

CHAPTER 2 DATABASE SYSTEM

2.1 Objectives

In order to implement the Study, a wide range of natural and social data had to be collected, compiled, integrated, analysed and displayed by the proper device/media to evaluate the spatial distribution of earthquake disaster in the study area. Much of the data to be collected were provided only in paper format and had to be digitised.

GIS is considered to be the most valuable and powerful methodology for spatial data compilation, integration, analysis and display. Lots of data showing regional characteristics can be combined and superimposed by GIS software and analysed to display the spatial distribution of the earthquake disaster.

The final products of the database are series of maps and tables showing current conditions and analysed results. All the data and the results will be overlapped and utilised for the development of seismic disaster mitigation planning. This database is only a primitive one because of many limitations such as study period and insufficient data. Therefore, this database should be updated in the future.

2.2 Design

Prior to the database establishment, the Study Team collected information about the existing database based on GIS techniques in the Kathmandu Valley. The Study Team found that some organisations such as Kathmandu Valley Town Development Committee (KVTDC), Department of Mines and Geology (DMG), Survey Department, International Centre for Integrated Mountain Development (ICIMOD) and Kathmandu Valley Mapping Programme (KVMP), have already started utilising GIS for their respective purposes. However, the existing data of past projects and the other organisations such as Nepal Water Supply Corporation (NWSC) and Nepal Telecommunication Corporation (NTC) used only AUTOCAD.

In this study, a “modified UTM” coordinate system, the same as used by the Survey Department, KVTDC and DMG, was adopted. All the data in other formats and using different coordinate systems were converted and transformed to GIS data based on modified UTM coordinate system before being used in this database. This brought the Team to realise the necessity for providing a precise coordinate system in maps and projections in Nepal, not only for this study but also for all current and future projects and tasks in Nepal. It should be the base

for urban planning as well.

Based on this background of database and on discussion with counterpart personnel of the Survey Department, the Study Team designed and specially developed the system “Kathmandu Earthquake Risk Mitigation Tool (KERMIT)” including both the database and a new simulation function as shown in attached Figure 2.2.1.

2.3 Specifications

Based on the design of the database system and taking the amount of related data and results into account, the specifications for the database system are as follows:

- a) Hardware consists of a PC with free hard disk space of more than 400 Mega bytes, the display of 1024x768 pixels and a colour printer/ plotter, speaker system if necessary.
- b) Software consists of Windows 95/98/ME, Arc View GIS (Version 3.1 or 3.2) by ESRI, Microsoft Excel 2000, Microsoft Word 2000, Microsoft PowerPoint 2000 and Windows Media Player (Version 6 or 7).
- c) Originally developed software by the Team for the study can display whole data and results in the Study. This software can also make new simulations for various scenario earthquakes.

The adopted coordinate system in this database system is “Modified UTM” and the detail is shown in Table 2.3.1.

Table 2.3.1. Factors of “Modified UTM” Coordinate System

Spheroid	Everest 1830	
Projection	Universal Transverse Mercator	
Origin	Latitude	84 degree East
	Longitude	0 degree North
False co-ordinates of origin	500,000m Easting	
	0m Northing	
Scale factor at central meridian	0.9999	

The municipal wards and the VDCs are adopted as the basic units for the administrative boundaries in this study. Every municipal ward and the VDC are identified with each ID No. as shown in Table 2.3.2 and the actual ID No. of each municipal ward and VDC is shown in attached Table 2.3.3.

Table 2.3.2 ID No. of Municipal Ward and VDC

First digit	Second digit	Third and forth digits	Fifth digit
District	Municipality/ VDC	Serial Number for each municipality ward or VDC	Number of enclave
1: Kathmandu	1: Kathmandu	35 wards (01-35)	1
	2: Kirtipur	19 wards (01-19)	1
	0: VDC	56 VDCs (01-56)	1
2: Lalitpur	3: Lalitpur	22 wards (01-22)	1
	0: VDC	26 VDCs (01-26)	1
3: Bhaktapur	4: Bhaktapur	17 wards (01-17)	1
	5: Madhyapur Thimi	17 wards (01-17)	1-3
	0: VDC	16 VDCs (01-16)	1

For various analyses as described in Chapter 1, a grid with a mesh of 500m square was used as shown in attached Figures 2.3.1 to 2.3.2. At first, a rectangular area with the origin of 617,000 in longitude and 3,046,000 in latitude was established. Secondly, the rectangular area was divided into 500m square meshes (see attached Figure 2.3.1 above). And then, the meshes which include the area of the Valley were selected. Total 2,826 meshes cover the whole Valley (see attached Figure 2.3.1 below). After that, each mesh was identified with an ID number which relates to the coordinates of longitude and latitude as shown in attached Figure 2.3.2.

