Republic of Uzbekistan
Ministry of Construction, Housing and Communal Services

Data Collection Survey on Promotion of DRR Investment for Earthquake Disaster in Uzbekistan

Final Report

February 2025

Japan International Cooperation Agency (JICA)

Oriental Consultants Global Co., Ltd.

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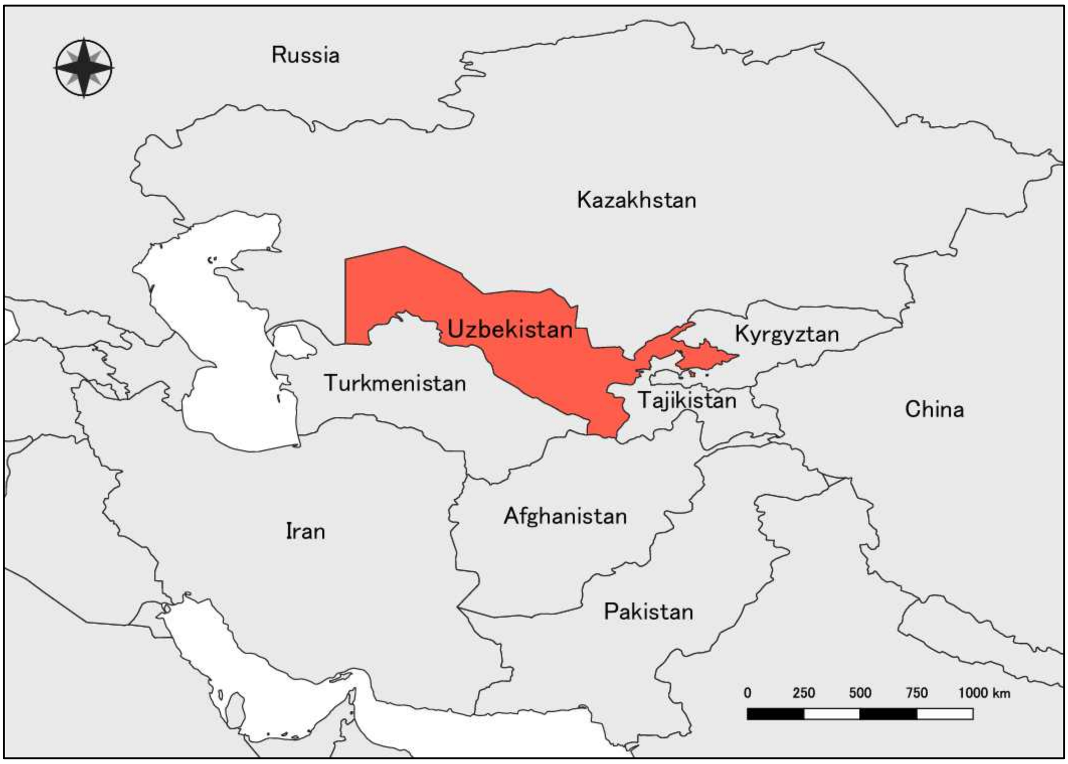
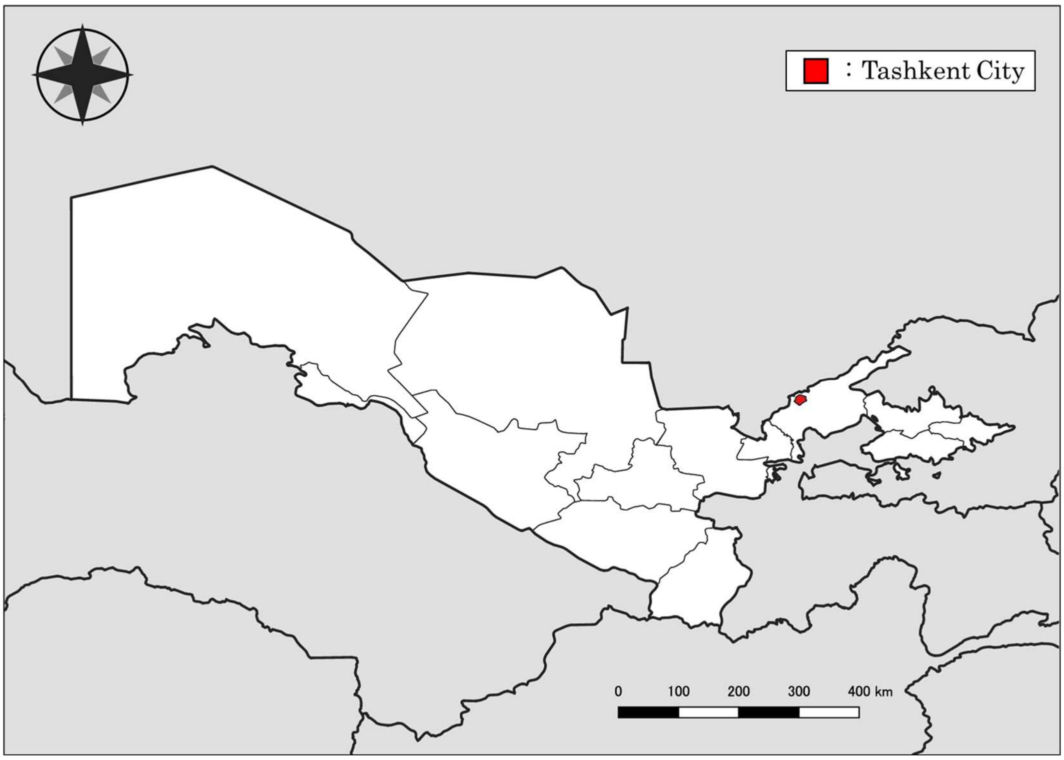
Currency exchange rate
1.00UZS＝ 0.0000773USD＝ 0.01194JPY
(JICA Rate in February 2025)

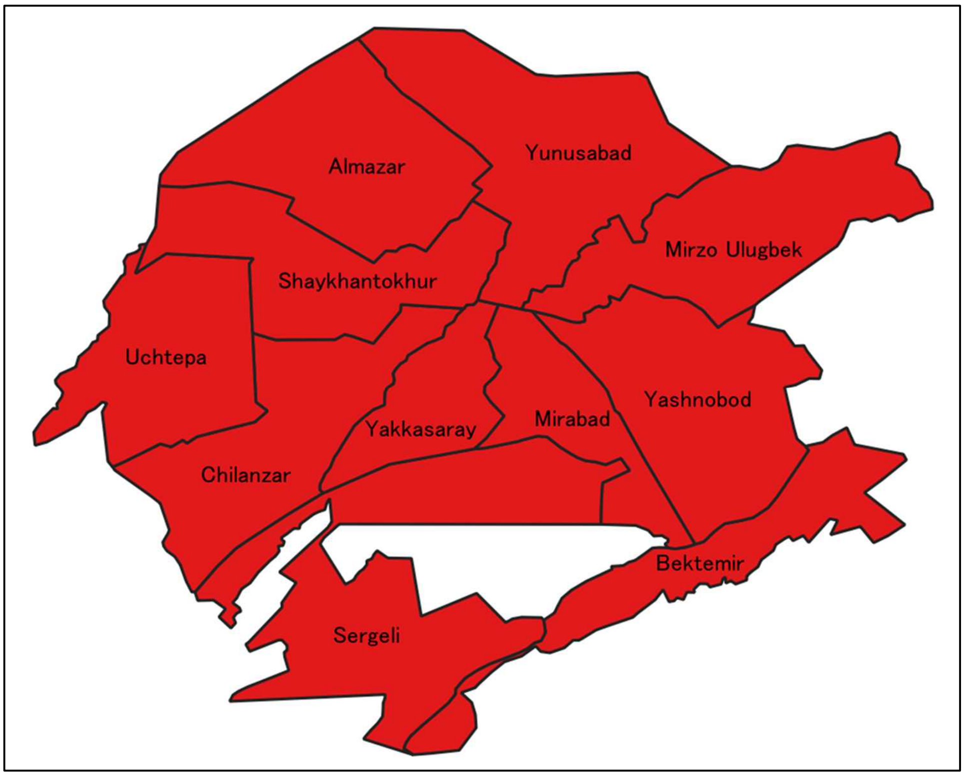
In this report, the currency unit of Uzbekistan is shown as UZS, and the US dollar unit as USD, after the number.



Uzbekistan and Neighboring Countries



Location of Tashkent City



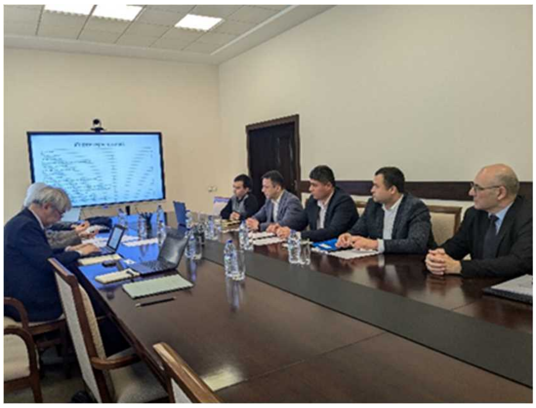
Tashkent City Administrative Divisions

Source: JICA Survey Team

Location Map of Surveyed Areas

Photos

Exterior of the Ministry of Construction, Housing and Communal Services



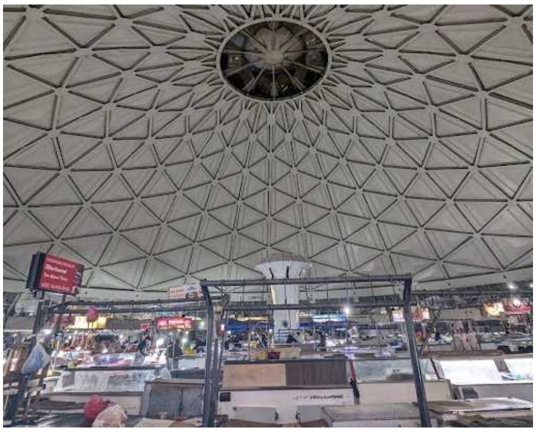
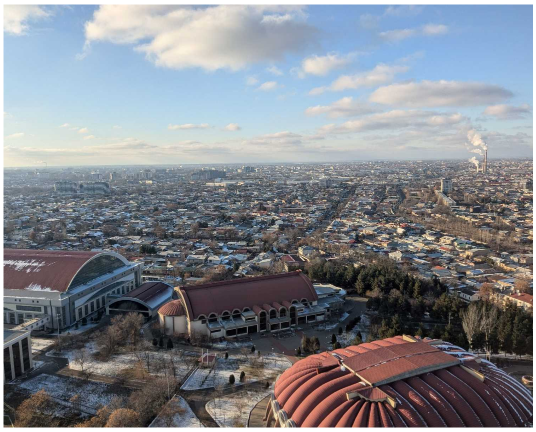
Interview at the Ministry of Construction, Housing and Communal Services

Exterior of Tashkent City Hall

The operation room inside Tashkent City Hall, where information is gathered, and responses are made at times of emergency

Tensile testing machine for rebar (UzTest)

Compression strength testing machine and test piece for concrete (UzTest)

	
A residential building that has been converted into a store on the first floor Such buildings can be seen all over the city.	The right-hand building (Nest One) is the tallest building in Uzbekistan, at 266.5m high.
	
Subway (Kosmonavtlar Station)	Tashkent Station
	
Chorsu Bazaar A distinctive building with a latticed dome that achieves a large space without pillars	An area with many low-rise buildings constructed between the late 1950s and 1960s

	
Navoi Theater	A building that was once used as a school, which is currently being renovated to be used as a facility for the Ministry of Employment and Poverty Reduction
	
The roof of the renovated building Many government buildings have solar panels installed (however, many schools and hospitals do not have them installed due to budget constraints)	The interior of the renovated building The columns and beams are made of reinforced concrete, and the precast floor slab is placed on top of the beam, with concrete laid on top as a finishing material.
	
New residential building construction site The columns and beams are made of reinforced concrete and are approximately 40 cm wide.	A material, foamed concrete, commonly used for walls in modern reinforced concrete buildings. It has good insulation and, when dry, matches brick strength but is less dense. Joints are filled with cement and reinforced horizontally, but not vertically.

	
Vibration machine used on rooftops to assess the condition of buildings (Turin Polytechnic University, Tashkent Campus)	Car used by Tashkent State Transport University to inspect structures. It has shelves for storing inspection equipment and a desk for analyzing the results of the on-site inspection

Source: JICA Survey Team photos

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List of Abbreviations

Abbreviation	Term
ADB	Asian Development Bank
AOTS	The Association for Overseas Technical Cooperation and Sustainable Partnerships
BIM	Building Information Modeling
CAREC	The Central Asia Regional Economic Cooperation
CIS	Commonwealth of Independent States
DIPECHO	Disaster Preparedness European Commission Humanitarian Office
DRR	Disaster Risk Reduction
DX	Digital Transformation
GEM	Global Earthquake Model
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
INSARAG	International Search and Rescue Advisory Group
JICA	Japan International Cooperation Agency
JMA	Japan Meteorological Agency
KOICA	Korea International Cooperation Agency
M	Magnitude
MES	Ministry of Emergency Situations
MoCHCS	Ministry of Construction, Housing and Communal Services
MSK	Medvedev-Sponheuer-Karnik scale
PGA	Peak Ground Acceleration
PPP	Public Private Partnership
QS	Quacquarelli Symonds
RC	Reinforced concrete
SATREPS	Science and Technology Research Partnership for Sustainable Development
SMT	Scalable Terrain Model
TAQU	Tashkent University of Architecture and Civil Engineering
TPUT	Turin Polytechnic University in Tashkent
United Nations	United Nations
UNCRD	United Nations Centre for Regional Development
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNESCO	United Nations Educational, Scientific and Cultural Organization
USD	United States Dollar
USGS	United States Geological Survey

UZS	Uzbekistani Som
VR	Virtual Reality
WB	World Bank

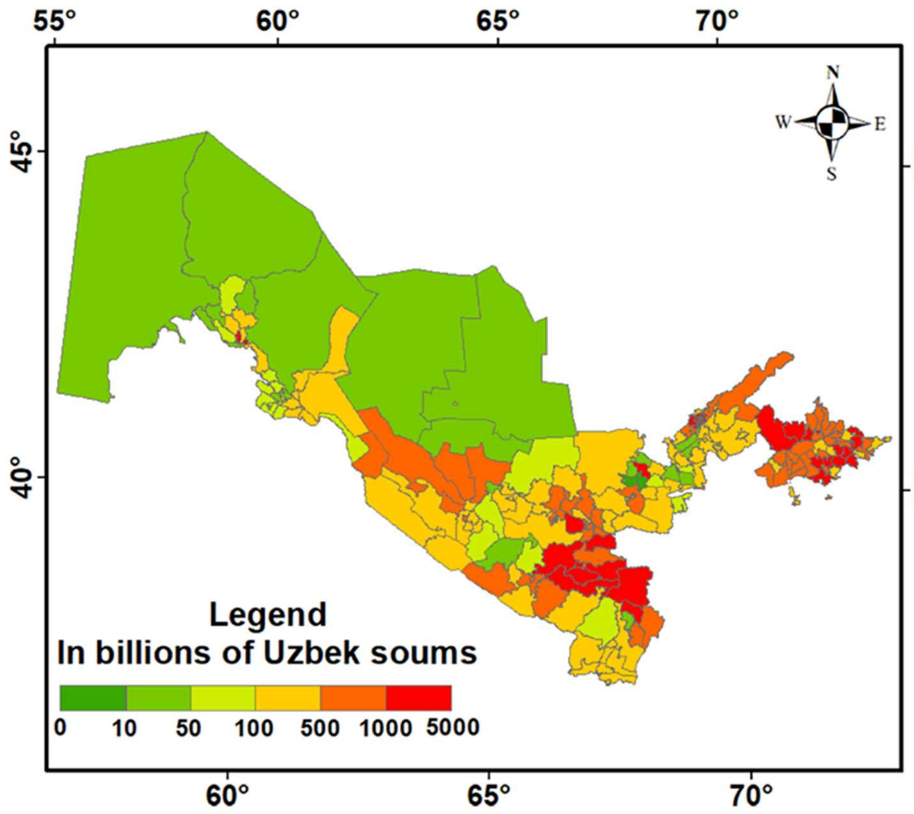
1. Survey Overview

1.1 Background and purpose of the survey

The Republic of Uzbekistan (hereafter referred to as Uzbekistan) is an earthquake-prone country, with about 150 earthquakes of magnitude 4.0 or greater per year (183 times in 2021, 143 times in 2022, 225 times in 2023, and 176 times in 2024) occurring in Uzbekistan and its bordering countries. In particular, Andijan, Fergana, and Namangan provinces, which are east of Tashkent, the capital city, and Samarkand province, are located around the boundary between the Fergana tectonic basin and the Tien Shan Mountains, and are prone to large earthquakes. The surrounding provinces of Tashkent, Sirdarya, Jizzakh, and Samarkand are also seismically active. The capital city of Tashkent was hit by the Tashkent Earthquake (M5.3) in 1966, which destroyed many residential and public buildings, mainly in the old town. After the earthquake, new residential units were constructed under the leadership of the former Soviet Union, and although no major damage from the earthquake has been observed since then, it is assumed that buildings constructed in the same period were designed according to the standards of the former Soviet Union and do not have sufficient resistance to the seismic forces defined by the current standards. It is also estimated that in the event of a 475-year return period earthquake, some districts in Tashkent City may suffer economic losses of approximately 77.3-380 million USD due to damage to residential buildings (Figure 1-1). The government of Uzbekistan has identified “Emergency and disaster response” as one of the priority areas in its “Development Strategy of New Uzbekistan for 2022-2026”, and believes that investment in disaster risk reduction in preparation for future major earthquakes is urgently needed to achieve the sustainable economic growth.

The country has the largest population in Central Asia (approximately 35 million people) and has played a central role in the region since the days of the former Soviet Union. It is the only country in Central Asia where all JICA aid schemes, including yen loans, can be implemented, so it has the potential to serve as a hub for demonstrating Japan’s presence across Central Asia. Therefore, this study will focus on identifying potential future projects and collecting necessary information with a view to expanding them in Central Asia.

This study will collect and analyze information on the needs for earthquake resistance of critical buildings in response to earthquakes, one of the natural disasters expected in Uzbekistan, organize target projects for critical buildings that will contribute to investment in disaster risk reduction in the capital city of Tashkent, review Uzbekistan’s action plans for promoting earthquake resistant buildings , and propose candidate projects for loan projects, grant aid, and technical cooperation projects (including loan account technical assistance) from among those. Candidate projects will be targeted at buildings of public interest (buildings that can serve as disaster prevention centers, especially government buildings, hospitals, educational facilities, public markets, stadiums, etc.).



Source: Institute of Seismology

Figure 1-1 Assessment of Economic Losses Resulting from Damage to Residential Buildings Caused by Earthquakes

1.2 Survey method

This study was conducted on public buildings in Tashkent, the capital city of Uzbekistan, using the procedures described below. A flowchart of the work implementation is shown in Figure 1-2

(1) Collection and analysis of related materials, policies and plans

The project team collected materials necessary for earthquake disaster and disaster prevention related projects, related policies and plans, reports on projects by other donors targeting Uzbekistan, and other materials, and organized the current status and issues.

(2) On-site inspections, interviews with relevant organizations, etc.

Starting with the implementing agency, the Ministry of Construction, Housing, and Communal Services (hereafter referred to as "Ministry of Construction"), interviews were conducted with central ministries, research institutes, universities, and other relevant organizations to hear about the latest situation regarding critical buildings and the needs and challenges of building earthquake resistance in Uzbekistan. In addition, the team continued to collect information on laws and regulations (norm), presidential decrees, and resolutions of the Cabinet of Ministers related to building design and disaster prevention activities, inventory lists of critical buildings (medical and educational facilities) in Tashkent, and reports on earthquake disaster risk assessments.

(3) Analysis

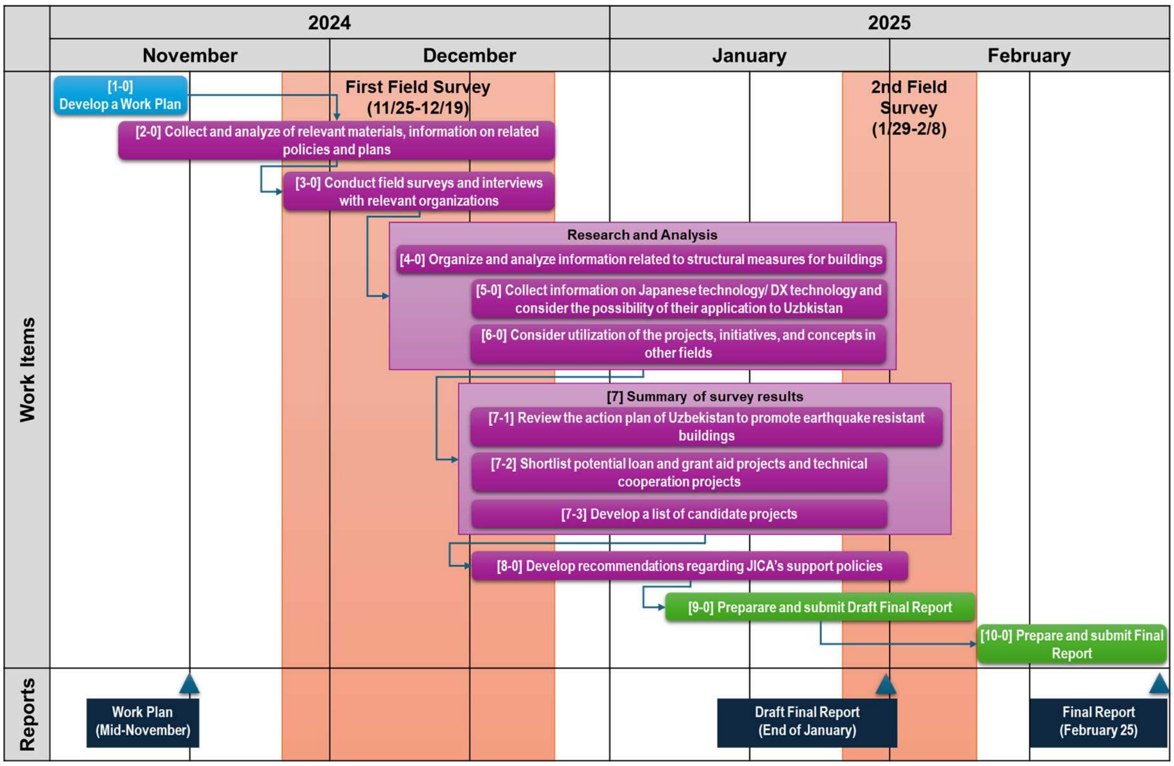
The collected information related to structural measures for buildings and needs for seismic retrofitting of buildings in Uzbekistan were analyzed. Subsequently, a bottleneck phase analysis in the promotion of earthquake resistant building in Uzbekistan was conducted to identify bottleneck factors in the plan, preparation and implementation phases of earthquake disaster prevention measures, and to analyze the issues involved. Based on the results of the analysis, we also examined the feasibility of introducing Japanese technologies of earthquake resistance and seismic isolation, and related DX technologies. At the same time, the possibility of contributing to the solution of complex issues from a broad perspective, including smart cities, decarbonization in the environmental field, and other fields such as climate change countermeasures, was also examined.

(4) Summary of Survey Results

Based on the results of the above bottleneck phase analysis, we reviewed the roadmap/action list for improvement of seismic safety systems developed by the Government of Uzbekistan and examined measures for improvement. Further, based on the results of the analysis of the status of earthquake resistance of the buildings, candidate projects for loan and grant assistance were reviewed. A short list of candidate projects for technical cooperation for the promotion of earthquake resistant buildings was prepared as well. The above-mentioned candidate projects are summarized in table format in this report.

(5) Consideration of recommendations for JICA’s support policies

Based on the results of the bottleneck phase analysis, potential bottlenecks to the promotion of structural countermeasures for important buildings, public buildings, and other structures were identified. Recommendations are made for the direction of JICA’s support to resolve these bottlenecks.



