# RADIUS INITIATIVE FOR IDNDR - HOW TO REDUCE URBAN SEISMIC RISK

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## SUMMARY

The Secretariat of the International Decade for Natural Disaster Reduction (IDNDR 1990-2000), United Nations launched the RADIUS (**R**isk **A**ssessment Tools for **Di**agnosis of **U**rban Areas against **S**eismic Disasters) initiative, which aims to reduce seismic disasters in urban areas, particularly in developing countries. In collaboration with 9 selected cities around the world, the RADIUS initiative develops practical tools for seismic risk assessment of urban areas are developed to raise public awareness and provide directions for the development and implementation of disaster mitigation measures.

The nine cities selected serve as case studies to develop seismic damage scenarios and a risk management plan in a multi-sectoral way, involving decision makers, public sectors, and mass media and to strengthen the collaboration among local governments, local scientists and communities. The experiences of the nine cities are incorporated into the development of practical tools for seismic damage assessment in urban areas, which could be applied to any earthquake prone cities.

Some results of RADIUS are presented in 12 WCEE. All the results of RADIUS and similar experiences in the world will be presented in the RADIUS Symposium to be held in Tijuana, Mexico, one of the case study cities, in October 1999. The results will be also available through internet.


## INTRODUCTION

The world is rapidly being urbanized with almost half of its population living in cities. Cities where population and all kinds of human activities are concentrated, are more and more vulnerable to disasters, particularly to earthquakes, which could not be predicted precisely. Once an earthquake takes place in a big city, the damage would be tremendous both in human and economic terms. Even an intermediate earthquake could cause a destructive damage to a city as in the case of the 1995 Kobe Earthquake in Japan.

However, there is a tendency to look at disasters only from a humanitarian angle, bringing us into the position of giving priority to the response to disasters. There is also an unfounded tendency to consider that the investment to strengthen the existing infrastructure before disasters will cost much more than the cost of response after the disasters. It is actually just the reverse. It is clear that from the economical view point, preparedness pays off in the long term. Besides, the response activities never save human lives which have already been lost. In order to reduce the impact of the disasters, it is therefore essential to concentrate our efforts on prevention and preparedness.

The UN General Assembly designated the 1990s as the "International Decade for Natural Disaster Reduction" to reduce loss of life, property damage and social and economic disruption caused by natural disasters. In 1994, the World Conference on Natural Disaster Reduction was held in Yokohama, Japan, declaring the "Yokohama Strategy and Plan of Action for a Safer World". It stresses particularly the importance of making appropriate

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technology available to all freely and of the involvement of local governments and communities. It also defines the risk assessment as a required step for the adoption of adequate and successful disaster reduction policies and measures.

To realize the concept of the IDNDR and "Yokohama Strategy and Plan of Action," the IDNDR Secretariat launched the RADIUS initiative in 1996 with financial and technical assistance of the Government of Japan. It aims to promote worldwide activities for reduction of seismic disasters in urban areas, particularly in developing countries. The initiative develops common tools for seismic risk assessment of urban areas in order to raise the awareness of decision makers, government officials, business leaders, communities and citizens and to provide them with directions for disaster mitigation. Through the project, state-of-the-art studies and technologies for seismic disaster mitigation are incorporated into appropriate tools available to all people in the world.

The total cost of the initiative is approximately $ 2.5 million. The Japanese Government has contributed approx. $2 million while several international organizations such as UN University (UNU), UN Centre for Regional Development (UNCRD), and Japan International Cooperation Agency (JICA) have cooperated to hold training seminars and a symposium.

## OBJECTIVES OF THE INITIATIVE

The objectives of the RADIUS Initiative are four fold:
1) Develop seismic damage scenarios and risk management plans for the nine case study cities selected worldwide
2) Develop practical tools for the seismic damage assessment and management, which could be applied to any earthquake prone city in the world.
3) Conduct a comparative study to understand urban seismic risk around the world
4) Promote information exchange for the seismic risk mitigation at city level

Decision makers and government officials, who are responsible for disaster prevention and disaster preparedness in the cities could utilize the results;
1) to decide priorities for urban planning to mitigate seismic disasters
2) to prepare an improvement plan for the existing urban structures such as reinforcement of vulnerable buildings and infrastructures, securing of open spaces and emergency roads and designation of areas for evacuation
3) to prepare for emergency activities such as life saving, fire fighting, emergency transportation, and assistance to the suffering people

The results are useful to communities, NGOs, and citizens;
1) to understand the vulnerability of the area where they live
2) to understand how to behave in case of an earthquake disaster
3) to participate in preparing a plan for disaster prevention

They are also useful to semipublic and private companies, particularly to those who maintain urban infrastructure such as electricity and telephone, to understand the necessity of prevention and preparedness so that they could minimize the damage on their business.