2.4 Functions

This system, the “Kathmandu Earthquake Risk Mitigation Tool (KERMIT),” is specially developed for the “Study on Earthquake Mitigation in Kathmandu Valley, Kingdom of Nepal”. KERMIT has two main functions as follows:

(1) View and Query the Entire Results of This Study

KERMIT menu dialogs lead the user to the target result which the user has an interest in. The user should choose the title in menu dialogs or list box in the submenu. The contents are listed in attached Table 2.4.1. KERMIT can display mainly the GIS data provided as the results of the Study by using the GIS software ArcView (Version 3.1 or 3.2). KERMIT is capable of displaying not only GIS data but also tables, graphs, etc., which are provided as the results of the Study. They are displayed by Microsoft Excel 2000, PowerPoint 2000, Word 2000 and Windows Media Player (Version 6 or 7).

(2) Simulate Various Scenario Earthquakes

Another function is the simulation of ground motion and damages caused by various scenario earthquakes. When the parameters of an earthquake are

specified, the results of the calculation will be automatically converted to the GIS data and displayed.

There are three steps as follows:

Step 1: Calculate Seismic Hazard

At first, fault parameters such as location, fault size and magnitude of a new scenario earthquake shall be specified. After that, calculation starts.

Step 2: Display Seismic Hazard

In this step, the following items of seismic hazard will be displayed:

- a) Peak Ground Acceleration Distribution.
- b) Seismic Intensity Distribution.
- c) Liquefaction Potential Distribution.

Step 3: Calculate and Display Seismic Damage

Based on the previous calculation of Step 2, the following items of seismic damage will be calculated and displayed:

- a) Heavily Damaged Building Number Distribution.
- b) Heavily Damaged Building Ratio Distribution.
- c) Death Toll Density Distribution.
- d) Total Casualty Density Distribution.
- e) Death Toll Number Distribution.
- f) Damage to Water Supply Network
- g) Damage to Sewerage Network.
- h) Damage to Electric Power Supply Network.
- i) Damage to Telecommunication Network.

2.5 Operation Manual

In this section, a brief operation manner is described, and the detailed manual is shown in Appendix Volume "Database System Manual".

(1) Installation

As **KERMIT** does not have its own setup function, the user should execute the following two simple operations.

- a) Copy the Directory "*eqdm-ktm*" with all sub-directories from distributed CD-ROM to the root directory of C drive.
- b) Edit the configuration file "*eqdm.inf*" in directory "*|eqdm*", using your text editor. "*eqdm.inf*" consisting of the following contents.
 - First line: directory path which includes the file "*arcview.exe*"
 - Second line: directory path which includes the file "*excel.exe*"

- Third line: title of your **ArcView**. See the title bar of active window of **ArcView**

An example of "eqdm.inf" is shown below.

```
C: |esri |av_gis30 |arcview |bin32|
C: |Program Files |Microsoft Office |Office|
arcview gis version 3.1
```

(2) Operation

The user can execute "eqdm.exe" in the “|eqdm-ktm |system” directory. The main menu appears at center of the display as shown in Figure 2.5.1.

