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RADIUS PROJECT IN TASHKENT, UZBEKISTAN

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SUMMARY

Taking into account the great importance of the problem of the growing earthquake risk for cities located in seismic prone territories world-wide and urgency of mitigation measures, the Secretariat of the International Decade for Natural Disaster Reduction (IDNDR), United Nations launched in 1996 the RADIUS initiative (**R**isk **A**ssessment Tools for **Di**agnosis of **U**rban Areas against **S**eismic Disasters) with financial assistance from the Japanese Government. From 58 cities world-wide applied for participation in the project the IDNDR Secretariat selected 9 case study cities. Among them the city of Tashkent was selected as a full case study with providing grant of the total amount of US$50,000. There was the Grant Agreement concluded between the IDNDR Secretariat and Khokimiyat (Municipality) of the city of Tashkent for the RADIUS project implementation for the period from 01.02.1998 to 31.07.1999. For one year and a half the case study was implemented in two general phases: first, earthquake damage scenario preparation and, second, seismic risk management plan development. This paper describes the implementation and main achievements of the RADIUS project in Tashkent.

INTRODUCTION

The city of Tashkent, one of large cities of the world, is located in Tashkent oasis of Central Asia. It is the capital of the Republic of Uzbekistan. The territory of the city is about 33 thousands hectares, its population is about 2.2 million residents. It is a large diversified industrial centre of Uzbekistan producing a quarter of industrial production of the country. The main branches are aircraft industry, electronics, electrotechnical engineering, tractor construction and agricultural engineering, metal working industry. The factories of the city produce air-planes, spinning machines, tractors, excavating machines, paper, varnish and painting materials, cranes, cables, light-industry equipment and other production. All the important key questions related to political, economical, social life of the country are considered and decision are made in Tashkent. It is the city where different sport competitions, scientific forums and cultural festivals of international and regional scale are held. Tashkent is an important tourist centre of the region.

The city has about 36,000,000 square meters of residential space, that is in average one citizen has 16,8 square meters of dwelling space. The dwelling stock is presented by different structural types of buildings.

Vital activity of the city is provided with a complicated system of lifelines and infrastructure. There are on the territory of the city more than 2000 km of automobile roads with more than 130 bridges, tens of tunnels and grade-crossing elimination structures. It is expected that total length of three subway lines will reach 50 km by the year of 2000. There are two airports in the city, two large railway stations and several railway cargo stations. Total length of the water-supply system is more than 3600 km, sewerage system - 2300 km. The total potable water volume a day is about 2.5 thousand cubic meters, that is about one cubic meter per a citizen. About 60 % of the population use services of the centralized heating system. And most of the city population use gas supply

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system. The city is supplied with power from 5 internal sources and 3 external sources, 124 distributing stations apply a voltage to 3200 transformers, connected with each other with more than 5000 underground cables and 2500 aerial cables.

The city is located in a seismic prone region and for its 2000 years history has been shaken by many strong earthquakes. So, the problem of earthquake safety is a topical one for the city. And the community paid considerable attention to the problem for years. However, detailed analysis shows that despite of constant attention to the problem of seismic safety and considerable achievements on the way of preparedness to future disastrous earthquakes, the city of Tashkent might not be considered as ready in full for probable future large earthquakes. This was one of the reasons providing high interest and motivation of the city for participation in the international RADIUS project, that is to promote seismic vulnerability and risk reduction in Tashkent.

2. PREPARATION OF THE CASE STUDY

2.1 Objectives of the case study

The main objectives of the case study in Tashkent were the same as common goals of the IDNDR-RADIUS project:

- attracting attention and raising awareness of decision makers and the community for the seismic threat;
- preparation of an earthquake damage scenario describing possible consequences of a large earthquake;
- preparation of a comprehensive action plan aiming at reduction of possible earthquake consequences;
- arrangement of multidisciplinary cooperation between local authorities, urban services, emergency services, scientists, planners, builders;
- using of international experience, communication and interaction with other cities located in earthquake prone zones worldwide.

