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Application of Urban Ground Database for Geological Studies in Osaka Plain, Southwest Japan (part I)

—Preliminary report on structure of the Ground Database and it's input-output interfaces—

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(with 6 Figures)

Abstract

It is difficult to make geological investigations under alluvial plains. For these investigations, it is very important to accumulate boring data for constructions. Therefore, we are going to proceed with constructions of the multiple database on subsurface geological data in the Osaka plain.

Geological column data and standard penetration test data (N-value) are boring data in general use. In the first place, these data are included in this database.

So BASIC programs are made for geological column data and standard penetration test data. These programs are easy to input these data and are able to output geological columns to monitor screen or XY-plotter by locational retrieval.

Introduction

Almost great cities in Japan situate at aluvial plains. It is difficult to make geological investigations under alluvial plains. Urban ground in alluvial plains is usually made investigations for public works.

Boring which is carried out for public works, generally furnishes geological column data and standard penetration test data (N-value). These data accumulated by boring, when interpreted in the context of the geological setting, offer valuable guidelines for a better understanding of geological truths. Therefore, the database system is needed for the geological investigations in urban ground. The database systems for boring columns with computer, have been developed since 1970's in Japan (KISHI *et al.*, 1971; FUKUMA *et al.*, 1980; KISHI, 1982; TOCHIMOTO *et al.*, 1983).

In Osaka Plain, because great cities, including Osaka City, situate at alluvial plain which is consisted of thick soft layer, such as clay, sand, it is difficult to carry out geological survey by usual method. Therefore, it is necessary to accumulate boring data for public works and to proceed with constructions of Urban Ground Database in Osaka Plain.

The JSSMFE Kansai Branch and the JSA Kinki Branch (1966) published the Osaka Subsurface Geologic Map. Many boring data in Osaka Plain are accumulated in this publication. And Osaka City Hall Bureaus which carry out public works, have many boring data. Urban Ground Database is aimed at managements and geological applications of these data.

This paper, as a preliminary report, outlines Urban Ground Database System for geological studies in Osaka Plain.

Construction of Database

A. Environment of Database System

This Urban Ground Database consists of geological column data and standard penetration test data which are got by boring. In order to offer valuable guidelines for geology, it is necessary for the database system to have the following functions. That is easy to input correctly these data and able to output geological columns for profiles by locational retrieval. Moreover operations need to be simple and easy. In these circumstances, this database system is developed by 16 bit personal computer system (Fig. 1).

(1) Hardware

Hardware of this database system is as follows: Main frame consists of 16 bit personal computer system (PC-9801vm system, NEC). This system has a graphic dipslay and XY-plotter as output devices, and its storge device is folppy disk drive unit.

(2) Software

Software of this database system is as follows: Disk operating system is the MS-DOS system for PC-9801 system. This database management system consists of input-output programs which are wrote by N88BASIC (copyright by NEC). These programs can carry out data file managements and geological column output by locational retrieval.

(3) File structure

File structure of this database system is as follows: Boring data is input from keyboard by the input program which make three kind of files to floppy disks. The first of these files is the boring number file, named as "BRN.ODS", that records the last input boring number. The next is the index file, named as "INDEX.ODS", that records all locational data of input boring data and that is used to locational retrieval. The last is boring data file that consists of geological column data and standard penetration test data. This boring data file is made at every boring log and gave a file number in order of input. One boring data file take records of about 1K bytes, therefore one floppy diskette, had 1M byte records, can store 1000 boring data files. All these files are made as sequential access files on MS-DOS.

(4) Linkage to Data Processing Center

This database system is constructed on 16 bit personal computer system, because are used frequently for drawing geological profiles by graphic display and XY-plotter.

