

Basic study on the computer-aided mapping system for earthquake disaster mitigation

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ABSTRACT: In Southern Kanto Area (central part of Japan), there is much possibility of outbreak of earthquake. And computer-aided mapping system is very useful to cope with the situation. This paper is one of the series of basic study on developing the computer-aided mapping system. In this paper, we describe the process of arranging data base and explain the system we have developed. To arrange data base, 1)we give the base condition, 2)draw process of spreading the earthquake disasters, 3)how to use mapping system at each phase of disasters, and 4)give items of the data base.

1. PURPOSE OF THIS STUDY

In Southern Kanto Area (central part of Japan), there is much possibility of outbreak of earthquake because there are many boundaries of plates. So far, disaster mitigation plannings have been made to prevent the disaster of a large scale earthquake like Kanto Big Earthquake in 1923. But a little smaller earthquakes are supposed to break out with higher possibility. In this case, part of the area, not all the area, are destroyed and recovery action is done keeping a normal function in rather safe area. This means that we should know the characters of areas in detail to cope with the situation. So it is helpful to have a system to analyze the characters of areas in the map. This is a basic study to develop a computer-aided mapping system for this purpose.

2. CONDITIONS OF EARTHQUAKE DISASTER

Disaster occurs in the condition shown in Table 1. We can divide the condition into three categories. They are basic condition, constructed condition and activity condition. Some of them play as spreading factors and the others as controlling factors in the process of breaking out a disaster.

3. IMAGE OF MAPPING SYSTEM

Activity of coping with disaster is divided into 4 phases. They are 1)pre-event, 2)just before the event, 3)response and 4)recovery. Mapping system is useful especially for the

first three phases. Figure 1-1 to 1-3 are the flow chart of data processing.

In pre-event phase, we can evaluate the character of areas for measures. In just before the event phase, we can predict damages more accurately by using revised data that are revised because of a certain measure. In res-

Table 1. Conditions of earthquake disaster

Basic condition	<ul style="list-style-type: none"> ·Ground <ul style="list-style-type: none"> - height, shape, kind of soil ·Climate <ul style="list-style-type: none"> - wind, temperature, rainfall ·Rivers and sea <ul style="list-style-type: none"> - quality and quantity of water
Con-structed condition	<ul style="list-style-type: none"> ·Land use <ul style="list-style-type: none"> - open space, park, road, site for building ·Building <ul style="list-style-type: none"> - use, structure, date of completion, volume, coverage, useful or dangerous for disaster ·Infra-structure <ul style="list-style-type: none"> - electricity, gas, water, communication, railroad, utility tunnel
Activity condition	<ul style="list-style-type: none"> ·Population <ul style="list-style-type: none"> - day and night ·Traffic <ul style="list-style-type: none"> - quantity, parked cars ·Energy <ul style="list-style-type: none"> - consumption of electricity, gas and water

ponse phase, we can assume damages in the areas with no information by analyzing the information from damaged areas.

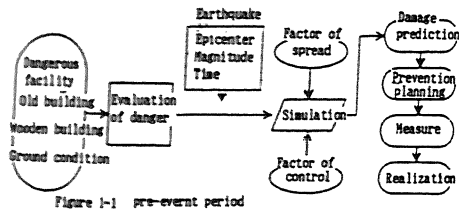


Figure 1-1 pre-event period

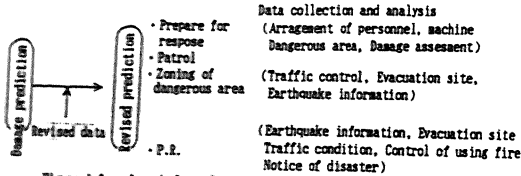


Figure 1-2 Just before the event

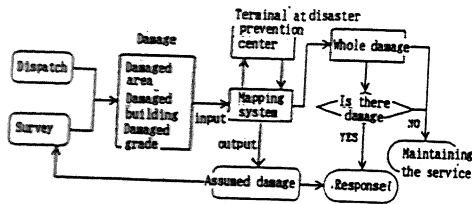


Figure 1-3 Response

4. LIST OF DATA BASE ITEMS

By analyzing the measures and activities for disasters in each phase, we arranged the list of data base items. The results are shown in Table 2.

