THE SYSTEM OF CLASSIFICATION OF MAP DATA FOR DIGITAL MAP

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ABSTRACT

There are several systems for digital mapping in Japan. However, they are independant each other, so that the convertibility has not established yet. Therefore, it has been recognized that the digital mapping sytem should be standardized. On the background of this situation, the Geographical Survey Institute has studied about the standard of digital mapping system. In this paper, the results of our research, especially the cahracteristics of digital map and code system, are discussed. The examples of maps which were produced in accordance with the standard are also shown.

INTRODUCTION

Preamble

The recent development of computer and information processing method has made it possible to make maps directly from airphotoes by digital processing. This new method for map making is called digital mapping and several systems for digital mapping have been developed in Japan. The development of these systems have been mainly by the private surveying companies or CAD makers, so that they are independent each other and not convertible. Therefore, it is strongly recognized that the standard of digital mapping should be required. As there have not been ideal system so far and some companies are planning to develop furthermore their own digital mapping systems in near future, the present is definitely the time for making the standard of digital mapping. This paper is the interim report concerning the standard of digital mapping. Particularly, the structure and code system of map data are discussed in this paper.

Basic Principles

Although there are several advantages in the digital mapping, the most inportant point is utilization of digital map data derived from the digital mapping. Therefore, first of all, considering the utilization of digital map data is the most fundamental principle. The digital map data should be used for various purposes, those are, road management, utility facilities management, transportation control and so forth.
The second fundamental principle is not to specify the hardware or software itself. Sevral systems are working at present and they have advantage and disadvantage respectively, so it is undesirable and impossible to specify the system.

Instead of specifying the system, the standard refers to the procedure, final products and required accuracy of digital mapping.

DIGITAL MAP AND PRINTED MAP

In the conventional method of photogrammetry and cartography, the printed map is the main product. In the digital mapping, the digital map, which is expressed in the magnetic tapes and also drawn by outputting from them, is important.

Comparison of Digital Map and Printed Map

In order to understand the characteristic points of digital map, it is helpful to compare the digital map and printed map. Table 1 shows the comparison between them.

Basically, on the printed map, three dimensional ground information is projected to two dimensional plane in accordance with scale, so that there is limitation of expression of objects and topographies. If all of the objects and topographies were drawn exactly on one sheet of map, the expression would become too complicated and it would be difficult to read and understand the content of map. Therefore, it is important to harmonize the accuracy of location and the convenience of reading. For this purpose, there sometimes occurrs dislocation, enlargement, omission, symbolyzing and so forth of objects and topographies. On the other hand, the digital map is free from size of paper or easiness of reading, so that it is possible to express objects and topographies exactly on the digital map in accordance with the scale.

	PRINTED MAP	DIGITAL MAP
Identification of objects	By colour, type of line, symbol and text	By code and associated attribute
Expression	Two dimensionally drawing on paper sheet	Three dimensional data
	Limited attributes of objects	Linkage between co-ordinate and many associate attributes
	Dislocation, enlargement and omission of data	No need of dislocation, enlargement and omission
	Impossible to draw the objects hidden under other objects	Capable to hold the data under other data
Products	Printed map	Three kinds of magnetic tape which are utilized for various purpose Drawn map from magnetic tapes
Topological relation	Recognized graphically	Recognized by computer

Table 1 The Comparison between Printed Map and Digital Map

Merits of Digital Map

The merits of digital map are shown on Table 1. It is realized that we should take advantage of the merits of digital map, when we discussed the standard of digital mapping. Concerning the standard of digital map, following two concepts were resolved.

Convertibility In the digital mapping, the utilization of digital data is important. Therefore, the standard should be applied for not only output drawn map but also digital data itself. The procedure of digital mapping was established and magnetic tapes in which digital data are stored systematically were defined strictly in the standard. The convertibility of magnetic tapes are guaranteed and the digital data in magnetic tapes are utilized for multi-purposes.

True position data As mentioned above, it is possible to record the true position data of objects and topographies in the magnetic tape, because digital data do not have to be edited to make easy reading. The true position data can be expressed in the digital map.

CHARACTERISTICS OF DIGITAL MAP

The data of digital map areacquired from airphotoes through plotter and field reconnaissance survey. The characteristics of these data are as follows.

(1)These data are directly dizitized of objects and topographies and not edited in accordance with the manual of map symbols.

(2)These data are convertible between different systems and independent from software and hardware.