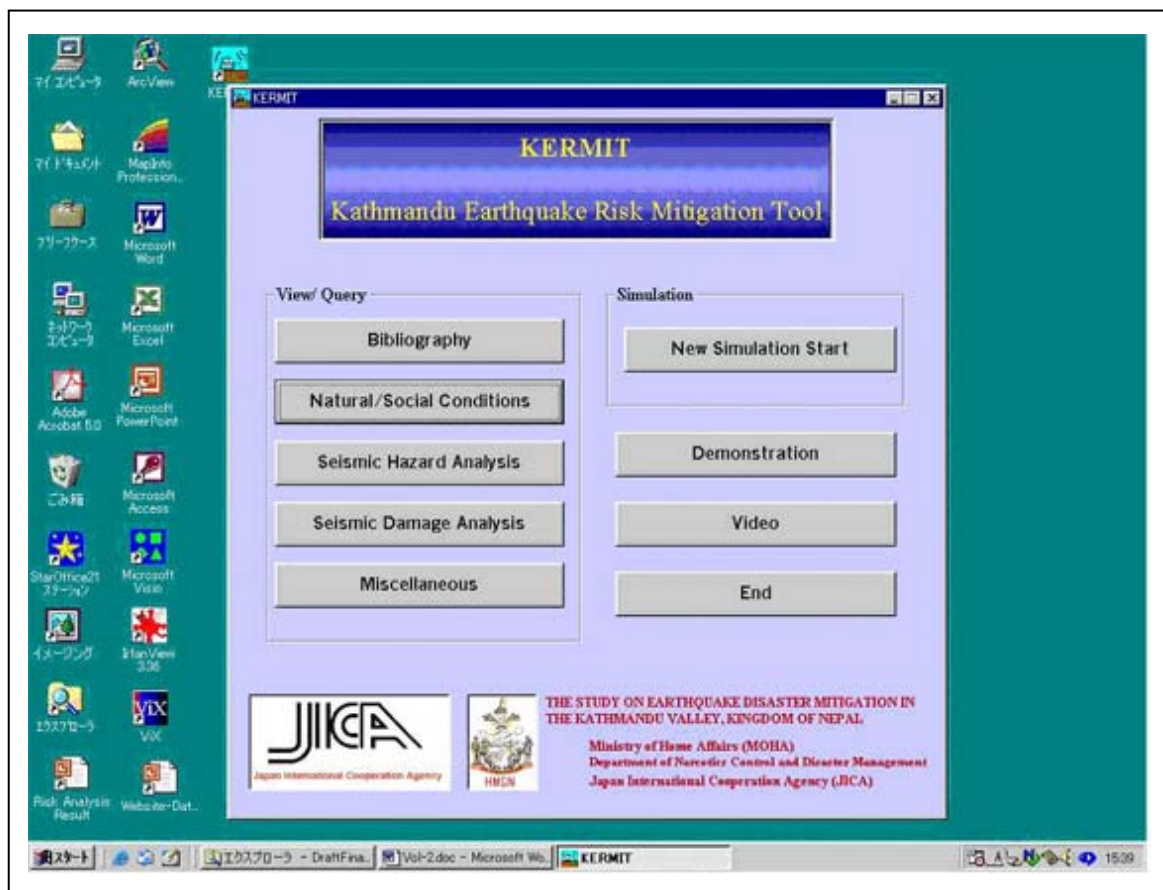


Figure 2.5.1 Main Menu of KERMIT

The main menu indicates eight buttons to lead to each category as mentioned in Section 2.4.

- a) Bibliography
- b) Natural / Social Conditions
- c) Seismic Hazard Analysis

h) Video

At the categories, “Bibliography”, “Natural / Social Conditions”, “Seismic Hazards”, “Seismic Damage” and “Miscellaneous”, the user can see the results of the Study as the user likes from the list box in the sub-menu.

An example of the “Natural / Social Conditions” sub-menu with some list boxes at the left side of the display is shown in Figure 2.5.2. The user should only choose the title which the user would like to see in the list box and then click the ‘Go’ button just under the list box. Figure 2.5.2 shows an example when the user chooses the title “Land Use” in the list box.