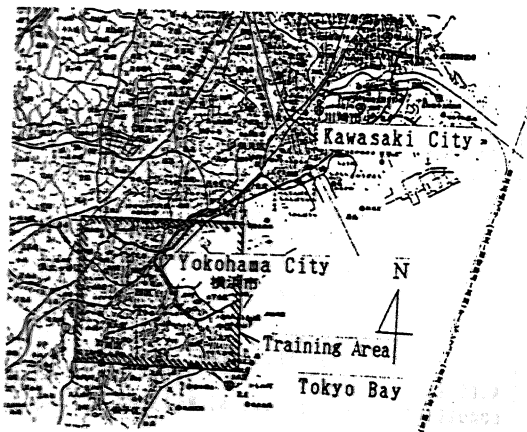


Fig.2 Training Area

Table 2. List of data base items

Ground	<ul style="list-style-type: none"> Land : topography, coast line, river, hill, cliff, underground water Soil : nature of the soil, alluvium, reclamation, developed area, artificial ground surface Dangerous area : subsidence area of ground, landslide area, liquifaction area
Climate	<ul style="list-style-type: none"> Factor : wind, temperature, moisture Fluctuation : yearly, monthly, daily
Space	<ul style="list-style-type: none"> Land : land use, occupation Facility : large evacuation site, park, green, parking Characteristic area : fire prevention area, large scale developed area
Buildings	<ul style="list-style-type: none"> Building : use, structure, volume, coverage, story, age, history of damage Characteristic building : high-rise building, underground public space, public facilities Useful facilities : school, hospital District : wooden house rate, fire proof rate
Infra-structure	<ul style="list-style-type: none"> Facility (plant and network) : electricity, gas, drink water, discharged water, communication, waste, utility tunnel, spot of under construction Consumption : peak load, fluctuation (yearly, monthly, daily) Storage or emergency facility : emergency generator, water pond, block of gas system, emergency telephone
Transportation	<ul style="list-style-type: none"> Road <ul style="list-style-type: none"> Facility : high-way, ordinary road, inter-change, tunnel, elevated part, bridge, pedestrian bridge, parked car Flow : traffic, jam, control, accident, condition Emergency : route for emergency car, evacuation route Mass-transport : railroad, subway, bus <ul style="list-style-type: none"> Facility : network, stop, elevated part, bridge Flow : schedule, number of passengers, accident, condition
Danger	<ul style="list-style-type: none"> Fire : restaurant, public bath, building where fire is often used, cleaning shop Fuel : building where combustible staff is often used, producing and storing plant (for oil, gas and gunpowder), oil pipeline, gas station, tanker, tank lorry, storage for emergency generator, parked car Poison : building where chemicals and radio-active staff exists
Population	<ul style="list-style-type: none"> Inhabitants, daytime, night, employed, handy-capped, students, densely habited area
Activity	<ul style="list-style-type: none"> Fire department <ul style="list-style-type: none"> Facility : fire department, fire engine, hydrant, machine parts Staff : Firemen Medical treatment <ul style="list-style-type: none"> Facility : hospital, capacity Staff : doctor, inpatient

5. EXAMPLE OF THE SYSTEM

We have developed mapping system for small training area in Yokohama (Figure 2.). The area is about 100 km². Figure 3. shows components of hardware. The data are stored