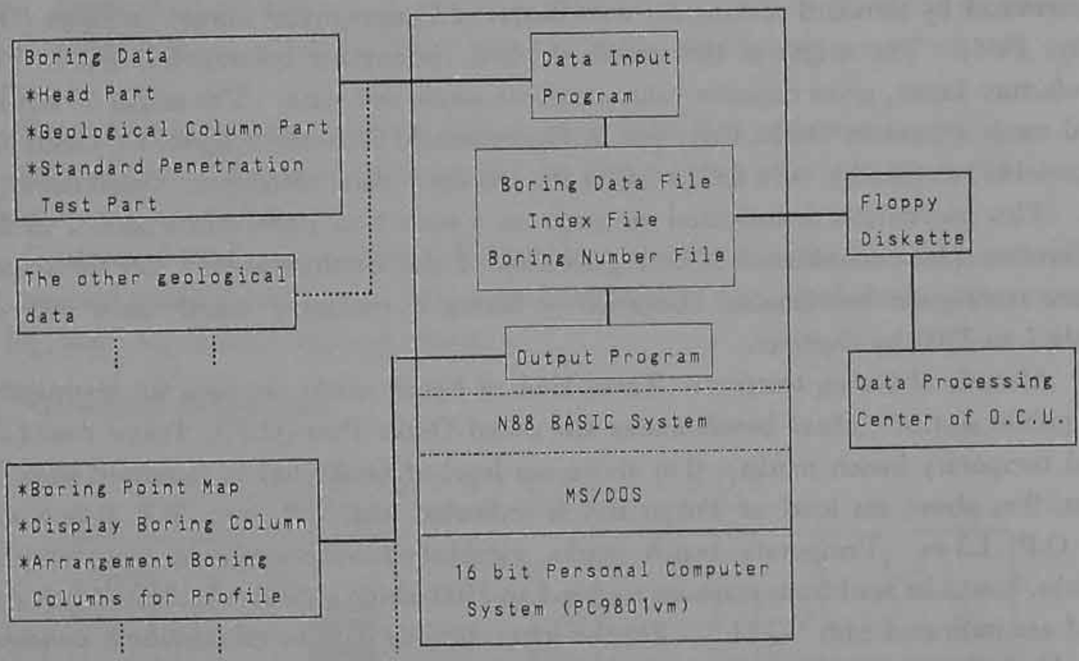

Fig. 1. Outline of Urban Ground Database System.

An area of one locational retrieval is a small part of the whole, so the personal computer system is applied effectively.

But, boring logs, stored in the Osaka City Office until now, are estimated that they amounted to more than 20000 logs. so this data base system on personal computer system cannot manage all data.

Therefore, it is necessary that this database system is linked to Data Processing Center of Osaka City University by floppy diskettes. Boring data, filed by the personal computer, are converted into IBM format file and managed as a relational database. Its relational database will be applied to statistical analysis or various kinds of simulation by application programs in the data processing center.

B. Input Interface

Boring logs consist of geologiacl columns and standard penetration tests. This database takes these data and makes boring data files. One boring data file is composed of three parts. They are Head part, Geological column part and Standard penetration test part.

(1) Head part

Head part, used as index, stores location data, map number, date of investigation, contents of investigation data and so on. The index file consists of this head part. Constituents of this head part are as follows.

Boring number: Boring number is assigned in order to input as a reference number. Boring data file is named by this assigned boring number.

Plane coodinates of boring location: Osaka City has an original mesh system which is determined by standard rectanguler coordinates of Geographycal Survey of Japan (Osaka City, 1985). The origin of this standard plane rectanguler coordinates, put in Fukui Prefecture Japan, gives negative values towards south and west. The origin of the original mesh system in Osaka City, put at Kawaramachi 2-chome Higashi-ku Osaka City, has −146 km (south), −46 km (west) in the standard plane rectanguler coordinates (Fig. 2). This coordinates is indicated on maps on a scale 1 to 10000 and a scale 1 to 2500. Therefore, plane coordinates of boring location of this database system use the standard plane rectanguler coordinates. Location of boring is measured exactly on a map on a scale 1 to 2500 by digitizer.

Altitude of boring location: Three kind of bench marks are used for investigations of public works. These bench marks are called Osaka Pear (O.P.), Tokyo Pear (T.P.) and temporary bench marks. 0 m above sea level of Osaka bay is indicated with O.P. 0 m. 0 m above sea level of Tokyo Bay is indicated with T.P. 0 m. T.P. 0 m is equal to O.P. 1.3 m. Temporary bench marks, established temporarily in areas of public works, has to be read from maps on a scale 1 to 2500 which indicates by T.P. bench mark, and are indicated with "G.H.". So, the input altitude data in this database consists of the kind of bench marks and the altitude above the bench mark.