Source: Prepared by the survey team

Figure 1-2 Survey Workflow

1.3 Selection method for target buildings

(1) Definition and ranking summary of subject buildings

The first target buildings are public buildings that are important for disaster prevention. The possible public buildings and their uses and functions are summarized in Table 1-1

Table 1-1 Uses and functions of public buildings

JICA's Critical Facility Classification		Anticipated Usages and Functions
Most Important Facilities 1	Disaster prevention infrastructure	Ministry of Emergency Situations, shelters, etc.
	Government office building	Central and city government buildings, etc.
	Major hospital	Base hospital for disasters
	Police and Fire	Police related facilities, etc.
Most Important Facility 2	Transportation facilities	Railroad-related facilities, etc.
	Lifeline	Water and sewage related facilities, etc.
	Public service facility	Infrastructure-related facilities, schools, hospitals, etc.
	Schools with shelter functions	Kindergartens, schools, universities
	Supply Chain Related	Railroads, automobiles, and other transportation-related facilities

Most Important Facilities 3	Schools that do not have shelter functions	Kindergartens, schools, universities
	Hospital	(Medical) Clinic
	Business and livelihood facilities	Postal facilities, etc.

Source: Prepared by the JICA Survey Team

The City of Tashkent has compiled a list of public buildings, both medical and educational, from those shown above. As a first step, this section analyzes this list and provides an overview of the buildings. Historic buildings, which have not yet been listed, will also be analyzed because of their function as shelters, high cultural and economic value, and potential for seismic retrofitting.

In a second step, the analyzed medical and educational buildings and historical buildings are ranked in terms of "Building Importance", "Iconicity", "Efficiency", and "Building Vulnerability". Specific evaluation items and proposed scores are shown in Table 1-2 . However, since sufficient data was not available in this study to fill in the table, potential projects were considered in light of the evaluation items to the extent possible.

Table 1-2 Draft evaluation items and scores for ranking buildings

Evaluation item				Score/Threshold				
Main items	**Middle items**	**Sub items**	**Valuation index**	**1**	**2**	**3**	**4**	**5**
Building Importance	Normal function	Number of users	Number of users, beds, etc.					
	Disaster functions	Evacuation base function	Number of people accommodated					
		Substitutability	Availability of alternative buildings, travel distance					
	Prevention of secondary damage	Hazardous materials	Presence of pathogens, chemicals, flammable gases					
		Administrative Functions	Availability of resident service functions					
		Base function	Availability of instruction function					
		Lifeline Function	Impact on infrastructure and lifelines					
Iconicity			Degree of historical and scenic position					
Efficiency	Cost effectiveness	emaining period	Year built					
		Reinforcement cost	Building scale					
		Reinforcement effects	Use as a showcase					
		Restoration effect	Seismic activity					
Building Vulnerability			Building evaluation results					

Source: Prepared by the JICA Survey Team

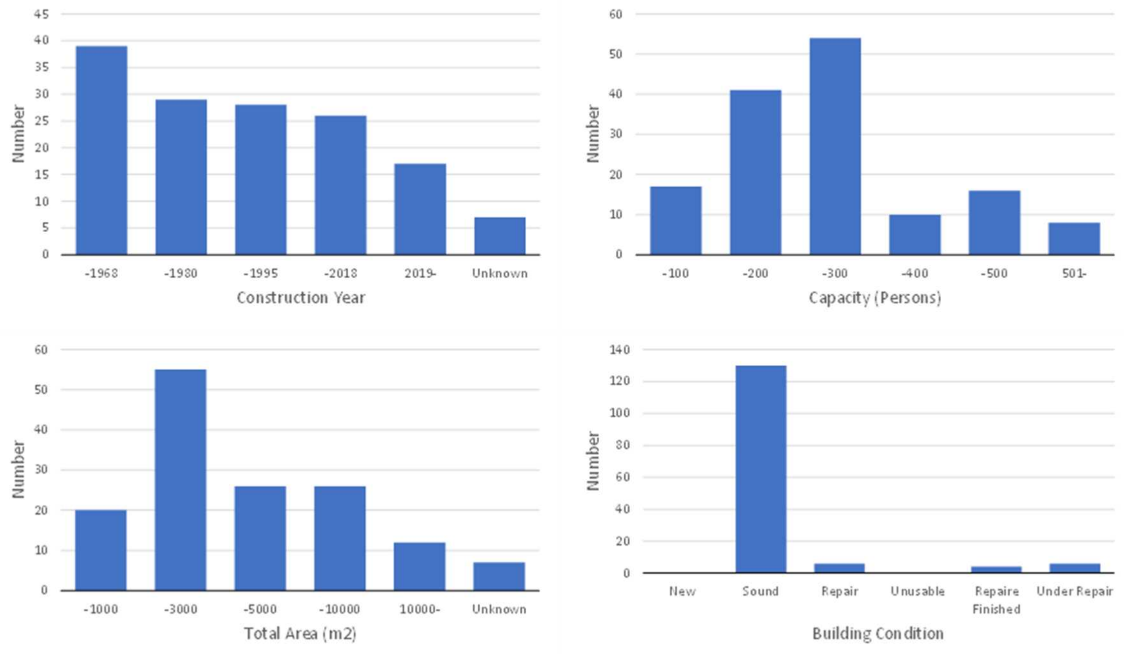
(2) Overview of medical and educational buildings

The medical and educational buildings for which building lists were obtained are summarized in Figure 1-3 ,Figure 1-4, Figure 1-5 to provide a basis for building selection.

Hospital buildings are relatively uniformly distributed in terms of construction date, with the largest number of buildings constructed before 1968, although there is little bias toward extremes. The number of hospitals with less than 100 or more than 300 patients is relatively small. In terms of total floor area, buildings between 1,000 and 3,000 m^2 are the most common. A simple visual inspection of the condition of the buildings reveals that the majority of the buildings are “sound”, with a few “in need of repair”, “completed repair”, or “in the process of repair”. No buildings were classified as “new” or “unusable”. The criteria for judgment are the same as for schools and kindergartens, and details of the building evaluation are shown in 2.2.2 and 2.3.4.

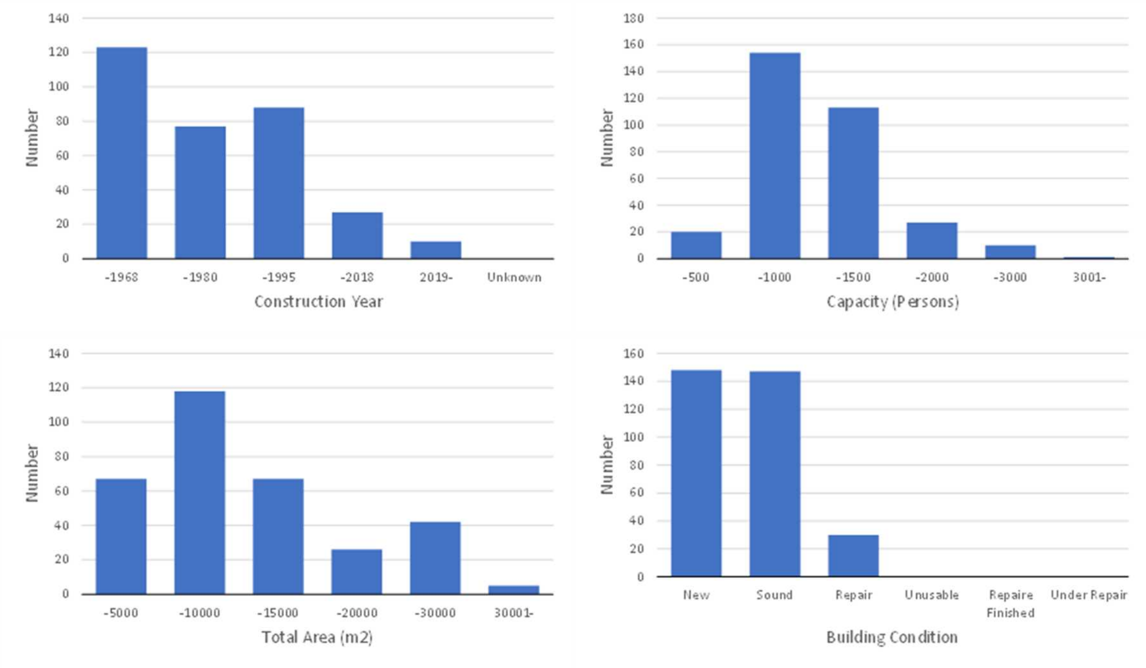
The majority of school buildings were constructed before 1995, with the largest number of buildings constructed before 1968. The largest number of buildings are between 500 and 1,000 students, followed by those with 1,000 to 1,500 students. There are also a few large schools with more than 3,000 students. In terms of total floor area, buildings of 5,000 to 10,000 m^2 are the most common. Depending on the classification of the bar graph, the number of students and the total floor area correspond well with each other in school buildings where the required floor area per student is determined. As for the condition of buildings based on visual inspections, most of them were judged to be “new” or “sound”, but there were some buildings that were judged to be “in need of repair”. No buildings were judged to be “unusable”, and no buildings have taken measures to improve earthquake resistance.

The majority of kindergarten buildings, as well as school buildings, were built before 1995, with the largest number of those built before 1968. In terms of number of children, the largest number of kindergartens is 300 to 400. In terms of total floor area, 7,500 to 10,000 m^2 buildings are the most common. The condition of the buildings shows a similar trend to that of the school buildings, with the majority of the buildings judged to be “new” and “sound”, although there is a certain amount of buildings that are considered to be “in need of repair” . The absence of buildings in other conditions is also similar to that of school buildings.



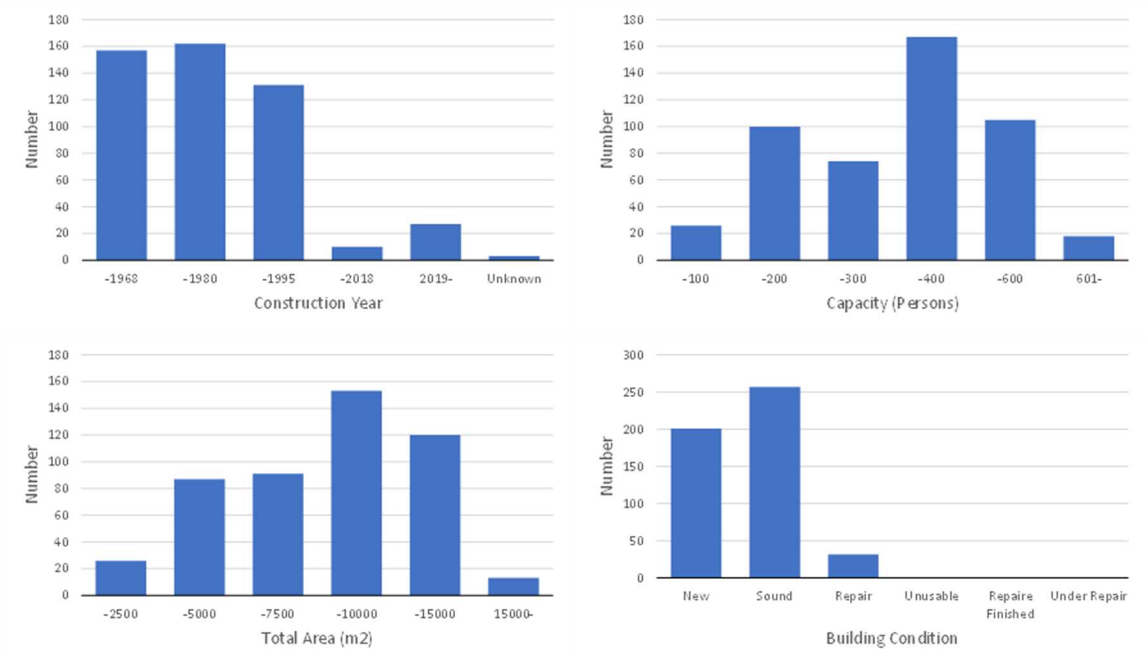
Source: Prepared by the survey team based on data provided by the City of Tashkent.

Figure 1-3 Hospital Building Overview



Source: Prepared by the survey team based on data provided by the City of Tashkent.

Figure 1-4 School Building Overview



Source: Prepared by the survey team based on data provided by the City of Tashkent.

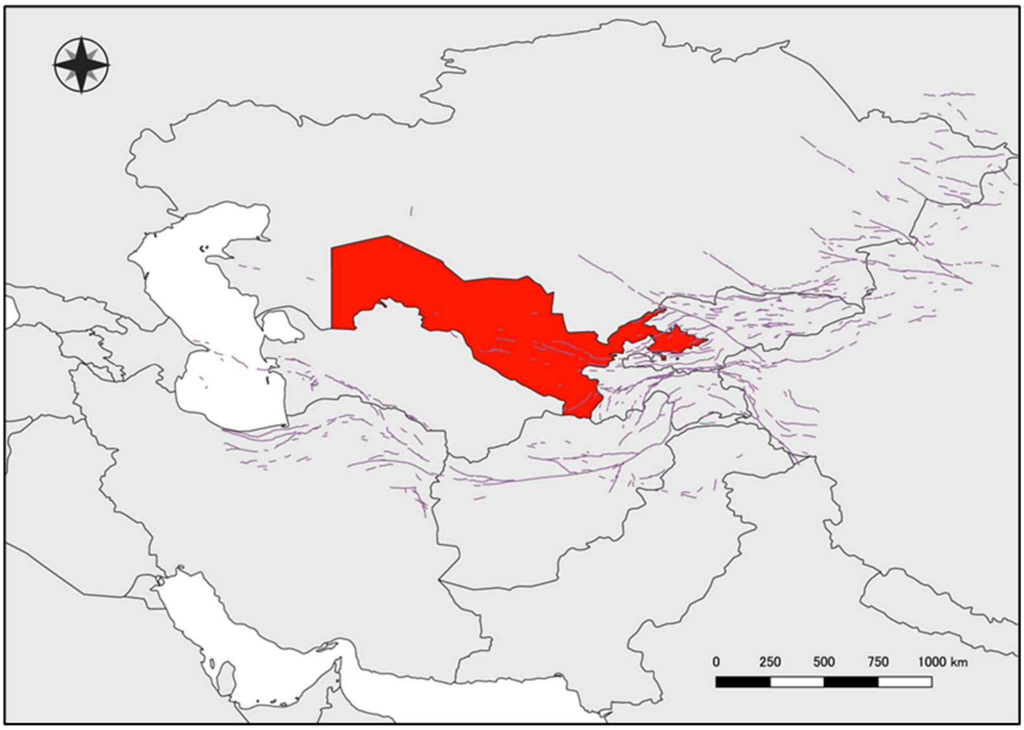
Figure 1-5 Kindergarten Building Overview

2. Status of Seismic Risk Management Efforts and Support Measures in Uzbekistan

This chapter presents the status of seismic risk management efforts and support measures in Uzbekistan.

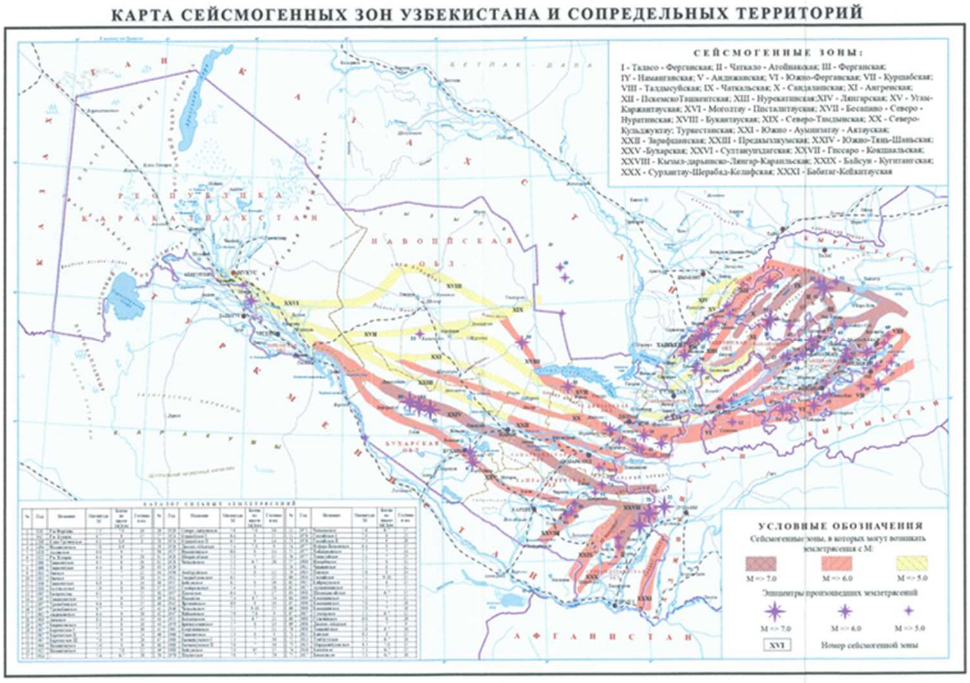
2.1 Seismic risk and history of major seismic events in Uzbekistan

Uzbekistan is located in Central Asia and is included in the Alpine-Himalayan orogenic belt located at the boundary of the Eurasian and Indian plates. As Figure 2-1, there are many active faults, indicating very active earthquake zones. In particular, the Tashkent Fault runs through the suburbs of the capital city of Tashkent, and there are concerns about its impact on the Tashkent City. In addition, according to a map of seismogenic zones and epicenters of past earthquakes (Figure 2-2) prepared by the Institute of Seismology of the Academy of Sciences in Uzbekistan, the Fergana Basin, which is located in eastern Uzbekistan and where the Taras-Fergana Fault is located, and the southern part of the country have many seismogenic zones, and thus the risk of seismic hazards is considered high in the Fergana Basin and the southern part of the country. Figure 2-3, Tashkent is expected to be hit by an earthquake of seismic intensity 8 (equivalent to a seismic intensity level of 5 Lower to 5 Upper on the JMA Seismic Intensity Scale). Areas predicted to experience an earthquake of intensity 9 (equivalent to a seismic intensity level of 5 Upper to 6 Lower on the JMA Seismic Intensity) include parts of Namangan and Andijan provinces in the Fergana Basin in eastern Uzbekistan, and parts of Kashkadarya and Surkhandarya provinces and Bukhara province in southern Uzbekistan.



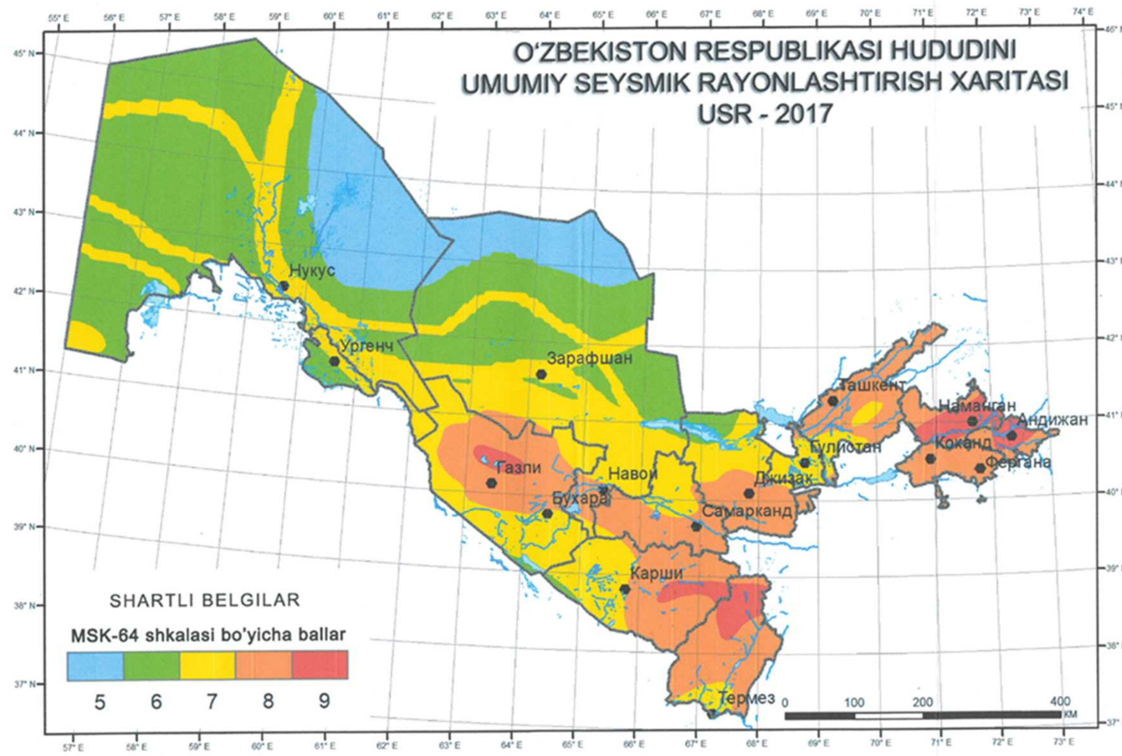
Source: Prepared by the JIAC Survey Team based on WB Central Asia Seismic Fault Database

Figure 2-1 Active Fault Map



Source: Institute of Seismology

Figure 2-2 Seismogenic Zones and Epicenters of Past Earthquakes



Source: Institute of Seismology

Figure 2-3 Seismic Intensity Map (2017)

A list of major earthquakes that occurred in Uzbekistan and its borders is given in Table 2-1. The parameters of these earthquakes were taken from the database of the Institute of Seismology. All of the earthquakes are characterized as shallow earthquakes, with epicentral depths of less than 30 km. Tashkent experienced two earthquakes of magnitude 5.0 or greater in 1966 and 2008, with seismic intensity levels from 6 to 8 on MSK scale (equivalent to a seismic intensity level from 4 to 5 Upper on the JMA Seismic Intensity Scale).

(1) 1966 Tashkent Earthquake

On April 26, 1966, an earthquake of magnitude 5.3 occurred with its epicenter in the City of Tashkent. The observed MSK seismic intensity was 8. In the affected areas, more than 236 government facilities, about 700 commercial and food establishments, 26 public facilities, about 180 educational facilities, and 185 medical facilities were reportedly damaged. The earthquake is estimated to have displaced 78,000 households, meaning approximately 300,000 people.

(2) 2008 Earthquake in Tashkent Province

A magnitude 5.0 earthquake with epicenter outside the Tashkent City occurred at 1:26 PM on August 22, 2008. The observed MSK seismic intensity was 6-7, and minor damage was reported, including bricks falling from the walls of buildings.

Table 2-1 List of Major Earthquakes in Uzbekistan or Around Its Borders

No.	Date	Epicenter	Latitude	Longitude	Magnitude	Depth, km	Intensity, MSK-64
1	1955, July 19	Bakhmal	39,7	68,0	5,2	21	VI-VII
2	1959, October 25	Burchmulla	41,67	70,0	5,7	13	VIII
3	1965, March 17	Koshtepa	40,7	69,6	5,5	11	VII
4	1966, April 26	Tashkent	41,33	69,28	5,3	8	VIII
5	1968, March 13	Kyzylkum I	42,43	66,47	5,3	30	VII
6	1968, March 14	Kyzylkum II	42,59	66,45	5,0	30	VII
7	1968, July 8	Baysun	38,11	66,9	5,0	15	VI-VII
8	1970, January 19	Pskent	40,83	69,33	5,0	20	VII
9	1971, October 28	Chatkal	41,95	72,25	5,6	25	VI-VII
10	1976, April 8	Ghazli I	40,33	63,67	7,0	25	IX
11	1976, May 17	Ghazli II	40,28	63,38	7,3	20	IX
12	1977, January 19	Isfara-Batken	40,11	70,79	6,4	15	VIII
13	1977, April 21	Khaidarkan	40,11	70,95	5,7	14	VII
14	1977, December 6	Tavaksai	41,58	69,68	5,1	25	VII
15	1980, December 30	Nazarbek	41,33	69,05	5,5	12	VIII
16	1982, May 6	Chimyon	40,0	71,42	5,5	12	VIII
17	1984, February 17	Papal	40,22	71,5	5,6	14	VIII
18	1984, March 19	Gazli	40,38	63,36	7,2	15	IX-X
19	1985, October 28	Kairakkum	40,28	69,8	5,5	15	VIII
20	1987, March 26	Altyntepa	41,72	70,05	5,0	8	VII
21	1988, December 21	Shamaldysai	41,28	72,19	5,5	15	VI-VII
22	1992, May 15	Izbazkent	40,99	72,4	5,9	25	VIII
23	1999, December 25	Kamashi	38,64	66,42	5,1	12	VII
24	2000, April 21	Kamashi	38,68	66,52	5,0	10	VII
25	2000, January 19	Kamashi	38,66	66,5	5,0	10	VII
26	2007, January 27	Sumsar	41,38	71,31	5,1	12	VI-VII
27	2008, January 1	Gulchin	40,32	72,97	6,0	20	VIII
28	2008, October 28	Jalal-Abad	40,98	73,16	5,1	9	VII
29	2008, August 22	Tashkent	41,3	69,4	5,0	10	VI-VII
30	2011, July 19	Kanskoe	40,16	71,42	6,1	10	VIII
31	2013, May 24	Tuyabogoz	40,89	69,15	5,6	18	VII
32	2013, May 26	Marzhanbulak	39,96	67,34	6,1	18	VIII
33	2017, September 29	Bakhmal	39,75	67,91	5,1	5	VI-VII
34	2022, May 15	Baysun	38.03	66.89	5,7	20	V-VI

Source: Prepared by the JICA Survey Team based on data from the Institute of Seismology.