(3)These are basic data for digital mapping, which can be compiled for multi-purpose, those are, drawn map, Geographical Information System and so forth.

(4)The line data of roads, contours and so forth are continuous at any circumstances.

(5)The text and/or associated attribute are linked to the co-ordinates of the object.

(6)The line data is composed of a series of points. The sequential order of co-ordinates of points is specified for the sake of following manipulation of data.

(7)In the digital map, the co-ordinate of elevation data is acquired through a stero plotter.

DETAIL OF DATA

Data Structure

The unit of data is called an Element, which corresponds to one objects. An Element is consisted of Sub-elements. A Sub-element corresponds to a series of co-ordinates composing a part of object, a text of name of object or an associated attribute respectively. The data structure is shown on Fig.1. In order to explain clearly, the authors would like to take an example of one bridge. In this case, one bridge is an Element. Fig.2 shows Sub-element of the bridge. The Sub-elements are

two sides, two poles, two feet and one text. Fig.3 shows the

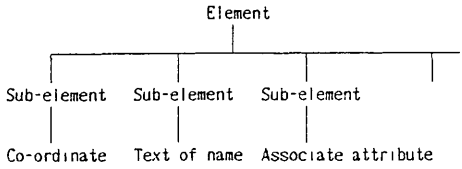

Fig.1 Data Structure

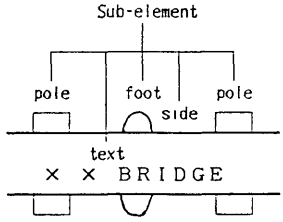

Fig.2 The Example of Sub-element of Bridge

records sequence of this example by which the data structure is realized in the MT. The words "Bridge", "Side1", "Pole1" etc in Fig.3 are not recorded in the MT. The codes correponding to those words are recorded in the MT. Being based on this structure, the text is linked to co-ordinates of the bridge, because text record and coordinate record are in the same Element record.

Data Type

There are five data types. Objects are classified to one of these types.

Closed line applied to the objects which requires the distinction whither inside or outside of them: building, pool, etc.

Line applied to the line data: road, river, etc.

Point applied to the point data: roadside trees, control point, etc.

Circle applied to the circle data: tank, manhole, etc.

Direction applied to the point data which requires the direction of symbols.

Classification Items

There are several classification items which describe the detail feature of object. These classification items are accuracy classification, figure classification, overlapping classification, "the minimum" classification and so forth.

Continuity

The data of several objects are continuous in the digital map, even when they are covered three-dimensionally by another object. These objects are roads, buildings, coastlines, boundaries, contour lines and river lines.

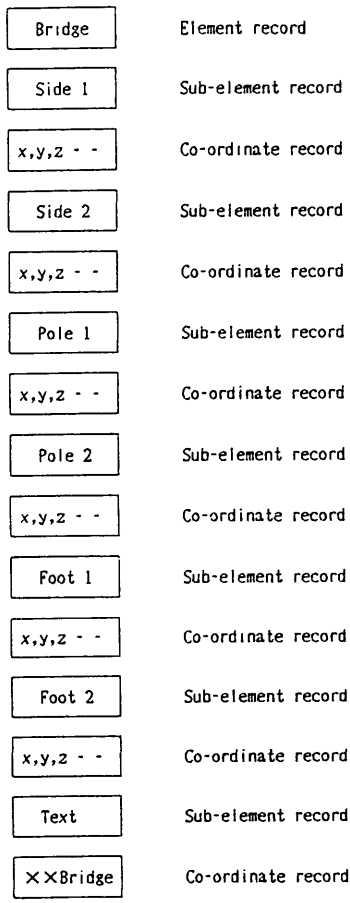

Fig.3 The Example of Record Sequence

CODE SYSTEM

Kind of Code

In order to identify the object, three kinds of codes are prepared. Each object is expressed by the combination of Area

code, Identification code and Information code with more than six digits code number.
Area code: This code identifies in which area the object is located. The ground surface is divided to twenty four areas as Table 2. This code is assigned to these twenty four areas and has two digits.

code	area	code	area
11	road	51	park or stdium
13	plaza & parking	53	recreation area
15	railway	55	temple & cemetery
17	airport	57	forest & wild area
19	bay & port	61	agricultural land
21	building	63	fishing area
23	area of residence	65	green area
31	river	71	objects crossing areas
33	lake or pond	73	undefined area
35	sea	81	topography
41	underground structure	82	boundary
43	facilities underground	83	place name