Map number: This database system use maps on a scale 1 to 2500 as the base map. Boring points, input to this database, are entered with boring number in this base

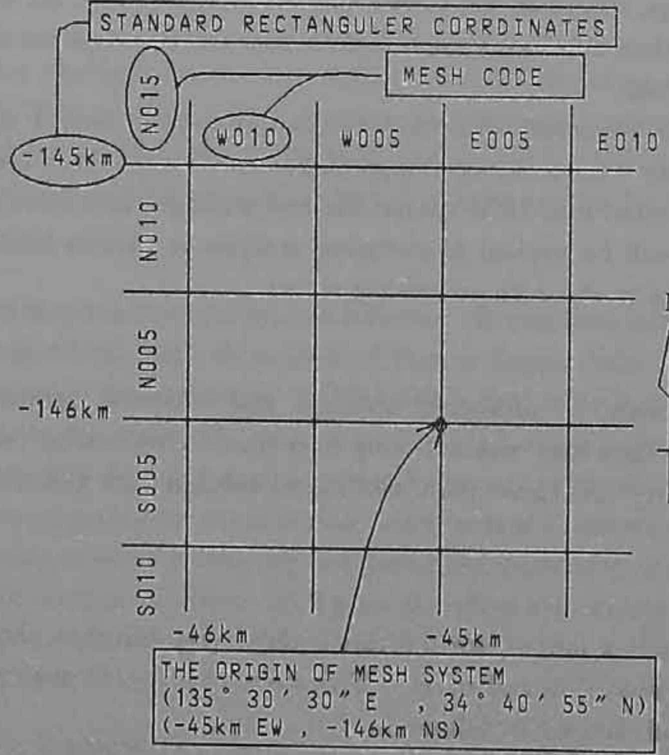

Fig. 2. Relation between original mesh code in Osaka City and the standard plane rectanguler coordinates in Kinki District.

map. Every sheet of these maps, showing a $2 \times 1.5\ km^2$ area, is numberd in numerical order. Map number is this reference number of the map which is entered each boring point.

Date of investigation: Annum and month are the date of boring sounding.

Offiece code: This code is a number in four figures, which is given the charged department in city office.

Contents of investigation data: This content consists of eight investigations. They are standard penetration test, soil test, water permeability test, borehole jack test, resistivity log, sonic log, density log and others.

(2) Geological column part

GEOLCGICAL CODE

CODE	4th		3rd		2nd		1st
1	CLAY		CLAYEY		SHELL		FINE
2	SILT		SILTY		PLANT		FINE-MEDIUM
3	SAND		SANDY		SHELL& PLANT		MEDIUM
4	GRAVEL		GRAVELY				MEDIUM-COASE
5	PEAT						COASE
6	VOLCANIC ASH						
7	BANK						
	FACIES		SUB-FACIES		FRAGMENTS		GRAIN SIZE

COLOR CODE

CODE	3rd	2nd	1st
1	——	WHITE	WHITE
2	DARK	BROWN	BROWN
3	LIGHT	GRAY	GRAY
4	GREEN	GREEN	GREEN
5	LIGHT BROWN	LIGHT BROWN	——
6	YELLOW	YELLOW	——
7	——	BLUE	——
8	——	BRACK	——

Fig. 3. Coding sheets of geological facies codes and color codes.

Geological column part consists of facies code, boundary depth and color code. The constituents of this part are as follows.

Facies code: This code is a number in four figures which are indicated by Fig. 3. Facies notes of each strata, recorded on boring logs, takes various expressions, but this database system cannot store all these facies notes. Therefore, when we need to get more detailed geological information from this database, we must refer to the report number in the head part. The report number shows the stored place of the log sheet file which are put away in filing cabinets.

Input data of geological column facies consists of these codes. These coding operations are carry out by human works with coding sheets. This artificialy coding often involves mistakes between the items mentioned and their codes (WATANABE and KISHI, 1973). Therefore, in this database system, facies codes are not input directly. The input program of this system, in the first place, indicates geological facies names on the monitor screen. Then the human operator modifies this displayed facies name to the applicable facies name on the boring log with cursor keys. The modified facies names are converted applicable code by the input program. These procedures are effective to decrease the coding mistakes.

Boundary depth: This data is the lower boundary depth of the strata from ground level.

Color code: This code is a number in three figures which are indicated by Fig. 3.