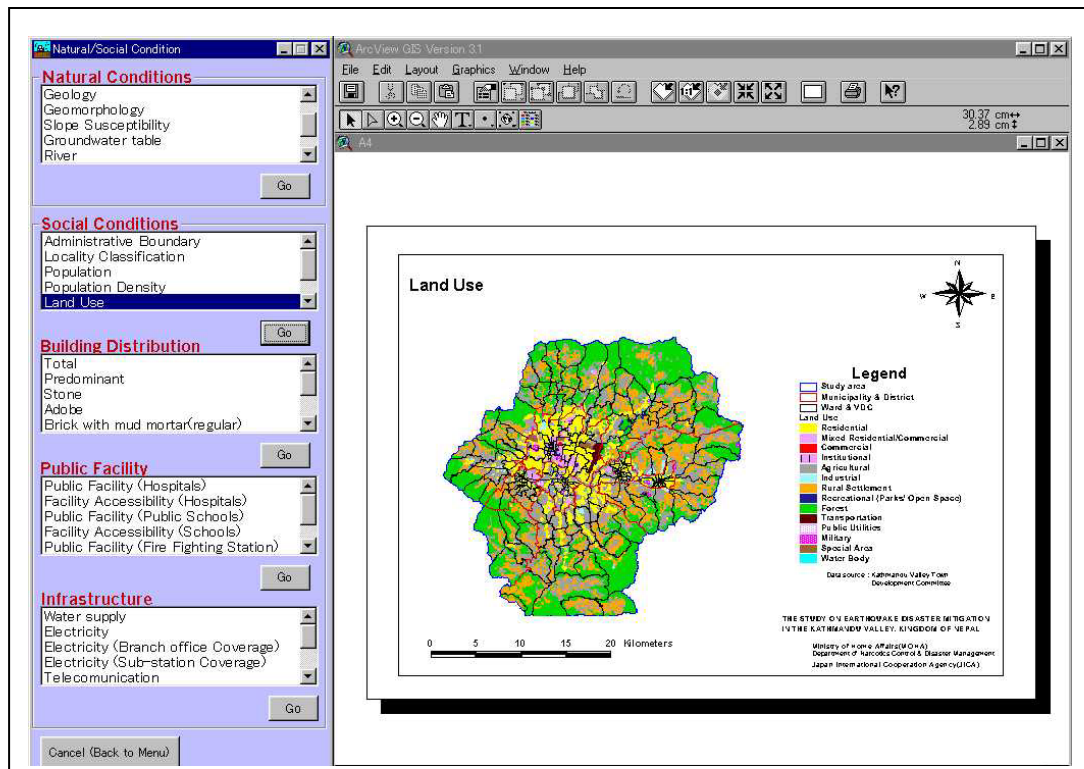


Figure 2.5.2 Example of “Natural / Social Conditions” sub-menu and “Land Use” Result

In the category “New Simulation”, the user can simulate the ground motion and damages caused by a scenario earthquake with new parameters step by step as described in Section 2.4. Figure 2.5.3 shows the condition of parameters setting for “New Simulation” in Step 1.

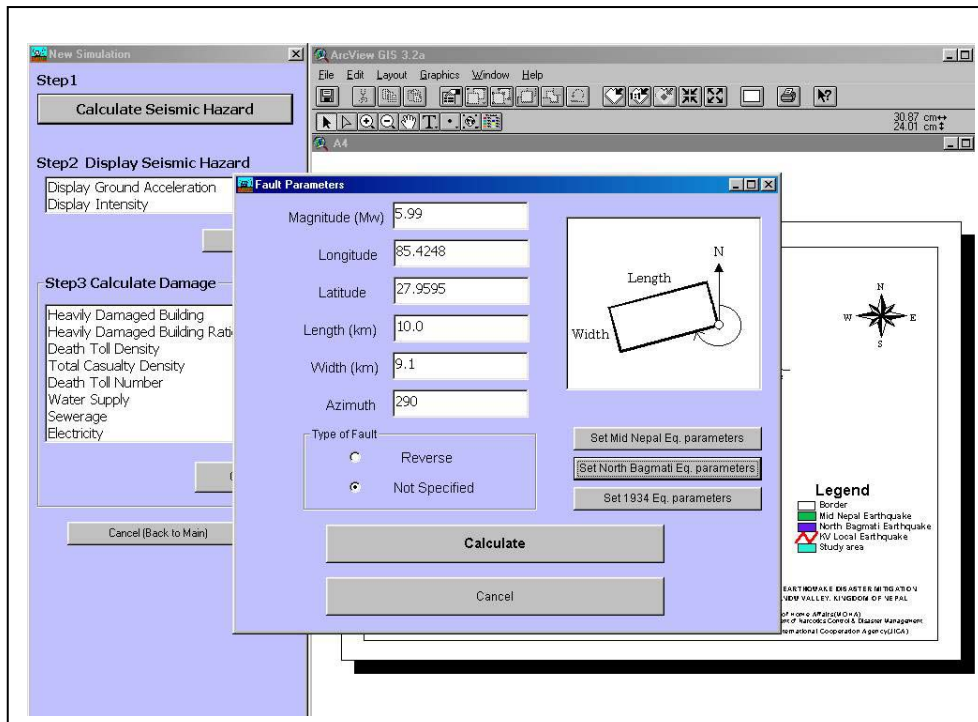


Figure 2.5.3 Parameter Setting for “New Simulation” Sub-menu

In the category “Demonstration”, users can see an outline result by the slideshow of PowerPoint 2000. In the category “Video”, you can see an information dissemination video of the pilot community meeting by Windows Media Player as shown in Figure 2.5.4.



Figure 2.5.4 Example Picture from “Video” Menu

2.6 Contents

In accordance with the design, the contents of the database were formulated and the details are shown in attached Table 2.6.1.