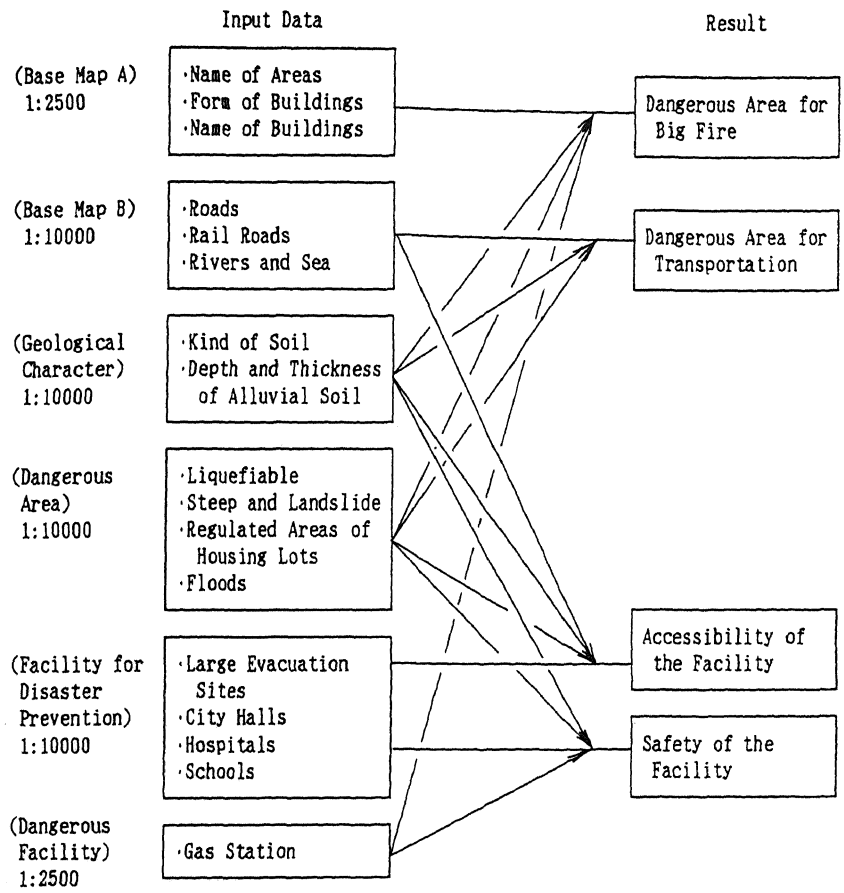


Fig.3 Input Data and Output of Mapping System

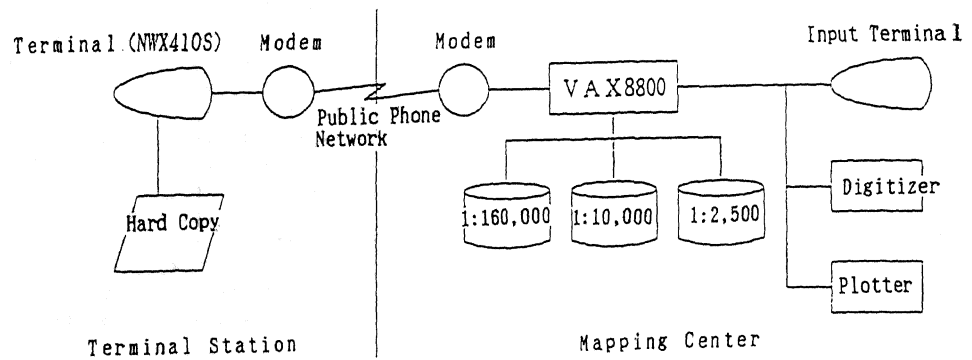


Fig.4 Hardware Components

and displayed in three different scale : one-2,500th, one-1,000th and one-160,000th. The maps have addresses of areas. The function of software is to overlay data and displays in the map. And there is a search system that can identify areas by inputting addresses. Input data and output results are shown in Figure 4.

6. CONCLUSION

Mapping system is useful for each phase of disaster. Particulary, it is very useful for response phase. But to realize mapping system, we must solve some problems. They are the cost for the system and how to gather the necessary data.