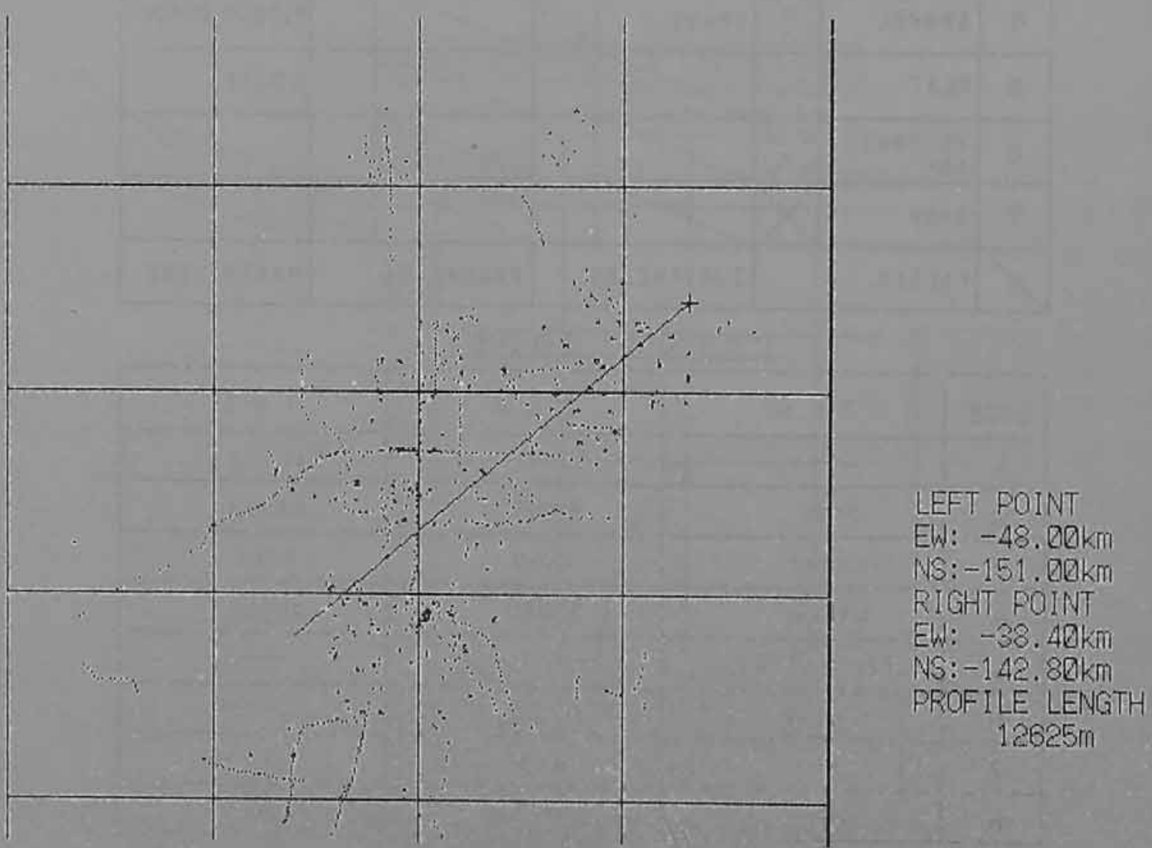

Fig. 4. Example of boring point map on monitor screen.

The strata color are converted applicable code by the similar procedures of the facies input program.

(3) Standard penetration test part

Standard penetration test gives the N-values which suggest the strengh parameters of soil. This part consists of start depth of this test, N-value and penetrate length. The consituents of this part are as follows.

Start depth: The standard penetration test is usually carried out at 1 meter intervals in one borehole. This input data is composed of start depth of each penetration.

N-value: The N-values of the standard penetration test is usually reported to range from 0 to 60 for 300 millimeters. The location where non-disturbance sampling was carried out, is marked by "−1".

Penetrate length: This test needs penetration length for 300 millimeters, but in soft