To attain these ends the following tasks were to be solved:

- using available data about seismic history of the region, geological information to prepare conclusions about seismic hazard and potential influence on the territory of Tashkent from probable future earthquakes;
- to select a scenario earthquake as an event of high probability and presenting a real threat for the city;
- to compile a map of seismic intensity distribution on the territory of the city resulting from the selected scenario earthquake;
- to conduct inventory of residential and public buildings, lifelines and infrastructures with the purpose of identification of most vulnerable areas and structural types;
- to estimate possible damage to residential and public stocks of the city, lifeline systems and infrastructure facilities and economic losses resulting from the scenario earthquake;
- to develop an earthquake scenario for the selected seismic event;
- to expose the obtained results and estimations to representatives of urban services related to earthquake disaster preparedness and get their comments and proposals;
- to prepare an action plan with the purpose of seismic risk mitigation;
- to generalize the methodology and prepare recommendations on earthquake preparedness and risk mitigation for using in other cities located on seismic prone territories.

2.2 Steering Committee and Working Group

For the purposes of the project implementation the Steering Committee was appointed by the order of the Khokim (Mayor) of the city and the Working Group was formed from a number of leading scientists and specialists in the fields of Seismology, Earthquake Engineering and Emergency Management. The working program was developed consisting of four blocks:
BLOCK 1. Seismic Hazard Assessment,
BLOCK 2. Seismic Vulnerability and Risk for Buildings,
BLOCK 3. Seismic Vulnerability and Risk for Lifelines,
BLOCK 4. Earthquake Scenario and Emergency Response Plan.

2.3. Working schedule

Table 1: Timetable of the case study

Activity	1998											1999						
	Months																	
	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
Project Management																		
Preparation	■	■																
Kick-off meeting				■														
First progress report							■											
Scenario workshop										■								
Second progress report													■					
Action Plan Workshop																■		
Final report																		■
Project implementation																		
Sesmic hazard assessment			■	■	■	■	■	■	■	■	■	■						
Assessment of vulnerability and seismic risk for buildings			■	■	■	■	■	■	■	■	■	■	■	■				
Assessment of vulnerability and seismic risk for lifelines			■	■	■	■	■	■	■	■	■	■	■	■				
Preparation of an earthquake scenario and response plan			■	■	■	■	■	■	■	■	■	■	■	■	■			
Preparation of Action Plan													■	■	■	■	■	■

2.4. Kick-off-Meeting

The first city conference on the RADIUS project (Kick-off-Meeting) under the title of «Problems of implementation of the IDNDR-RADIUS project on reduction of seismic risk for the city of Tashkent» was held on 19 May 1998 in the City Hall (Mayor's Office) of Tashkent. Invitations had been sent to 123 different organizations located on the territory of Tashkent. Representatives of more than 60 of them attended the Kick-off Meeting. Thus, among the participants there were representatives of municipality, urban services, Emergency Ministry of Uzbekistan and City Emergency Department, business leaders and responsible workers of large industrial enterprises, banks, as well as scientists and specialists from research, design and educational institutes, mass-media, in total about 100 persons.

The main purposes of the Kick-off meeting were to inform the community about the objectives and problems of the RADIUS project and give an initial impulse to it; to arrange cooperation and interaction of related organizations; to look for financial support and technical assistance, international cooperation and mutual aid for successful implementation of the project.

3. IMPLEMENTATION OF THE CASE STUDY AND RESULTS OBTAINED

3.1. Earthquake scenario preparation.

In the framework of the first block "Seismic Hazard Assessment" on the base of detailed analysis of dangerous source zones of the region several hypothetical earthquakes were selected capable to cause on the territory of Tashkent strong and destructive ground shaking. Also parameters of attenuation of seismic energy and seismic intensity with the distance were estimated and theoretical isoseisms were constructed for selected variants of potential earthquakes. Having considered and compared seven variants of potential dangerous earthquakes and their possible effect on the city the research team concluded that the worst case with high probability of occurrence could be from a local earthquake, which was selected as the scenario event. Thus, at further stages of the study the local earthquake was considered with magnitude M=6.1 and the source on the depth H=10 km underneath the city.

