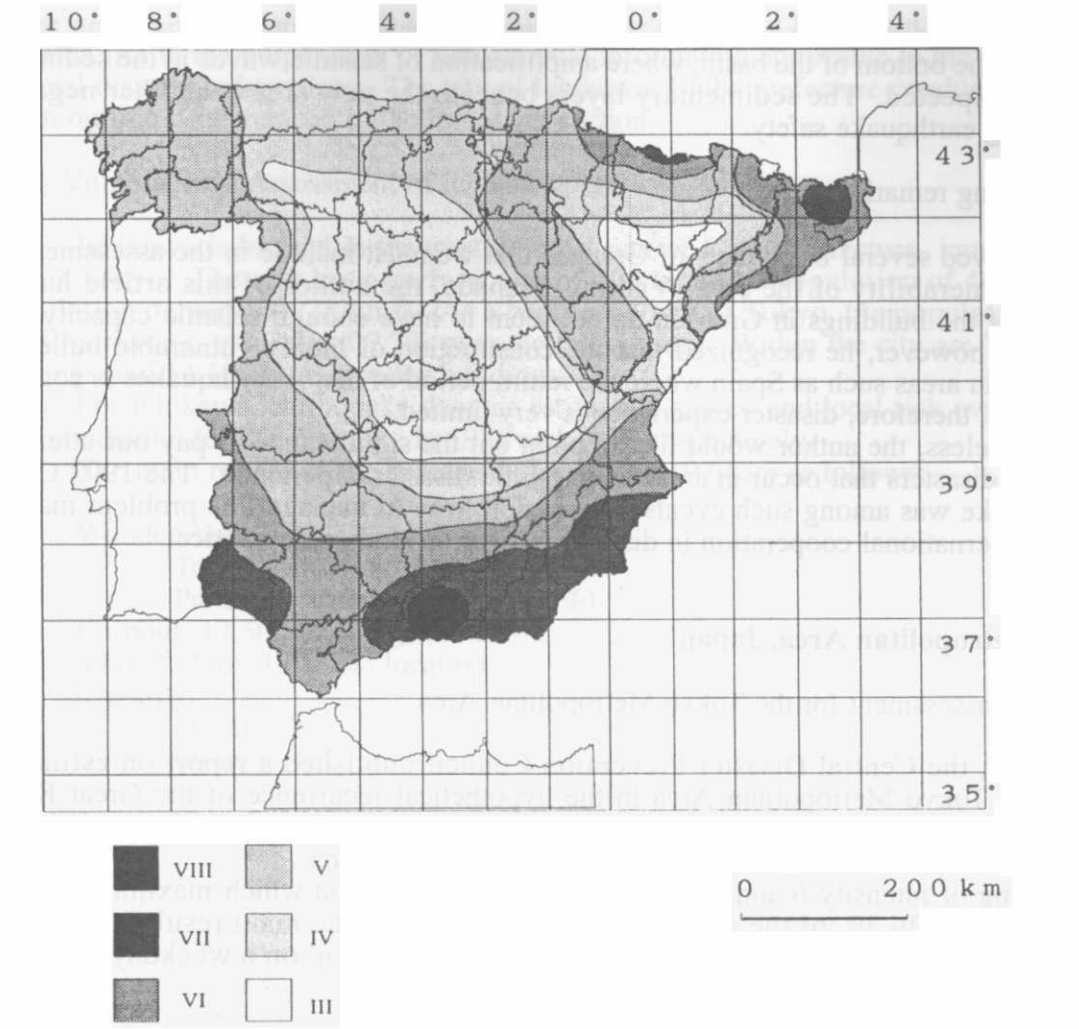

Figure 5.6.1 Map showing expected isoseismals for a return period of 500-years.
(Source: Instituto Geografico Nacional, Peligrocidad Sismica en Espana)

5.6.3 Topography and geology

Granada lies in a basin formed in the middle of Sierra Nevada mountains. The geology consists of alluvial deposits. There are uncountable faults in the mountain range, the Granada area as well, and the level of seismic activity of this area is remarkably high.

5.6.5 Population

Spain is made up of 52 provinces and has a total population of about 40,000,000. Granada is the capital city of Granada province with a population of about 800,000, which roughly coincides the average of provincial population in Spain. Approximately a third part of the provincial population, 255,000, are concentrated in Granada. Since Granada is the only major city that carries a population more than 50,000 in the province, the city is the key element for seismic safety measures in the province.