The results of the seismic risk assessment by applying the tools are so rough that they must be only the first step for the seismic risk assessment. It should be noted that the main purpose of the project is to raise the awareness of decision makers, government officers, communities and private sectors.

## CASE STUDIES

### Objectives

The objectives of the case studies are two fold:
1) Develop an earthquake damage scenario which describes the consequence of a possible earthquake
2) Prepare a risk management plan and propose an action plan for earthquake disaster mitigation

An earthquake damage scenario describes physical damage to buildings and infrastructure (roads, water supply, electric power supply, sewage system, etc.) and human losses as well as the effects to the urban functions and

activities during and after a probable earthquake. The result may be shown in visual forms by Geographical Information System (GIS).

A risk management plan is prepared in the case study cities, based on the earthquake damage scenario. It contains the following aspects.

- urban development plan to mitigate seismic disasters.
- improvement plan for the existing urban structures such as reinforcement of vulnerable buildings and infrastructures, securing of open spaces and emergency roads and designation of areas for evacuation
- emergency activities such as life saving, fire fighting, emergency transportation, and assistance to the suffering people.
- individual counter measures for important facilities
- dissemination of information to and training of the public and private sectors

Based on the risk management plan, a practical "Action Plan" is proposed. It prioritizes necessary actions so that they can be implemented soon after the project. The scenario and action plan are disseminated to relevant organizations and the public.

The final goals of the case studies are;
1) to raise the awareness of decision makers and the public for seismic risk, involving mass media
2) to transfer appropriate technologies to the cities from the advanced world as well as the scientific world
3) to set up a local infrastructure for a sustainable plan for earthquake disaster mitigation
4) to promote multidisciplinary collaboration among the local government, scientists and the public
5) to promote worldwide interaction with other earthquake prone cities

**Selection of the case study cities**

Nine cities were selected from 58 cities, which had applied for the case studies, under consultation with the STC (Scientific and Technical Committee for IDNDR) subcommittee for RADIUS (Members are Dr. Tsuneo Katayama (Chair), Mr. Robert Hamilton, Prof. Mustafa Erdik). The case studies were carried out from February 1998 until July 1999 with financial assistance from the IDNDR Secretariat ($50,000 to a full case study city) and technical assistance from internationally renowned institutes in this field.

<u>9 case study cities</u>
Addis Ababa (Ethiopia), Antofagasta (Chile), Bandung (Indonesia), Guayaquil (Ecuador), Izmir (Turkey), Skopje (TFYR Macedonia), Tashkent (Uzbekistan), Tijuana (Mexico), Zigong (China)

<u>58 cities that applied for RADIUS case studies</u>

**- Asia** (27 cities)
Almaty (Kazakhstan), Amman (Jordan), Ashgabat (Turkmenistan), Bandung (Indonesia), Baoji (China), Bishkek (Kyrghistan), Calcutta (India), Damascus (Syria), Daqing (China), Dushanbe (Tajikistan), Hefei (China), Istanbul (Turkey), Izmir (Turkey), Kathmandu (Nepal), Mandalay (Myanmar), Metropolitan Manila (Philippines), Mumbai (India), Shiraz (Iran), Tabriz (Iran), Tangshan (China), Tashkent (Uzbekistan), Tbilisi (Georgia), Tehran (Iran), Urumqi (China), Yangon (Myanmar), Yerevan (Armenia), Zigong (China)

**- Europe and Africa** (12 cities)
Accra (Ghana), Addis Ababa (Ethiopia), Algiers (Algeria), Belgrade (Yugoslavia), Bucharest (Romania), Conakry (Guinea), Dodoma (Tanzania), Giza (Egypt), Petropavlovsk-Kamchatsky (Russian Federation), Skopje (TFYR Macedonia), Sofia (Bulgaria), Tirana (Albania),