CHAPTER 3 WEBSITE

The website for this Study was published at the following URL after the approval at the steering committee.

<http://www.jica-eqdm-ktm.org.np>

The top page is shown in Figure 3.1.1



Figure 3.1.1 Top Page of the Website

CHAPTER 4 RECOMMENDATION ON HAZARD ASSESSMENT

The earthquake hazard assessment in this study was done applying recent technology; there was limitation such as quality/quantity of collected data, study period, however. This assessment is not the final result and desired to be upgraded. Following measures are recommended to upgrade seismic damage estimation results.

- a) Precise determination of the location and magnitude of imminent Mid Nepal Earthquake
 - Improvement of micro-earthquake observation system
 - Establishment of GPS continuous observation system
- b) Proper arrangement of the basic data
 - Unification of the format of map data, made by each organisations
- c) Accumulation of data on ground condition
 - Exploring the structure of the basement in Kathmandu basin
 - Establishing database of drilling and other prospecting results
- d) Establishment of database on infrastructure
 - Building inventory database
 - Lifeline GIS database
 - Bridge ledger
- e) Establishment of a data clearing centre
 - Establishment of data arrangement system to maintain/update/disseminate all the earthquake-related information
- f) Improvement of the damage function
 - Collecting, classifying and analysing existing earthquake damage data in Nepal
- g) Others
 - Installation of the strong motion seismograph to acquire the basic data for engineering purpose
 - Establishment of the earthquake engineering laboratory
 - Training earthquake engineering researcher and technician

CHAPTER 5 REFERENCES

[1.2]

Ambraseys, N. and R. Bilham (2000): A note on the Kangra Ms=7.8 earthquake of 4 April 1905, *Current Science*, 79.

Auden, J. B. (1939): The Bihar-Nepal earthquake of 1934, Section D – NEPAL, *Geol. Surv. India Mem* 73.

Bilham, R. (1995): Location and magnitude of the 1833 Nepal earthquake and its relation to the rupture zones of contiguous great Himalayan earthquakes, *Current Science*, 69.

Bilham, R., P. Bodin, and M. Jackson (1995): Entertaining a great earthquake in western Nepal: Historic inactivity and geodetic test for the development of strain, *J. Nepal Geol. Soc.*, 11, Special Issue.

DMG (1998): Engineering and environmental geology map of the Kathmandu Valley.

Pandey, M. R. and P. Molnar (1988): The distribution of intensity of the Bihar-Nepal earthquake 15 January 1934 and bounds on the extent of the rupture zone, *J. Nepal Geol. Soc.*, 5.

Pandey M. R., R. P. Tandukar, J. P. Avouac, J. Vergne and Th. Heritier (1999): Seismotectonics of the Nepal Himalaya from a local seismic network, *J. Asian Earth Sci.*, 17.

Rana, Maj. Gen. Braham Sunsher J. B. (1935): The great earthquake of Nepal (in Nepalese).

UNDP/UNCHS (1994): Seismic Hazard Mapping and Risk Assessment.

Utsu, T. (1990): Table of world hazardous earthquakes.

Yagi K., H. Maemo, K. Saijo, Y. Ootsuki and Y. Nakata (2000): The activity of active faults in Lesser Himalaya Kathmandu Valley and surrounding area, *Chikyū Monthly*, Special Issue 31 (in Japanese).

[1.3]

JICA (1980): Natural Gas Resources in Kathmandu Valley.

JICA (1980): Basic Design Study Report on The Project for Reconstruction of Bridges in Kathmandu, The Kingdom of Nepal.

JICA (1990): Groundwater Management Project in the Kathmandu Valley.

JICA (1994): The Project for the Construction of New Bagmati Bridge at Thapathali.

Department of Mines and Geology (1998): Engineering and Environmental Geological Map of Kathmandu Valley.

[1.4]

Boore D., W. Joyner and T. E. Fumal (1997): Equation for estimating horizontal response spectra and peak acceleration from western north American earthquakes: A summary of recent work, *Seism. Res. Lett.* 68.

Fujiwara T., T. Sato, T. Kubo and H. Murakami (1990): Main causes of building damage done by the 1988 Nepal-India earthquake, *Proceedings of 9th Symposium on Earthquake Engineering.*

Imazu M. and K. Fukutake (1986): Dynamic shear modulus and damping of gravel materials, *Proceedings of the 21th Japan National Conference on Soil Mechanics and Foundation Engineering.* (in Japanese)

Iwasaki T., F. Tatsuoka and Y. Takagi (1977): About the shear deformation coefficient of sand and strain dependency of dumping, *Proceedings of the 12th Japan National Conference on Soil Mechanics and Foundation Engineering* (in Japanese).