5.6.5 Urban setting

Granada consists of two parts, or the old town and the new area. The old town was built first by the Moors prior to the 15th century and then by the Spanish since the 16th century. The roads in the old town, except main streets, are narrow forming a negative element in disaster safety.

While the old town is situated on a hilly area, the new districts are spreading to the southwest into the bottom of the basin, where amplification of seismic waves in the sedimentary layers is expected. The sedimentary layers beneath the new area is another negative factor objecting earthquake safety.

5.6.6 Concluding remarks

We showed several basic facts of Granada that we must include in the assessment of the seismic vulnerability of the city. Visiting Granada, the author of this article had an impression that the buildings in Granada do not seem to have enough seismic capacity. At the same time, however, he recognized that the construction of highly vulnerable buildings was inevitable in areas such as Spain where the return period of major earthquakes is considerably long and, therefore, disaster experience is very limited.

Nevertheless, the author would like to point out the significance to pay our attention on earthquake disasters that occur in areas having little disaster experience. The 1992 Cairo, Egypt earthquake was among such events. A possible way to manage this problem may be found in the international cooperation in disaster mitigation study and practice.

5.7 Tokyo Metropolitan Area, Japan

5.7.1 Damage assessment for the Tokyo Metropolitan Area

In 1988, the Central Disaster Prevention Council published a report on estimated damage in the Tokyo Metropolitan Area in the hypothetical recurrence of the Great Kanto earthquake of 1923. The survey area had a surface area of 13,600 km^2 and a population of 30.3 million (1985), accounting for 25% of the national population.
Ground shaking of intensity 6 and more on the Japanese scale, on which maximum is 7, is estimated to affect 36.3% of the surface area of the region. The main results of damage estimation, where the earthquake was assumed to strike at 5 p.m. on a weekday in winter with a wind speed of 4 m/s, are as follows:

Area of soil liquefaction (high likelihood): 9.1% of the study area
Maximum height of tsunamis in Sagami Bay: 5.9m
Damage to wooden buildings:
    Total destruction: 341,000 (4.7%)
    Partial destruction: 369,000 (5.1%)
Damage to non-wooden buildings:
    Total destruction: 46,000 (3.5%)
    Partial destruction: 50,000 (3.7%)
Burnout:
    Buildings: 2,600,000 (30%)
    Households: 3,770,000 (39%)
Major damage to roads and bridges: 218 locations
Damage to telephone lines: 37%
Disruptions to power supply: 43%
Disruptions to water supply: 32%
Casualty:
    Deaths: 150,000
    Injuries: 203,000

At present for the Tokyo area, many seismologists do not expect the recurrence of the Kanto earthquake as the next event. They expect a smaller, M7 class earthquake having a focus just beneath the urban area as the most probable "next event." Vulnerability assessment against an earthquake of this type is now in progress.

Apart from the survey by the Central Council, many local governments, prefectures

and municipalities, carried out vulnerability assessment for their own area. Their survey intention lies in the preparation of fundamental information applicable to the development of regional disaster safety plans. The city of Ichikawa, Chiba prefecture conducted a survey, of which outline is introduced in the following section.

5.7.2 Vulnerability Assessment of Ichikawa

Ichikawa is located in the western most part of Chiba prefecture, immediately to the east of Tokyo. The city has a surface area of 56 km^2 and a population of 447,000 in 1992 (population density: 7,925/km^2). As a bedroom town of Tokyo, the population of the city keeps increasing, at a rate of 7.7% over the last 5 years. Within the city are 78,200 wooden buildings and 14,100 non-wooden buildings.

For Ichikawa, earthquake damage estimation survey and local risk evaluation survey were conducted for the first time in 1978 and 1979, respectively.