**- Latin America** (19 cities)
Ambato (Ecuador), Antofagasta (Chile), Cali (Colombia), Cumana (Venezuela), Guayaquil (Ecuador), Kingston (Jamaica), La Paz (Bolivia), Lima (Peru), Manizales (Colombia), Medellin (Colombia), Pasto (Colombia), Pereira (Colombia), Popayan (Colombia), Quito (Ecuador), San Juan (Argentina), Santiago (Chile), Santo Domingo (Dominican Rep.), Tijuana (Mexico), Toluca (Mexico)

**Technical Guidance**

Three international institutes have offered technical assistance to three cities in each region. They visited the cities several times to supervise their activities. They also provided technical guidance through electronic communication. Three international advisory committees were established in May 1998 regionally so that they advise the case study cities in the region. The role of the committees is to visit the RADIUS case study cities to give technical advice to the cities and to raise the public awareness there.

Three international institutes
- Asia (Bandung, Tashkent, Zigong)
Center for Disaster Mitigation Engineering (INCEDE) and OYO Group, Japan
- Europe, Middle East and Africa (Addis Ababa, Izmir, Skopje)
Bureau de Recherches Géologiques et Minières (BRGM), France
- Latin America (Antofagasta, Guayaquil, Tijuana)
GeoHazards International (GHI), USA

Regional Advisory Committee Members
- Asia
Dr. Anand S. Arya (India), Dr. Jack Rynn (Australia), Dr. Tsunehisa Tsugawa (Japan)
- Europe, Middle East and Africa
Dr. Mohamed Belazougui (Algeria), Dr. Victor Davidovici (France), Prof. Dr. Rainer Flesch (Austria)
- Latin America
Dr. Andrew Maskrey (Peru), Ms. Shirley Mattingly (USA), Prof. Carlos E. Ventura (Canada)

Two training seminars were held mainly for the RADIUS case study cities in 1998. The JICA (Japan International Cooperation Agency) Seminar on "Seismology and Earthquake Engineering," was held for the technical experts with assistance of IISEE, BRI, Japanese Ministry of Construction, in support of the RADIUS initiative in Tsukuba, Japan, from 11 May to 19 June 1998. The seminar was attended by 17 scientific/technical experts from the 9 RADIUS case study cities and other cities pre-selected for the RADIUS case studies.

The RADIUS training seminar for city government officials was held from 22 to 30 June, 1998, in Tokyo and Fukui, Japan, with 18 participants from 13 cities, including the RADIUS case study cities. It was co-organized by UNU (United Nations University), UNCRD (UN Centre for Regional Development), and the IDNDR Secretariat.

**Implementation**

Most of the cities established a steering committee, which is responsible for the implementation of the case study. They also established a local advisory committee, whose role is to give advice to the steering committee in defining needs and priorities, and to help in raising the public awareness. The local advisory committee consists of representatives from various sectors such as relevant organizations, private sectors, mass media, politicians, and communities.

In order to launch the case study substantially, the RADIUS kick-off meeting was held in most case study cities from April to July 1998. Its purpose was to explain the objectives and methodologies of the RADIUS case study to the relevant experts and organizations as well as government officers, raising the public awareness.

All the case study cities held the Earthquake Scenario Workshop from October 1998 to March 1999 at the end of the first stage of the case study. The common objectives of the Workshop are:
· to present the damage estimates to the city and ask for feedback from the participants
· to estimate the impact of the estimated damage on the city activities
· to produce ideas of actions that could reduce the impact of an earthquake on the city
· to discuss the conditions needed to institutionalize the risk management activities

The Action Plan Workshop was held in most of the case study cities at the end of the second stage in order to develop the risk management plan, based on the evaluation of the earthquake damage scenarios and propose Action Plan for immediate actions.

All these activities were broadly covered by mass media such as TV, radios, and newspapers, helping people understand the seismic risk in their cities and necessity of preparedness.

**Earthquake Damage Scenario**

Below is a brief introduction of the earthquake damage scenario developed by the City of Tashkent.