Jain S., A. D. Roshan, J. N. Arlekar and P. C. Basu (2000): Empirical attenuation relationships for the Himalayan earthquakes based on India strong motion data, *Proceedings of 6th International Conference on Seismic Zonation.*

Trifunac M. D. and A. G. Brady (1975): On the Correlation of seismic intensity scales with the peaks of recorded strong ground motion, *B.S.S.A.*, 65, 1975.

[1.5]

ISSMFE (1993): Manual for zonation on seismic geotechnical hazards, Technical committee for earthquake geotechnical engineering, TC4, International society of soil mechanics and foundation engineering.

Iwasaki, T., K. Tokida, F. Tatsuoka, S. Watanabe, S. Yasuda and H. Sato (1982): Microzonation for soil liquefaction potential using simplified methods, *Proc., 3rd Int. Conf. on Microzonation.*

Japanese Design Specification of Highway Bridge (1996).

JICA (1990): Groundwater management project in the Kathmandu Valley.

[1.8]

Cochran, W.G., (1997): Sampling techniques, Wiley series in probability and mathematical statistic, New York, Second edition, ISBN:047116240X.

Rao, S.P.S., Sedransk, J., W.G. Cochran's (1984): Impact on Statistics, Wiley series in probability and mathematical statistics. Probability and mathematical statistics, pp. 321-330, ISBN:0471099120.

The Development of Alternative Building Materials and Technologies for Nepal (1994): His Majesty's Government of Nepal Ministry of Housing and Physical Planning, UNDP/UNCHS (Habitat) Subproject NEP/88/054/21.03, Appendix C - Seismic Vulnerability Analyses, BECA, TAEC, SILT, URR.

Arya, A. (2000): Non-Engineerd Construction in Developing countries - An Approach toward earthquake Risk Prediction, Proceedings of the 12WCEE2000, No. 2824,pp.1-22, 2000.

Murakami, H., O., Fujiwara, T., Sato, T., Kubo, T. (1990): Pattern of Casualty Occurrence Due to the 1988 Earthquake in the Nepal-India Border Region, 9SEE-90, Roorkee, Vol.1, pp3-25 – 32.

Dikshit, A.M. (1991): Geological Effects and Intensity Distribution of the Udayapur (Nepal) earthquake of August 20, 1988, Journal of NGS(Nepal Geological Society) ,Vol. 7, pp.1-17, DMG, Kathmandu, Special Issue.

Trifunac, M. D. and A.G.Brady (1975): On the Correlation of seismic intensity scales with the peaks of recorded strong ground motion, Bull. Seism. Soc. Am., Vol.65, No.1, 139.

[1.10]

Coburn, A.W. and R.J.S. Spence (1992): Earthquake Protection, John Wiley.

Niranjan Thapa (1988): The Earthquake of August 1988 AD (in Nepalese).

Pandey, M. R. and P. Molnar (1988): The distribution of intensity of the Bihar-Nepal earthquake 15 January 1934 and bounds on the extent of the rupture zone, J. Nepal Geol. Soc., 5.

[1.11]

Disaster Prevention Council of the Tokyo Metropolitan Area (1978): Report on the Earthquake Damage Estimation of Central Area in Tokyo.

[1.12]

Applied Technical Council (ATC) (1985): Earthquake Evaluation Data for California (ATC-13).

Dikshit, A. M. (1991): Geological effects and intensity distribution of the Udayapur (Nepal) earthquake of August 20, 1988, Journal of N. G. S., 7.

Kubo, K. and T. Katayama (1975): Chap.7 Damage Estimation of Underground Water Supply Pipeline, Investigation Study Report on the Earthquake Disaster Prevention of Kawasaki City (in Japanese).

Kubo, K. and T. Katayama (1981): Chap.2 Study on the Supply Reliability of the Water Supply Network in Kawasaki City during Earthquake, Investigation Report on the Earthquake Disaster Prevention of Kawasaki City (in Japanese).

Saitama Prefecture (1998): Report on Sesimic Microzoning Study in Saitama Prefecture (in Japanese).

[1.13]

Kanagawa Prefecture (1986): Investigation Study Report on Earthquake Damage Estimation, Fire Outbreak and Hazardous Materials (in Japanese).