The main results of the damage estimation in 1979 are as follows:

Wooden buildings:
- Total destruction: 1,977 (2.6%)
- Partial destruction: 3,789 (5.0%)

Burnout: 17,500 buildings (10.5%)
Slope failure: 130–205 locations
Casualty:
- Deaths: 260
- Injuries: 481

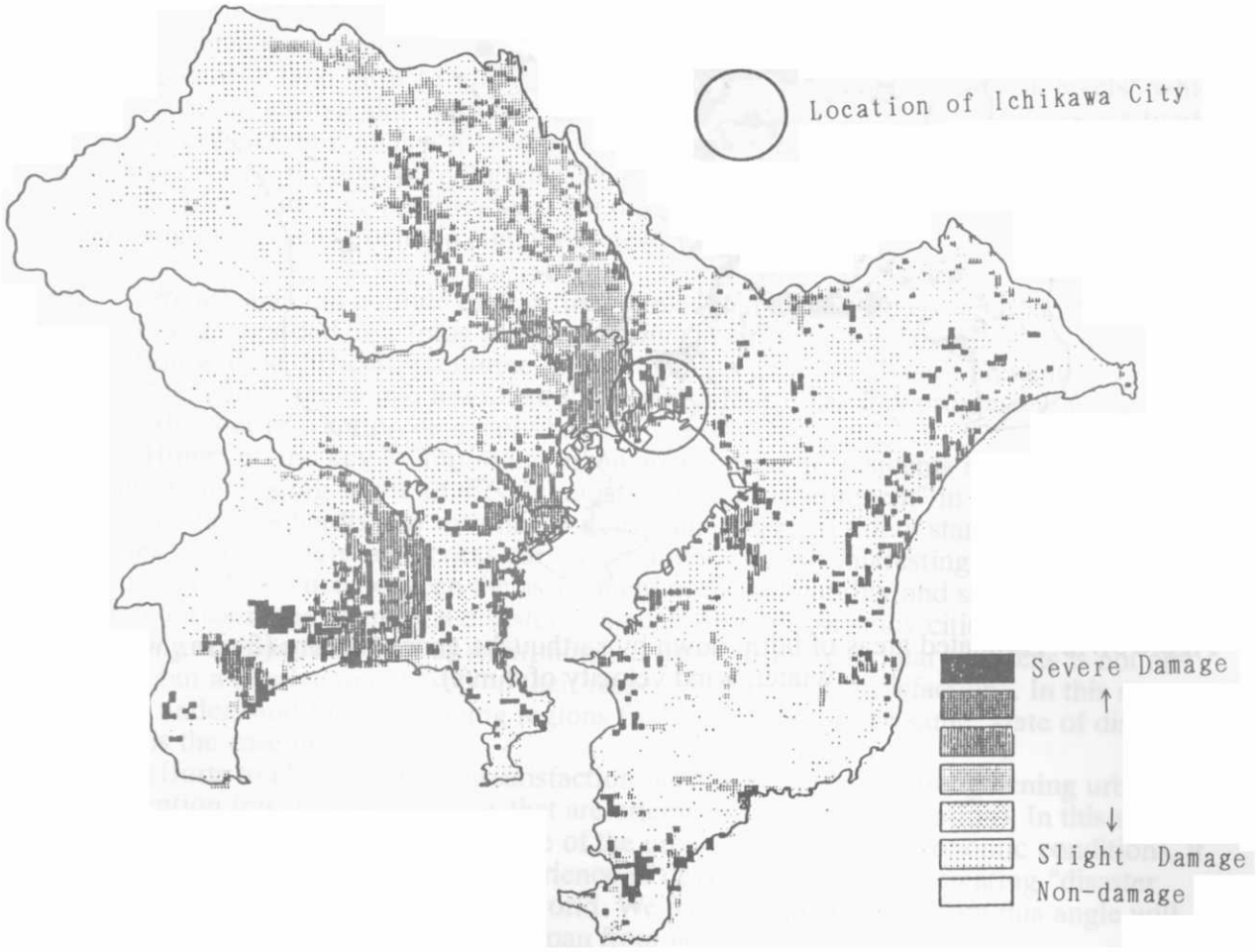

Figure 5.7.1 Estimated damage of wood frame buildings due to earhtquake.

The population in 1979 was 353,000, and the number of wooden houses was 75,700. The population has increased dramatically since then, and, with an increase in population by 94,000, the urban setting has been considerably changed. As for buildings, although the number of wooden buildings increased only by about 2,500, non-wooden buildings have increased greatly, even though most of them are apartment blocks. Taking the change in urban setting into account, we started to re-evaluate the city's seismic vulnerability by conducting damage estimation and comparative risk measurement.