2.2 Status of earthquake disaster prevention efforts

2.2.1 Related laws, policies and plans

This section provides an overview of the laws, regulations, and national plans that form the basis for implementing earthquake disaster risk management measures.

(1) National development plan

The Development Strategy of New Uzbekistan for 2022-2026 established seven strategic axes and 100 goals.

Seven Strategic Axes of the Development Strategy of New Uzbekistan for 2022-2026

1. Build a people's state by enhancing human dignity and promoting civil society.
2. Establish the principles of justice and the rule of law as the most fundamental and important condition for the development of our country.
3. Develop a strong national economy that guarantees rapid growth.
4. Pursue fair and equitable public policy and human resource development.
5. Develop its responsible institutions to ensure the improvement of spiritual values.
6. Approach global challenges through the lens of our national interests.
7. Strengthen our security and defense capabilities and pursue an open, pragmatic and proactive foreign policy.

Under Strategic Axis 7, Goal 92 was set to “Create an effective emergency prevention and response system” and the following actions were specified

- Improve legislation in the area of emergency prevention and response
- Train the Republican Special Rescue Center of the Ministry of Emergency Situations according to the standards of the INSARAG (International Search and Rescue Advisory Group)
- Organize the aviation service at the Ministry of Emergency Situations
- Systematize measures for the prevention and rapid elimination of emergencies in tourist zones
- Modernize the emergency notification system
- Improve coverage of remote areas of the country with professional and volunteers fire and rescue units
- Involve the private sector in the production of firefighting equipment
- Increase the effectiveness of forest fire prevention measures

Although disaster risk management is not directly mentioned here, natural disasters are included in the list of emergencies, and the direction to strengthen prevention and response to natural disasters is set forth.

In 2023, following constitutional amendments, a new development plan, Presidential Decree No. 158 of 2023 “On the Uzbekistan - 2030 Strategy” was enacted. This plan established five strategic axes and 100 goals.

“Uzbekistan -2030” Strategy (Presidential Decree No. 158 of 2023)

1. Creation of appropriate conditions for all to fulfill their potential a. Education System Reform b. Reform of public health care c. Reform in provision of social service and poverty reduction d. Youth Policy and Sports Reform e. Reforms to ensure spiritual development and bring the cultural sector to a new level
2. Ensuring the well-being of the people through sustainable economic growth

3. Preservation of water resources and protection of the environment a. Reforms to conserve water resources b. Environmental protection reform
4. Ensuring the rule of law and the organization of government to serve the public a. Reform of administrative organization and improvement of public management in public services b. Ensuring the rule of law and reforming the judicial system
5. Consistent continuation of policies based on the principle of a "secure, peace-loving state" a. Reforms to pursue an open, pragmatic and proactive foreign policy b. Reforms to strengthen our nation's security and defense

Under Strategic Axis 5, in the area of "Reforms to strengthen our nation's security and defense capabilities", "Preventing emergencies and disasters related to global climate change that threaten the lives of the population" is stated as Goal 98, and the following actions are established.

- Establishment of a national early warning system for strong earthquakes in the Republic, based on integration with the global international seismic observation system.
- A system to monitor and forecast emergencies at reservoirs and other high-risk facilities.
- Deepening cooperation in areas such as ensuring unified global security, strengthening the capacity to act in emergency situations, exchanging information rapidly with all countries in the region, and conducting joint training exercises.

Although natural disasters are mentioned more specifically here, the content is strongly focused in emergency response.

(2) Laws and regulations related to earthquake disaster management

The Ministry of Emergency Situations was established to protect the population and state economic facilities from natural disasters and to create an effective system to prevent and eliminate the effects of emergency situations due to natural and man-made disasters in the Republic, under the Presidential Decree No. 1378 of 1996 "On the Establishment of the Ministry of Emergency Situations of the Republic of Uzbekistan". Following this, Cabinet Resolution No. 558 of 1997 "On the State System of Prevention and Action in Emergency Situations in the Republic of Uzbekistan" provided for the creation of a state system for dealing with emergencies. At the national level, the Ministry of Emergency Situations is to take the lead, while at the local level, the state and local governments, as well as the managers of individual facilities, are to assume responsibility at their respective levels.

The current basic law governing disaster management in Uzbekistan is the Law of the Republic (No. 790 of 2022): On the Protection of the Population and Territories from Natural Disasters and Man-Made Emergencies (enacted in 1999, with successive revisions). This law is intended to protect the public in emergency situations, including natural disasters. It stipulates the powers of the national government, ministries and agencies, and local governments in emergency situations, the rights and obligations of the public, and the national system for prevention and response. It also envisages measures to be taken in advance as prevention against emergencies.

The Resolution of the Cabinet of Ministers No. 71 of 2007 “On the Approval of the State Program for the Forecasting and Preventing Emergency Situations” approved the National Program for Emergencies to be implemented during 2007 to 2011. The natural hazards area of this program included an earthquake risk mitigation program and specified the following activity items.

- Creation and implementation of seismic zoning regulation maps
- Seismic zoning of cities located in seismically active areas
- Improvement of step-by-step earthquake forecasting methods and development of technology to remotely identify signs of major earthquakes
- Expansion and strengthening of earthquake observation network and creation of information analysis and monitoring center
- Development of earthquake damage mitigation measures, taking into account the design features of buildings in Uzbekistan and the natural and climatic conditions
- Development of effective seismic retrofitting methods for buildings and structures
- Improved GPS technology and geodetic measurements
- Crustal deformation measurements at a crustal deformation test site

Based on the Sendai Framework for Disaster Risk Reduction, the Strategy and Action Plan for achieving the goals of the Sendai Framework for Disaster Risk Reduction were developed in the Resolution of the Cabinet of Ministers No. 299 of 2019, “On Measures for the Implementation of the 'Sendai Framework for Disaster Risk Reduction 2015-2030' in the Republic of Uzbekistan”. In the Resolution of the Cabinet of Ministers No. 362 of 2023 “On the Development and Effective Implementation of the National Action Plan on Climate Change and Natural Disaster Risks”, the national strategy, action plan and its roadmap for climate change and disaster management were presented.

Furthermore, with regard to earthquake disaster risk management, a series of important laws and regulations pertaining to seismic safety have been issued since 2020. These laws and regulations were repeatedly mentioned in the interviews with the agencies involved in this study, and many of the issues and support needs raised were related to the actions stipulated in these laws and regulations. This also indicated that each organization is working on the measures and actions stipulated by these laws and ordinances. The laws and regulations are not limited to buildings, but include infrastructure facilities and dams. The programs, roadmaps, etc. stipulated in these laws and regulations will be described in Section 2.5.3. The following are excerpts from the main laws and regulations and the main items related to seismic resistance of buildings.

Presidential Decree No. 4794 of 2020 “On Measures to Fundamentally Improve the System of Ensuring Seismic Safety of the Population and Territory of the Republic of Uzbekistan”

- Establishment of the Republican Council for coordinating measures to ensure seismic safety of the population and territory of the Republic of Uzbekistan.

- Establishment of a fund to support seismology, structural stability and seismic safety.
- Creation of electronic technical passports (electronic documents containing the necessary. information on the seismic vulnerability of buildings and structures, hereinafter referred to as “electronic passports”).
- Program for improvement of seismic safety systems in the Republic of Uzbekistan (Action List).

Law of the Republic of Uzbekistan No. 713 of 2021 “On Ensuring Seismic Safety of the Population and Territory of the Republic of Uzbekistan”

- Define direction of national policy in the field of seismic safety.
- Define authority of the State, the Ministry of Emergency Situations, the Ministry of Construction, the Academy of Sciences, and local authorities in the field of seismic safety.
- Stipulate organization of activities in the field of seismic safety.

Presidential Decree No. 144 of 2022 “On Measures to Further Improve the Seismic Safety System of the Republic of Uzbekistan”

- Definition of the concept and roadmap for improving the system to ensure seismic safety by 2025, and establishment of indicators for achieving this goal (inter-institutional collaboration in earthquake engineering, seismic engineering, earthquake observation, and research, emergency response, and proactive measures).

Presidential Decree No. 158 of 2023 “On Additional Measures to Further Improve the System of Ensuring Seismic Safety of the Population and Territory of the Republic of Uzbekistan”

- Various additional technical measures.
- Program on ensuring seismic safety and strengthening management during construction (with mention of promoting technical cooperation with Japan).

Presidential Decree No. 161 of 2024, “On Measures to Increase Earthquake Resistance of Buildings and Structures and Improve Seismic Risk Monitoring Activities”

- Roadmap for ensuring seismic safety and developing a system for earthquake resistance of buildings and structures.
    - ✧ The Roadmap specifies various actions, for example, the development of a norm for the design and construction of high-rise (16+ stories) buildings and structures.
- Installation of automatic monitoring devices in certain buildings and automatic shut-off devices, etc. to the gas and electricity grids.
- Develop Regional earthquake preparedness plans.
- Establishment of the Association of Earthquake Engineering Scientists within the Academy of Sciences.

2.2.2 Seismic risk assessment

This section reviews the status of seismic risk assessment in Uzbekistan in order to understand the seismic performance of public buildings in Tashkent. First, the status of public buildings is described, followed by the status and results of risk assessment.

(1) Status of public buildings

In Uzbekistan, the creation of an electronic passport (equivalent to an inventory) to record building and structural attributes is underway in accordance with a series of laws and regulations described in the section on laws and regulations related to seismic safety. For the City of Tashkent, the work has been carried out ahead of the others, and the collection of key information is largely complete.

Medical Facilities

According to the Ministry of Health, there are approximately 19,010 buildings in 3,820 medical facilities nationwide. Medical facilities are classified into four categories

1. Clinic (family doctor)
2. Hospital
3. Special Medical Center
4. Large Hospital

As for Category 2 above, infectious disease treatment, maternity hospitals, and other facilities have been integrated. Local medical institutions have been established in 208 districts and 32 cities. 3. Special Medical Centers are facilities that provide academic and research services, such as university-affiliated specialized hospitals. There used to be only four medical schools, but the number is now increasing due to the conversion of Special Medical Centers into medical schools. It also has a clinic attached to it. 4. Large Hospital is a new classification and so far there is only one; it was newly built in 2017 as a loan project after the President visit to an advanced hospital in Korea. At the time of construction, it was an advanced hospital that provided special treatment but it is no longer particularly advanced, as today other hospitals have been upgraded. For private hospitals, a licensing center has been established within the Ministry of Health.

In accordance with Presidential Decree 283 of June 16, 2022, emergency medical centers (call centers) have been established at national, regional and district levels, in addition to medical facilities. The emergency medical centers are located in the buildings of the Ministry of Health, are typically about 12 rooms in size, have drivers and nurses on standby, and are equipped with ambulances and medical supplies (in some cases, they were previously located in regional medical institutions and remain there today).

Base Hospitals for Disaster Management are designated in consultation with the Ministry of Emergency Situations, the Ministry of the Interior, and the Fire Department, and are located primarily in the center of the various regions. Historically, base disaster hospitals were established after World War II, together with the Ministry of Emergency Situations and the Ministry of the Interior. These hospitals have not been relocated since then. Under the guidance of the Ministry of Emergency Situations, the hospitals are also equipped with disaster prevention facilities (mainly fire prevention equipment).

The Ministry of Health's perception was that the following conditions existed with respect to the seismic resistance of the facility (**Note: Based on the totality of the interviews conducted with the various agencies in this study, it is likely that the condition survey and evaluation of the building conducted by the Ministry of Construction was mistaken for an evaluation of seismic resistance**).

- The evaluation of the building is carried out by the GASN (department in charge of inspections) under the Ministry of Construction.
- There are examples of buildings without foundations and buildings formerly used as a dormitory that are now being used as a hospital; one building was built in 1911 and is still in use today without reinforcement.
- There is no record of seismic retrofitting in hospital buildings.
- The number of buildings that have been determined to be weak (in need of reconstruction or repair) in the evaluation based on Presidential Decree No.161 of 2024 is 84, as of this moment the results are known. Of these, 4 buildings are located in the City of Tashkent. It has not yet been decided whether they will be rebuilt or repaired.
- It plans to rebuild and repair 94 buildings by 2025 and has applied for a budget of 1.15 trillion UZS.

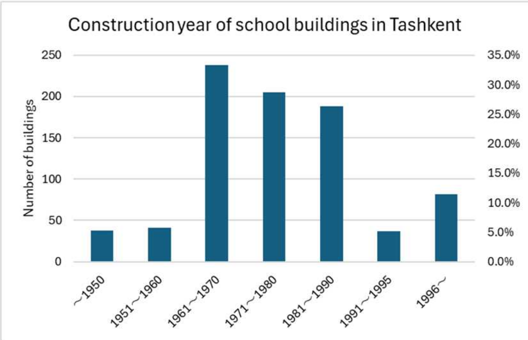
Educational Facilities

According to the Ministry of Pre-primary Education and School Education (hereafter referred to as "Ministry of Education"), there are approximately 10,100 preschools and schools throughout the country. There are approximately 350 in the City of Tashkent, and about 150 private schools (although not under the control of the Ministry). The local facilities departments have conducted visual inspections and determined that about 1,500 schools need to be renovated, but it is not clear at this time whether this includes seismic problems. If there are serious problems such as unequal building settlement, GASN under the Ministry of Construction will conduct a detailed inspection.

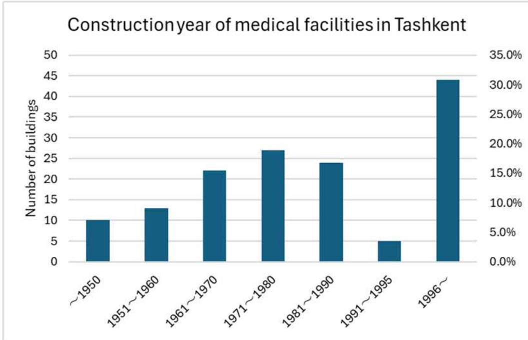
School buildings in Tashkent are generally well maintained. However, it is unclear whether the structural integrity of the buildings, which were built in the 1960s, 70s, and 80s, has been maintained, even if the exterior and other aspects of the buildings appear clean. Any inspections of earthquake resistance have not been conducted.

Medical and educational facilities (Situation in Tashkent City)

As described in Section 1.3, the Tashkent City Municipality provided us with a list of buildings for medical and educational facilities in Tashkent. Included here are public schools (schools: 325, pre-school: 490) and public medical facilities (146 facilities). The number of buildings and their percentages by year of construction are shown in Figure 2-4



Public schools in Tashkent



Public medical facilities in Tashkent

Source: Prepared by the survey team based on data provided by the City of Tashkent.

Figure 2-4 Construction date of public schools and public health care facilities in Tashkent

For schools, it is apparent that buildings of relatively old age, prior to the collapse of the former Soviet Union in 1991, are still in use, while for medical facilities, the percentage of buildings constructed after 1996, when the current seismic norm was stipulated, is relatively high.

The City of Tashkent has made a database of buildings in Tashkent available on the Internet, mainly to promote redevelopment and real estate investment, although not for the purpose of earthquake resistance. Buildings are color-coded by construction year, and by clicking on a building, the user can see the construction year, address, latitude and longitude, and building use. (Figure 2-5)

Source: https://age.tashkent.uz/

Figure 2-5 Building database published by the City of Tashkent

Sports Facilities

According to the Ministry of Sports, there are more than 10,000 sports facilities in the country. Of these, more than 8,000 are attached to schools, and the Ministry of Sports manages nearly 1,000 facilities of various types, including open and closed facilities. In addition, there are 360 government buildings and other facilities (e.g., educational facilities related to the Olympic and Paralympic Games). The Olympic City Complex includes various sports facilities such as stadiums, which will be equipped with earthquake detectors. There are also universal sports facilities.

They mentioned that they were working on developing electronic passports and the information was available on the platform. In accordance with the Presidential Decree, visual facility assessments would be conducted and response measures would be considered. Funding for the implementation of response measures comes from investment programs (grants and loans from national and foreign sources). Those identified as weak will be addressed during 2025, and discussions are underway with the Ministry of Construction. The study is being conducted taking into account the condition of the buildings, the hazard level of each area, and soil investigations (geotechnical conditions).

Historical and Cultural Heritage

Designated cultural heritage sites are listed in the Resolution of the Cabinet of Ministers No. 846 of 2019 "Approval of the National List of Cultural Heritage Properties". There are 288 in the Republic of Karakalpakstan, 422 in Andijan, 829 in Bukhara, 427 in Jizzakh, 1,468 in Kashkadarya, 437 in Navoi, 274 in Namangan, 1,607 in Samarkand, 561 in Surkhandarya, 78 in Shirdarya Tashkent, 376 in Fergana, 259 in Kholazm, and 354 in Tashkent City (note: including those with more than one registration per site). According to the Cultural Heritage Agency, 370 of these sites have been inscribed by UNESCO as World Heritage, Intangible Cultural Heritage, etc. There are 7 World Heritage Sites in Uzbekistan.

According to the Cultural Heritage Agency, the 1966 Tashkent earthquake reported that heritage sites in the City of Tashkent were largely undamaged. They recognize that an earthquake with an epicenter in Afghanistan caused damage to Buddhist monuments in Surkhandarya, and that other earthquakes have also caused damage, such as cracks and partially broken walls, but the number of cases is not as large.

Although monuments in areas near deserts are relatively resistant to deterioration, the outer walls of the royal palace in Khiva, Kholazm near the Caspian Sea are susceptible to deterioration, because of the effects of humidity due to the fact that the joints of the bricks are made of soil, and the possibility of damage due to climate change is increasing. It seems that many buildings need to be repaired now (e.g., rain damage to the walls of Ichan Kala).

As part of the system for monitoring the condition of designated cultural heritage sites, the regional branches of the Cultural Heritage Agency visit cultural heritage sites to check for cracks and other damage. The monitoring results are compiled in weekly reports and reported to the headquarters. For repairs, etc., the government (Ministry of Economy and Finance) allocates a certain budget to the Cultural Heritage Agency each year, and the Agency decides which properties to repair within that budget. The actual repair work is carried out by the Repair Department of the Cultural Heritage Agency, which prepares a repair plan, and the repair work is carried out by state and private companies licensed to repair cultural heritage, or by repair specialists from other countries. However, when experts from other countries are hired, funding is provided by the Cultural and Technological Development Fund.

(2) Vulnerability and risk assessment of public buildings

Seismic risk assessments conducted or available in Uzbekistan include the following. In general, seismic risk assessments use fragility curves for buildings (including public buildings), but the details of fragility line curves are not always published.

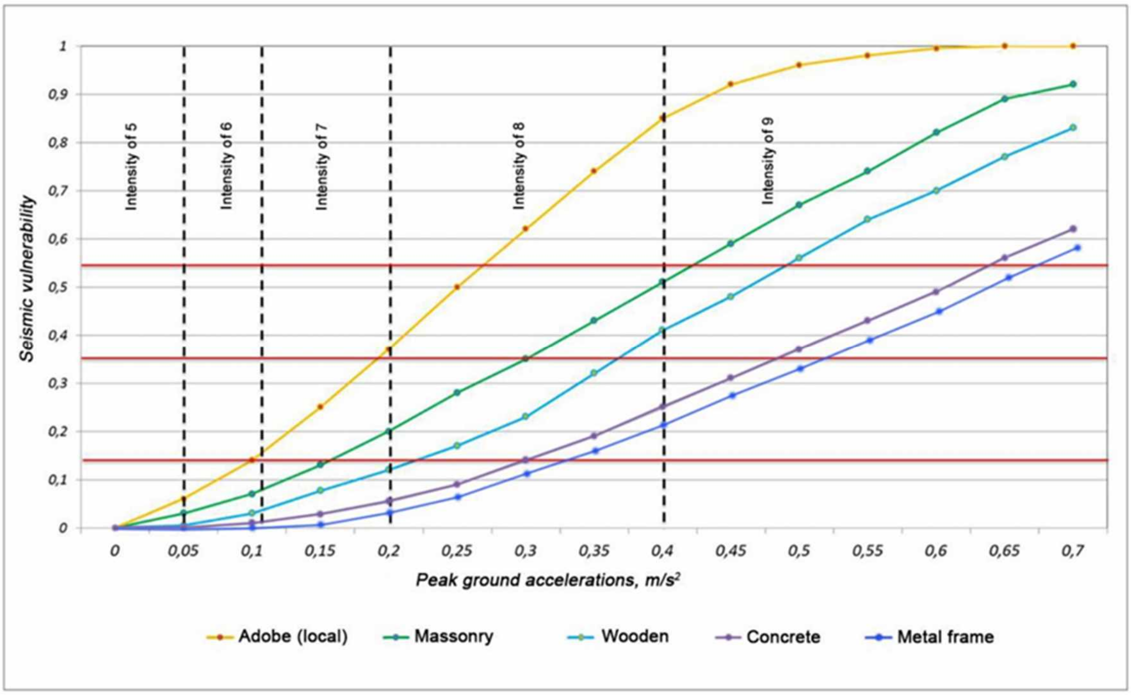
Risk Assessment by Institute of Seismology

The Institute of Seismology of the Academy of Sciences prepares seismic hazard maps at the request of the Ministry of Construction. Hazard maps are not necessarily revised on a regular basis, and the occurrence of a major earthquake (M5 or greater) triggers the request for updating them. If there is no change in the hazard map (based on MSK seismic intensity) as a result of the review, the map is not revised. 1976, 1979, 1980, and 1984 also had earthquakes of M5 or greater, but the map was not revised. The latest hazard map also considers the 2022 earthquake (M5.6), but the map has not been revised because no difference is shown in the hazard map.

Figure 2-6 and Figure 2-7 show the earthquake risk maps including residential damage assessment and graphs of ground surface acceleration vs. earthquake vulnerability functions for each structure type prepared by the Institute of Seismology at the request of the Cabinet Office. It should be noted that the earthquake vulnerability function here shows the ratio of the cost of repair and reconstruction to the cost of new construction, and not the probability of total destruction or damage as in the general vulnerability curves. This seismic risk map evaluates seismic risk based on the probability of damage to residential buildings per 1,000 square meters. As mentioned earlier, eastern and southern Uzbekistan have many earthquake fault zones, and the risk of residential damage from earthquakes is assumed to be high in these areas. In addition, the surface acceleration-seismic vulnerability function indicates that an earthquake equivalent to MSK seismic intensity 8, which is expected to occur in Tashkent, would result in repair or reconstruction of sun-dried bricks, which are vulnerable to earthquakes, at a cost of approximately 40% or more of the cost of new construction, and RC buildings at RC buildings will also suffer damage at a maximum cost of approximately 20% of the cost of new construction.

