

THE EFFECTIVE CONSTRUCTION OF MAP DATABASE USING A DATA MODELING

Kang Joon-Mook^{*}, Yun Hee-Cheon^{**}, Lee Hyung-Seok^{***}

^{*} Chungnam National University,
Dept. of Civil Engineering, Professor, KOREA
kang_jm@hanbat.chungnam.ac.kr

^{**} Ansan College of Technology,
Dept. of Civil Engineering, Professor, KOREA
yoonhc60@ansantc.ac.kr

^{***} Chungnam National University,
Dept. of Civil Engineering, Research Assistant, KOREA
s_hs2@hanbat.chungnam.ac.kr

IC Working Group IV/III.1

KEY WORDS: data modeling, cadastral map, E-R diagram., spatial data.

ABSTRACT

The database of Geographic Information System should be established with the method to be able to manage by inputting attribute information more easily and exactly through linking attribute information to graphic information.

In this study, the module could be developed that be able to input attribute information effectively by representing the relationship with the entity of attribute information related to cadastral through using a data modeling method and construct the database that be able to be linked with map data.

As for data modeling, the Entity-Relationship Diagram is used to link the relationship among attributes by finding entity on all the registration matters of cadastral map. The schema is created about relational database as the physical model work about all the tables, after designing the concrete database by establishing an input method. And, cadastral map database could be established effectively by keying-in after completing the visual form that be able to be carried out through linking to database. Based on these results, the plan of efficient management system which linked graphic and attribute information can be suggested.

1 INTRODUCTION

Cadastral maps become the basis of land surveying, and they are being utilized as the basic data for establishing and designing all sorts of public plan including national land all-out plan and urban design. Moreover, present cadastral maps should be utilized as the basic data of all out graphic information to be operated in computer as well as digital surveying directly by digitizing them and making them into information.

The system of cadastral map management is being used by inputting and storing attribute information mainly. In the state that graphic data and attribute data are not established through connection, limitation nature gets to follow in the scheme of mutual connection with land information system only with the computerization of this partial cadastral record.

In this study, this researcher tries to develop the module to be able to input attribute information effectively and establish the database to be connected with cadastral map data by expressing the relationship with entity among attribute data related to parcel through using data modeling method.

As for data modeling, this researcher used E-R diagram to connect the relationship among attribute by finding entity on all the register details of graphic cadastral maps. This researcher creates schema in relational database as the physical model work about all the tables after designing concrete database by establishing input method. Completing visual form to be able to input data directly by connecting with database was effective for establishing attribute information. This researcher tried to offer the scheme of efficient management system of graphic information by presenting various forms of spatial analysis and application method through the database established on the basis of the mutual connection between attribute information and graphic information.

2 CONSTRUCTION OF CADASTRAL INFORMATION

2.1 Cadastral information

Cadastral maps should be grafted with geographic information system by being linked to the key item to be based on unified parcel number system. We should consider the diverse scales and administration district boundary etc. of existing cadastral maps, and database should be established through structuralization compilation to be able to connect with all-out land information system by combining with the attribute information of register.

Cadastral maps are being used as base map in various fields including route design and plant plan etc. In case of cadastral maps, the improper and confusing rearrangement and integration of graphic outline contents at the time of arranging the arable land for the development of housing land may cause confusion at the time of reading and issuing the cadastral map and forest map of civil petition people. The inexact and excessive quantity of drawing like this causes inconvenience for removing and arranging the duplication of graphic data at the time of establishing and utilizing geographic information system, and it enables update to be uneasy.

In addition, it is considered that much time is required for the input of exact parcel and that considerable difficulty will be caused in the side of economical efficiency and efficiency at the time of establishing this cadastral maps database. Thus, it is the real situation that we should make a plan without a moment's delay for the efficient establishment of cadastral information about the efficient drawing management and the collective handling of all the attributes. Establishment through the mutual connection between graphic data and attribute data occupies great relative importance as much as it may govern the application nature.

Table 1 is what enumerated the data to be able to utilize in the choice of data. Then, graphic data included cadastral maps and forest maps, and attribute data included land register and forest register, on the basis of cadastral record.

Information	Data format	Related data
Cadastral Information	Graphic data	Cadastral maps, Forest maps
	Attribute data	Alphanumeric cadastral record

Table 1. Type and data of cadastral information

2.2 Spatial data

This researcher performed precise scanning by using the map scanner (ANAtch Eagle 3640) of high resolution after duplicating the cadastral maps(Scale 1:1000, 1:1200) and forest maps(1:6000) of study area precisely. This researcher used semi-auto vectorizing to change graphic attribute by designating parcel as occasion demands after displaying the cadastral maps and forest maps of raster format on monitor. Fig. 1 is what illustrated digitized part.