Taking into consideration local soil conditions the expected macroseismic field resulting from the scenario earthquake was constructed. According to the estimations obtained, there were identified zones with probable seismic effect of intensity VII, VIII and IX (measured by MSK scale) within the boundaries of the city. Within the zone of intensity IX some areas were identified with probable manifestation of seismogeological effects. Besides, scenario accelerograms were modeled, corresponding to different levels of seismic intensity - VII, VIII and IX. Thus, seismic input representing influence of the scenario earthquake on buildings, structures and infrastructures was given in the form both MSK intensity values and accelerograms. Distribution of seismic intensities and seismic effects resulting from the scenario earthquake is shown on the Figure 1.

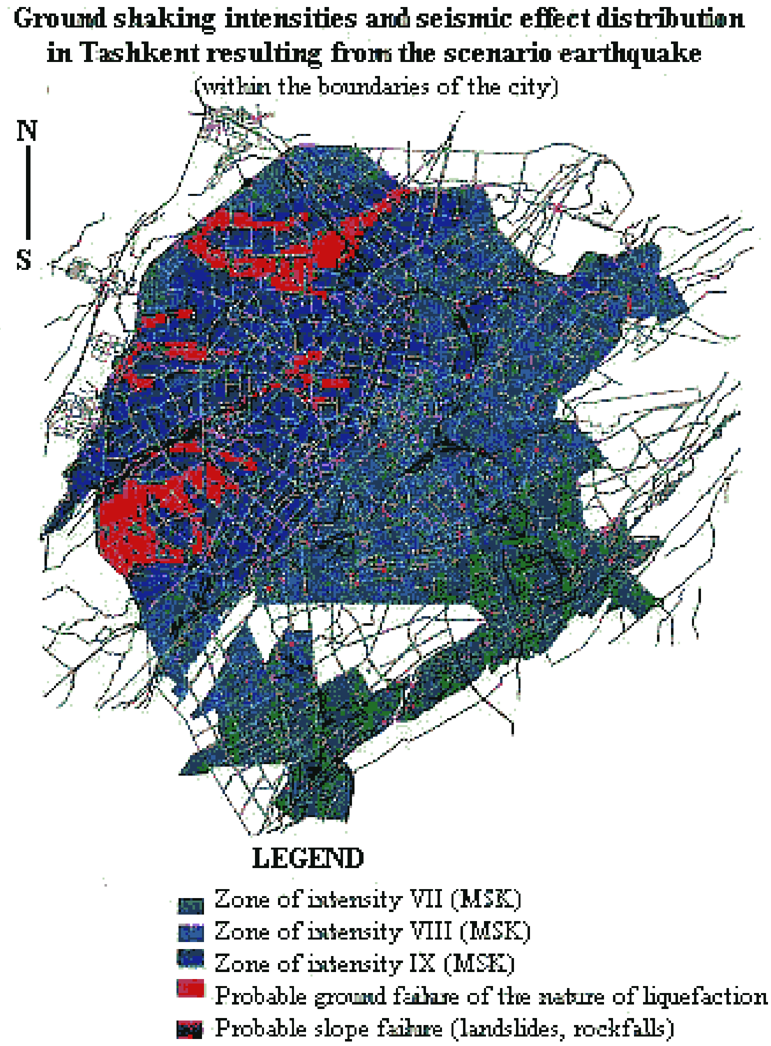

Figure 1: Distribution of seismic effects resulting from the scenario earthquake

In the framework of the second block "Seismic Vulnerability and Risk for Buildings" inventory of buildings on the territory of the city was carried out, their vulnerability was assessed and expected damage to buildings from the scenario earthquake was estimated. There were subsequently considered residendial, public and industrial stocks of buildings of the city of Tashkent. Information about buildings with various design systems was collected. The classification of buildings envelops 24 structural types. For all of them damage matrices were constructed depending on their design protection level and seismic intensity. For each of structural types of buildings cost functions were calculated. Damageability index was calculated as a criterion of vulnerablity depending on the type of bearing construction.

Using data on buildings of different design types, vulnerability curves and loss functions, economic losses resulting from the scenario earthquake for residential, public and industrial buildings were calculated. Depending on damageability of buildings the most vulnerable, and dangerous to live in, types of buildings were identified.

Scenario maps of building damage distribution on the territory of Tashkent were compiled. Expected damage to residential buildings is shown on the Figure 2.