Source: Institute of Seismology

Figure 2-6 Seismic risk map including damage assessment for residential buildings (2021)

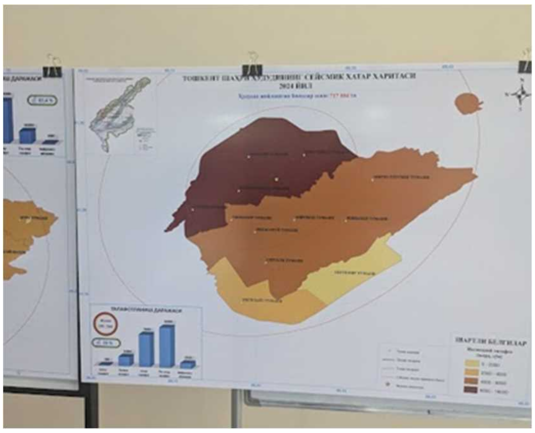


Source: Regional seismic risk assessment based on ground conditions in Uzbekistan

Figure 2-7 Structure-Type-Specific Ground Acceleration-Seismic Vulnerability Functions (2023)

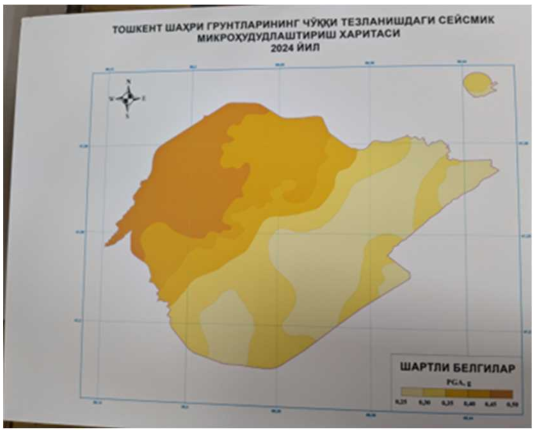
Seismic hazard maps are prepared in a probabilistic manner, with four types of maps: 1%, 2%, 5%, and 10% for 50 years. For the purpose of earthquake risk mapping, a scenario type hazard map using the peak ground acceleration (PGA) as an indicator has also been developed. Microzoning maps are available online, but require a permit from the Ministry of Construction.

Building data was generated in the above study. Previously, building vulnerability was assessed by placing an exciter at the top of the building, but now the assessment is done analytically using computational software. The number of building data is 804,700. All of them are residences, of which 68% are detached houses. Buildings are classified into seven types according to their structural materials, of which detached houses are classified into four types. Details of the building construction types are described in 2.3.1 and Table 2-18.



Seismic Hazard Map of Tashkent City (2024)

Seismic Hazard Map of Fergana Area (2024)



Seismic Microzonation Map of PGA in Tashkent City (2024)

Seismic Microzoning Map of Tashkent City (2024)

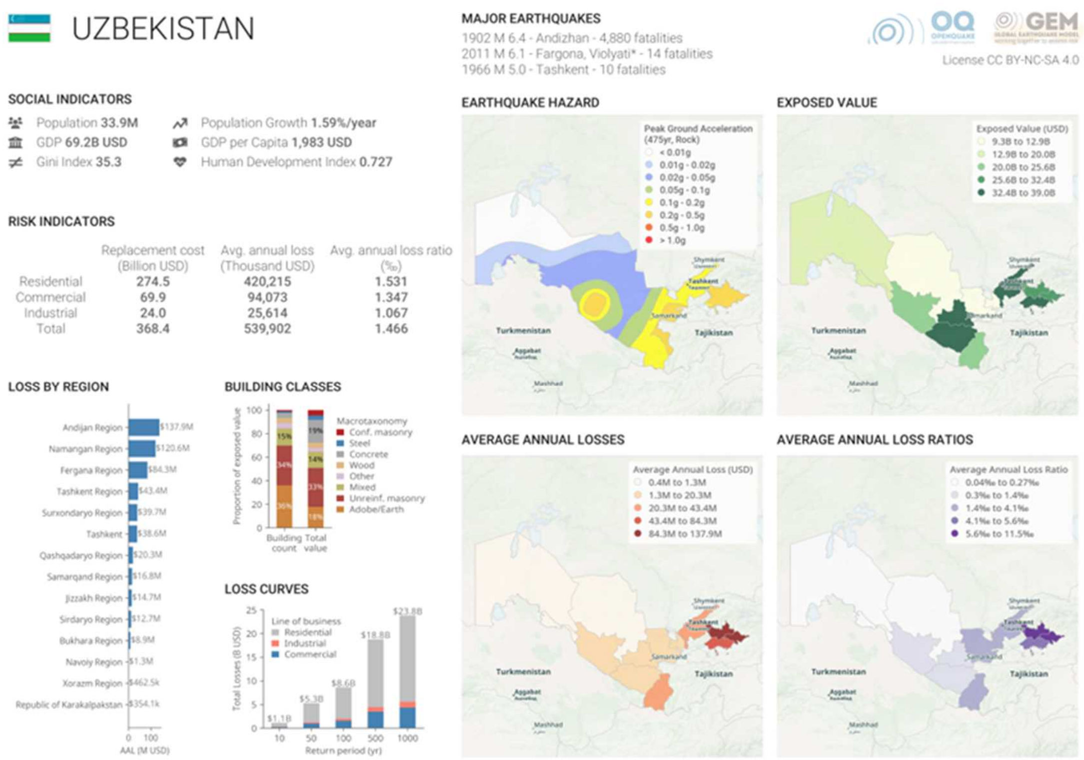
Source: JICA Survey Team photo

Figure 2-8 Exhibit of Hazard Maps and Other Information Prepared by the Institute of Seismology

Global Earthquake Model (GEM) Risk Assessment

One of the seismic risk assessments available for Uzbekistan is that of the Global Earthquake Model (GEM), a non-profit scientific public-private partnership that develops transparent seismic risk assessments for global risk management.

GEM participated in the consortium implementing the Asian Development Bank-supported project “Development of a Disaster Risk Transfer Facility for Regional Economic Cooperation in Central Asia” and was responsible for the exposure and seismic vulnerability component of the project. The project included three main components: 1) disaster risk assessment and model development in all CAREC countries; 2) design of a regional disaster risk transfer pilot facility for at least three CAREC countries; and 3) disaster risk reduction, risk retention, and risk transfer, and capacity building and awareness raising activities to educate key public and private stakeholders in CAREC countries on the benefits of the solution.



Source: Global Earthquake Model

Figure 2-9 Risk Assessment of Uzbekistan by GEM

The GEM assessment model shows that the Average Annual Loss Ratio is very high in the Fergana Basin, indicating that it is rated as an area with high seismic risk. (Figure 2-9)

2.2.3 Implementation structure for earthquake and seismic countermeasures

This section describes the implementation system of earthquake and seismic safety measures in Uzbekistan. First, it describes the main institutions involved in seismic safety as stipulated by law, then the ministries with jurisdiction over public buildings, and finally the related institutions, including universities and research institutes.

(1) Key organizations involved in seismic safety

Law of the Republic of Uzbekistan No. 713 of 2021 on Seismic Safety generally defines the roles of key agencies as follows

Table 2-2 Role of key Organizations involved in seismic safety (Law No. 713 of 2021)

Organization	Role in ensuring seismic safety
Ministry of Emergency Situations	Responsible for crisis management, including earthquake observation and earthquake emergency response.
Ministry of Construction, Housing and Communal Services	Responsible for ensuring the earthquake resistance of buildings in accordance with norms, standards and regulations.
Academy of Sciences	Responsible for supporting policies related to seismic safety through seismic hazard and risk assessment and research on earthquake resistant buildings.
Local government	Responsible for supporting the implementation of the national program and contributing to improving the safety of the population and earthquake resistance of the buildings.

Source: JICA Survey Team based on Law No. 713 of 2023.

Ministry of Emergency Situations

The Ministry of Emergency Situations was established by Presidential Decree No. 1378 of 1996. Its purpose is to establish an effective system to protect the population and the national economy from natural disasters and to prevent and eliminate the effects of natural and man-made emergencies in the Republic.

Traditionally, emergency response and preparedness have been the primary area of activity, but in August 2024, a new department, the Department of Earthquake Safety, was established. In accordance with the Resolution of the Cabinet on Ministers No. 171 and Presidential Decree No. 158 of 2023, this department is to analyze the status of earthquake response in each ministry, make recommendations, and submit a monthly report to the Cabinet Office.

The Resolution of Cabinet of Ministers No. 754 of June 15, 2019 stipulates the development of emergency response and education on the behavior of the population. Training programs for ministries are conducted for two levels: 1) Minister/Mayor level, and 2) District Director level, with the Ministry's staff serving as instructors. Training programs are developed by the Ministry and the research institute. As for training for the general public, how to train for actions in pre-schools, schools, and universities is defined and taught in classes. Disaster preparedness training for people with disabilities is also being implemented.

In addition, the following activities are being conducted to raise awareness about earthquake disasters. It provides a code of conduct for employees in companies. It has a free electronic platform that is accessible to the general population. Nationwide drills are held annually in May and October to prepare for earthquakes. In addition, every Wednesday is designated as “Disaster Day”.

Under the Ministry of Emergency Situations, the Seismic Monitoring Center has been established; it has been conducting seismic observations since 1901 as a department of the Institute of Seismology, which since 2017 belongs to the Ministry of Emergency Situations. The seismic observation network currently includes 120 stations, with 140 strong-motion seismometers and 45 broadband seismometers. It also conducts array observations down to a depth of 100 meters. The number of observation bases is planned to increase to 250 by 2025.

In terms of collaboration with other countries, the Center conducts joint research with the University of Michigan, Swiss Seismological Service, Azerbaijan Earthquake Research Institute, Russian Soil Mechanics Center, USGS, and International Seismological Centre. There are also exchanges with the Asian Disaster Reduction Center in Japan.

As for the early warning system, they are interested in introducing the Japanese earthquake early warning system, but they believe it would be difficult to introduce it immediately, as it requires a lot of localization, such as different earthquake ground motion indices to be used.

The Emergency Simulation Center (ESC) was established as part of the Ministry of Emergency Situations in January 2015, with the aim of educating and raising awareness about disaster preparedness for the general public, based on the Presidential Decree No. 208 of 2011. When it was first established, the Center was called the “Earthquake Simulation Center” and exhibited in six rooms, and this number has now increased to 11 rooms, including the exhibition and experience sections as follows.

- Exhibition of materials related to earthquake observation in Uzbekistan
- Earthquake experience room (using earthquake simulation equipment), smoke evacuation experience room
- Various panel displays related to natural disasters (earthquakes, droughts, avalanches, etc.) and man-made disasters (traffic accidents, nuclear disasters, explosions, etc.)
- Disaster experience through VR (in each panel exhibition room)
- Emergency medical care

A new museum building is currently under construction, and the material exhibits will be transferred to the new building when it is completed.

Reference Exhibition Room　　Fire Experience Room　　Earthquake Experience Room

Source: JICA Survey Team Photos

Figure 2-10 Emergency Simulation Center

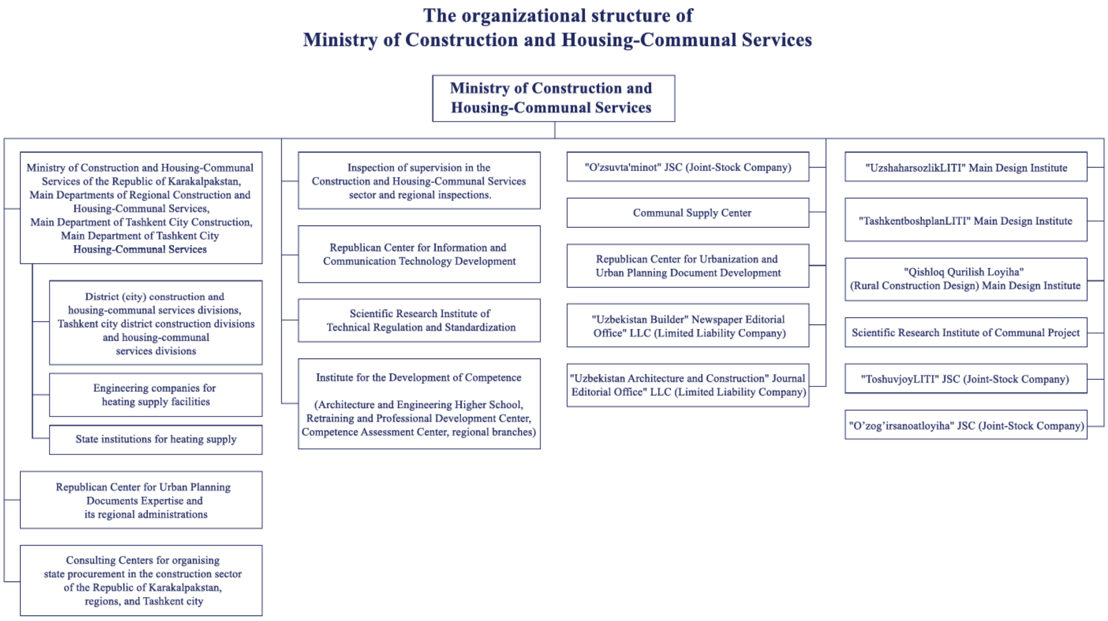
The Center is open five days a week, Monday through Friday, but closed in July and August. The number of visitors in 2024 was around 5,400, and this number tends to increase as the years go by. It accepts both individual visitors and groups of companies and schools. Individuals do not need to make reservations, but groups must make reservations in advance, and pay an admission fee of 15,000 UZS for adults and 10,000 UZS for students. The Center is staffed by four people: the director, two instructors, and an equipment manager. Training programs and materials for training are developed at the Center. The Ministry of Emergency Situations has organizations in each of the 12 states that are responsible for awareness-raising activities. However, they do not have hands-on programs such as earthquake simulators, but mainly exhibit-based programs.

Ministry of Construction, Housing and Communal Services

The Ministry of Construction is the organization that oversees the administration of urban planning and construction through the development of laws, regulations, and standards, etc. Its main duties are as follows

- Pursuit of a unified national scientific and technological policy in the field of engineering and technical research for urban planning and construction, introduction of innovative projects and solutions for energy efficiency and energy conservation in construction activities that guarantee increased labor productivity, reduced construction and installation costs, and rational use of resources.
- Development and approval of district plans, master plans of settlements and other urban planning documents for the Republic of Karakalpakstan, the Province, the City of Tashkent, districts and cities, and monitoring of their implementation.
- Participation in the preparation of proposals on the main directions of national policy in the field of urban planning, in the preparation of long-term and medium-term national programs for the development of building and construction activities, and in the preparation of sectoral and regional programs for the socio-economic development of the region.
- Coordination of design work and construction activities; improvement of efficiency of design and survey organization and expansion of regional networks; organization of individual, standard, serial and experimental projects and development of design solutions; expertise in urban planning documents.
- Further improvement and updating of the regulatory framework for urban planning and urban planning activities; coordination of the formulation of building codes and regulations in various sectors; standardization work in the areas of design, construction, and production of building materials and products.
- Support the training of qualified personnel in the fields of architecture, design, and construction, radically improve the level and quality of the educational process in professional educational institutions, and retrain and upskill designers and professionals in the construction field, including major overseas institutes.

The figure below shows the organizational chart of the Ministry of Construction. Uzsuvtaminot, a public corporation that operates water and sewage systems, and ToshuyjoyLITI, a government-owned design firm, which were also interviewed for this study, are also under its jurisdiction.



Source: Ministry of Construction, Housing and Communal Services

Figure 2-11 Organization Structure of the Ministry of Construction, Housing and Communal Services

<u>Institute of Seismology of the Academy of Sciences</u>

The Academy of Sciences is under the jurisdiction of the Cabinet of Ministers. After the Tashkent earthquake of 1966, a decree was issued on August 31 of the same year establishing the Institute of Seismology. The purpose of the institute was to conduct research on earthquake prediction and to evaluate regional seismic hazards. 1,120 employees were employed in 1980, but the institute was temporarily closed after the collapse of the Soviet Union. 7 years ago, a presidential decree was issued to reopen the institute, which now has 129 employees, including 48 researchers, 17 PhD and 10 Dr.Sci. The institute has a total of 1,860 researchers, including 17 PhD and 10 Dr.Sci. The institute has been operating for more than 10 years, but the number of researchers has declined since then. The number of research divisions expanded from 7 to 13 before the reopening, and now there are 8 divisions, and they are engaged in research and development for the purpose of understanding seismic risk in each region, earthquake forecasting, and GNSS systems.

The annual budget of the institute is 9.5 billion UZS (742,000 USD), with 11 billion UZS (859,000 USD) of other income (grants, etc.). The budget for 2024 is 1,600,000 USD, and the budget from the government is increasing.

Institute of Mechanics and Seismic Stability of Structures of the Academy of Sciences

The Institute of Mechanics and Seismic Stability of Structures was established in 1943 under the name of mathematics and mechanics, and later became independent as the Institute of Mathematics and Mechanics. The Institute became the Institute of Mechanics and Seismic Stability of Structure as a result of the Tashkent earthquake in 1966. Currently, the Institute conducts research in the following three areas:

1. Mechanics of materials, seismic engineering (mainly buildings)
2. Fluid dynamics (gases, liquids), combustion
3. Mechanical engineering (mainly agricultural machinery)

In the area of earthquake resistance, the Institute is focusing primarily on the following:

- Ground stability: for construction of underground structures (subways, underground storage tanks, underground pipes)
  While the Institute of Seismology deals with seismic motion and ground soil conditions, the effects of earthquakes are studied here.
- Above-ground structures: safety of high-rise buildings is an issue
- Seismic isolation: learning this field from Japan and would like to realize it with Uzbek technology.

The Institute of Mechanics and Seismic Stability of Structures employs 150 people and has 10 departments. Of these, there are laboratories for three departments (structural, geotechnical, and hydraulic), which are for dam studies. The budget of the institute is 1,000,000USD.

The experimental shaking table is currently being constructed and is scheduled to start up in 2025. The shaking table was imported from California, USA (1,300,000USD).

The staff of the Institute is engaged at the University of California. About two researchers a year from the Laurence Livermore National Laboratory come to the Institute, and the Institute also has a research agreement with Tohoku University. Although there are many collaborations, we consider them insufficient.

Tashkent City (Municipality)

The Inspection Department of the City of Tashkent inspects and manages buildings in the city (central government buildings, metro, etc.). The buildings subject to this inspection fall into two categories: those used by the city (a small number of buildings) and those managed by the city (a large number of buildings).

The Tashkent Building Inspection Department consists of 21 staff members (including institute staff) and conducts inspections when, for example, a building in Tashkent needs to be inspected for cracks, etc., to check safety and identify the cause (e.g., subsidence, etc.). Each city other than Tashkent has its own department with the same role. However, it does not measure the seismic performance of buildings like a seismic diagnosis. Other checks include inspections of rebar in foundations, brick quality, and concrete strength at new construction sites.

In the process of requesting an inspection of an existing building, the user of the building (for example, the principal of a school) first makes a request to the district in which the building is located, and then the district makes a request to the municipality of Tashkent, and the municipality then conducts the inspection.

For new buildings, the construction company submits a request to the municipality, which then conducts the inspection. The number of buildings inspected is about 100 or more per year, but the number of requests is much higher.

If the inspection results indicate that the building is unsafe to use, the municipality informs the competent ministry (for example, the Ministry of Education for an elementary school) that the building cannot be used, and a committee is convened within the ministry to consider subsequent actions such as renovation or demolition.

(2) Ministries responsible for public buildings

The ministries with jurisdiction over major public buildings are listed in the table below.

Table 2-3 Public Buildings under the Jurisdiction of Central Ministries and

Organization	Public Buildings under jurisdiction
Ministry of Health	Hospitals, clinics, medical facilities, etc.
Ministry of Preschool and School Education	Schools, kindergartens
Ministry of Higher Education, Science and Innovation	University, vocational school, etc.
Ministry of Sports	Stadiums, sports facilities, etc.
Ministry of Emergency Situations	Firefighting related facilities, etc.
Ministry of Internal Affairs	Police related facilities, etc.
Cultural Heritage Agency	Historical and cultural heritage

Note: Information on fire and police related facilities could not be obtained in this survey due to the nature of the facilities (confidentiality).

Source: Prepared by the JICA Survey Team based on publicly available information.

Although departments such as the Construction Department exist in each ministry and agency with jurisdiction over public buildings, they only provide requirements for matters related to the construction and repair of buildings, and the Ministry of Construction and local governments are responsible for the design and implementation of construction. Historical and cultural heritage is managed directly by the Cultural Heritage Agency as an exception.

<u>Ministry of Health</u>

Management of building facilities under the jurisdiction of the Ministry of Health is handled by the Construction Department, which has five members: one director, two chiefs, and two staff members. In addition, each local branch has 2 to 3 employees, for a total of 25. In addition to medical facilities, there are Ministry's buildings located in the capital and local areas, which are also managed. The budget for facility management is approximately 1,063 billion UZS (2024).

New construction and repair of buildings are under the jurisdiction of the Ministry of Construction. For example, in the case of new construction, the Ministry of Health only prepares the specifications and requirements for the facility and submits them to the Ministry of Construction, while the actual design, implementation, and procurement of the work is managed by the Ministry of Construction.

Ministry of Preschool and School Education

Buildings and facilities under the jurisdiction of the Ministry of Education are managed by the Facilities and Building Development Department. The Facilities and Building Development Department consists of four divisions: Construction, Effective Use of Owned Assets, PPP, and Goods (Management), and has a total of 24 staff members at headquarters (four in the Construction division), with about three staff members in each Regional Construction Division.

Some maintenance of buildings and facilities is carried out directly by the Ministry of Education, but usually the school division of the Ministry of Construction or the City/District municipality carries out daily maintenance. Presidential Decree No. 241 of 2019 stipulates that the budget of City and District municipalities may be used to manage local school facilities, buildings, infrastructure, and roads.

When repairing or building new buildings, the Ministry of Education only submits planning specifications and requirements to the Ministry of Construction, leaving the design details to the Ministry of Construction (the Ministry of Construction orders the design to a design firm). When building a new school, the Ministry of Education and the local government first discuss the new construction, establish the requirements, and then approach and propose the project to the relevant ministries (Cabinet Office, Ministry of Construction, and Ministry of Economy and Finance). Once permission is granted by the Ministry of Economy and Finance, the order is placed by the Ministry of Construction. The structural type of the new school will be RC structure for the foundation, and the walls will be fired bricks or blocks. Depending on local characteristics such as ground conditions, the Ministry of Construction may specify a different structural type. Standard specifications based on size include: for 330 people (1 story), for 660 people (2 stories), for 990 people (3 stories), for 1,350 people (4 stories), and for 1,650 people (5 stories). The standard construction cost of a new school for 660 students is about 30 to 35 million UZS per student (standard 30 students per class).

In 2024, 747 buildings are planned for new construction and repair with a budget of 3,913,612,000,000 UZS (328 buildings were not yet completed at the time of the survey); in 2025, 374 (schools) and 174 (kindergartens) are planned for new construction and repair. In past years, the number of buildings implemented has been higher than planned, and this is due to the fact that additional budgetary measures are sometimes taken in response to presidential visits to the regions. As mentioned earlier, in addition to the budget of the Ministry of Education, local government funds are also used.

The Ministry has not prepared any plan for earthquake disaster risk management or risk reduction. The Ministry of Emergency Situations is responsible for designating evacuation centers in the event of an earthquake, and schools are not often designated as such. Since earthquake disasters are infrequent, there does not seem to be much stockpiling.

Ministry of Higher Education, Science and Innovation

Uzbekistan has 113 national universities, 62 of which are under the jurisdiction of the Ministry of Higher Education, Science and Innovation (hereafter referred to as Ministry of Higher Education). Universities not under the jurisdiction of the Ministry of Higher Education are under the jurisdiction of affiliated ministries, such as the Ministry of Health for medical schools and the Ministry of Transportation for transportation. The Tashkent University of Architecture and Civil Engineering used to be under the jurisdiction of the Ministry of Construction. The Turin Polytechnic University in Tashkent is under the control of UZ Automobile, a joint stock company 51% owned by the government. In addition to the universities, the Ministry of Higher Education also administers technical or vocational schools (about 600) and university-affiliated lycées (more than 60).

In the field of seismic safety, the Tashkent University of Architecture and Civil Engineering, which is under the Ministry of Higher Education, the Samarkand State Construction University, and the Institute of Seismology of the Academy of Sciences are seen as centers for research.

For higher education facilities, electronic passports are also being prepared, mainly by the Academy of Sciences. According to the Ministry of Higher Education, the Institute of Seismology is responsible for building evaluation methods, while the Research Institute under the jurisdiction of the Ministry of Construction is responsible for repair design, etc. (Note: The evaluation here is considered to be mainly a visual assessment of building deterioration, etc.). Experts from the Academy of Sciences survey the building conditions, and if reconstruction or renovation is necessary, the design is carried out by the Ministry of Construction's design institute. After construction costs are calculated, application for government program funding is made and construction is implemented.