Figure 1. Cadastral maps in the study area

One of the problems of graphic cadastral maps is that the unconformity among graphic outlines appears. As for this boundary unconformity, there are the case that it appears among the graphic outline of cadastral maps of same reduced scale, the case that it appears among the graphic outline of cadastral maps of different reduced scale, and the case that it

appears in uniting the graphic outline of cadastral maps at the boundary of legal degree etc. The types may be classified into the case that duplication and isolation are made, the case that mutual crossing is made, the case that cadastral maps are not fit for present situation at all etc. The work of boundary congruence of cadastral maps and forest maps follows the borderline of cadastral maps. And, in case that the cadastral maps of different reduced scale are adjacent, it follows the borderline of cadastral maps of large scale.

For the overlay and matching among data that accuracy is different mutually, it was desirable to use affine transformation method to maintain line as it is by considering the computerization and compilation of cadastral maps.

Fig. 2 is what summarized the stage for making polygon database by combining boundary and non-graphic attribute. Spatial data complete vectorizing with line type. In the error of space data that we should correct, there are the duplicate line, undershoot and overshoot in case of line, the error to appear from the omission or duplication of representative dot, and the wrong intersection etc. in case of polygon. We get to designate parcel boundary as areal boundary feature and create the area centroid at this parcel boundary feature automatically. We get to create database table at areal boundary feature and input attribute data related to cadastral maps.

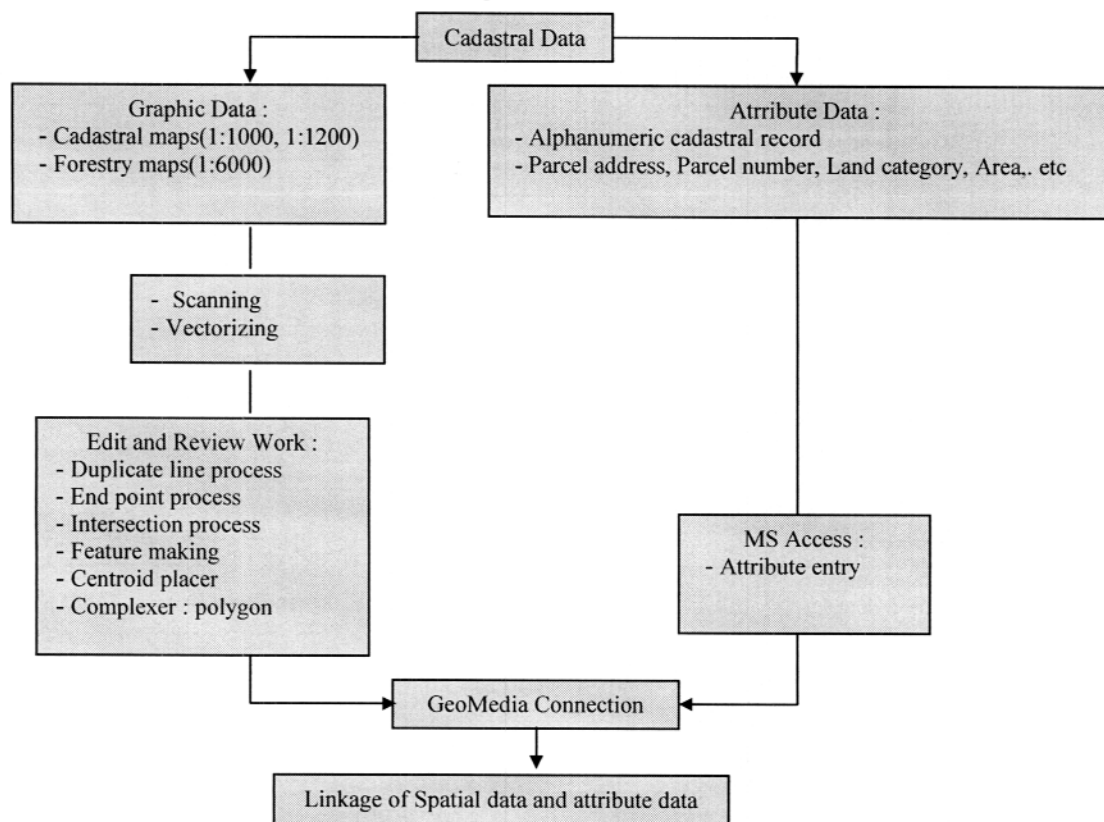


Figure 2. Construction process of vector polygon database

2.3 Attribute data

2.3.1 Data modeling

Entity-relational model is composed of entity, relationship and attribute, and it is the data modeling technique to explain the entity, the attribute about each entity and the relationship among entities. It is one of the most general methods to be used in developing logical data model as the graphic and stereotyped expression tools of concept model.