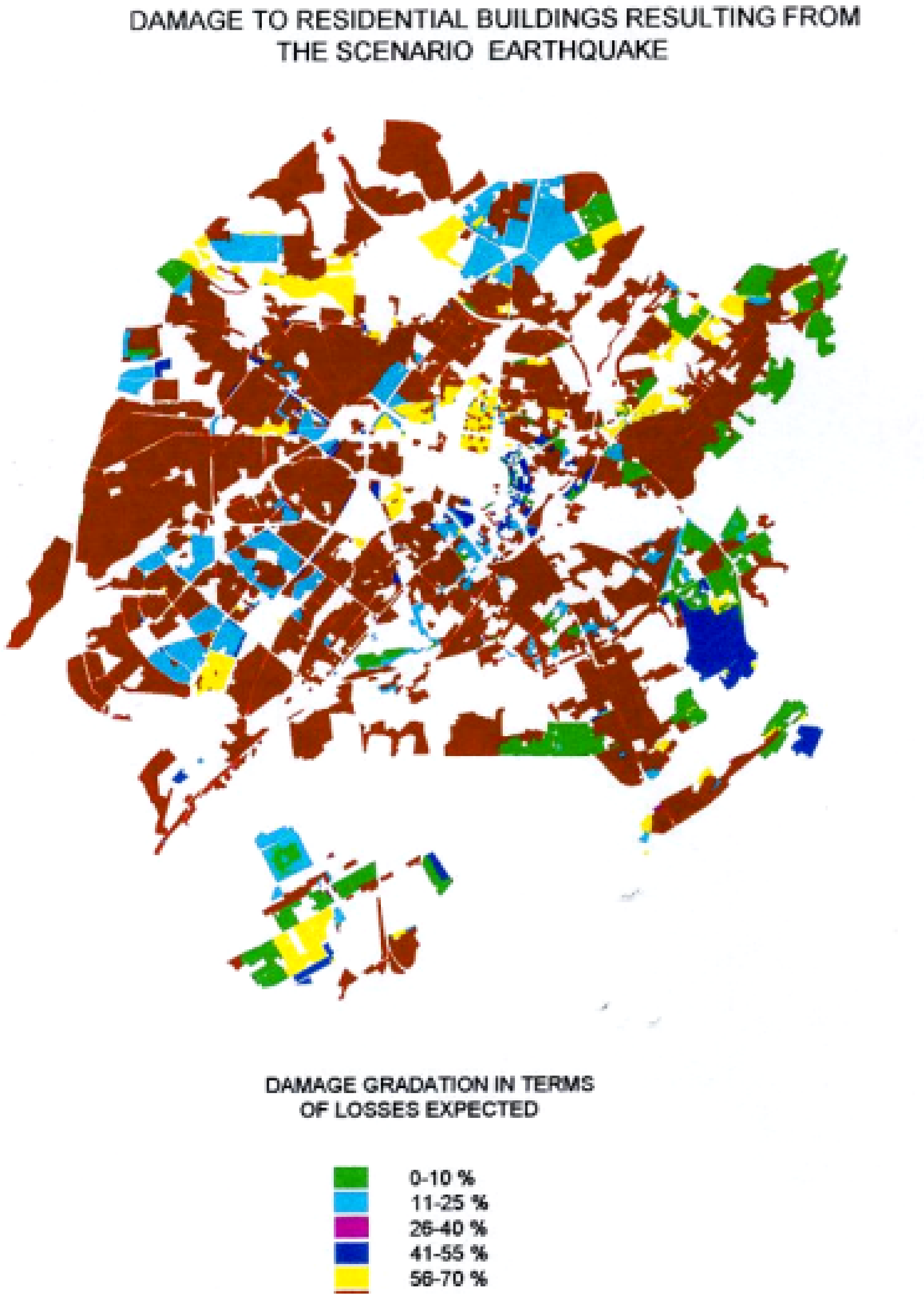

Figure 2. Damage to residential buildings resulting from the scenario earthquake

The reasons of vulnerability for different types of buildings were revealed. Recommendations were proposed on the simplest ways of improvement of seismic performance of the most vulnerable types of buildings in Tashkent. Effect of realization of those preventive measures was estimated. Results obtained in the framework of the second block would be useful for decision makers of community to take efficient measures for risk mitigation and safety of population under future earthquakes.