Table 2 The Area Ccode

code	object	code	object
0000~0099	road	0720~0729	monument
0110~0159	railway	0730~0779	object of mark
0160~0179	wall	0780~0089	manhole & telephone pole
0180~0189	bridge	0790~0799	utility pole
0200~0299	river, pond & coastline	0810~0819	contour
0300~0359	low building	0820~0829	scarps
0400~0459	medium or high building	0830~0859	cover of ground surface
0500~0559	building without wall	0860~0879	control point
0580~0589	belongings of building	0880~0889	boundary of local body
0600~0659	vegetation	0890~0899	other boundary
0660~0689	special places	0900~0999	text of place name
0710~0179	observatory		

Table 3 The Identification Code

Identification code This code identifies each object; road, building, railway, contour line, vegetation, boundary, etc. This code is systematically arranged and addition of new objects on request is possible. This code has four digits. The examples of this code are shown in Table 3.
Information code This code is for establishing the Geographical Information System. The detail of this code is being discussed now.

EXPERIMENTAL EXAMPLE OF DIGITAL MAP

The experimental work to make the example of digital map based on the standard was performed. Fig.4 shows the drawing image of digital map in which all the objects are drawned. Fig.5 shows the drawing image of buildings. Fig.6 shows the drawing image of contour lines. It seems that readers can easily understand that contour lines are continuous at evrywhere in Fig.6. In order to show the effectiveness of area code, all objects included in the area code of road are drawn in Fig.7.

CONCLUSION

The Geographical Survey Institue has discussed and resolved the standard of digital mapping in Japan. In this paper the standard of digital map which is the main product of digital mapping is shown. The digital mapping technology is still in progress and being utilized. It is recognized that the standardization of digital mapping is urgent problem.
The Geographical Survey Institute intends to continue the research of digital mapping and establish the digital mapping method as the most effective method for making map and developing multi-utilization of map data.