*A Strong Earthquake Hits Tashkent, Uzbekistan, at 5:00 am*
*Strong tremors hit the city of Tashkent, capital of Uzbekistan, at 5:00 am in early morning. It is estimated that the epicenter is located just beneath the city with a magnitude of 6.1 (in the Richter scale). The intensity is 7 and 8 (MSK) in most of the parts, and reaching 9 in some areas of the city. The shaking lasted for about half a minute.*

*Traditional (adobe) houses located near the central part of the city are devastated. Some of modern reinforced concrete buildings are damaged considerably, having cracks in walls and bearing elements. Self-built homes located in the old town collapse, killing many inhabitants. Water supply pipelines are damaged throughout the city. As there is no emergency cut-off device in water supply system, large quantity of water is lost due to breakage of pipes. Some of sewage pipes are ruptured, causing serious pollution in the city. Damages to power supply system keep the city without electricity, immediately after the earthquake.*

*Survived and non-injured city-dwellers are searching in ruins of destroyed houses for their relatives and friends, trying to free victims from the destroyed structures. Some of people trapped are still alive. But the death toll is frightening. It is estimated that several thousands of people are homeless. Some older houses catch fire as a result of sparkling short-circuits or from explosion of broken gas pipes. Hospitals are overcrowded with injured patients. There is a deficit of medicaments in many of medical establishments, and a great deal of medical equipment has been damaged - - - - - - - - .*

## DEVELOPMENT OF TOOLS

A technical manual for the urban seismic risk assessment is developed, based on the analysis of the case studies. By applying the manual, the result will show how buildings and infrastructure in a city could be damaged and how many human loss would be estimated. It will be available as a CD-ROM to be used for personal computers. It should be noted that the result will be so rough that it must be only the first step for the seismic risk assessment of the city.

In order to facilitate any earthquake prone city to conduct a RADIUS type project, guidelines are also developed, based on the experiences of the 9 case studies. The emphasis are made on:

- How to involve decision makers, relevant organizations/institutions, communities, private sectors, mass media, and scientists at a multi-disciplinary way
- How to transfer the scientific data into decision making information in a practical way
- How to disseminate information and educate the people, particularly through the mass media
- How to prepare a risk management plan as well as an action plan
- What would be the next step

## COMPARATIVE STUDY ON "UNDERSTANDING URBAN SEISMIC RISK AROUND THE WORLD"

More than 70 cities participated as "Member Cities" in the comparative study on "Understanding Urban Seismic Risk Around the World," which started in June 1998 and was completed in August 1999. The study developed a better understanding of the various aspects contributing to the seismic risk of a city, underlining the common earthquake risk problems in different urban areas of the world, and identifying solutions and risk management practices that were successful and could be duplicated. GeoHazards International (GHI) conducted this study. A paper on the study is presented in 12 WCEE Conference separately.

74 Member Cities
Accra (Ghana), Addis Ababa (Ethiopia), Algiers (Algeria), Almaty (Kazakhstan), Ambato (Ecuador), Antofagasta (Chile),Athens (Greece), Bandung (Indonesia), Baoji (China), Beijing (China), Bogota (Colombia), Bucharest (Romania), Cairns (Australia), Caracas (Venezuela), Colima (Mexico), Delhi (India), Dehra Dun (India), Dhaka (Bangladesh), Gilgit (Pakistan), Giza (Egypt), Guadalajara (Mexico), Guatemala City

(Guatemala), Guayaquil (Ecuador), Gyumri (Armenia), Huaraz (Peru), Irkutsk (Russia), Izmir (Turkey), Jakarta (Indonesia), Kampala (Uganda), Kathmandu (Nepal), Khartoum (Sudan), Kingston (Jamaica), La Paz (Bolivia), Lima (Peru), Lisbon (Portugal), Manizales (Colombia), Metro Manila (Philippines), Mumbai (India), Newcastle (Australia), Pasto (Colombia), Pereira (Colombia), Pimpri (India), Popayan (Colombia), Potenza (Italy), Quito (Ecuador), Rome (Italy), St. George's (Grenada), San Jose (Cost Rica), San Juan (Argentina), San Salvador (El Salvador), Santiago (Chile), Santiago (Dominican Republic), Santo Domingo (Dominican Republic), Seattle (USA), Seoul (Republic of Korea), Shiraz (Iran), Skopje (TFYR of Macedonia), Sochi (Russia), Sofia (Bulgaria), Spitak (Armenia), Tabriz (Iran), Tai'an (China), Tashkent (Uzbekistan), Tbilisi (Georgia), Tehran (Iran), Tijuana (Mexico), Tirana (Albania), Tokyo (Japan), Tuscan Region (Italy), Ulaanbaatar (Mongolia), Urumqi (China), Vladivankaz (Russia), Yerevan (Armenia), Zigong (China)