The evaluation of all buildings was completed over a period of two years, and about 10 to 15 buildings were determined to be weak. This led to the demolition of some university buildings in Tashkent. Priorities for construction work will be determined by the Ministry of Economy and Finance. First, budget allocations are determined for each region, and priority is given to buildings in the worst condition.

For construction work, the Ministry of Higher Education submits a request to the engineering department of City Municipality, which then contracts with the design and construction firms, and after the work is implemented, a use permit is granted. Here, experts in 12 fields, consisting of various ministries and other organizations, conduct the evaluation (the field of accommodating people with disabilities has been added since 2024). The Ministry of Higher Education only checks the requirements, for example, that $2m^2$ are needed per student or $4m^2$/person are needed for a computer room.

The budget distributed to the universities is approximately 5 trillion UZS. Maintenance costs for university buildings are contributed from the university's administrative budget. When major renovations are needed, funds are obtained from the national program (Social and Infrastructure Program). The Ministry of Higher Education makes the request to the Ministry of Economy and Finance, and funds are contributed to the City and District Municipalities.

Ministry of Sports

It has jurisdiction over a variety of sports facilities, with the exception of school gymnasiums. The Ministry of Construction is responsible for the maintenance and earthquake resistance of the buildings, and the

Ministry of Sports does not have details. The annual budget for the maintenance of facilities is more than 3 trillion UZS.

Stadiums and other facilities in various regions are used for education and training by the Ministry of Emergency Situations. An example of its use during emergencies is during the Covid-19 pandemic. Processes are determined by the Ministry of Emergency Situations.

Cultural Heritage Agency

The Agency for Cultural Heritage is primarily responsible for maintaining and managing the 8,300 cultural heritage objects currently in Uzbekistan. The objects managed by the Agency include mosques, seminaries, archaeological sites, buried artifacts, art galleries, museums, mosaic houses, residences of great men, cemeteries, and the number is increasing every year.

The Agency is under the Office of the President and has a total of 217 staff members at the headquarters and in the regional branches. Each regional office has 8 to 10 staff members, with branches located in 14 regions. In addition, a Repair Department, which is in charge of repair and renovation, has been established in each region, and the number of staff members differs from region to region. For example, in Bukhara, there are 170 to 200 employees in the Repair Department. There is also a research institute within the Repair Department. The Samarkand Archaeological Institute is also under its jurisdiction. The archaeological sites and museums are managed by about 100 people per facility.

(3) Universities, research institutes, and other related organizations

Tashkent University of Architecture and Civil Engineering

Tashkent University of Architecture and Civil Engineering (hereafter referred to as "TAQU") consists of four faculties (Faculty of Architecture, Faculty of Construction, Faculty of Management, and Faculty of Engineering). It currently has approximately 10,000 students, 350 faculty members, and 400 staff members. Rector himself had studied in Germany and had worked on vulnerability assessments of hospitals and schools in Uzbekistan from 2005 to 2007.

It has about 120 agreements/agreements and cooperates with Yokohama National University, Wakayama University, and Nagoya University in Japan. In China, 37 researchers will be sent to China for 2 months and another 6 researchers will be trained at Chinese universities (6-month or 2-year course). Seven researchers were sent to Germany for training in ETABS and SAP2000, structural design and analysis software. There are also programs to study at Chinese and German universities, and Chinese and German advice is being sought on design standards for buildings over 16 stories.

TAQU is also cooperating with the creation of electronic passports, seismic hazard assessments and risk assessments that are being conducted under the Presidential Decree. In addition, based on the provisions of the decree, TAQU would implement the following actions.

- New center for seismic risk reduction and technical assessment of buildings and structures
- Bachelor and master courses in seismology

- IT and digital data
- Use of Artificial Intelligence
- Method of restoring a tilted building (ground injection)

Turin Polytechnic University in Tashkent

The Turin Polytechnic University in Tashkent (hereinafter referred to as “TPUT”) was established in 2009 under an agreement with the Turin Polytechnic University in Italy. TPUT is composed of five departments: Natural Sciences and Mathematics; Management, Economics and Humanities; Automatic Control and Computer Engineering; Civil Engineering and Architecture; and Mechanical and Aerospace Engineering. The number of students is approximately 2,000, of which 100 to 200 are enrolled in the “Civil Engineering and Architecture” field. The school follows a European-style educational policy, and the number of students who graduate from the school is about 25% of the total enrollment.

TPUT places particular emphasis on nurturing human resources who can contribute to industry and who can be immediately effective in the workplace, and it devises educational content that is directly related to the work that graduates will do after graduation. After graduation, students are sought after by industry, and the employment rate of graduates is estimated to be almost 100%.

It is also permissible for faculty members to establish their own companies (like intra-university ventures) and contract them to conduct experiments, etc., using the university's experimental equipment. For external companies, it is simpler to contract with a venture company than with the university, and faculty members can diversify their sources of income. The University considers the exchange of human resources with practitioners (engineers involved in practical work) and bureaucrats (Ministry of Construction) to be important, and invites them as lecturers. In terms of relations with Japan, it has sought the guidance of Professor Yasushi Niitsu of Tokyo Denki University (Netplus) and Chikahiro Minowa (who continues to visit the school on a regular basis).

The Department of Architecture also conducts projects such as structural stability evaluation based on 3D measurements of historical buildings. A shaking table, albeit on a small scale, has been installed in the experimental building with the support of Japan. The advantage of this system is that it can be operated with a small actuator, eliminating the need for a large, expensive actuator. A large reaction wall has also been installed, and if a large-capacity actuator is installed, the facility will be capable of conducting large-scale experiments.

Shaking table | Reaction wall | Experiment on reinforcement of brick walls with Basalt

Source: JICA Survey Team Photos

Figure 2-12 Experimental facilities at Turin Polytechnic University in Tashkent

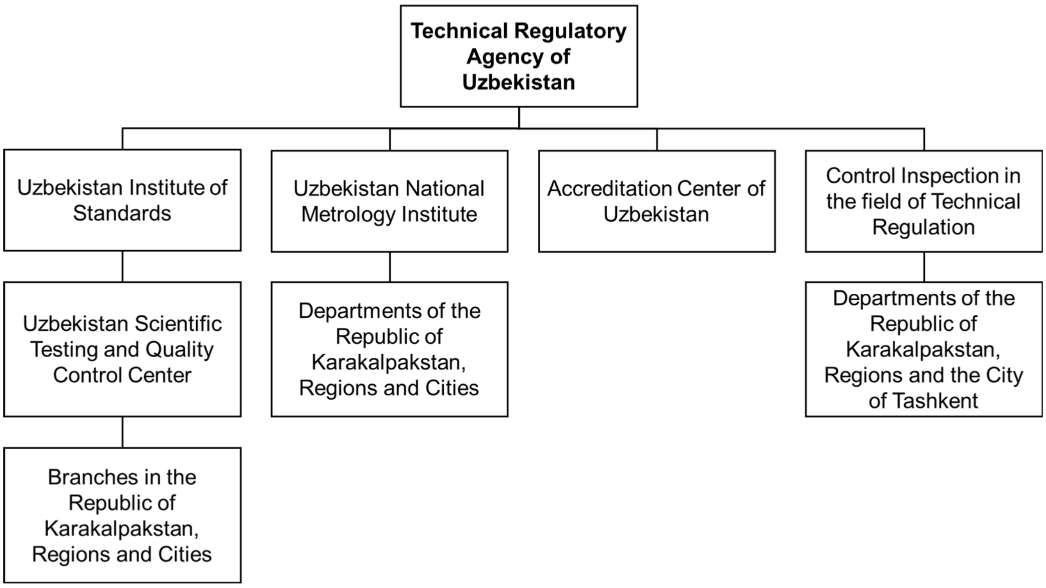
In terms of the comparison with TAQU in the field of civil and structural engineering, TAQU covers a broader range of disciplines and is stronger in design, planning and management, while TPUT is stronger in research and more engineering-oriented disciplines.

<u>ToshuyjoyLITI</u>

ToshuyjoyLITI is a corporate organization, with 60% of its shares owned by the state. There are six design organizations under the Ministry of Construction, of which ToshuyjoyLITI is one. ToshuyjoyLITI has 150 employees. In addition to the work for the government, ToshuyjoyLITI also works for the private sector. The company provides comprehensive design services, including not only seismic and structural design, but also electrical and water supply design. The company also conducts studies on the conformity of designs done according to the codes of China and Turkey.

<u>Uzbek Institute of Standards</u>

The Uzbek Institute of Standards is a government agency under the jurisdiction of the Cabinet Office that conducts annual checks to ensure that factories for building materials and others can manufacture products that meet the standards. Only those factories that have been checked and determined to be capable of manufacturing products that meet the standards are allowed to manufacture those products. There is no rating system for checking factories, but only whether or not the products are in compliance with the standards.



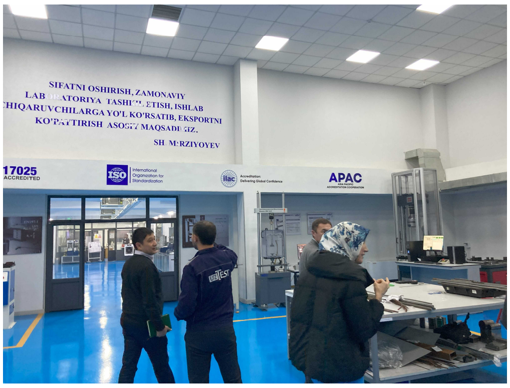
Source: Uzbek Institute of Standards

Figure 2-13 Composition of standards-related bodies in Uzbekistan

Uzbekistan began adopting international standards (ISO standards) and standards from other countries (British Standards, American Standards, etc.) around 1997, and has adopted 1,700 ISO standards in 2024 (of which about 180 are for building materials). The Uzbek Institute of Standards website (https://uzsti.uz/) provides a searchable database of standards sorted by serial number and category.

The main tests performed on building materials in the adjacent UzTest lab include

- Tensile Testing of Reinforcing Steel Bars
- Rebar fatigue test
- Compressive strength testing of cement and concrete
- Concrete slump test
- Strength testing of bricks and concrete in cold weather (The process of storing bricks in a machine that can keep them at -20°C, and soaking them in boiling water is repeated 50 times.)



Interior view of the UzTest lab

Compressive Strength Tester for Concrete and Cement

Source: JICA Survey Team Photos

Figure 2-14 Inside the UzTest Lab

In terms of relations with Japan, UzTest officials visited Aichi and Osaka prefectures in 2022 under the AOTS program (Association for Overseas Technical Cooperation and Sustainable Partnership).

Agency for Management of State Assets

The Agency for Management of State Assets is responsible for the management of state-owned assets (not the maintenance of buildings). Maintenance of buildings and facilities is handled by the other ministries and agencies, and funds are available from the Ministry of Economy and Finance's Investment Program if there is a need for maintenance. State-owned assets managed by the Agency include public buildings and facilities, real estate, stocks, and public transportation (e.g., buses). The work of the Agency includes management of land sales (e.g., auctions) and leases, as well as operations related to corporate governance of the shares owned. In total, there are about 27,000 buildings and facilities under control, of which about 20,000 are universities, schools, nursery schools, and hospitals.

Assets are managed through an electronic system that has been in operation since late 2020, and state owned buildings and assets are entered once every three months. The input is done by each ministry and agency by distributing an electronic key to each ministry. Only information on ownership status is registered (including the area of land and buildings). In the future, from the perspective of improving the value of buildings, the Agency may consider inputting more detailed information, such as the history of renovations, as well as linking the data with the electronic passport.

When a building is leased, 60% of the rent from the renter goes to the national treasury and 40% to the concerned ministry. Alterations to the building by the renter must be approved by the Ministry of Construction (the design institute of the Ministry of Construction conducts survey). Penalties (fines and penalties) are provided for unsolicited alterations, but unsolicited alterations are rare. If the renter makes minor alterations (with approval), the costs incurred are refunded in the form of a deduction from the 40% paid to the ministry.

The Agency recognizes that energy conservation and earthquake resistance are primarily to be considered or concerned by the renters (or users) of buildings and facilities. State-owned buildings and facilities are properly maintained before being leased. They mentioned that, since buildings in Tashkent were designed with MSK seismic intensity 9 after the 1966 earthquake, and earlier buildings also withstood the earthquake, they do not have much concern about earthquake resistance of public buildings in Tashkent.

(4) Infrastructure-related organizations

Since infrastructure facilities also include buildings, this study also interviewed the following infrastructure-related institutions that were available for interviews during the 2nd survey period in Tashkent.

Ministry of Digital Technologies

The Ministry of Digital Technology is the regulatory authority for telecommunications administration in accordance with the Telecommunications Law (Republic Law No. 1015 of 2024), and each operator is responsible for the operation and management of its telecommunications facilities. A state-owned company under its jurisdiction, Telecom Network Management, is in charge of connecting network operators, and in case of emergency, the Telecom Network Management Center coordinates necessary communications. For example, in the past, when there were many outgoing calls due to a power outage, the data communication was restricted and calls were prioritized to avoid congestion.

There are currently no regulations requiring operators to continue services in the event of a disaster, to develop a business continuity plan, or to set recovery goals. Each operator has a two-year business plan to improve and modernize its facilities and other equipment. The Ministry of Digital Technology regulates telecommunications, and it is the role of the Ministry of Construction to provide guidance on the earthquake resistance of building facilities. However, standards (norms) for telecommunications-related facilities are established with the agreement of the Ministry of Digital Technologies. It was mentioned that the introduction of Cell Broadcast in times of disaster is being considered, and that Japan is expected to provide technical assistance.

Ministry of Transport

The Ministry of Transportation is responsible for road, vehicle and bus traffic, airport, rail, and river traffic. In accordance with Presidential Decree No. 161 of 2024, monitoring of seismic safety has been initiated. Technical matters, including seismic safety, have been outsourced to the State University of Transportation (see below). The Ministry of Transportation is the regulatory authority, while the operation and management of transportation facilities is mainly handled by the respective operators (e.g., the Railway Authority for station buildings).

Railroads total 700 km with 500 bridges. Roads total 42,700 km and are divided into major roads (international, national, and regional roads) and urban roads (district and private roads), which are managed by the Ministry of Transportation. According to the Ministry, airport facilities are designed and constructed in accordance with international standards, and most of the airports were built in the 1960s and 1970s, and are designed to withstand the MSK seismic intensity 9. The Ministry has been working on maintenance and modernization of the transport facilities, but there has been little awareness of the need to strengthen them against earthquakes.

State University of Transport

The Sate University of Transport was established under Presidential Decree No. 4703 of 2020 (its predecessor was the University of Railways) and is ranked in the 700th range in the QS Asian University Rankings; it offers 42 courses in 8 faculties, with 2,500 students and 700 faculty members conferring degrees in 9 fields.

With regard to the field of seismic safety, the studies cover the seismic resistance of infrastructure facilities and buildings, e.g. evaluating the behavior of railroad bridges during earthquakes and their impact on running. With regard to buildings, research is conducted on the seismic performance of old mud-walled houses (in collaboration with the University of California, Berkeley) and on seismic isolation mechanisms.

The University receives funding for its activities from the Seismic Safety Fund under the Presidential Decree.

The University have also undertaken condition surveys of buildings at the request of Tashkent City and other cities. It has conducted about 30 condition assessments of railroad car repair shops and other facilities. It also owns inspection equipment such as a rebar probe and a Schmidt hammer that are used for condition assessment.

An international conference on transportation, construction, and seismic is planned for October 2025.

Uzsuvtaminot

Uzsuvtaminot is a state-owned company under the jurisdiction of the Ministry of Construction, with more than 22,000 staff nationwide, including 12 Regions and 96 Districts, and is responsible for the operation and management of water and sewage systems nationwide. The total length of water supply system is 92,000 km, and there are more than 10,000 related facilities. Currently, water and sewage systems cover approximately 80% of the country. The amount of water needed is 55km^3, 90% of which is for agriculture, 4% for drinking water, and the rest for industrial use and aquaculture. The proportion of potable water is low and is prioritized by law, which means that there is no shortage of potable water.

Facilities are being upgraded with the support of more than 20 donor agencies. 5 to 10% of the facilities are believed to be from the 1930s to 1960s and are being updated as needed. Older water piping and other facilities are being replaced with more earthquake-resistant piping materials at the opportunity of renewal. There is an earthquake-resistant design norm for water supply and sewage facilities, and building facilities are constructed in accordance with the seismic design norm. As a consequence, sufficient earthquake resistance will be ensured at the time of reconstruction of the buildings. The design of facilities is reviewed by the Ministry of Construction.

In the 1966 Tashkent earthquake, water was cut off in some areas, but was restored in 2 to 3 days. In other earthquakes, restoration was generally achieved within a few days. There is no set recovery target for earthquakes, but there is a target recovery time in case of daily problems.

2.2.4 Budget status of earthquake disaster management and seismic retrofit promotion

Judging from the interview with the Ministry of Economy and Finance, there is no dedicated budget heading for disaster management. Uzbekistan's total budgets for 2024 and 2025 are 317,708 billion and 344,780 billion UZS, respectively. The budgets allocated for earthquake disaster prevention and promotion of earthquake resistant buildings include the following.

- Reserve Fund of the Cabinet Office for emergencies (no maximum amount set)
- Budget for pre-disaster preparedness from the Ministry of Emergency Situations
- Fund for Seismic Safety in accordance with Presidential Decree No. 4794 of 2020.
- Innovation Fund
- Budget for research areas such as higher science and higher education (approx. 11 trillion UZS)

- Budgets of ministries and agencies, for example, the budget used for natural disaster risk reduction from the Road Development Fund (370 billion UZS)

The following section details the Fund for Seismic Safety in accordance with Presidential Decree No. 4794 of 2020 and the Innovation Fund. In addition, the budget application and approval process/timeline, as well as the concept and status of foreign loans related to disaster management, are presented.

Fund for Seismic Safety in accordance with Presidential Decree No. 4794 of 2020.

Presidential Decree No. 4794 of 2020 created a fund to support activities for seismology, structural stability and seismic safety. The management of the Fund is detailed by the Resolution of the Cabinet of Ministers No. 681 of 2020. The Fund is administered by the Council established under the Cabinet Office. The main uses envisaged for the Fund are as follows:

- Grants to support research activities in the fields of seismology, structural earthquake resistance, and seismic safety
- Implement human resource development and capacity building programs; organize and participate in conferences, seminars, and other events, including overseas
- Equipment, calculators, building materials, and installation thereof necessary for scientific laboratories
- Introduction of digital technology in the field of ensuring seismic safety of the population and the territory of the Republic, and development of a national program on anti-seismic structures
- Strengthening the physical and technical basis of seismology, national institutions and organizations responsible for ensuring the seismic stability and seismic safety of structures
- Create electronic passports of existing buildings and structures in seismically active areas
- Support for scientists (including young scientists) who have achieved high scientific results and made significant contributions to the development of science
- Incentive for employees of organizations that conduct scientific research and observations in the field of seismology to ensure the earthquake resistance of structures

In 2020, the first year of its implementation, 20 billion UZS was contributed from the existing Innovation Fund (see below), in accordance with the provisions of the Presidential Decree; 45 billion UZS in 2024, and 35 billion UZS in 2025 were approved for the budget.

The breakdown of the budget is discussed by the Council of the Cabinet Office, and the uses are (1) training (e.g., travel to Turkey by the Ministry of Construction, Academy of Sciences, etc.), (2) research and inspection (e.g., Academy of Sciences), and (3) equipment (for electronic passport production), not for building renovation (renovation is from the building maintenance budget of each agency). There is no annual cap set for the fund, and additional budgetary measures are taken in the event of an emergency, for example.

Innovation Fund

A national program that can be used in the field of research is the Innovation Fund, which is also used for research on seismic resistance of buildings. Applications are submitted to the Cabinet Office by the Ministry of Higher Education. The budget for 2024 is 715 billion UZS, and the same level of funding is expected for the following year.

Budget Application and Approval Process

The budget application and approval process is as follows

1. Budget request from each ministry to the Ministry of Economy and Finance (August 1, August 15, August 20, etc., depending on the institution)
2. Budget proposal submitted to the Cabinet Office by the Ministry of Economy and Finance (September 15)
3. Scrutinized by the Cabinet Office's Computation Department and submitted to the Office of the President (September 20)
4. Reviewed by the Office of the President and returned to the Cabinet Office (Oct. 5).
5. Submitted by the Cabinet Office to the National Assembly (both upper and lower houses) (October 15)
6. Assembly deliberation period 1 month (November 15)
7. Budget agreement (November 20)
8. Budget Approval (December 5)

Budget requests are made for two-year budgets. In addition, an indicator is established for the budget (e.g., the number of people treated if the budget is for medical care), which is used for ex-post evaluation.

International Cooperation Related to Disaster Management

The interview with the Ministry of Economy and Finance yielded the following observations regarding external loans.

- Currently, the amount of loans accepted per year is fixed, making the origination of loan deals more difficult.
- The Foreign Loan Acceptance Division of the Ministry of Finance and the Ministry of Investment, Industry and Trade conduct the examination. There is a guide/manual on the screening process. The terms and structure of the loan, such as interest rate and method of receipt (percentage of money, equipment, people, etc.) are important factors in the screening process.
- Climate change action, which is also considered part of disaster management, is one of the key issues and an area that has received support, and is a high priority. For example, in the case of the Aral Sea issue, a tree-planting project is underway on Aral Sea lands in accordance with

Presidential Decree No. 5202. There is even an opinion to change the name of the Ministry of Environment to include the term Natural Disaster in the name.

The Ministry of Investment, Industry, and Trade accepts and reviews applications for foreign assistance projects and prepares the documents. According to the Ministry, the application process is based on Presidential Decree No. 3857 and is generally as follows:

1. The C/P agency (committee of the C/P agency) and the donor agency conduct a conception, decide on the outline of the project, and submit the application to the Ministry of Investment, Industry and Trade.
2. The Ministry of Investment, Industry and Trade and the Ministry of Economy and Finance will review and, if approved, submit the request to the donor agency.
3. The donor agency will send an expert to determine the detailed terms of the project.
4. The Ministry of Investment, Industry and Trade conducts feasibility study (not required for grants or technical cooperation).
5. The project documents are prepared and approved by the Ministry of Investment, Industry and Trade and the Ministry of Economy and Finance.
6. Final approval by the Office of the President.

The minimum time required from application to approval is three months. The following items were considered as priorities for the projects.

- Priority will be given to projects that lead to the resolution of important social issues (i.e. according to the level of importance).
- All areas have their challenges, especially education, energy, and infrastructure. Expert opinions will be important.
- Thinking along the lines of what issues will emerge in the next 5, 10, or 30 years. Seeking expert opinions, including solutions to problems.
- Development of a three-year investment program became law in 2018 (though the plan had been prepared before then). The plan is a reference to a prospective direction.

2.3 Status and initiatives of earthquake resistance of buildings

2.3.1 Transition of seismic codes (including a summary of the current building standards in Uzbekistan and a comparison with the standards of the former Soviet Union era)

(1) Current seismic code (2019)

The latest seismic code (called “norm”) for Uzbekistan is the "СЕЙСМИК ҲУДУДДЛАРДА ҚУРИЛИШ (ҚМҚ 2.01.03-19)" effective in 2019, and it establishes requirements for the preparation of design documents necessary for construction, reconstruction, strengthening, and repair in areas with design seismic intensities of 7, 8, 9, and above. Locations with a design seismic intensity higher than 9 are divided

into two types as follows:
>9: Regional seismic intensity is 9 and the ground type is III (Table 2-5)
9*: Areas where earthquakes of magnitude 7.1 or greater occur

This code is for the design of buildings and structures in general and does not apply to the design of transportation and hydrotechnical facilities, nor to the design of nuclear power plants. They also do not apply to the following buildings and facilities

- Facilities located in areas where there is potential for structural changes in the earth's surface
- Where the scale and structural characteristics do not conform to this code
- If the number of floors or height exceeds the specified value
- New structural systems, techniques, materials, and special seismic systems may be required

The table of contents of the code is as follows: Chapter 2 presents the method for calculating seismic forces in seismic design, and the same policy is applied to seismic forces regardless of the building or structure in question; Chapter 3 specifies seismic design requirements for buildings according to structural type; Chapter 4 specifies seismic requirements for lifeline and infrastructure structures; and Chapter 5 provides a list of the seismic design requirements for buildings and structures. Chapter 4 specifies seismic requirements for lifeline and infrastructure structures. Section 4.11, however, specifies seismic requirements for structures against strong ground motions, regardless of whether they are buildings or lifelines and infrastructure structures. Chapter 5, Reconstruction and Strengthening of Buildings, refers to seismic strengthening as a proactive measure as well as repair, but it is not intended to be used as a specific seismic strengthening standard.