In the framework of the third block of the case study Seismic “Vulnerability and Risk for Lifelines” inventory of lifelines was conducted and their vulnerability assessed as well. Taking into account experience of past earthquakes it was found that damages to pipelines occurred mainly in the following:

- at places close to sharp turns, intersections through the rivers and ravines, and also at complicated junctions;

- at places of rigid junctions (using flanges and welding);
- at places of laying of pipelines in water-saturated soft soils having distinctive physical and mechanical properties;
- because of unsatisfactory quality of construction and non-observing building rules and standards.

Vulnerability of underground pipelines depends on:

- depth of the underground pipelines;
- diameter and material of pipelines;
- fluid pressure of liquid in the pipeline;
- type of junction;
- service life and maintaining conditions.

Estimations of damage to lifelines resulting from the scenario earthquake were obtained on the base of using the scenario map of seismic intensity distribution and taking into consideration localisation of lifeline networks on the territory of the city. Specific breakage level and damage to elements of lifeline systems were calculated and damage maps were compiled for water-supply system, sewerage system, heat-supply system, gas-supply system, and infrastructure of automobile roads, bridges, tunnels, subway. On the base of these maps, using constructed graphs of damage versus intensity, data about cost of repair and restoration of different elements of lifelines estimations of damage to lifelines were calculated (Figure 3).