We may make entity-relationship diagram by drawing the relationship among objects by choosing object from toolbar. This researcher expresses the entities of space information of subject and the relationship through using entity-relationship diagram by extracting necessary entity from many objects to exist in real world and changing into the concept world to define the relationship among these. Fig. 3 and 4 showed the establishment of database of cadastral maps of this study by classifying into logical model and physical model as what made out it by using entity-relationship diagram.

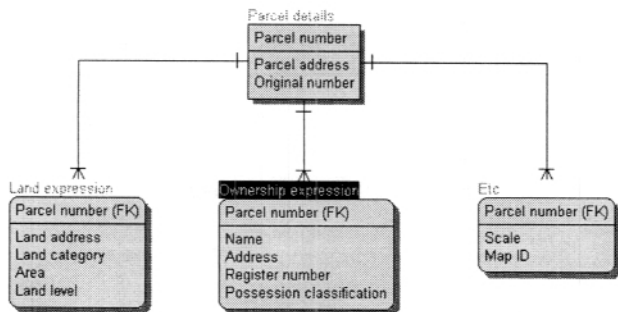


Figure 3. Entity-relationship diagram(logical model)

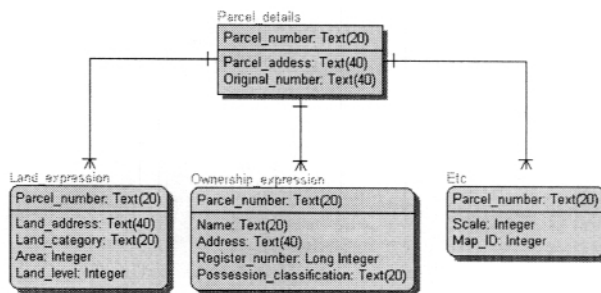


Figure 4. Entity-relationship diagram(physical model)

2.3.2 Conversion relational model to E-R diagram

This researcher designs logical schema by using relational model from conceptual schema. In addition, this researcher converts conceptual schema into logical schema. Converting the concept model expressed with E-R diagram to relational data model is required.

Fig. 5 shows the process of establishment of cadastral map database to use data modeling. First, it forms the structuralization among cadastral businesses through data flow diagram. We make the data dictionary to be able to explain by making each list. Here, business analysis and data dictionary should be minute and clear. Data modeling to insert attribute and connect relationship by finding entity gets to be established with E-R model to consider the feature of RDBMS. We design schema after establishing input method. Access 97 at MicroSoft Co. creates schema, after the physical model work about all the tables ends.

- 1. Data Flow Diagram
- 2. Data Dictionary
- 3. Data Modeling : E-R Diagram
- 4. Schema Desgin
- 5. Cadastral Maps DB Construction

Figure 5. Cadastral maps database construction

Figure 6. Attribute entry window

Fig. 6 shows the form executed by compiling at Visual Basic 5.0 after completing by linking to Access to be database program. We get to be able to input cadastral data by inputting here with key-in or importing existing database. We get to pass through the inspection work to confirm the data input finally.

2.4 Attribute input and data linkage

About the data of land register as table 2, this researcher input them on the basis of the most basic details such as parcel number, parcel category, area and land level etc. And, about the relevant informations recorded in land register like fig. 7, this researcher established them by using access program and connected this with graphic data through GeoMedia 2.0.

Only in case that spatial data and attribute data are connected mutually, it may be referred to as GIS data. This researcher could confirm that each one graphic entity has non-spatial data after completing the input of spatial data and non-spatial data.

Original number	Land address	Parcel number	Parcel category	Area	Land level	Date of level modify
210-105-00-1-12-1	JamHong-Dong	12-1	02	2142	135	1994.1.1
210-105-00-1-779-2	JamHong-Dong	779-2	15	112	13	1995.2.1
210-105-00-1-10-3	JamHong-Dong	10-3	15	1547	132	1993.1.1
210-105-00-1-11-3	JamHong-Dong	11-3	02	3640	136	1993.1.1
210-370-26-1-924-3	SangHong-Ri	924-3	05	357	137	1994.1.1
210-370-26-1-924-1	SangHong-Ri	924-1	05	536	132	1995.2.1
210-370-26-1-904	SangHong-Ri	904	02	1280	130	1993.2.1
210-370-26-1-907-2	SangHong-Ri	907-2	11	69	132	1994.1.1
210-370-26-1-907-3	SangHong-Ri	907-3	11	119	99	1984.7.1
210-370-26-1-907-1	SangHong-Ri	907-1	02	1036	134	1994.1.1
210-370-26-1-905	SangHong-Ri	905	02	823	131	1993.1.1
210-370-26-1-902	SangHong-Ri	902	02	2112	132	1993.1.1
210-370-26-1-906	SangHong-Ri	906	01	992	131	1994.1.1
210-105-00-1-10-2	JamHong-Dong	10-2	02	334	136	1994.1.1
210-370-26-1-901-3	SangHong-Ri	901-3	02	2838	132	1994.1.1
210-105-00-1-9	JamHong-Dong	9	01	486	138	1994.1.1