Table 2-4 Table of Contents of Seismic Code in Uzbekistan

Chapter	Section	Description
1		Principle
2		Calculation of seismic force
3		Residential, public, and industrial buildings and structures
	3.1	General rules
	3.2	Buildings with frame structure
	3.3	Large panel building
	3.4	Frameless integrated structure building
	3.5	Stone and brick building
	3.6	Large block building
	3.7	Low-rise buildings constructed with low-strength materials
	3.8	Reinforced concrete building
	3.9	Non-load-bearing structure and architectural elements of the building
	3.10	Steel-framed building
4		Underground facilities and engineering network
	4.1	General rules
	4.2	Water supply system
	4.3	Sewerage System
	4.4	Water pipes and sewer systems inside buildings

	4.5	Heat supply system
	4.6	Gas supply system
	4.7	Trunk conduit
	4.8	Plastic conduit
	4.9	Construction Structures
	4.10	Underground facilities and wells
	4.11	Additional requirements imposed on buildings and infrastructure in areas with a seismic intensity of 9 or higher
5		Rebuilding and strengthening buildings
6		Quality inspection of manufacturing characteristics and construction operations
Appendix 1.		List of regions of the Republic of Uzbekistan located in the seismic zone, showing the relationship between seismic intensity and recurrence period
Appendix 2		Seismic Zoning Map of the Republic of Uzbekistan
Appendix 3.		Terms and Definitions

(2) Calculation method of design seismic intensity

The design seismic intensity is set from Table 2-5 based on the regional seismic intensity given in Figure 2-15 “Seismic Hazard Distribution of the Republic of Uzbekistan” and the ground type at the construction site. The design seismic intensity for the sites of ground type II is equal to the regional seismic intensity, while the design seismic intensity for the sites of ground type I is one rank lower than the regional seismic intensity. The design seismic intensity for the sites of ground type III is increased by one rank if the regional seismic intensity is 7 or 8, but if the regional seismic intensity is 9, the design seismic intensity is >9 instead of 10, as mentioned above.

Source: СЕЙСМИК ҲУДУДДЛАРДА ҚУРИЛИШ (ҚМҚ 2.01.03-19)

Figure 2-15 Seismic hazard distribution in the Republic of Uzbekistan

Table 2-5 Ground types and design seismic intensity

Ground Type	Geotechnical Overview	Design seismic intensity by regional seismic intensity		
		7	8	9
I	1. Includes any type of solid bedrock that is saturated with water and has a strength limit in uniaxial compression greater than Rc > 1 MPa or a seismic wave propagation velocity greater than Vp > 3,000 m/s and Vs > 1,700 m/s. 2. Large crushed stone ground (including large stones (conglomerates) with rounded or sharp corners and megaglomerates) with seismic wave propagation velocities greater than Vp > 2,500 m/s and Vs > 900 m/s.)	6	7	8
II	1. Includes all types of solid bedrock that are saturated with water and have strength limits in uniaxial compression of Rc ≤ 1 MPa or less, or (collapsed or very collapsed) with seismic wave propagation velocities exceeding Vp > 1,300 m/s and Vs > 600 m/s. 2. Large crushed ground (including polished gravel, fine gravel, crushed stone, and fine gravel with sharp corners (colluvial)) with seismic wave propagation velocities greater than Vp > 300 m/s and Vs > 500 m/s. 3. Sandy soil: – Sand containing coarse- and medium-grained gravel with seismic wave propagation velocities greater than Vp > 500 m/s and Vs > 350 m/s, low water content, and porosity coefficient e < 0.7. – Fine-grained and silty sands with seismic wave velocities greater than Vp > 400 m/s and Vs > 300 m/s, low water content, and porosity coefficient e < 0.6. 4. Clayey ground: – Clay soils for cases of permeability (JL < 0.5) or seismic wave velocity (Vp > 900 m/s, Vs > 500 m/s). – Dry sandy or sandy soils with permeability (JL < 0.5) and porosity e < 0.8 or seismic velocity (Vp > 500 m/s, Vs > 300 m/s). – Clayey soils (loess, sandy soils, sandy soils and clays) for permeability (JL ≤ 0.5) and porosity e < 0.8 or seismic velocity (Vp > 500 m/s, Vs > 300 m/s). 5. Reclaimed ground: – Large naturally consolidated crushed stone ground with seismic wave propagation velocities of Vp > 500 m/s and Vs > 300 m/s. – Consolidated sandy and silty cohesive soils with modulus of elasticity E0 > 12 MPa or seismic wave velocities greater than Vp > 500 m/s and Vs > 300 m/s.	7	8	9
III	1. Sandy soil: – Sandy soils containing gravel, coarse-grained and medium-grained sand when the moisture content is Sr ≤ 0.5 and the porosity coefficient is e ≥ 0.7 when dry. – Sandy soils containing wet (Sr > 0.5) and saturated (Sr > 0.8) gravel, coarse- and medium-grained sand with a seismic wave velocity Vs ≤ 350 m/s and a porosity coefficient e < 0.7. – Wet (Sr > 0.5) and saturated (Sr > 0.8) conditions with porosity coefficient e < 0.6 and fine-grained and silty sands with porosity coefficient e ≥ 0.6 in dry conditions (Sr ≤ 0.5) with seismic wave velocity Vs ≤ 300 m/s. 2. Clayey ground: – Clays with a flow index of JL > 0.5 or seismic wave velocity Vs ≤ 500 m/s. – Sandy and sandy soils with a flow index of JL > 0.5 and a porosity coefficient of e > 0.8 or e < 0.8, or sandy soils with a seismic wave velocity of Vs < 300 m/s. – Soils containing clayey soils (res, res-like sand, sandy soil, clay) with a flow index of JL > 0.5 and a porosity coefficient of e ≥ 0.8 or e < 0.8, or with a seismic wave propagation velocity of Vs ≤ 300 m/s.	8	9	>9

	3. Reclaimed ground: – Naturally consolidated sandy and silty clay soils that are water saturated and have a modulus of elasticity E0 ≤ 12 MPa or seismic wave velocity Vs ≤ 300 m/s.			

Note:

1. If clayey settleable soils are present in the soil layer, it is recommended that anti-settlement measures be taken.
2. A construction site is classified as an inadequate category if it contains more than 5 m of heterogeneous soil layers within a 10 m thick soil layer when calculated from the base of the foundation.
3. If the groundwater table rises during the operation of a building (structure) and the soil is expected to be submerged, the soil category is considered water-saturated soil.
4. In areas with a regional seismic intensity of 6 and a ground type of III based on seismic risk assessment, the design seismic intensity is considered to be 7.
5. Clayey and compressible (sandy and powdery sandy clay) soils are considered seismically ineligible if the groundwater table is greater than 5 m and there is no adequate information on the engineering and seismic properties of the soils. If construction is required in these areas, detailed engineering and geotechnical or engineering and geophysical survey should be conducted to determine the category regarding the seismic properties of the soils.
6. The values of the wave propagation velocities of the longitudinal Vp and transverse Vs waves serve as additional parameters for determining their categories based on the seismic characteristics of the soils of the construction site. These parameters are determined by theoretical or experimental methods based on the results of engineering and geological or engineering and geophysical investigations.
7. Changes to the design seismic intensity of the construction site as shown on the SMT (Seismic Microtopography) map will not be permitted.

(3) Calculation method for earthquake loads

This section outlines how to determine the design seismic loads based on the current seismic code. In principle, the calculation of seismic loads by modal analysis is used in building design, and the current seismic codes are based on this principle. In modal analysis, buildings are generally modeled with mass points as shown in Figure 2-16

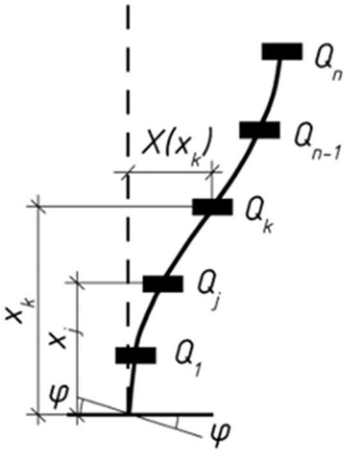


Figure 2-16 Building Modeling Concepts

If the order of the mode in the modal analysis is$i$, then the seismic loadS_{ik} acting on the building mass point$k$ is expressed as follows

$$S_{ik} = K_o K_n K_{эm} K_p S_{oik} \quad (1)$$

$$S_{oik} = \alpha Q_k W_i K_\delta \eta_{ik} \quad (2)$$

WHEREAS,

S_{oik}: Inertia force assuming the building is elastic

α: Acceleration factors determined from Table 2-6 based on the design seismic intensity of the construction site

Q_k: Weight of the mass k

W_i: Spectral coefficients determined from Table 2-7 based on regional index and soil type

K_δ: Energy dissipation coefficient, obtained by the following equation

$$K_\delta = e^{(0.548-\sqrt{\delta})(0.1+\frac{0.7}{\sqrt{T_1}})}$$

$\delta$is the vibration displacement, determined from Table 2-8 , and T_1 is the first natural period of the building

η_{ik}: Coefficients that depend on the natural vibration shape and load placement in the calculation model for the$i$ order mode of the building.

In general, the following equation is used (symbols are according to Figure 2-16)

$$\eta_{ik} = \frac{X_i(x_k)\sum_{j=1}^{n} Q_j X_i(x_j)}{\sum_{j=1}^{n} Q_j X_i^2(x_j)}$$

$X_i(x_j)$is the displacement of the mass point j in the ith mode

If the building has five or fewer floors, the first natural period is less than 0.4 s, and the mass and deformation angle are nearly uniform, the building can be evaluated simply by the following equation (symbols are from Figure 2-16)

$$\eta_{ik} = \frac{X_k\sum_{j=1}^{n} Q_j X_j}{\sum_{j=1}^{n} Q_j X_j^2}$$

K_o: The importance factor of the building, determined from Table 2-9

K_n: The coefficient on the interval between earthquakes, determined from Table 2-10.

$K_{эm}$: Factor for the number of floors in a building, determined from Table 2-11

K_p: A coefficient that reflects the irregularity of a building in plan or elevation, determined from Table 2-12 .

Table 2-6 Design seismic intensity vs. acceleration coefficient

Design seismic intensity at construction site	7	8	9	>9	9*
Acceleration factorα	0.25	0.5	1.0	1.4	2.0

Table 2-7 Spectral coefficients

Area	Tashkent（seismic intensity 9 area)		Tashkent (Seismic intensity 8 area), Tashkent City area		Fergana Basin		Bukhara, Samarkand and other areas	
Ground Type	I, II	III	I, II	III	I, II	III	I, II	III
First order natural period (sec)	Spectral coefficient W_i							
0.00	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
0.05	0.87	0.58	0.61	0.48	0.52	0.45	0.94	0.58
0.10	1.11	0.73	0.83	0.55	0.79	0.50	1.13	0.73
0.15	1.21	0.81	1.00	0.63	0.97	0.56	1.21	0.83

0.20	1.24	0.87	1.09	0.70	1.09	0.65	1.24	0.88
0.25	1.22	0.91	1.14	0.75	1.15	0.73	1.22	0.91
0.30	1.17	0.92	1.16	0.80	1.16	0.79	1.18	0.92
0.35	1.11	0.93	1.16	0.83	1.15	0.83	1.13	0.93
0.40	1.04	0.92	1.15	0.86	1.11	0.85	1.07	0.92
0.45	0.97	0.89	1.10	0.87	1.06	0.87	1.01	0.91
0.50	0.89	0.88	1.03	0.88	1.00	0.87	0.94	0.89
0.55	0.82	0.85	0.97	0.88	0.94	0.87	0.88	0.86
0.60	0.76	0.82	0.91	0.87	0.88	0.86	0.82	0.84
0.65	0.69	0.79	0.85	0.86	0.81	0.84	0.76	0.81
0.70	0.63	0.76	0.79	0.85	0.75	0.82	0.71	0.78
0.75	0.58	0.73	0.73	0.83	0.69	0.80	0.66	0.76
0.80	0.53	0.69	0.67	0.79	0.64	0.77	0.61	0.73
0.85	0.49	0.66	0.62	0.76	0.59	0.74	0.57	0.70
0.90	0.45	0.63	0.58	0.74	0.54	0.72	0.53	0.67
0.95	0.42	0.60	0.54	0.71	0.50	0.69	0.50	0.64
1.00	0.38	0.57	0.52	0.68	0.47	0.66	0.47	0.62
1.05	0.36	0.54	0.49	0.65	0.43	0.63	0.44	0.59
1.10	0.33	0.51	0.48	0.63	0.40	0.60	0.41	0.57
1.15	0.31	0.49	0.47	0.60	0.38	0.57	0.39	0.54
1.20	0.29	0.46	0.46	0.57	0.35	0.55	0.36	0.52
1.25	0.27	0.44	0.45	0.55	0.33	0.52	0.35	0.50
1.30	0.26	0.41	0.44	0.52	0.32	0.50	0.33	0.47
1.35	0.25	0.39	0.43	0.50	0.30	0.47	0.31	0.45
1.40	0.24	0.37	0.42	0.47	0.29	0.45	0.30	0.44
1.45	0.23	0.36	0.41	0.45	0.27	0.43	0.29	0.42
1.50	0.22	0.34	0.40	0.44	0.26	0.41	0.28	0.40
1.55	0.21	0.32	0.39	0.42	0.26	0.39	0.27	0.38
1.60	0.20	0.31	0.38	0.40	0.25	0.37	0.26	0.37
1.65	0.20	0.29	0.37	0.39	0.24	0.35	0.25	0.35
1.70	0.19	0.28	0.37	0.38	0.24	0.34	0.24	0.34
1.75	0.19	0.27	0.36	0.37	0.23	0.32	0.24	0.33
1.80	0.18	0.26	0.35	0.36	0.23	0.31	0.23	0.32
1.85	0.18	0.25	0.35	0.36	0.22	0.30	0.23	0.30
1.90	0.18	0.24	0.34	0.35	0.22	0.29	0.22	0.29
1.95	0.18	0.23	0.33	0.35	0.22	0.28	0.22	0.28
≧2.00	0.17	0.22	0.32	0.34	0.22	0.27	0.22	0.27

Table 2-8 Relationship between building features and vibration displacement

	Outline of Buildings and Facilities	Vibration displacement δ
1	Tall buildings that are not large in design area (towers, masts, chimneys, independent lift shafts, etc.)	0.15
2	Buildings with a frame structure in which walls and other fillers do not affect the deformation of the frame and the ratio of the height of the columns to their cross-sectional area in the direction of the calculated seismic forces has a value of 25 or more.	0.15
3	Buildings and facilities not included in paragraphs 1 and 2	0.3

Table 2-9 Coefficients for building importance

Explanation of Severity Classification	Building Use	Severity rating	Importance factor K_o
1. unique buildings and	Cultural facilities such as theaters, cinemas, concert halls, indoor stadiums, and other cultural, cultural and entertainment facilities with an audience of	I	2.0

facilities of exceptional social importance	3,000 or more Museums, institutions where national cultural treasures are kept, national archive buildings Buildings and installations exceeding 60 m in height, monuments of significant artistic and historical value, other buildings and installations as discussed with the Cabinet of Ministers of the Republic of Uzbekistan and the Ministry of Foreign Affairs		
2. Very important buildings and facilities operated for the civil defense of the population	Buildings and facilities associated with fire station buildings, energy and water supply systems, including fire suppression systems and reserve systems for facilities falling under Criticality Category II Buildings and facilities related to mobile communications (towers, masts, struts, and other antenna mast structures) and data transmission and reception, especially fiber optic communications systems, related to national communications systems Administrative buildings of the Ministry of the Interior and National Security Agencies, organizational buildings and special facilities for emergency response Hospital and clinic buildings with trauma and surgical departments; buildings serving as emergency medical bases Large and medium-sized rail station and airport buildings, system facilities to support their operations (e.g., operations management), hangars for aircraft Garage buildings for medical and other services to participate in eliminating the effects of earthquakes Other facilities in accordance with the consultation of the Ministry of Internal Affairs of the Republic of Uzbekistan	II	1.5
3. Significant buildings and facilities that could cause social impacts	Buildings where large numbers of people are expected to stay for long periods of time • Buildings of kindergartens, elementary schools, secondary schools, vocational schools, and institutions of higher education • Hospitals (not included in importance category II) and obstetrics and gynecology • Elderly Facilities • Buildings for the less mobile and unspecified purposes, as well as for their specific purposes • Theaters, cinemas, indoor stadiums, other cultural facilities, cultural event venues, and recreational facilities with a capacity of 300 to 3,000 spectators • Buildings between 30 m and 60 m in height (buildings falling under Materiality Category II are excluded) • Buildings and facilities with a capacity of more than 100 people and commercial use (markets, supermarkets, etc.) • Dormitories, barracks, criminal enforcement (correctional) services and other facilities	III	1.2
4. buildings and facilities that do not fall under items 1, 2, 3, and 5	All residential, public and industrial buildings not falling under Criticality Categories I, II, III and V	IV	1.0
5. Buildings that are important to community safety but of low secondary importance	A building or structure that is not a constant gathering place for people and whose collapse would not cause expensive equipment to fail or cause environmental contamination • Greenhouses (plastic or glass greenhouses), small warehouses for temporary storage, lightweight and open pavilions • Temporary, auxiliary, and mobile facilities	V	0.8

Note:
1. The value of the importance factorK_o may be increased at the request of the client.
2. For a building in the V importance category constructed in an area where the seismic intensity is 6 and the ground based on seismic characteristics belongs to category III,K_o is reduced by a factor of 2, which is 0.8/2＝ 0.4.
3. The list of facilities listed in paragraph 1 may be modified and supplemented by the state authorities of the Republic of Uzbekistan responsible for the safety of the population.
4. Buildings related to national defense or those storing extremely toxic or highly explosive materials are not included in this provision.

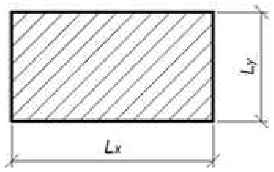
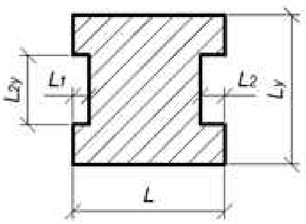
Table 2-10 Coefficients for earthquake intervals

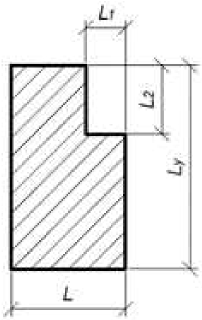
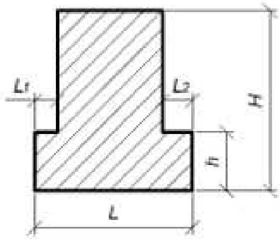
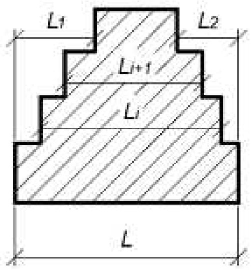
Interval between earthquakes (years)	Coefficient K_n	
	For seismic intensity 7 and 8	Seismic intensity 9 and above
≦250	1.20	1.25
300-600	1.0	1.15
650-1000	0.8	1.0
>1000	-	0.9

Table 2-11 Coefficients for the number of floors in a building

	Building Structure	Coefficient $K_{эm}$
1	Frame, large block, composite or integrally reinforced concrete buildings with seismic walls or cores with 5 or more stories	$K_{эm} = 1 + 0.1(n - 5)$ However, not exceeding 1.5
2	Large panel and large block buildings with up to 5 floors	0.75
3	Large panel and large block buildings with 5 or more floors	$K_{эm} = 0.9 + 0.075(n - 5)$ However, not exceeding 1.3
4	Buildings (facilities) not shown in Sections 1, 2, and 3	1.0

Table 2-12 Coefficients for building irregularity

	Shape	Parameter	Degree of irregularity		
			Coefficient K_p		
			Regulars	Almost regular	Irregular
1		$\frac{L_x}{L_y}$	1.0 (<5)	1.1 (5-8)	1.2 (8<)
2		$\frac{L_1}{L}$ $\frac{L_2}{L}$	1.0 (<0.15)	1.15 (0.15-0.25)	1.25 (0.25<)
		$\frac{L_{2y}}{L_y}$	1.0 (<0.5)	-	1.25 (0.5<)

3		$\frac{L_1}{L}$ $\frac{L_2}{L_2}$	1.0 (<0.15)	1.15 (0.15-0.25)	1.25 (0.25<)
4		$\frac{L_1 + L_2}{L}$	1.0 (<0.2)	1.1 (>0.2,)$h/H \leq$ 0.15	1.2 (>0.2,)$h/H >$ 0.15
5		$\frac{L_1 + L_2}{L}$	1.0 (<0.25)	1.1 (0.25-0.5)	1.2 (0.5<)
		$\frac{L_i - L_{i+1}}{L_i}$	1.0 (<0.1)	1.1 (0.1-0.3)	1.2 (0.3<)

Note:

1. Items 1, 2, and 3 in the table relate to the plan shape of the building, while items 4 and 5 relate to the elevation shape.
2. If the building dimensions change in one direction in height (items 4 and 5), the calculation parameters are increased by a factor of two.
3. If there are two parameters corresponding to one scheme, the one that gives the larger coefficient is adopted.

(4) Reflection of nonlinear response

The increase in bearing capacity due to nonlinear response effects such as increasing damping and etc., has been reflected as an apparent reduction in seismic load in the codes up to 1996. This is the same concept as the structural characteristic factor (Ds) in Japanese seismic design. In contrast, in the current code, it is reflected as a reduction in the obtained seismic stress rather than a reduction in the seismic load. If the response analysis is linear, the reduction of seismic forces and member forces have the same effect, but the former is a uniform reduction regardless of the subject, whereas the latter has the advantage that the reduction ratio can be adjusted to the member.

In the current code, this reduction factor is represented by the variable r and is given as follows

$$r = 1 - 1.07\mu \cdot T_1 \quad \text{, if} \quad r \geq 0.03 + 1.95T_1$$

$$r = 0.85\mu^{-0.67} \quad \text{, if} \quad r < 0.03 + 1.95T_1$$

Where μ is the allowable plasticity factor and T_1 is the first natural period. For structures where plastic deformation is not allowed, the reduction factor is assumed to be 1.

The allowable plasticity factor takes different values depending on the object, such as structure, member, etc. In the case of structures, eight different values are given as shown in the Table 2-13

Table 2-13 Relationship between structure and allowable plasticity

Number	Structure Overview	Allowable plasticity	Reduction factor (Note*)
1	Stacked stone building	2.5	0.46
2	Composite structure	5.0	0.29
3	Skeletal structure -Reinforced concrete -Steel frame	 10.0 15.0	 0.18 0.14
4	Large panel, large block, and integral wall structure buildings	10.0	0.18
5	Skeletal structure -Reinforced concrete -Steel frame	 7.5 10.0	 0.22 0.18
6	Integrated reinforced concrete system (with rigid core)	8.0	0.21
7	A building with one or more lower levels of a rigid-frame structure and the remaining upper levels consisting of load-bearing walls	3.0	0.41
8	Cantilever structure in the form of a tower	2.0	0.53

Note: T_1 Estimated assuming = 0.3

(5) Major changes in seismic codes

Uzbekistan's first seismic design codes or norms were established in 1984 under the former Soviet Union and were created in 1996 after the country gained independence. They were subsequently revised in 2004 and 2019. The current codes mentioned above are largely based on the technical codes used in the former Soviet Union, the "Building Codes and Regulations", and have been modified as appropriate for Uzbekistan's conditions.

The main area of improvement is in the way design shear (base shear) is given for the design seismic intensity category, specifically the maximum acceleration and spectral magnification. A summary of the changes is summarized in Table 2-14 . In the current code, the maximum acceleration can be obtained by the product of the acceleration factor and the spectral factor for a period of 0 s (unit: G).