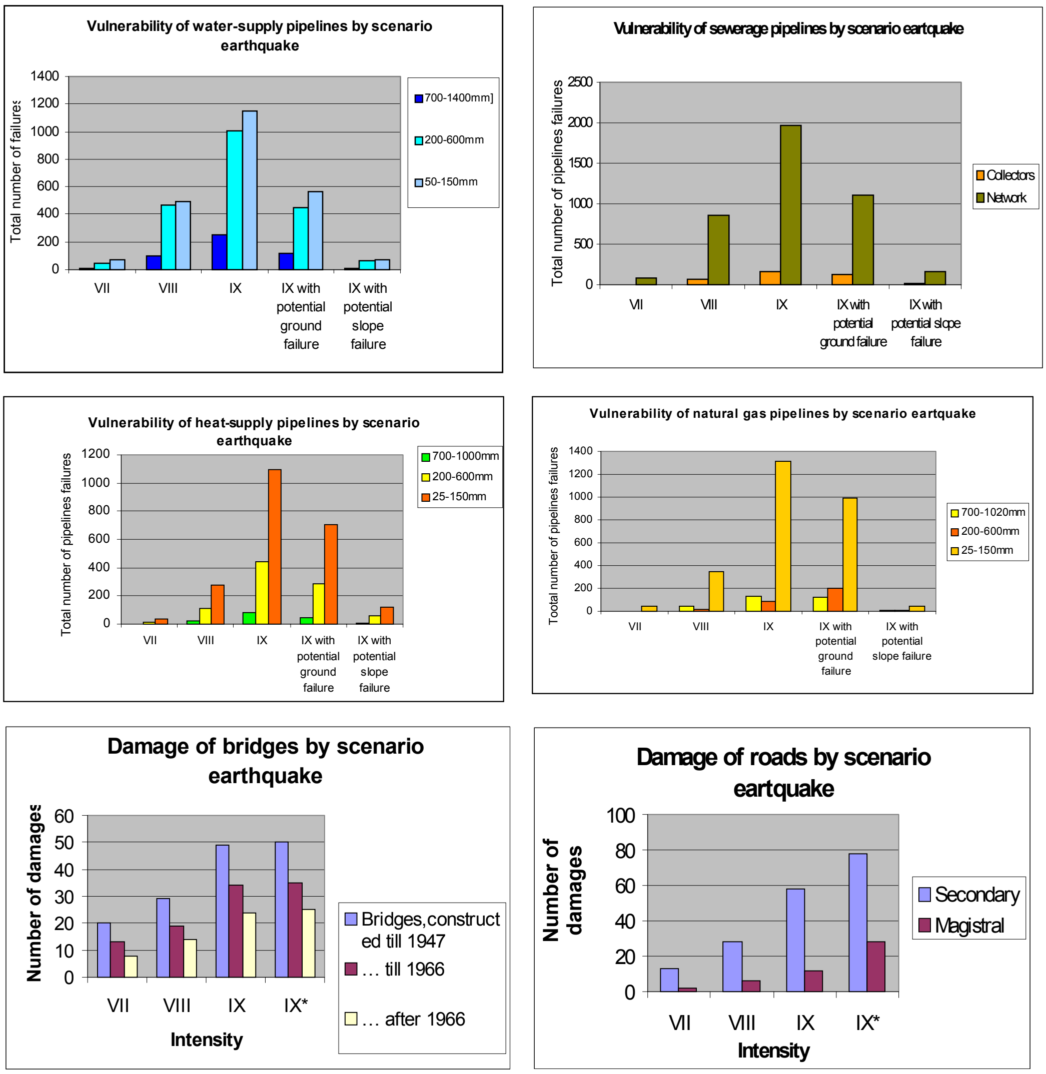

Figure 3. Damage of lifelines and infrastructure elements

In the framework of the fourth block an earthquake scenario was compiled, where combining estimations of engineering-seismological analysis and vulnerability of the city, using results of interviews conducted with different urban services, the research team attempted to assess possible impacts of a large earthquake on the complex urban mechanism. Based on the materials of the technical analysis and taking into account experience of past earthquakes the prepared scenario describes step by step possible impacts of the scenario earthquake and life in the city in the course of time after the earthquake. The scenario describes performance of different types of buildings and lifelines, behavior of people and activity of urban services. Emergency response plan, describing immediate actions of rescue teams and other emergency units, was prepared by the City Emergency Department.

3.2.Scenario Workshop

Following the working schedule the city of Tashkent organized the Earthquake Scenario Workshop from 11 to 13 November, 1998. The workshop was held in the City Hall of Tashkent with 78 participants.

Figure 4. Participants of the Scenario Workshop

As the main goals of the scenario workshop were considered:

- To present results obtained by blocks of the RADIUS-Tashkent project at the first stage of the case study;
- To present an earthquake damage scenario prepared by the working group;
- To discuss the damage scenario with representatives from different related urban organizations and obtain comments from other specialists;
- To initiate a discussion determining direction of the Action Plan development.

3.3.Action plan development

During the second phase of the case study, based on the results of the first phase, in particular, taking into consideration conclusions of the prepared earthquake scenario, the research team of the RADIUS-Tashkent project developed an Action Plan aiming at reduction of existing seismic risk for the city.

The Action Plan proposed to the city government consists of four directions corresponding to the blocks of the working program:

Project 1. Seismic Hazard Assessment.

Project 2. Seimic Stability of Buildings and Structures

Project 3. Seismic Stability of Lifeline Systems
Project 4. Emergency Response.

3.4. Action Plan Workshop

The Action Plan Workshop was held on May 25-28, 1999. The total number of participants was more than 200 with participation of local specialists and foreign experts as well. On the day before the workshop a drill was conducted by the City Emergency Department based on materials of the earthquake scenario.

During the workshop the blocks of the Working Group presented results of the case study. There were discussed directions of the Action Plan proposed by the research team of RADIUS-Tashkent project to the audience. Hand-outs were distributed among those presented to show achivements and main conclusions of the case study and to obtain comments of specialists from different institutions and urban services.

4. FINAL REMARKS

The case study was implemented for 18 months. Leading scientists of the country in the field of seismology, earthquake engineering, representatives of scientific and design institutes, specialists of urban services and departments were engaged in the project implementation. Co-ordination of the works was conducted by the Steering Committee headed by the City Khokimiyat locally and by INCEDE/OYO group.

As result of the RADIUS project implementation the following objectives have been achieved:

- awareness for seismic risk and understanding the problem, attention, responsibility, preparedness of the NGOs (Red Crescent, Makhalla fund, etc) have been considerably raised;

- the earthquake scenario developed is not abstract one. It describes plausible consequences of possible Tashkent earthquake in the proper manner and with non-technical language;

- the Action Plan includes all the principal issues related to seismic risk management in four projects;

- for the first time considerable success was scored in organization of broadened co-ordinated actions of different institutions for the earthquake preparedness;

- more than 20 city services, 8 designing and research institutes, few ministries and departments, public city organizations participated in the international project;

International experience in the field of seismic risk assessment and mitigation was used for the first time. It was provided by the IDNDR Secretariat, INCEDE/OYO group, International Advisory Committee.