Examination of evacuation routes considering damage caused by liquefaction

*KOYA TAKAHASHI[1]

1. tosa high school

Currently, evacuation drills for the Nankai Trough Earthquake are carried out in Kochi City. However, I realized that the damage predicted after the earthquake is not taken into account. Therefore I wonder if we can evacuate safely in the same way as the evacuation drills when the earthquake occurs. Then, I studied the influence of ground liquefaction on evacuation in order to propose more realistic procedure for evacuation.

In this study, I targeted Ushioe area in Kochi City. When the earthquake occurs in the assumed maximum scale, it is predicted that a more than 30cm–high tsunami, which makes our evacuation difficult, will reach 30 minutes after the earthquake occurs. Also, it is predicted that ground subsidence will happen due to liquefaction, so a hazard map was created by earthquake specialists. At first, I thought to use this hazard map in this study, but I recognized that this hazard map was not detailed and I couldn’t consider narrow areas because it adopted 250m mesh. For this reason, I decided to create my own hazard map. I obtained some documents of the boring survey in this area and read the information such as “Fine particle content”, “N value” and so on in the data. And, I calculated "the earthquake shear stress ratio", "the dynamic shear stress ratio" and "a liquefaction index" (PL level). Then I calculated the liquefaction index at the point, and I made a hazard map of the 125m mesh based on the value.

I actually superimposed the evacuation routes used in the evacuation drills on my hazard map. Then I found that some liquefaction would occur over a wide area. And, in this area, about three-minute shaking is predicted. Therefore, we can’t start to evacuate within four minutes after the earthquake occurs. Also, we need two minutes for vertical evacuation. It means that we can have only 24 minutes to evacuate. That is why I decided to compare the evacuation considering damages caused by liquefaction with that not considering them. I focused on an area which will have a big damage caused by liquefaction. I selected 18 places randomly, and simulated two evacuation patterns.

First I considered the evacuation not considering the damage caused by liquefaction. In this case, I found that people in the 18 places can evacuate in 24 minutes, and more than half of them can in 15 minutes. From these things, I found that administrative agencies had established evacuation shelters in consideration of evacuation time and the number of people.

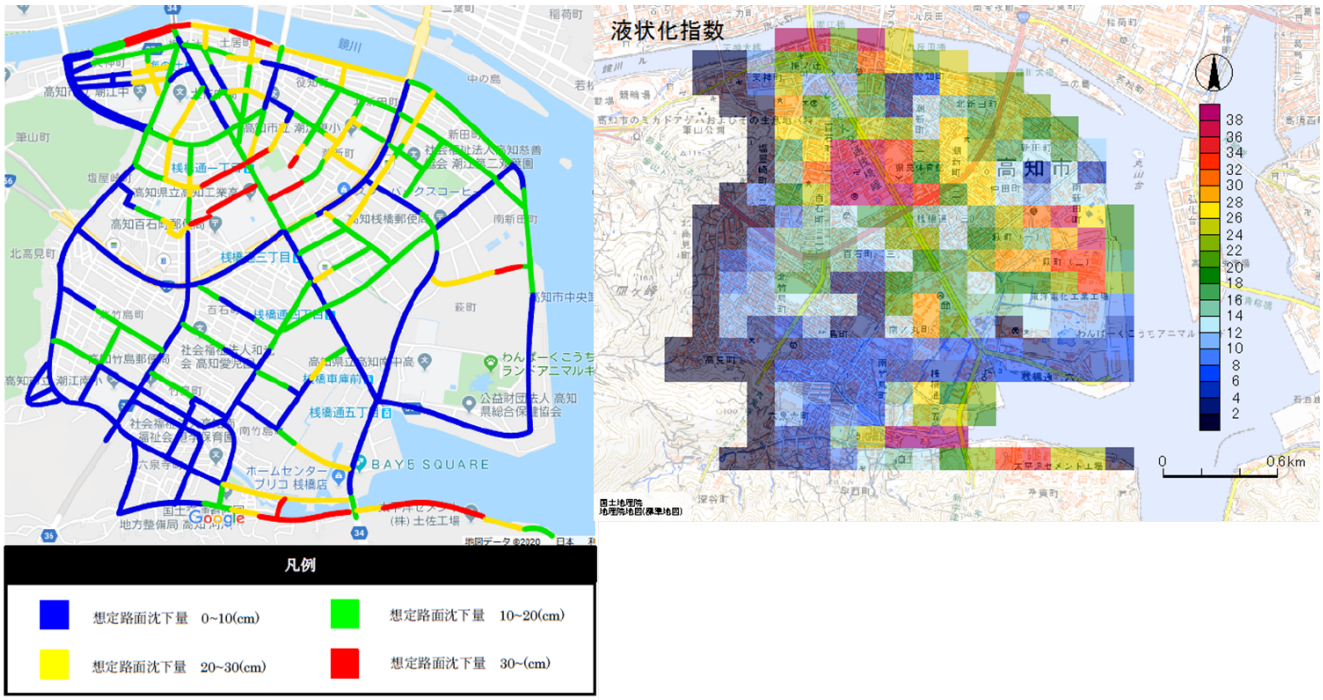
Next, I considered the evacuation considering the damage caused by liquefaction. In this case, I found that there are some evacuation routes which we won’t be able to use because of liquefaction. For this reason, we need to go a long way round and it takes long time to go to shelter. Also I found that it takes 1.5 times as long as the first research, and some people can’t evacuate within 24 minutes. For these reasons, we must regard these areas as vulnerable to damage by liquefaction. That is why I feel that not only the number of the evacuation routes but also the shelters should increase even more.

In this study, I only studied an evacuation when the routes are damaged by liquefaction of the ground because now we don’t know where liquefaction will occur. So now, we will have to evacuate looking for a safe evacuation route. As a result, we will actually spend more time to evacuate than this prediction.

Because of these, it is necessary to inform people more about the danger of the damage caused by liquefaction. And, local governments need to examine evacuation drills considering damage by liquefaction.

In this study, I considered only evacuation routes considering damage caused by liquefaction. But, actually there will be various factors which will make our evacuation difficult, for example, collapse of block walls and wooden buildings. For this reason, I think that it is necessary to consider more factors in order to make realistic procedure for evacuation.

Keywords: earthquake, liquefaction



避難路用の道路での地盤の液状化による想定路面沈下量