Table 2-14 Transition of base shear coefficients for design

Seismic Codes	Ground classification	Maximum acceleration for design by regional seismic intensity (G)			Spectral amplification
		7	8	9	
ҚМҚ II-A.12-69 ҚМҚ II-A.12-69*	I	0.0125	0.025	0.05	$0.8 \leq 1/T \leq 3.0$
	II	0.025	0.05	0.1	
	III	0.05	0.1	0.2	
ҚМҚ II-7-81*	I	0.05	0.1	0.2	$0 \leq 1/T \leq 3.0$
	II	0.1	0.2	0.4	$0 \leq 1.1/T \leq 2.7$
	III	0.2	0.4	0.8	$0 \leq 1.2/T \leq 2.0$

ҚМҚ 2.01.03-96	I	0.0625	0.125	0.25	$0.75 \leq 1/T \leq 2.0$
	II	0.125	0.25	0.5	
	III	0.225	0.45	0.9	
ҚМҚ 2.01.03-19	I	0.05	0.1	0.2	Table 2-4
	II	0.1	0.2	0.4	
	III	0.2	0.4	0.56 / 0.8	

Note:
For criteria prior to ҚМҚ 2.01.03-96, we have reflected the descriptions in the literature (Shodiljon Umarov et al.)

In ҚМҚ II-A.12-69 and ҚМҚ II-A.12-69*, the maximum accelerations in areas with regional seismic intensity 7, 8, and 9 are 0.025, 0.05, and 0.1, respectively, for Class II ground, which is the standard ground. The maximum acceleration in Class I ground is halved because it is hard ground and the ground amplification is small, and the maximum acceleration in Class III ground is doubled because it is soft ground, and the ground amplification is large. These values are modified according to the number of building floors. If this coefficient is $K_{эm}$ following the current code, then $K_{эm}$ is given by n is the number of stories.

$$K_{эm} = 1.0 + 0.1 \times (n - 5) \qquad (1.0 \leq K_{эm} \leq 1.4) \qquad \text{multi-tiered building} \tag{3}$$

$$K_{эm} = 1.0 + 0.06 \times (n - 5) \qquad (1.0 \leq kK_{эm} \leq 1.3) \qquad \text{Large PC panel construction RC construction} \tag{4}$$

In ҚМҚ II-7-81*, the maximum acceleration is increased by a factor of 4 to 0.1, 0.2, and 0.4 for Class II ground in regions of design seismic intensity 7, 8, and 9, respectively. However, the spectral multipliers are reduced by 10% and 33% for Class II and Class III ground, respectively. In addition, coefficients for building height have been formally introduced as k_2 and are given below. n is the number of stories.

$$k_2 = 1.0 + 0.1 \times (n - 5) \qquad (1.0 \leq k_2 \leq 1.4) \qquad \text{Pure Ramen Construction Large block construction} \tag{5}$$

$$k_2 = 0.9 + 0.075 \times (n - 5) \qquad (1.0 \leq k_2 \leq 1.3) \qquad \text{Large PC panel construction RC construction} \tag{6}$$

In BRR 2.03.01-96, the maximum acceleration is increased by 25%, and the maximum accelerations in the regions of design seismic intensity 7, 8, and 9 are 0.125, 0.25, and 0.5 for Class II ground, which is standard ground, respectively. While the maximum acceleration for Type I ground is still half of the maximum acceleration for Type II ground, the value for Type III ground is now 1.8 times (80% increase) instead of 2.0 times as before. In addition, the aforementioned coefficient k_2 is independent of the structural type and is given as follows n is the number of floors.

$$k_2 = 1.0 + 0.06 \times (n - 5) \qquad (1.0 \leq k_2 \leq 2.0) \tag{7}$$

Interviews also revealed that the earthquake resistance codes have been improved according to the situation within Uzbekistan, as appropriate. For example, in the former Soviet Union, only up to 9 stories were permitted for evacuation and fire response, but in ҚМҚ 2.01.03-96, the height restriction was relaxed to 16 stories or 50 m. In addition, ҚМҚ 2.01.03-96, the height of the building was reduced to 16 stories or 50 m. In addition, in ҚМҚ 2.01.03-19, the height limit was significantly relaxed to 50 stories or 150 m.

(6) Comparison of seismic codes

In order to examine the appropriateness of the current seismic codes in Uzbekistan, a comparison with Japanese seismic design codes is made. Since the seismic design level itself is set from the perspective of the country's seismic hazard and economic strength, the comparison is not concerned with the size of the numerical value, but rather with what perspective is reflected in the design. In addition, although there are several limit states (service limit and ultimate limit) in Japanese seismic design, the ultimate limit is adopted here from the viewpoint of comparison with the seismic codes of Uzbekistan.

A comparison of seismic codes is shown in Table 2-15 . It can be seen that items that should be considered in seismic design are considered in both codes, and that Uzbekistan's seismic codes include items that are not considered in seismic codes in Japan. Specifically, they include important coefficients, coefficients related to seismic activity, coefficients related to the number of stories, and coefficients related to energy dissipation. In Japan, however, there is a movement to differentiate design earthquake ground motions based on building use, such as by setting importance coefficients independently for government buildings.

The most significant difference between the two is whether the seismic intensity map obtained from seismic hazard analysis is directly adopted or not. In Uzbekistan, the seismic intensity map is respected, and it is accepted that the design earthquake ground motions may differ significantly among regions, while in Japan's seismic codes, the results of seismic hazard analysis are converted into regional coefficients in the form of reduced seismic forces, and in doing so, add judgment to ensure that large differences do not appear among regions. Also, as mentioned above, with regard to the reduction of seismic force due to ductility, Uzbekistan used to treat the effect of building ductility as a reduction of seismic force as in Japan, but the current code treats it as a reduction of response, which is another major difference between the two.

Table 2-15 Comparison of seismic codes

Item	Uzbekistan	Japan	Remarks
Base earthquake ground motion strength	Give the peak ground acceleration from the regional seismic intensity map. (0.1G, 0.2G, 0.4G)	Base shear factor 1.0 multiplied by the regional coefficient Z	Compared to the regional coefficients in Japan, there are large regional differences in Uzbekistan.

Item	Uzbekistan	Japan	Remarks
Ground Type	Three types of ground types are considered. The design seismic intensity differs by one rank depending on the ground type.	Three ground types are considered. The ground type is reflected in the shape of the response spectrum, but has no effect on the peak height.	Compared to the ground classification in Japan, the effect of ground classification on design earthquake ground motions is significant in Uzbekistan.
Importance factor	Yes (5 levels, 0.8-2.0)	No	The Japanese Building Standard Law does not give importance coefficients, but for government and school buildings, importance coefficients (3 levels, 1.0-1.5) are given in the Government Office Building Guideline.
Modification of seismic force by seismic activity level	Yes	No	Japan is based on maximum values, and seismic history is not reflected in the code.
Modification of seismic forces by floor number	Yes (4 levels)	No	-
Seismic force reduction through toughness	Yes	Yes (Ds value)	The Uzbekistan code reduces response, not seismic forces.
Seismic force premium due to irregularity	Yes	Yes (Fes value)	-
Reduction of seismic force by energy dissipation	Yes	No	-

Note:

Restrictions on the application of the Uzbekistan codes are established for building height (number of stories), span, etc., and are specified according to structural type and design seismic intensity.

The applicable limit of the Japanese code is a height of 60 m or less, and for buildings exceeding this height, deformation verification by time history response analysis is required.

Source: Prepared by the JICA Survey Team

A comparison of seismic force formulas for Uzbekistan and Japanese codes is shown in Figure 2-17, where $Q_{k\text{-}UZ}$ indicates the seismic force based on the Uzbekistan code, and $Q_{k\text{-}JP}$ indicates the seismic force based on the Japanese one. The area circled in red corresponds to the evaluation of the base shear coefficient, which is common to both codes. The part circled in green corresponds to the evaluation of seismic layer shear force from the base shear coefficient, and the basic concept is the same, although mode superposition is used in Uzbekistan and Ai distribution is used in Japan. The part circled in blue is an increment of seismic force related to the irregularity of the building, which is common to both codes. The other parts are coefficients that are used only in one of the codes. Note, however, that the structural property coefficient used in the Japanese code D_s is separately considered as a reduction of response, as mentioned above.

$$Q_{k-UZ} = K_o \cdot K_n \cdot K_{эm} \cdot K_\delta \cdot K_p \cdot \alpha W_i \cdot \sum (Q_k \eta_{ik})$$

$$Q_{k-JP} = (D_s \cdot F_{es}) \cdot (Z \cdot C_0 R_t) \cdot A_k \sum W_k$$

Figure 2-17 Comparison of seismic force calculation formulas

2.3.2 Efforts to improve seismic codes

(1) Status of efforts

Currently, Uzbekistan is considering the creation of new seismic codes. In the past, they considered German codes, but decided that they were not appropriate for consideration since they are not an earthquake-prone country in the first place. Currently, they are considering the application of the Eurocode, U.S. codes, and Japanese codes by referring to them. However, since the Eurocode has been adopted in many CIS countries, the Eurocode is first being tested in parallel with the current codes from the perspective of consistency and technical coordination.

In addition, since Presidential Decree No. 161 indicates the adoption of seismic isolation structures for hospitals with five or more stories and for apartment buildings with nine or more stories, it is necessary to develop standards for seismic isolation structures in the future.

(2) Procedure for revising codes

The revision of seismic codes is discussed by the Ministry of Construction's Technical Committee (chaired by the Vice Minister of the Ministry of Construction), which includes experts from various fields. This committee is a permanent committee that meets two to three times a month to discuss not only earthquake resistance but also a wide range of technical fields related to construction. The revision of seismic codes is also addressed in these discussions. When discussions are completed and revisions are made, the Committee confirms them with the relevant ministries and agencies, with the final confirmation to be given to the Ministry of Justice.

(3) Revision of seismic hazard

Seismic hazard maps, which form the basis for seismic codes, are prepared by the Institute of Seismology at the request of the Ministry of Construction. The occurrence of an earthquake of M5.0 or greater triggers the request for hazard maps, but the resulting hazard maps (MSK seismic intensity floor maps) will not be revised unless differences appear in the hazard maps. The latest hazard map is from the 2022 earthquake (M5.6).

2.3.3 Status of efforts to promote earthquake resistance of new buildings

The following are items of focus in the area of earthquake resistance.

- Ground stability: for construction of underground structures such as subways, underground storage tanks, and underground pipes
- High-rise buildings: Safety is an issue; currently buildings with 30 or more floors are being designed overseas.
- Seismic isolation: part of what are expected from Japan, and aiming to achieve this with Uzbekistan's technology in the future.

In addition, related to the above, specific items for strengthening technical capabilities are listed below.

- Enhanced analytical methods: dynamic analysis, nonlinear analysis, etc.
- Formulation of earthquake ground motions for high-rise building design
- Foundation Design
- 3D Scanning: Evaluation of Historic Buildings
- Seismic evaluation of dams

As for seismic isolation design, standards are currently in the process of being developed.

In an effort to ensure the earthquake resistance of buildings, structural design checks are conducted in building permits. In addition, in accordance with the Resolution of the Cabinet of Ministers No. 370 of 2018, the entire building permit process is conducted online. The process from design to delivery of a new building, including building confirmation, is as shown in the Table 2-16 (the Resolution of the Cabinet Ministers No. 200 of 2020).

Table 2-16 Process from design to delivery of new buildings

	Responsible organization	Contents
1	Design company	Prepare urban planning documents, submit documents to the Ministry of Construction for application
2	Ministry of Construction, Housing and Communal Services	A committee chaired by the Mayor of Tashkent or the Minister of Construction, in charge of 13 specialized areas (facilities, emergency, cultural heritage, transportation, sanitation, construction, etc.) will review the documents. If the documents are incomplete, they are sent back to the design firm.
3	Private structural calculation company or Tashkent Branch of the Urban Planning Documents Inspection Department of the Ministry of Construction	Examination of structural calculations for buildings
4	Building Registration for Construction	
5	construction company	construction

6	Ministry of Construction, Housing and Communal Services	Registration of construction numbers, interim inspections, completion inspections
7	Building Registration for Electronic Passport	
8	Handover	

Source: Prepared by the JICA Survey Team

The main urban planning documents to be submitted to the Ministry of Construction (Construction Management Agency) are as follows, with drawings in PDF format.

Basic plan (1:500 scale) and results of soil investigation

- Facade
- Floor plan of each floor
- Cross Sectional View
- Roof Layout
- 3D Perspective

When a building is constructed in Tashkent, the Deputy Director of the Construction Management Department of Tashkent Municipality reviews the documents in a committee meeting. 400 building permits are issued annually for buildings over 7 stories in Tashkent, and even more if smaller buildings are included. The committee meets every Wednesday at 15:00 to review urban planning documents, and reviews approximately 50 to 60 drawings per meeting. If there are any deficiencies in the city planning documents, they are sent back to the design firm, and in many cases, the review is not completed in a single session.

2.3.4 Status of efforts to promote earthquake resistance of existing buildings

(1) Seismic assessment methods and results

The earthquake resistance of existing buildings is to be determined by experts using measuring instruments. For example, for concrete, strength and salinity are measured, and the degree of deterioration is evaluated to determine its adequacy. For reinforcing bars, the diameter and placement will be checked using scanning equipment, and samples will be taken for strength measurements. In addition, to confirm the overall safety of the building, the following two methods will be used to determine the vibration properties of the building.

- A method of vibrating a building by pulling it with steel rods to induce forced deformation and then releasing the deformation:
  All old buildings (former Soviet-era buildings) were subjected to seismic diagnosis.
- A method of vibrating a building by installing an exciter on the roof of the building:
  Applicable to new buildings, but not all of them are sampled

For buildings determined to have inadequate seismic resistance by the above diagnostic methods, a reinforcement design plan is to be developed. However, the methods described above are intended to determine the degree of deterioration from the time of new construction, and do not directly evaluate the current seismic capacity of the building. Therefore, it is impossible to quantitatively evaluate the apparent inadequacy of seismic capacity due to revision of the design seismic intensity or due to illegal reconstruction.

As a specific building diagnosis, Tashkent City has conducted visual inspections mainly on hospitals, schools, and kindergartens, and has taken the actions shown in the Table 2-17 . However, it is not clear whether the cause of reconstruction or repair shown in the same table is a lack of seismic resistance.

Table 2-17 Status of actions taken after building diagnosis (Tashkent)

Building Type		Sound	Need for repair	Repaired	Reconstruction (including unavailable)
Hospital	General hospital	10	2	0	0
	Specialty Hospitals	44	1	0	0
Education	School	295	30	0	0
	Kindergarten	458	32	0	0

Source: Prepared by the JICA Survey Team based on data provided by the City of Tashkent.

Although still in the process of implementation, a project to inventory all buildings began in August 2024 in accordance with the Resolution of the Cabinet of Ministers No. 405 of 2021, which was issued in response to Presidential Decree No. 4794 of 2020. Under this project, basic building information will be converted into data as an electronic passport, and buildings will be visually inspected using a 32-item checklist to classify buildings into the following four categories (1. no action required, 2. seismic reinforcement required, 3. reconstruction required, 4. demolition required).

(2) Seismic retrofit techniques and results

With regard to seismic retrofitting, although the concept of retrofitting using inexpensive methods such as adding seismic walls, winding columns, installing braces, and out-of-plane reinforcement of framed walls, as well as advanced technologies such as seismic isolation and vibration control, has become widespread, specific retrofitting standards and manuals have not yet been developed. A conceptual reinforcement manual is currently being prepared by ToshuyjoyLITI. The preparation of seismic retrofitting standards is indicated in the Presidential Decrees (No. 144 of 2022 and No. 158 of 2023).

At present, when a specific reinforcement design is implemented, a temporary standard is created for the purpose of said design, and this is considered to be one of the factors preventing the widespread use of seismic retrofitting. Also, because of this, there are no results of seismic retrofitting at this time.

2.3.5 Seismic performance of existing important buildings in Tashkent

Of the important structures in Tashkent, the Ministry building was constructed to withstand a design seismic intensity of 9. Therefore, as long as there is no significant deterioration, the buildings are considered to have sufficient seismic capacity, but the evidence for this is weak, and a new method to measure the realistic capacity of buildings is needed.

In Uzbekistan, the seismic performance to be ensured in seismic design is the minimum performance required to protect human life and property, but for government buildings, hospitals, and school buildings that serve as disaster centers, it is necessary to maintain the performance required in the event of a disaster from the perspective of business continuity. However, at present, it is not known whether the performance required for business continuity is maintained. The development of an evaluation method that measures the multiple performance requirements of buildings and the evaluation of performance based on this method are issues to be addressed.

In addition, along with public buildings and disaster base buildings, historical buildings are also considered as important buildings, not only because of their historical value, but also because they are an economic resource for Uzbekistan. These buildings have been damaged in the past, and their earthquake resistance is not considered sufficient, as most of the construction method is masonry. During the Soviet era, some of the buildings (e.g., the Madrasahs in Samarkand's Registan Square) were reinforced with concrete, but it is not certain that they have the earthquake resistance required today. Historic buildings have domes, which are different from those of ordinary buildings, and it is necessary to develop a method of evaluating their seismic performance that is specifically tailored to this structure.

2.3.6 Analysis of challenges related to earthquake resistance policies for important buildings

This section analyzes the challenges to earthquake resistance measures for buildings of public importance for disaster prevention. In addition, the direction of support for resolving the challenges will be discussed for the identified problems.

(1) Lack of human resources and capacity related to earthquake resistance

- **[Challenges]** Although recent presidential decrees have set ambitious actions and goals for earthquake resistance of buildings, there is an overwhelming lack of human resources, capacity, and capability to take charge of seismic safety issues, and the relevant ministries and agencies are struggling to respond.
  - Education and research in the field of earthquake and seismic engineering at institutions of higher education and research are weak. There is also a lack of laboratory facilities and experimental equipment, and a lack of up-to-date materials and equipment.
  - When ministries that own or manage public buildings build, repair, or renovate buildings, they only inform the Ministry of Construction of their basic requirements, and it is the Ministry of Construction (or local government) that determines the design and other details and orders the work (the budget is contributed from ministries, national programs, local government budgets, etc.). As a result, ministries have little knowledge about earthquake resistance of buildings, and there is no drive to promote earthquake resistance in public buildings from the ministries.
  - The Ministry of Construction relies on the Academy of Sciences and universities for technical

aspects such as earthquake resistant structures. However, even the Academy of Sciences and universities lack subject matter experts, technical knowledge, and capacity in earthquake and seismic engineering.

- The Cultural Heritage Agency recognizes that the seismic risk in Uzbekistan is low, and they have little interest in seismic safety. They are aware of the lack of knowledge and awareness due to the absence of specialists in the subject, and believe that human resource development and capacity building are necessary.

Directions for Assistance in Resolving Challenges:

- Country-specific and task-specific training in earthquake and seismic engineering
- Dispatch of experts
- Inter-university exchange between Japan and Uzbekistan (personnel exchange, joint research, SATREPS)
- Provision of experimental facilities and equipment

(2) Insufficient development of seismic codes

■ **[Challenges]** Seismic design codes (called norms in Uzbekistan) are not well developed. In addition, structural analysis methods are not well developed (technical manuals, guidelines, etc.).

- The current seismic design norm is not applicable to high-rise buildings above 16 stories, and Presidential Decree No. 161 of 2024 states that the design norm should be developed and approved by May 2025. Currently, studies are underway to introduce the Eurocode on a temporary basis and to establish by-laws for local application.

- Presidential Decree No. 161 of 2024 states that medical facilities of 5 or more stories and buildings of 9 or more stories shall be designed with seismic isolation or damping devices when newly constructed in areas with MSK seismic intensity 8 or higher. However, there is currently no design method for seismic isolation or vibration control structures. In addition, there is little experience in Uzbekistan in constructing buildings with seismic isolation or vibration control devices.

Directions for Assistance in Resolving Challenges:

- Strengthening the organization and capacity of competent ministries (Ministry of Construction, Academy of Sciences) (e.g., support for development of seismic design methods)

- Implementation of pilot projects (e.g., new buildings using Japanese technology for seismic isolation and vibration control)

(3) Lack of codes for seismic diagnosis and retrofit design

■ **[Challenges]** The development of norms and technical guidelines for seismic diagnosis and seismic retrofit design has lagged behind. Correct knowledge on seismic diagnosis and retrofit design has not been widely disseminated.

- There is no norm on seismic evaluation and retrofit design of existing buildings; according to Mr. Shamil of ToshuyjoyLITI, a draft of the seismic retrofit norm has been prepared and is in the process of being approved. In terms of its content, however, it only provide the seismic performance that is expected to be possessed and should be possessed for 24 detailed structural types used in Uzbekistan (Table 2-18) and outline policies and conceptual methods of seismic retrofitting for each type. It does not specify building survey methods or structural analysis and calculation methods necessary for seismic diagnosis and seismic retrofit design.

Table 2-18 24 Detailed Categories of Structural Types

	Building type/structure
1	Residential buildings constructed from local low-strength materials (without anti-seismic measures)
2	One-story clay walls of the guvalyak and pakhsa types
3	Three- to five-storey frameless brick buildings with wooden floors constructed until 1958
4	Prefabricated reinforced concrete frame made of linear elements with a welded joint in the zone of maximum effort, or the same with stiffening diaphragms in one direction (framework III of the IIS-04 series and their modifications)
5	One- to two-storey frameless brick walls with wooden floors
6	Crossbarless frames or buildings erected by raising floors (crossbarless frame with stiffening core)
7	Buildings with a flexible ground floor and rigid upper floors
8	Walls made of bricks, small concrete or natural stones ; ceilings - prefabricated reinforced concrete
9	Large-panel walls without anti-seismic measures
10	Buildings with external load-bearing brick walls; internal - reinforced concrete frame elements
11	Prefabricated frame of flat reinforced concrete cross or H-shaped elements with monolithic nodes
12	Monolithic reinforced concrete frame
13	Walls made of large blocks (concrete, vibro-brick, or reinforced vibro-brick panels)
14	Reinforced concrete frame with brick filling
15	One- to two-storey wooden frames filled with raw bricks (sinch)
16	Walls of complex construction (with reinforced concrete inclusions); ceilings - prefabricated reinforced concrete
17	Prefabricated reinforced concrete frame-braced frame with monolithic nodes, with stiffening diaphragms in two directions or stiffening cores
18	Frame made of spatial elements (volumetric cross) with monolithic knots
19	Large-panel buildings with brick exterior walls
20	Monolithic walls
21	Large panel walls
22	Volumetric blocks per room

23	One- to two-storey wooden houses (chopped or panel)
24	Metal frame or frame with diaphragms (bonds)

Source: ToshuyjoyLITI

- When talking about a detailed seismic evaluation, most people talk about "installing a shaker on the roof of a building and shaking the building" and refer to building inspection methods that were probably conducted in the former Soviet Union to investigate the condition of buildings (generally, in Japan and other developed countries, such surveys are not conducted for the purpose of seismic evaluation). A series of presidential decrees have mandated the creation of electronic passports for buildings. The creation of electronic passports is proceeding mainly in the City of Tashkent. In the course of this work, visual inspections of building conditions are being conducted to determine the need for repairs, but it appears that evaluation of seismic performance, i.e. detailed seismic diagnosis, has not yet been conducted. As mentioned above, a method for evaluating seismic performance has not been established in Uzbekistan.

Directions for Assistance in Resolving Challenges:

- Strengthening the organization and capacity of competent ministries, i.e. the Ministry of Construction and Academy of Sciences (e.g., support for development of seismic diagnosis and retrofit design methods)
- Implementation of pilot projects (seismic retrofitting of existing buildings using Japanese technology of seismic isolation and vibration control structures)
- Strengthening the organization and capacity of the Cultural Heritage Agency (develop methods for seismic diagnosis and retrofit design according to the characteristics of cultural heritage)
- Seismic diagnosis and retrofitting of historic buildings using Japanese technology as a showcase
- Provision of inspection equipment

(4) Building stock requiring seismic retrofitting

■ **[Challenges]** The stock of buildings with low earthquake resistance is expected to be large, and there may be insufficient funds to upgrade existing buildings.