Table 2. Computerization data of land register

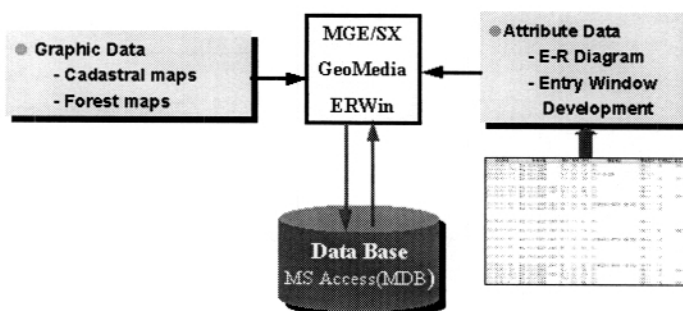


Figure 7. Linkage flowchart of graphic data and attribute data

3 SPATIAL ANALYSIS

Like this, storing attribute data by using the information related to cadastral maps and combining this with graphic data by utilizing geographic information system could establish cadastral information database. That this integrated spatial analysis function to be performed in geographic information system is distinguished from the analysis function to be offered from CAD or DBMS is that diverse analyses are possible as graphic information and attribute information are connected.



Figure 8. Query analysis(parcel less than 1,000 m² area)

Attribute information input in Access 97 through the window of attribute input may do the spatial analysis of database established per parcel by connecting with GeoMedia at Intergraph Co. Making out thematic map through the spatial analysis of area of study subject on the basis of it may offer effective basic data.

Thus, we get to be able to inquire about the object by administration district, parcel and parcel number and inquire about the attribute information of object chosen from scene and the attribute information about various objects. It is performed in the model of fixed size, and it may produce the diverse degrees such as sum, average, minimum and maximum etc. of a certain characteristics in neighbor region. In addition, utilizing the spatial query to use diverse spatial operators gets to be able to extract area from polygon automatically. Fig. 8 is what showed the parcel that land area is less than 1,000 m² out of the lands of study object.

4 CONCLUSIONS

In this study, this researcher could obtain the following conclusions by connecting and establishing graphic information and attribute information on the basis of the relevant details of cadastral maps through using data modeling.

Establishing database by creating visual form to be able to input attribute data efficiently through data modeling could aim at the efficiency tendency for the connection between spatial data and attribute data, and it enabled the spatial analysis to use diverse spatial operator on the basis of the attribute input in parcel which is graphic data.

Cadastral information system to be established on the basis of cadastral maps will have to be designed as the countermeasure for data renewal on the premise of additional supplement and correction.

In offering civil service to need cadastral information, integrating and establishing all the all-out land information in addition to cadastral information will be able to establish better cadastral information system about the data to be necessary for all sorts of land policy in conformity with policy goal.

Managing national land information efficiently in connection with the drawing information related to land on the basis of making cadastral maps into digital information will be able to support decision-making effectively.

REFERENCES

- Oh Yi-Kyun, Hwang Bo Sang-Won, Sin Dong-Yun, 1996. A Study for the Computerization of Cadastral Maps for Building Parcel Based Land Information Systems, *Journal of the Korean Society of Cadastre*, Vol.12, No.1, pp.102-113.
- Sin Dong-Yun, 1997. A Study on the Way to Establish the Computerization of Cadastral Surveying System, *Journal of the Korean Society of Cadastre*, Vol.13, No.1, pp.73-88.
- Robert Weibel, 1992. Improvement of GIS graphic for Analysis and Decision-making, *International Journal of Geographical Information Systems*, Vol.6, No.3, pp.223-245.
- Robert Laurini and Derek Thompson, 1994. Fundamentals of Spatial Information Systems, pp.351-398.
- Linda Tomaselli, 1994. Topological Transfer : Evolving Linear GIS Accuracy” , *URISA*, pp.245-259.