5.7.2 The disaster environment of Ichikawa as part of the Tokyo Metropolitan Area

Figure 5.7.1 shows the state of damage to wooden houses derived in the 1988 damage estimation. Figure 5.7.2 shows the extent of damage caused by earthquake-related fires. These two diagrams indicate that Ichikawa is among the areas in which serious damage was expected to occur in an earthquake affecting the Tokyo Metropolitan Area.

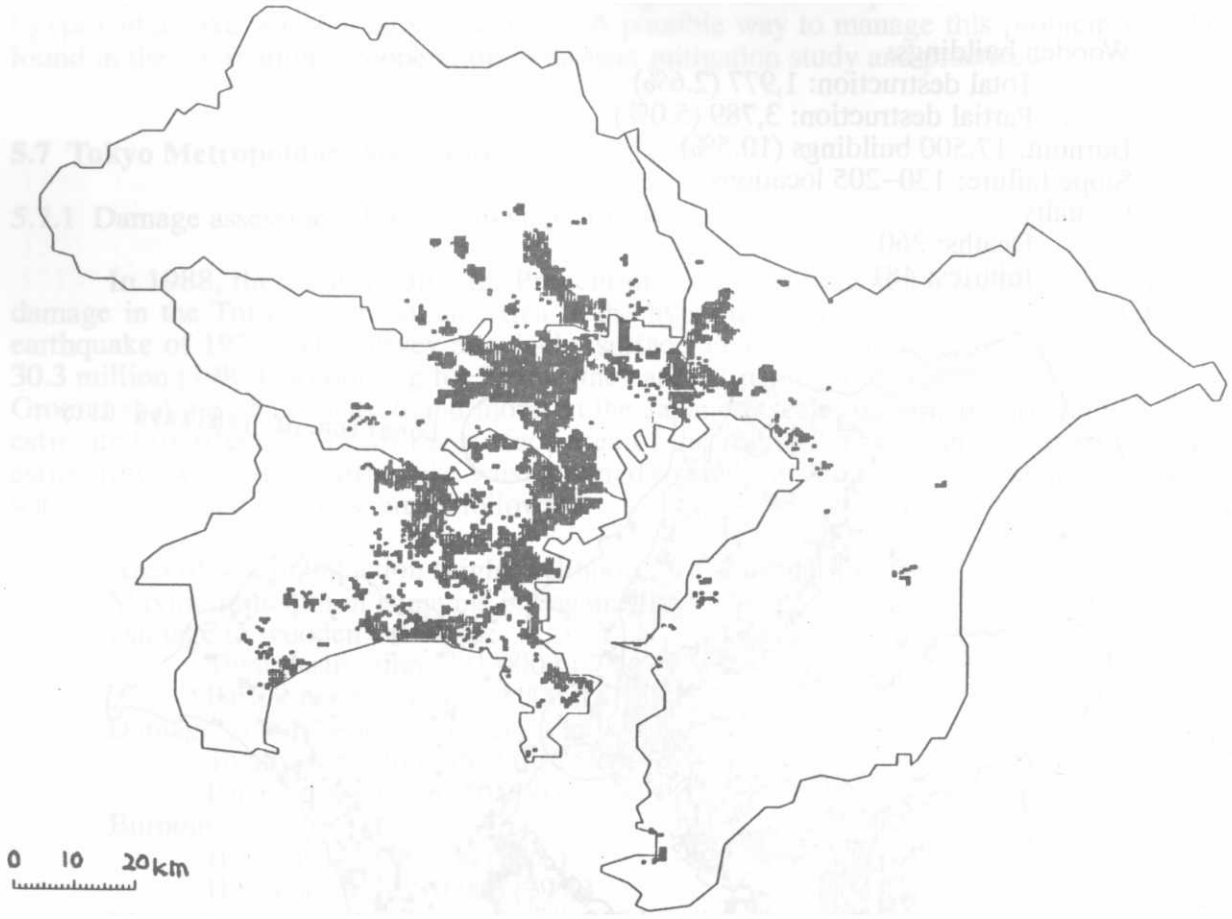

Figure 5.7.2 Estimated areas of burn-down by earthquake generated fire (5 p.m., weekday, winter, wind velocity of 4 m/s).

