The operational steps will be described taking the example of ARC command to change the map unit from inch to meter in UTM:
- -1 Create the new vacant coverage using CREATE command in ARC.
     CREATE   B   A   Create the coverage B that has only TIC file, same as the coverage A.
- -2 Set up the TIC file in INFO file to prepare the corresponding coordinates in a map.
  Change the TIC coordinates in the coverage B that will be transformed by using UPDATE in INFO.
- -3 Use TRANSFORM command.
     TRANSFORM   A   B   The coverage A will be transformed to the coverage B.

6.2   Mosaic of map

The mosaic of the coverage will be merged by APPEND command or MAPJOIN command. There are differences between these commands as follows:

Command Function	APPEND	MAPJOIN
Maximum of the coverage	100	100
Type of coverage	All data structure	Poly or Net
Node matching	No	Do
Intersecting	No	Do
Build topology	No	Do
Treatment of different coverage	Possible with the option	Impossible
Clipping after merge	No	Do
Attribute	Ignore with the option	Possible if the same data structure is given.

Pay attention to:
- -1 TIC coordinates must be coincided with each other.
- -2 Node coordinates must be coincided with each other.
- -3 The values of items in polygon must be coincided with each other.

6.3 Overlay Analysis

Overlay analysis in ARC/INFO needs to process the topological operation for overlay whenever it is done. To analyze data in target thematic maps, process the overlay operation in the following steps:
- Set up the purpose and criteria for overlay for data analysis.
- Operate overlay for the figure data
- Analyze data in tabular operation in INFO and display the thematic map and the evaluation map.
- Output the result by ARCPLOT

Topological overlay creates a new map in the overlay operation of features between two map layers. This new feature will be built in the overlapped areas of polygons. The attributes in two layers will be adjoined to each other to explain the each new feature.
Types and modules of overlay processing in ARC/INFO are shown in the following table:

Table of Overlay Modules in ARC/INFO

Function Command	INTERSECT	UNION	IDENTIFY	UPDATE	CLIP	ERASE
Type of input coverage	POLYGON, LINE, POINT	POLYGON	POLYGON, LINE, POINT	POLYGON	POLYGON, LINE, POINT	POLYGON, LINE, POINT, NET, LINK
Type of overlay coverage	POLYGON	POLYGON	POLYGON	POLYGON	POLYGON	POLYGON
Area of output coverage	Intersected area	Union area	Same as input coverage	Updating in the area of the overlay coverage.	Extracted in the area of the overlay coverage	
Attribute of output	Success in both coverages	Success in both coverages	Success in both coverages	Same as input coverage	Same as input coverage	Same as input coverage
User ID	Changed	Changed	Changed	Changed	No change	No change

7.   Data Exchange

ARC/INFO provides several conversion modules to exchange data in different GIS formats such as: AMS format, GBF/DIME format, DFAD format, DLG (Digital Line Graph), AutoCAD ASCII DXF, ERDAS GIS file, ETAK MapBase file, USGS GIRAS format, GRID Single Variable File(SVF), Data in PIOS system, IGES format, GIS data in the MIDAS system in USDA, MOSS file format, Digit file and SYMPLACE file in SCITEX, TIGER/LINE file, SDTS, GRASS data, Shape in ARCview, ARC/INFO Inter-Changing File (E00 file), Generate. There are some data conversion modules for the surface models such as coverage, TIN, Lattice, VRML, DEM. For the details, please refer to the manual for each formtat.
The list of conversion modules in the menu is as follows:

(1) To ARC ->   Dime to ARC, DFAD to ARC, DLG to ARC, DXF to ARC, Etak to ARC, IGES to ARC, MOSS to ARC, Shape to ARC, SLF to ARC, VPF to ARC, Defined layer to ARC, Import of E00 file, Generate, and INFO to Point

(2) To Region -> ARC to Region, Poly to Region

(3) To Grid ->   ADRG to Grid, Ascii to Grid, Float to Grid, Line to Grid, Point to Grid, Poly to Grid, Tin to Grid, DEM to Grid, Grass to Grid, and Image to Grid

(4) To Cogo -> Convert to Cogo Cover, ARCs to Cogo ARCs, and Convert field data

(5) From ARC ->   ARC to DLG, ARC to DFAO, ARC to DIME, ARC to IGES, ARC to DXF, ARC to SDTS, ARC to Shape, ARC to VPS, ARC to VDF tile, Export of E00 file, and Ungenerate

(6) From Grid -> Grid to image, Grid to Line, Grid to Point, Grid to Poly, Grid to Ascii,
Grid to Float, Grid to DEM, and Grid to Tin

(7) External DBMS -> INFO |DBMS, DBMS |INFO

(8)Surface ->   Tin to Coverage, Tin to Lattice, Tin to VRML, Lattice to TIN, Tin builder, DEM to Lattice, Lattice to DEM

8.   **TIN**

In the IIMS system, the TIN module to process the three-dimensional data is installed in the core module of ARC/INFO. TIN (Triangle Irregular Network to constitute) is the surface model of topographic module. There are two surface models to use TIN directly and to use a lattice on the grid. The user selects either depending on the situation in use. These models are used for the three-dimensional modules in ARC/INFO such as contour computation, volume calculation on surface model, three-dimensional view of the coverage on display.

There are two approaches to create TIN: based on the line coverage of the contour data and based on the Grid data. The coverage data of TIN can exchange data between the coverage and Grid. The example of processing the TIN from the coverage and GRID data will be given below.

   -1   Preparation for the coverage for TIN
        - The contour data is processed in the line coverage. The field to store the elevation
          data is registered in INFO.
        - Raster data of DEM data is processed in the GRID format.
   -2   Creation of surface model
        - Select the module in the menu of Surface ->Tin builder and create TIN.
        - Select the module in the menu of Surface ->Grid to Tin and create TIN.
   -3   Conversion of surface module
Alhough TIN supports the three-dimensional module in ARC/INFO, the user can convert its format to lattice as necessary.

8.1   Analysis Surface Contour

This module computes contours from an elevation model or isolines from any type of surface in TIN of lattice or tin.

8.2   Analysis Surface Line of Sight

This tool is used to calculate the visibility between two points on a surface. The required inputs are an observer and a target position. The tool draws a color-coded line on the map display. The colors represent those sections along the line that are visible or invisible to the observer.

8.3   Analysis Surface Profile

This tool is used to calculate a profile graph from a set of user-specified points. The profile is calculated on the current surface loaded in ARCPLOT. The graph is popped up in a separate window. An INFO table can optionally be saved for later use as a layout graph tool.

8.4   Analysis Surface Visibility

The Visibility Tool is used to compute those areas which are visible from one or more observation locations, using the ARC VISIBILITY command.

8.5   Analysis Surface Cut-Fill

This module creates a lattice and polygon coverage with volume information describing changes of the surface to a lattice after a cut-and-fill operation.

8.6   Analysis Surface Volume

This module calculates the area and volume of a tin.

9.   Reference

-   ARC/INFO Reference Manual
-   Inside of ARC/INFO
-   Understanding GIS