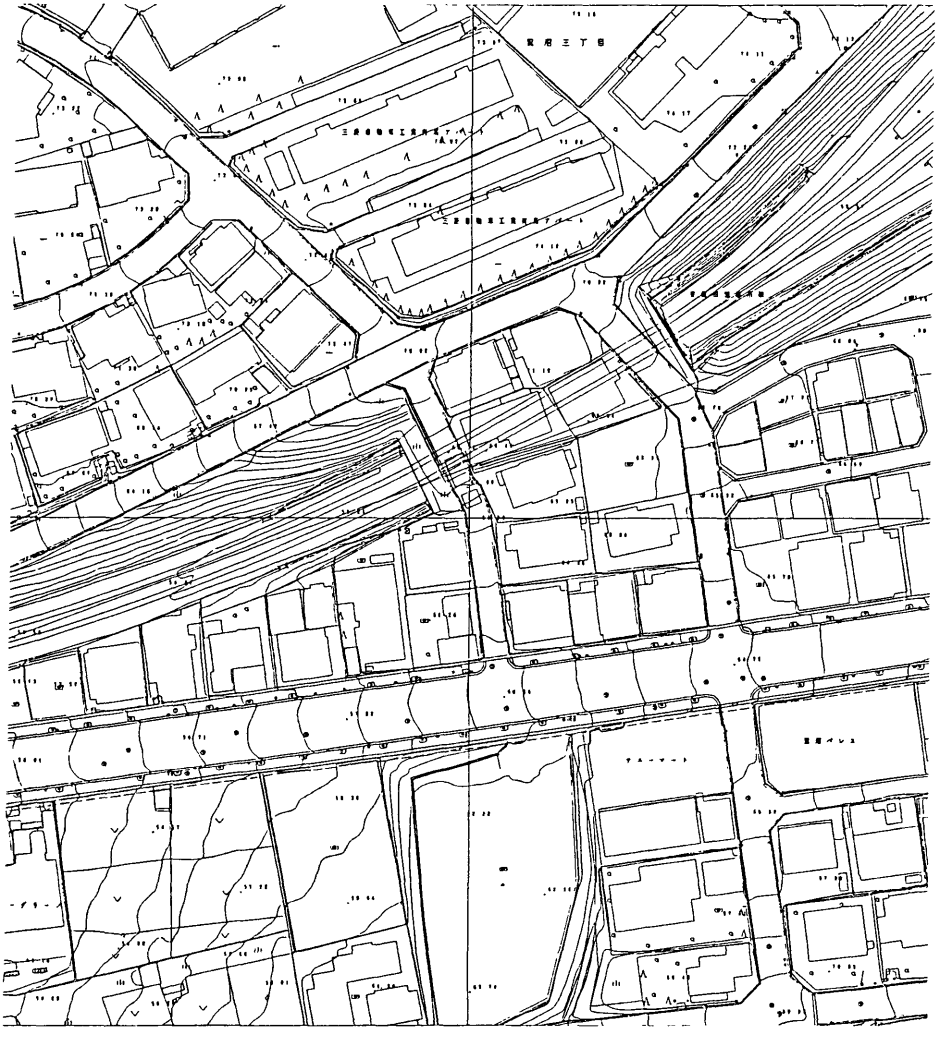

Fig.4 The Drawing Image of True Position Data

Fig.5 The Drawing Image of Building Area

Fig.6 The Drawing Image of Contour Line

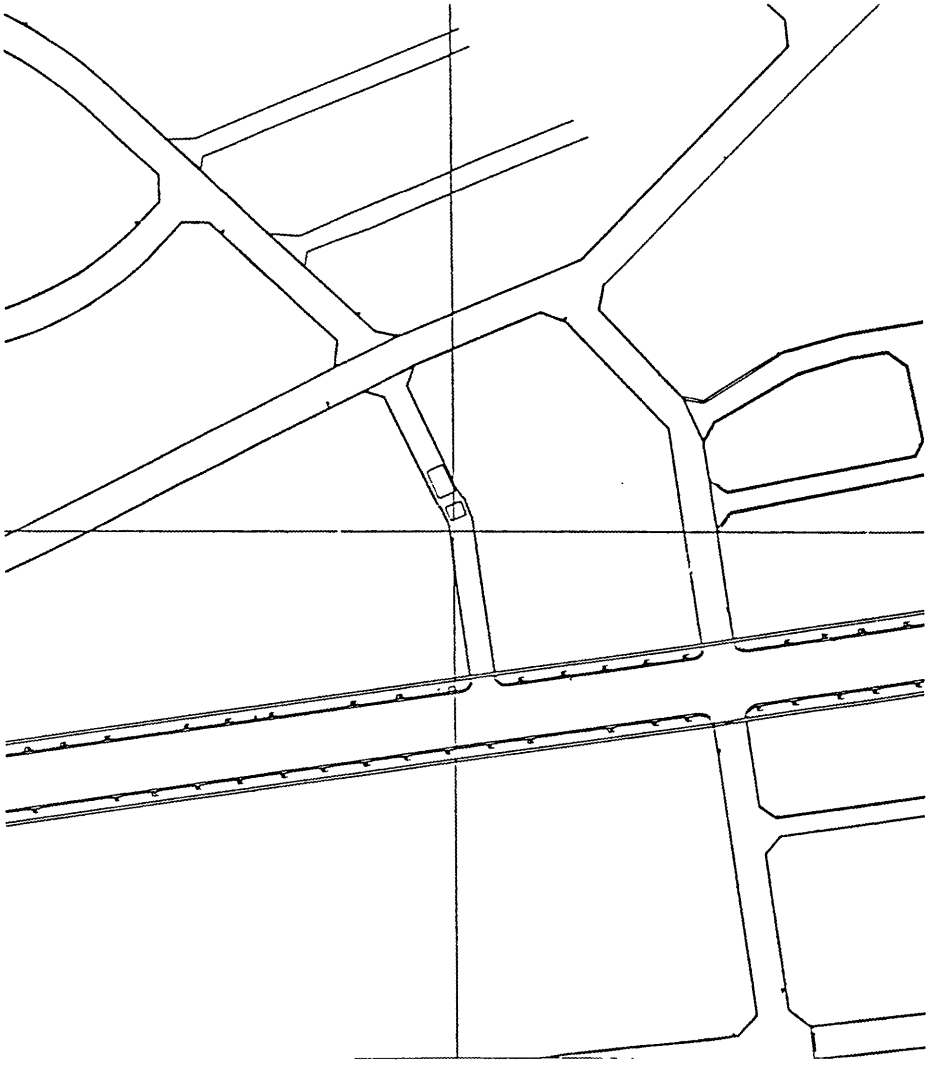

Fig.7 The Drawing Image of All Items Included in the Area Code of Road