第Ⅰ部門　　MIRISK –Mitigation Information and Risk Identification System-

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1.Background and purpose of research

In recent years, natural disaster appear to be increasing in frequency and severity. Disaster represent a major source of risk for the poor and wipe out development gains. As a result, the necessity for considering of natural disaster to projects at the planning phase is increasing.

To meet this need, computer tool MIRISK was developed for Multilateral Development Bank taking a risk of sustaining heavy losses from disasters.

2.Overview of MIRISK

MIRISK is intended to permit identification of natural disasters which are likely to occur at a site, and typical vulnerability each infrastructure have. MIRISK also quantify risks and vulnerabilities for infrastructure subjected to natural hazards and provide framework for simple analysis.

MIRISK is composed of three main parts and internal database. Three main parts are GIS system, asset taxonomy, and analysis system. To display worldwide disaster risk, some GIS system is implemented in MIRISK. Display of GIS system in MIRISK is shown in Fig-1. This system indicates data of worldwide relative hazard levels of earthquake, flood, cyclone and volcano from Hotspots project.

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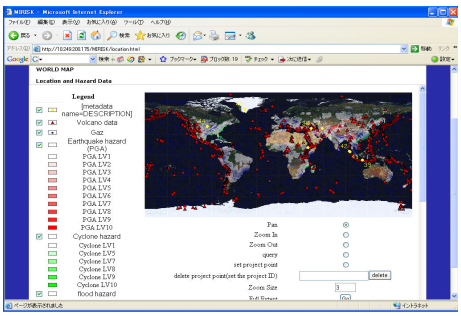

Fig-1 : Display of GIS system

MIRISK contains default asset taxonomy classified based on ATC-13, to assess the average losses of each asset types. Table-1 shows the taxonomy of building used in MIRISK.

Text information on typical vulnerability, basic design, mitigation plan etc. are also organized based on every type in this taxonomy. Display of this part is shown in Fig-2.

Table-1 building taxonomy

Asset Type	k
Buildings	
Wood	0.20
Light Metal	0.15
LR RM or RC	0.25
MR RM or RC	0.30
HR RM or RC	0.40
LR Steel	0.20
MR Steel	0.25
HR Steel	0.30
RC Panel and Precast	0.40
URM or Stone or Earthen Walled	0.70
Average	*0.30*

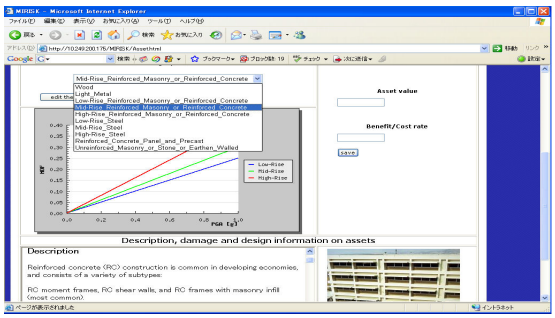

Fig-2 Display of asset taxonomy part

And in analysis part, users get the result of simple loss analysis of earthquake of project (still to be constructed for other hazards analysis)

Basic procedure to use MIRISK is outlined below. First, in GIS system part, users handle the map and layer, and get the information on hazard which is likely to occur at the site of project, then select and save site of project. Second, move to the asset taxonomy part, check the information on typical

vulnerability, design, and mitigation plan, then select the asset type to be constructed in the project, and input some value used for loss analysis. In MIRISK database, geographical data and data on assets are integrated into one 'project data' in this process. Lastly, move to analysis part, and get the result of simple cost analysis.

3.Methodology of simple cost analysis

Hazard and loss estimation is generally expressed by equation (1).

$$E(L) = \sum_{D}\sum_{H} E(L \mid D)P(D \mid H)P(H) \quad (1)$$

In equation (1), H, D, and L mean hazard, damage, and loss respectively. In MIRISK, the relation E(L|D) and P(D|H) is integrated into one relational expression between mean damage factor(MDF, measure of loss) and peak ground acceleration. To make analysis simple, following assumption is adapted.

- The relation between MDF and PGA is linear. So MDF is PGA times constant k, and k is provided to each asset class(as shown in Table-1.).
- The relation between the natural logarithm of the probability of exceedance of PGA and PGA is linear.

By first assumption, loss function is decided, and by second assumption and GSHAP data (worldwide PGA data set which is estimated under the condition of 10% exceedance probability in 50 years), hazard curve is modeled. In Fig-3 and Fig-4, results of sample analyses is shown.

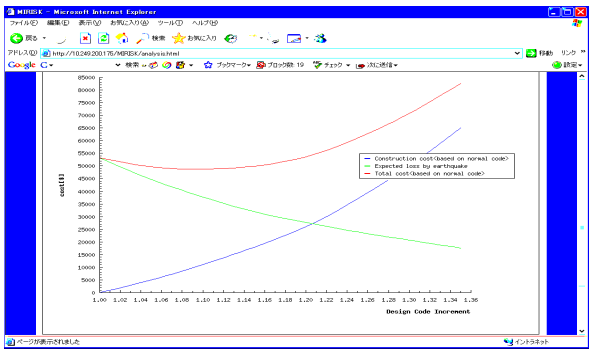

Fig-3 analysis result of low level hazard

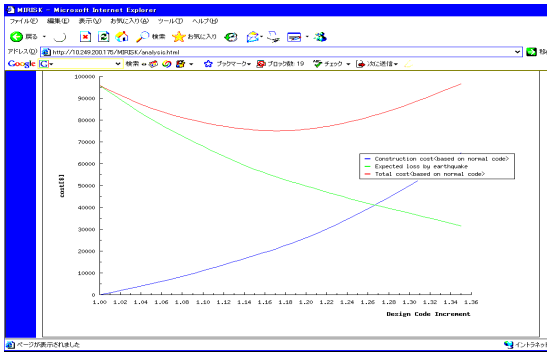

Fig-4 analysis result of high level hazard

These two sample analyses are the same, beside the expected peak ground acceleration. (Expected PGA is 0.3[g] in Fig-3, and 0.9[g] in Fig-4) The minimum of total cost shifts to right in Fig-4. This means that the optimal design intensity is higher if the seismic risk is higher. MIRISK can reflect the differences of results which is performed under different hazard levels.

In the current version of MIRISK, some problems exist in analysis. First, the measure to indicate the design intensity is too abstract. Second, the relation between design intensity and construction cost, and the relation between design increment and the reduction of loss are based only on expert's opinion, because of lack of these historical data. To make analysis more accurate, research on these issues is needed.

4.Conclusion and future research

In this research, MIRISK was developed. MIRISK has options to allow users to identify basic vulnerability, mitigation, and can help to choose alternatives. MIRISK effectively displays worldwide hazard by using a GIS tool, and has a simple framework to estimate the loss. In order to make MIRISK more efficient, data set of hazards, information on vulnerability and mitigation is needed. As described in chap.3, economic assessment data and development of empirical models are also needed. Lastly, more work is needed to complete the framework for analysis of hazards other than earthquake.