## INFORMATION EXCHANGE

### Associate Cities

More than 30 cities, which have carried out a seismic risk assessment with independent resources, joined RADIUS as “Associate Cities” for information exchange. The Associate Cities offered their valuable experience to other cities mainly through the RADIUS home page while they obtained useful information from the other cities. The reports from the associate cities are presented on the RADIUS home page.

35 Associate Cities
Algiers (Algeria), Baoji (China), Beijing(China), Bogota (Colombia), Cairns (Australia), Calcutta (India), Dalian (China), Damascus (Syria), Gyumri (Armenia), Hefei (China), Istanbul (Turkey), Jabalpur (India), Kathmandu (Nepal), Khartoum (Sudan), Lima (Peru), Manizales (Colombia), Mumbai (India), Newcastle (Australia), Pereira (Colombia), Pimpri (India), Quito (Ecuador), St. George's (Grenada), San Juan (Argentina), Shiraz (Iran), Sochi (Russia), Spitak (Armenia), Suva (Fiji), Tai'an (China), Tangshan (China), Tehran (Iran), Tianjin (China), Tuscan Region (Italy), Ulaanbaatar (Mongolia), Urumqi (China), Yerevan (Armenia)

### RADIUS Homepage

The IDNDR Secretariat launched the RADIUS website, providing a clear, user friendly and up to date access to all the information available concerning the RADIUS Initiative. It provides a fully interactive medium to exchange information on the experience of RADIUS. Full information on RADIUS, the mid-term reports from the 9 case study cities, and the associate city reports are presented on the home page. The results of RADIUS, including the developed tools, will be also presented there.

The address of the RADIUS home page is: **http://www. geohaz.org/radius**

### RADIUS Symposium in Tijuana, Mexico, in October 1999

International IDNDR Symposium on "The RADIUS Initiative - Towards Earthquake Safe Cities" will be held from 11 to 14 October 1999 in Tijuana, Mexico. The Symposium is an important closing event for RADIUS to present and discuss the results of the case studies, developed tools, comparative study on the urban seismic risk, and reports of similar efforts. It will bring together many city government officers and experts involved in RADIUS worldwide. The Symposium will be co-organized by the City of Tijuana, UN Centre for Regional Development (UNCRD), UN University (UNU), and the IDNDR Secretariat, in close cooperation with several international organizations such as International Association for Earthquake Engineering (IAEE), International Association of Seismology and Physics of the Earth's Interior (IASPEI), and World Seismic Safety Initiative (WSSI).

## TIMETABLE

The year 1996
- Planning and consultation of the initiative

The year 1997
- Applications and selection of case study cities
- Establishing STC subcommittee for RADIUS

The year 1998
- Selection of the 9 case study cities (January)
- Implementation of the case studies (1.5 years from February)
  Earthquake damage scenario workshop
- Training seminars (May/June)
- Comparative study (1 year from June)
- RADIUS Workshop at the International Conference in Yerevan, Armenia (September)

The year 1999
- Case studies (continued)
  Risk management plan workshop
- Comparative study (continued)
- Development of the practical tools
- International RADIUS Symposium in Tijuana, Mexico (October)
- Publication

## CONCLUSION

The main goal of RADIUS is to raise the public awareness, particularly at city level. The RADIUS case studies with assistance from the United Nations involved decision makers, communities, and mass media in the cities. Its activities were broadly covered by newspapers, televisions, radios, etc. It also created active partnership between scientists and local people. The local scientists closely cooperated with the local governments to transfer scientific data into decision making information. Thus, RADIUS has achieved a great progress in every case study city.

RADIUS does not draw a closed circle but draws an open circle. While all the results will be open to anybody interested, any kind of information and contribution are welcome. It is expected that further actions will be taken to reduce the impact of probable earthquakes in as many cities as necessary, following RADIUS by learning its experiences and by utilizing the practical tools developed.