Conclusion

The main points clarified by this survey on the aspects and characteristics of urban earthquake disasters in developing regions are as follows.

(1) The concentration of population and economic activity in major cities is more marked in developing regions than in developed countries. Moreover, densely concentrated buildings and facilities are markedly more vulnerable than those in developed countries in terms of "earthquake resistance efficiency". As a result, cities in developing regions face a heavily concentrated risk of "damage to buildings" caused by earthquake activity. It is this fact that determines the content and basic direction of preventive measures and emergency action after an earthquake, designed to create urban areas that can withstand disasters. In particular, in contrast to Japan, where countermeasures against simultaneous multiple outbreaks of fires after an earthquake form the backbone of disaster prevention countermeasure plans, the basic direction of earthquake countermeasure plans in many developing regions is "how to formulate disaster prevention countermeasure plans to withstand simultaneous multiple collapses of buildings".

(2) The concentration of population in cities makes it difficult to avoid the urgent problem of the mass supply of housing. As a result, particularly in this respect, restrictions are eased rather than intensified, housing built on inferior architectural principles is supplied, and in extreme cases this simply encourages unapproved development or illegal conversions and extensions. Under such circumstances, the lack of organized data relating to existing buildings deals a fatal blow to surveys for "damage estimates" and "local risk levels" which form a basis for earthquake disaster countermeasures. Just as population surveys are fundamental to population policies, so also building surveys are absolutely vital to earthquake countermeasures in developing regions. The situation of data on buildings is by no means satisfactory even in developed regions, but the importance of financial and technical aid in organizing these data is being recognized anew.

(3) We all share an attitude of "eat first, think about safety and comfort later". If disaster prevention is regarded as a "plus alpha economy" in terms of our daily lives, then disaster prevention will be difficult to enforce in developing regions. If disaster prevention is turned into an "economic problem", it will hardly be possible to make any progress in working towards disaster prevention on a daily basis.

However, the key to improving urban areas lies in the residents recognizing the "risk of disaster" and being aware of the "degradation of the environment" in their own city. In this sense, there is hardly any meaning in "environmental and safety standards common to all countries". This citizens awareness survey produced a highly interesting result in that there was no great difference between the assessment of the habitability and safety of major Japanese cities in the event of a disaster as against that in case study cities selected from developing regions. This sort of environmental assessment by ordinary citizens is not an absolute but a relative one, based on their respective "levels of satisfaction". In this sense, we ought to understand that developing regions find themselves in the same "state of dissatisfaction" as is the case in Japan.

Efforts to eliminate this dissatisfaction need to be based on strengthening urban disaster prevention (creating urban areas that are oriented to disaster prevention). In this sense, even given great differences in the state of the urban area or socio-economic conditions, it should be possible to draw on the experience of developed regions in creating "disaster prevention communities" in the third world. We feel that approaches from this angle will become more and more important in Japan from now on.

(4) The greatest remaining task at the research level is the technical development and diffusion of methods for localized "damage assessment" and "local risk evaluation" in developing regions, using readily available data.

Japan National Committie for IDNDR

What is the "Natinal Committie for IDNDR" ?

The United Nations designated the 1990s as "Internatinal Decade for Natural Disaster Reduction" at the 42nd United Nations General Assembly, through concerted international action, especially in developing countries, to reduce damages caused by natural disaster, and the resolution was adopted.

In Japan, "the Goverment Headquarters for the International Decade for Natural Disaster Reduction" headed by the Prime Minister as President was established, various measures are being undertaken.

But in order to succeed the International Decade for Natural Disaster Reduction, of course, the Japan goverment should be leading, both "Academic sectors wisdom and experience" and "Industrial sectors activity" are important to promote the decade.

The "Natinal Committie for International Decade for Natural Disaster Reduction" was established by industrial and academic sectors in August 1990 in order to widely acquaint by the public with the purpose of this movement.

IDNDR
国際防災の10年

1. This Logo was designed and authorized by the Japanese Goverment Headquarters in order to promote educatinal activities in relation to the IDNDR.
2. The circle in the logo for the IDNDR represents our globe, while the wavy lines in the lower half symbolize the natural disasters which occur all too frequently.
3. The triangular figures in the center represent the people of the world, working together to achieve the objectives of the IDNDR - a reduction of the damage caused by natural disasters.