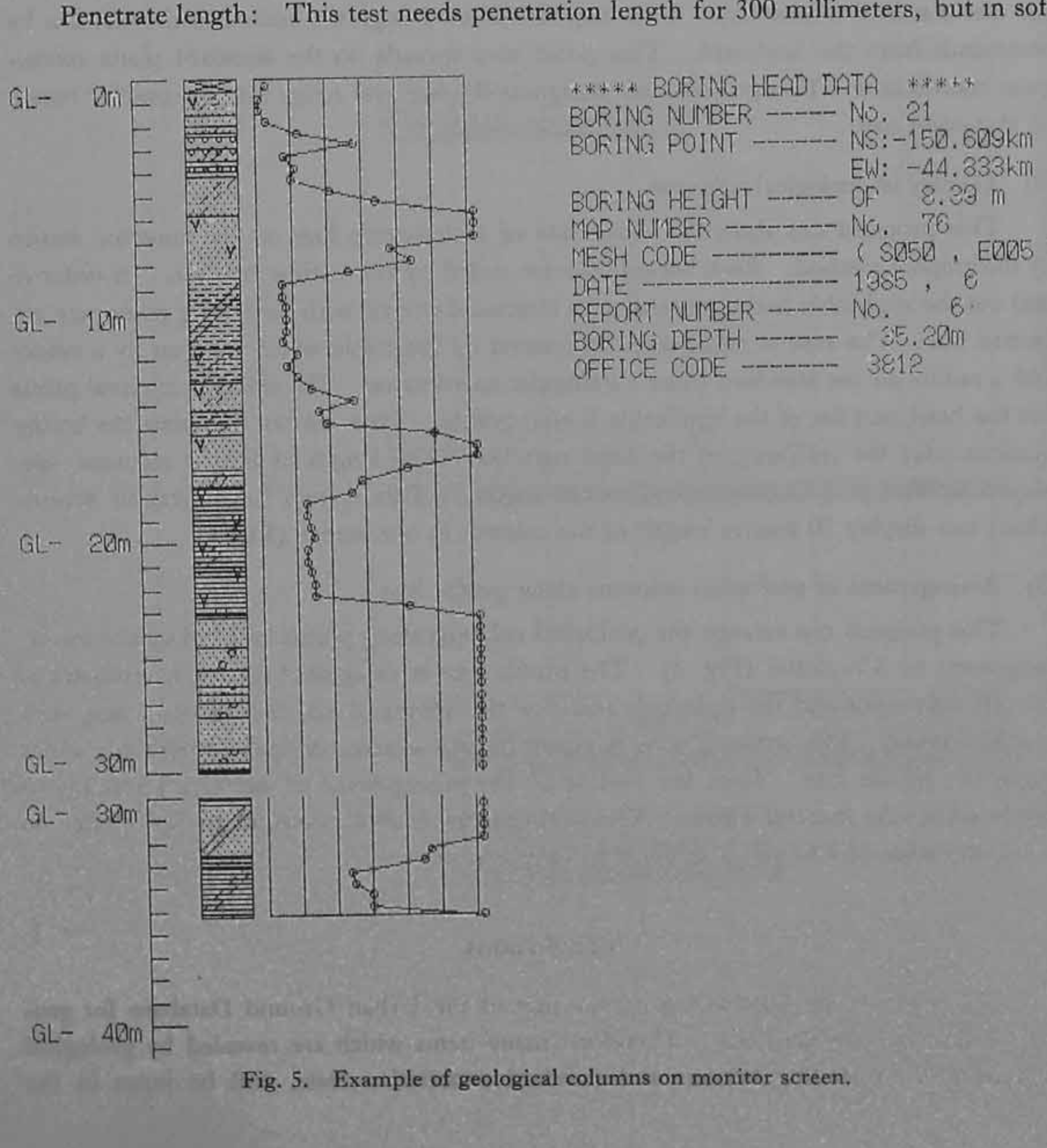

Fig. 5. Example of geological columns on monitor screen.

clayey layers, the penetrate length exceeds the regulation in one blow. In contrast to this, in hard gravely layers, this length is less than 300 millimeters at 60 hammerd. So, it is necessary to input the penetrate length.

C. Output Interface

The application program in this database system, carry out locational retrieval with boring point maps and output geological columns on the monitor screen. The functions of the application program are as follows.

(1) Boring point map for locational retrieval

The application program calls the index file which stores boring location data and shows boring point maps on the monitor display (Fig. 4). The first boring map covers the whole area of Osaka City. This map is able to change the scale and the location by commands from the keyboard. This point map spreads on the standard plane rectanguler coordinates. This program can designate the retrieval range with the graphic cursor on this point map.

(2) Display of geological columns

This program can show the input data of each boring logs on the monitor screen by the graphic method. Each boring data are called by the boring number. In order to find out the applicable boring number, the locational retrival with the boring point map are carried out. The area of retrieval is designated by the circle which is given by a center and a radius on the standard plane rectanguler coordinates. The effect of retrieval prints out the head part list of the applicable boring points. Then we can designate the boring number after the reference of the head part list. The length of boring columns, displayed by this program, is limited to 180 meters. This system has 6 graphic screens which can display 30 meters length of the column in one screen (Fig. 5).

(3) Arrangement of geological columns along profile line

This program can arrange the geological columns along profile line and output the arrangement to XY-plotter (Fig. 6). The profile line is designated by the coordinates of the left side point and the right side point on the screen of the boring point map with graphic cursor. The retrieval area is given by the square, designated with the width along the profile line. Then the outline of the arrangement of geological columns is displayed on the monitor screen. This arrangement is able to output to XY-plotter on a retrieval scale of 1 to 400, a optional horizontal scale.

Conclusions

The reported database system is one part of the Urban Ground Database for geological studies in Osaka Plain. Therefore, many items which are revealed by geological investigations, including borings and standard penetration tests, will be input in the

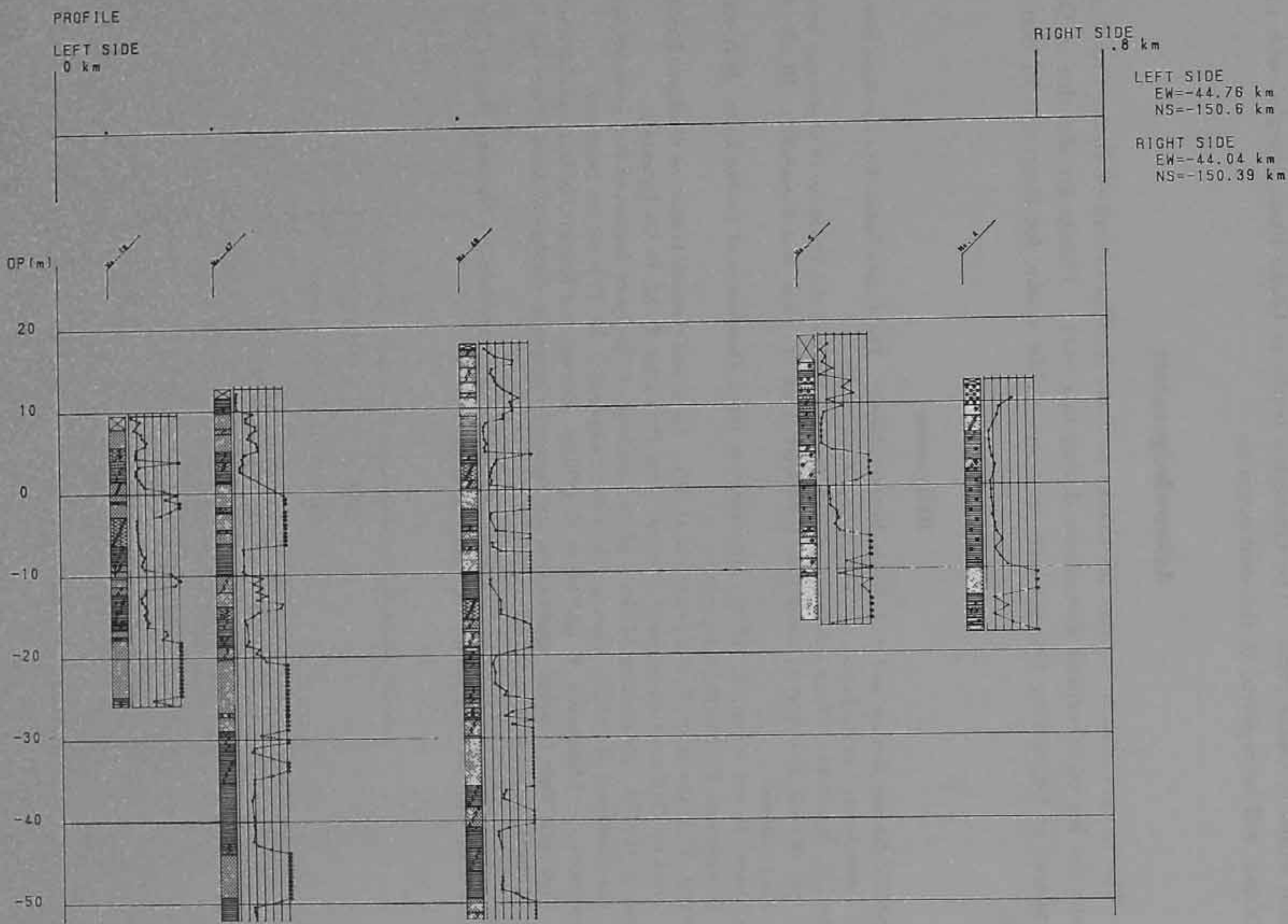

Fig. 6. Example of the arrangement of geological columns along profile line to XY-plotter.

Urban Ground Database. The Urabn Ground Database, when interpreted in the context of the geological setting, will offer valuable guidelines for a better understanding of geological truths in Osaka Plain. The Geological truths in Osaka Plain, revealed with this database, will be reported in the continuations.

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