- Seismic diagnostics have not yet been conducted, and the number of buildings that need to be made earthquake resistant (including reconstruction) and the required costs have not yet been determined. At present, with the issuance of a series of presidential decrees, it appears that the government is providing large budgetary allocations for development of standards or norms, research and development, and development of building inventories (i.e. electronic passports), but no seismic upgrading projects have yet been implemented, and there is a possibility that there will be a significant shortage of funds for seismic upgrading in the future.

Directions for Assistance in Resolving Challenges:

- Financing for seismic retrofitting (ministries that own and manage public buildings, local governments, national programs and funds)

2.4 Status of cooperation with international organizations (JICA and other donors)

2.4.1 Past earthquake disaster management assistance by JICA

One example of JICA's past earthquake disaster reduction support in the field of earthquake disaster reduction is the “Asian Region, Data Collection Survey for Disaster Risk Reduction Sector in Central Asia, Caucasus and Mongolia (2015-2016)”. The background of the survey was that human and economic losses due to natural disasters are one of the major challenges for development in the Central Asian region, Caucasus, and Mongolia, including Uzbekistan.

On the other hand, as for Japan's policy, the Japanese government presented its basic idea at the Third United Nations World Conference on Disaster Risk Reduction held in Sendai in March 2015, where Japan shared its knowledge and technology as an advanced disaster risk reduction country, while working with the international community to build a resilient society that will be able to withstand disasters. As a diplomatic trend between Japan and the Central Asian region in the field of disaster risk reduction, the “Central Asia + Japan” Dialogue was launched in 2004 as a framework for dialogue and cooperation among the Central Asian countries, with the aim of helping a free and open Central Asia to maintain and strengthen the international order based on the rule of law and to practice sustainable development.

Based on the above situation, a data collection survey was conducted to confirm and analyze the policies, administrations, and systems of each country in the three regions in the field of disaster prevention, and to consider a reporting system for cooperation among the countries in the three regions on common issues.

The issues raised in the survey regarding earthquake disaster countermeasures are as follows

- Early warning systems have not been established, and it is not clear where the next earthquake is likely to occur. The Institute of Seismology has a network with Tajikistan and Kazakhstan, and it takes 3 to 4 seconds for earthquake tremors to reach Tashkent after they are detected in those countries. There may be a need for assistance in establishing a system to transmit early warnings to relevant agencies in Uzbekistan by taking advantage of this time difference.

- The Institute of Seismology lacks gas chromatographs for monitoring changes in the chemical composition of water and gas during earthquakes, geomagnetic observation equipment, and geophysical and electrical survey equipment for subsurface structural exploration, and has a need for assistance in providing such equipment and instruction in operating techniques.

- It is necessary to establish a mechanism to determine the extent to which local residents are allowed to consider earthquake resistance for their independently built homes, to establish a method for evaluating earthquake resistance, and to introduce a method for reinforcing the earthquake resistance between the foundation and the upper structure.

In addition, as a part of assistance in the field of disaster risk reduction, “Project on Capacity Development for Landslide Monitoring in the Republic of Uzbekistan” was implemented from October 2007 to

September 2010, and the counterpart organizations are the State Landslide Monitoring Service for Hazardous Geological Process (SMS) and the Institute of Hydrology and Geological Engineering (HYDROENGEO).

The outputs of this project include

1. Ready to conduct monitoring
   In order to facilitate the smooth transfer of landslide monitoring and measurement technology, five monitoring sites were selected (Tikstersik, Uchitelek, Bedrengelet, Tangatpudi, and Chetu), where measurement equipment was installed, and boreholes were set. Then, based on the established monitoring plan, equipment such as borehole machines, borehole extensometers, and extensometers were provided.
2. Improved landslide subsurface survey and measurement techniques
   Borehole investigations were conducted at three of the monitoring sites: Tykstersik, Uchitelek, and Tangatopdi. In addition, borehole tiltmeters were installed and observed, and an electrical survey was conducted.
3. Improved landslide surface measurement techniques
   A surface extensometer was installed, and its fluctuations were observed. Technology was transferred in the form of appropriate instrumentation and data acquisition and analysis methods.
4. Improved landslide behavior analysis and hazard assessment techniques
   Displacement analysis of the in-borehole inclinometer and the extensometer were conducted to analyze the measurement results, calculate the risk of landslides and other geological slope disasters, and evaluate the risk of secondary damage such as debris flows.

2.4.2 Cooperation with other donors

With UNDP support, the Institute of Seismology conducted a seismic risk assessment of Tashkent in 1998, and a seismic evaluation project of urban social utilities was implemented in 2009 with a budget of 3 million USD. In addition, a Memorandum of Understanding was signed with KOICA in 2009 for a staff capacity building project.

The UNDP-supported project "Strengthening Disaster Risk Management Capacities in Uzbekistan (2011-2015)" included the development of earthquake microzonation map of Tashkent and its suburbs. The project also developed guidelines for building new earthquake-resistant houses ("How to Build an Earthquake-Resistant House?") and two types of earthquake-resistant construction guidelines for evaluating the earthquake resistance of existing houses and for low-cost seismic retrofitting ("Will Your House Sustain an Earthquake?"). However, these guidelines are intended for low-rise private homes made of sun-dried brick and wood framing, which are considered particularly vulnerable to earthquakes, and there are no guidelines for seismic retrofitting for general buildings yet.

With the support of UNDP and the European Commission Humanitarian Aid Department's Disaster Preparedness Programme (DIPECHO), an earthquake motion experience room was included to raise disaster awareness. The Earthquake Simulation Center of the Civil Defense Institute of the Ministry of Emergency Situations was established as a facility with the functions of an earthquake museum.

Collaboration with other donors in the field of earthquake disaster reduction is summarized in Table 2-19 .

Table 2-19 Cooperation with other donors in the field of earthquake disaster risk management

Name	Reducing Vulnerability of School Children to Earthquakes
Period	2004-2009
Donor agency Implementing agency	UNDESA/ UNCRD Uzbek Research Institute for Typical and Experimental Building (UzLITTI)
Summary	The project aims to ensure earthquake-resilient schools for children living in high seismic hazard areas and to build the capacity of local communities to cope with seismic hazards. The project included the renovation of several school buildings in a participatory manner with the involvement of the community, local government, and resource agencies; training on safe construction methods by engineers; and disaster education in schools and communities. Here, the Japanese experience was shared. These activities were implemented as demonstration cases in Fiji Islands, India, Indonesia, and Uzbekistan, and the results were disseminated throughout their respective regions through regional and international workshops. In Uzbekistan, three schools were evaluated for seismic resistance and two schools were reinforced as a pilot project.
Name	Strengthening Disaster Risk Management Capacities in Uzbekistan
Period	2011-2016
Donor agency Implementing agency	UNDP Ministry of Emergency Situations
Summary	This project worked with the Ministry of Emergency Situations to strengthen Uzbekistan's preparedness and response capacity to natural and man-made disasters. The main outcomes of the project are as follows Conduct earthquake exercises, conduct public awareness activities and training, prepare guidelines for improving earthquake resistance of new and existing housing, prepare earthquake maps of Tashkent and other cities, develop mobile apps to raise disaster awareness, conduct training to improve community disaster response capacity, conduct CPR training, Earthquake microzonation of the Tashkent city, creation of animated cartoons for children showing appropriate behavior during earthquakes, creation of educational videos on earthquake resistance of houses, provision of measuring equipment, creation of manuals on earthquake resistance measures for building accommodations, provision of video conferencing systems, creation of a department for mental care of victims and first responders, creation of a psychological support department, development of a website for the Ministry of Emergency Situations, development of an SOS button for cell phone emergency dispatch, training in earthquake-resistant construction at universities, establishment of an earthquake simulation center, disaster monitoring of mountain roads, and the organization of various other seminars and events.
Name	Strengthening Disaster Resilience in Uzbekistan
Period	2016-2020
Donor agency Implementing agency	Japan-World Bank Program Ministry of Emergency Situations
Summary	The objective of this project is to strengthen the capacity of the Government of Uzbekistan to identify, prioritize, and plan the implementation of investments and activities for earthquake risk reduction and emergency preparedness.
Name	Supporting Tashkent's Urban Resilience Strategy and the Development of an Investment Plan

Period	2019-2022
Donor agency Implementing agency	Japan-World Bank Program Tashkent City
Summary	This project supported the development and implementation of the “Tashkent 2025: Transformation Strategy for a Resilient Tashkent Development” being prepared by the Tashkent City Government. Specifically, the project aimed to provide Tashkent decision makers with a clear picture of city-level crisis events, risk factors, and medium- and long-term stresses, which will then be reflected in the city's long-term development strategy.
Name	Strengthening disaster resilience and accelerating implementation of the Sendai Framework for Disaster Risk Reduction in Central Asia 2019-2023
Period	2019-2023
Donor agency Implementing agency	UNDRR CESDRR
Summary	The project aimed to support implementation of the priorities of the Sendai Framework. The project supported the strengthening of regional coordination, including the development of a regional DRR strategy, a regional loss database, and the strengthening of CESDRR's role as the secretariat of the regional DRR platform as well as its role as a regional coordination hub. At the country level, support included the development and coordination of national DRR strategies, the development of a disaster loss database, and the establishment of a national DRR platform. At the local level, support was provided to assess the resilience of major cities to disasters.
Name	Scaling Up Efforts to Improve Safety and Resilience of School Infrastructure in Eastern Europe and Central Asia
Period	2020 - In progress
Donor agency Implementing agency	World Bank Ministry of Education, Ministry of Emergency Situations, Building, Construction and Public Services Agency (SAACCS)
Summary	This project will leverage the Bank's work on safe school practices in Central Asia to strengthen and facilitate the development of policy reforms and intervention plans to improve the safety and resilience of school infrastructure on a large scale. This engagement will seek opportunities to integrate existing information on school infrastructure, assist countries in developing long-term risk reduction and investment strategies, and facilitate knowledge sharing activities through workshops and learning exchanges. It will support all Central Asian economies, with particular emphasis on the Kyrgyz Republic and Uzbekistan. Major Results ・ Detailed inventory of typical building types and their vulnerability to earthquakes in Central Asia to facilitate disaster risk analysis ・ Regional Workshop on Safer Schools ・ Development of a “Learning by Doing” training program on key topics related to safer school infrastructure, including study tours, working sessions, and site visits ・ Thorough evaluation methodology for educational infrastructure networks based on accessibility and safety ・ Analysis of school infrastructure networks to optimize risk reduction interventions and increase resiliency

Source: Prepared by the JICA Survey Team based on publicly available information.

2.5 Summary of survey results

2.5.1 Bottleneck and phase comparison table

The bottleneck phase analysis, used in the “Project Study on Reassessment of Cooperation for Disaster Risk Reduction in the Earthquake Sector and Examination of Future Measures in Critical Areas” (November 2020 to March 2022), was conducted to identify bottleneck factors in the planning, preparation, and implementation phases of earthquake disaster countermeasures for new public buildings and existing public buildings. The analysis was conducted for buildings with below and above 16 stories as the boundary, considering the situation in Uzbekistan where the standards and norms for new buildings with more than 16 stories are not in place.

(1) Fault Tree Analysis

Assuming that “seismic performance of important public buildings is not ensured” is an undesirable event, the possible paths leading to the occurrence of the event are analyzed in a top-down diagram, from the top event to the bottom causes.

In conducting this analysis, a quantitative analysis to calculate the probability of occurrence was not performed in order to emphasize the purpose of brainstorming.

(a) Analysis of New Public Buildings (Figure 2-18)

As mentioned above, Uzbekistan does not have standards and norms for new buildings over 16 stories. When a foreign developer company develops a new building over 16 stories, the design is reviewed by comparing the design and earthquake resistance standards of the country with Uzbekistan's standards and norms. In the case of domestic developers, a Supreme Committee chaired by the Prime Minister has been established to conduct design reviews.

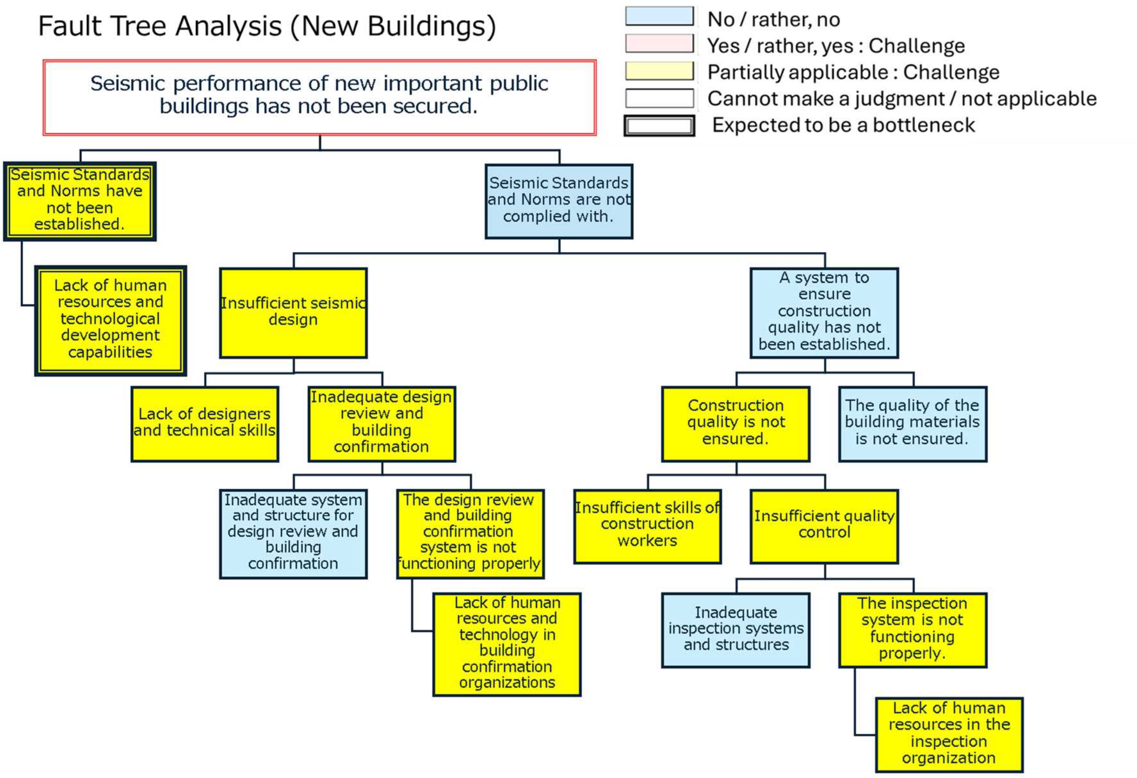
Based on the above, since it cannot be said that seismic standards are in place for all new buildings, the “Seismic standards are not in place” can be partially conformed to, but was considered an issue, and this was considered to be a bottleneck.

In terms of technological development, earthquake risk assessment and earthquake damage prediction are conducted by the Institute of Seismology of the Academy of Sciences and universities, but the Institutes and universities do not necessarily have sufficient equipment and human resources for technological development, and researchers and university professors are aware of this as a challenge. Therefore, “Insufficient human resources and technological development capacity” was regarded as a challenge, and this was also identified as a bottleneck.

(b) Results of Analysis of Existing Public Buildings (Figure 2-19)

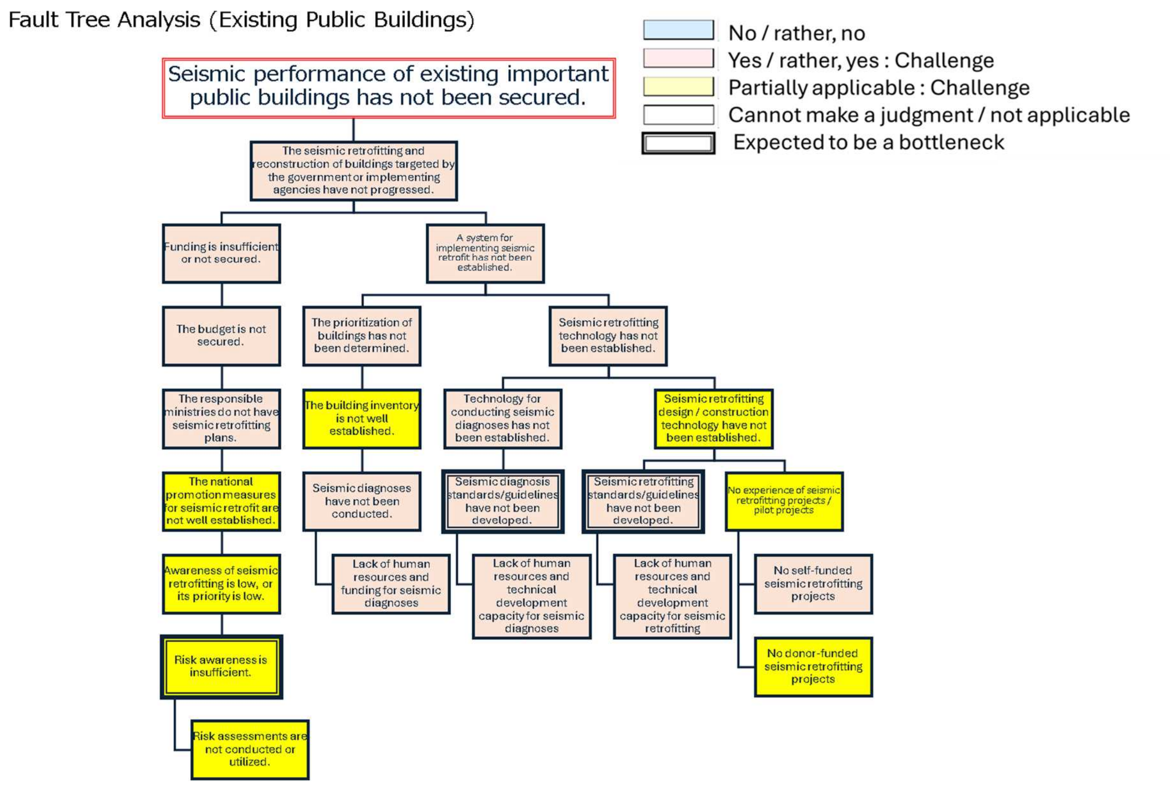
Through the survey, we found that in many central ministries and agencies, with the exception of the Institute of Seismology, universities, the Ministry of Construction, and the Ministry of Emergency Situations, there was a perception that earthquakes do not occur frequently or strongly in the country, and no awareness of the need for seismic diagnosis and retrofitting of existing public buildings as a challenge was obtained from the staff. The perception of sufficient seismic performance for buildings that remained undamaged by the 1966 Tashkent earthquake was also considered to indicate insufficient awareness of seismic risk, and “Insufficient awareness of risk” was considered as a challenge and was identified as a bottleneck.

As mentioned earlier, there is insufficient awareness of the need for seismic diagnosis and retrofitting, and there are no standards or norms for seismic diagnosis and retrofitting of existing buildings in Uzbekistan. However, ToshuyjoyLITI, a government-affiliated design firm, has prepared a draft norm for seismic retrofitting, which is awaiting approval, but it only outlines the expected seismic performance and reinforcement policies for each of the 24 detailed structural types, and does not specify the analysis and calculation methods required for seismic diagnosis and retrofit design. Although guidelines for seismic diagnosis and low-cost seismic reinforcement of low-rise private houses made of sun-dried bricks and wooden frames have been prepared by a UNDP-supported project, they cannot be applied to ordinary buildings. Therefore, “Seismic diagnosis criteria/guidelines are not in place” and “seismic retrofitting criteria/guidelines are not in place” were considered as challenges and bottlenecks.



Source: Prepared by the JICA Survey Team

Figure 2-18 Fault Tree Analysis (New Public Buildings)



Source: Prepared by the JICA Survey Team

Figure 2-19 Fault Tree Analysis (Existing Public Buildings)

(2) Bottleneck Phase Analysis

Based on the above fault tree analysis, a bottleneck phase analysis was conducted, including items not directly related to the events set at the top of the list, and analysis was also conducted for events that do not ensure the seismic performance of current critical public buildings. For reference, the results of the analysis for the 11 countries in the "Project Study on Reassessment of Cooperation for Disaster Risk Reduction in the Earthquake Sector and Examination of Future Measures in Critical Areas" are shown in Figure 2-22

(a) New public buildings (16 floors or less) (Figure 2-20)

As mentioned above, although the importance of earthquake resistance is not widely recognized, seismic standards and norms are specified and required to be applied to buildings with 16 or fewer floors.

(b) New public buildings (over 16 floors) (Figure 2-20)

Since there are no national-level seismic standards/norms in place for buildings with more than 16 stories, Phase 1: Planning "(5) Availability of national-level seismic standards" was identified as the bottleneck.

(c) Existing public buildings (Figure 2-21)

No laws and official documents have been developed or issued that would promote seismic retrofitting of existing buildings, and there is still no legal basis for promoting seismic retrofitting of existing nonconforming buildings. The New Uzbekistan Development Plan 2022-2026 has "Establish an effective emergency prevention and response system" as Goal 92, which sets out the direction to strengthen prevention and response to emergencies, including natural disasters, but there is no direct reference to earthquake retrofitting of existing buildings. From our interview in Tashkent, we learned that the city's disaster management plan exists, but it only describes the response to emergencies, not prevention. Therefore, Phase 1: Planning "(1) Laws concerning existing buildings such as the Law for the Promotion of Seismic Retrofitting are in place or official documents have been issued", "(2) Policies have been formulated (resolutions of the Cabinet of Ministers, etc.)", and "Disaster prevention plans based on higher-level plans have been formulated and are referred to buildings" were regarded as not in place or insufficient and were considered bottlenecks.

		Item	Uzbekistan (buildings with 16 floors or fewer)		Uzbekistan (buildings with more than 16 floors)	
Phase1 [Plan]	①	Positioning of important facilities, disaster prevention base facilities, etc.	●		●	
	②	Identification of the administrative authorities responsible for buildings (responsible ministries/agencies, chain of command)	●		●	
	③	Specific arrangements for funding mechanisms, subsidy rates, etc.	△		△	
	④	Existence of a third-party inspection system, such as audit inspections, for funds invested	−		−	
	⑤	Existence of national-level seismic standards	●		×	★
	⑥	Coordination system between central and local government	●			
	⑦	Sufficiency of building administrative technical officials or departments implementing project	●			
	⑧	Awareness of the importance of seismic retrofitting	×			
Phase2 [Preparation]	①	System for project implementation (procurement process, specification documents, securing top-level engineers)	−			
	②	Specification requirements at the time of procurement, including facility performance (design standards), importance level, etc.	−			
	③	Identification of the budget required for project implementation	●			
	④	Funding availability and procurement status	−			
	⑤	Development of design guidelines and manuals	−			
	⑥	Development of standard drawings and prototypes	●			
	⑦	Sufficiency and roles of architectural administrative technical officials	●			
	⑧	・Regulatory framework for architects and engineers (Architects Act, etc.) ・Contractor qualification frameworks, including construction and demolition business registration (Construction Business Act, etc.)	−			
Phase3 [Implementation]	①	Establishment of a quality control system (including permanent on-site supervisors)	●			
	②	Third-party review / inspection system	●			
	③	Design, construction, and supervision (technical / management skills)	△			
	④	Development of construction supervision guidelines and manuals (supervision principles, general standard specifications for construction, etc.)	△			
	⑤	Inspection and compliance verification with seismic standards	●			
	⑥	System for revising seismic design standards and manuals	−			
	⑦	Insufficient technical skills and understanding among engineers	△			

[Legend]●：Established　△：In progress / Insufficient　×：Not established　−：Not confirmed　★：Bottleneck

Source: Prepared by the JICA Survey Team

Figure 2-20 Bottleneck / Phase Analysis (New Public Buildings)

		Item	Uzbekistan	
Phase1 [Plan]	①	Legislation related to existing buildings, such as the Seismic Retrofitting Promotion Act, has been establishe	△	★
	②	Formulation of policies (e.g., Cabinet decisions)	△	★
	③	Disaster management plans aligned with national policies have been developed, addressing building safety	△	★
	④	Identification of the administrative authorities responsible for buildings (responsible ministries/agencies, chain of command)	●	
	⑤	Designation of critical facilities and emergency response facilities Development of methods for prioritizing seismic retrofitting and establishment of priority lists (e.g., inventory data creation)	△	
		Promotion of seismic strengthening for key government buildings, core hospitals, and schools.	△	
	⑥	Funding systems for seismic retrofitting Specific arrangements, such as the subsidy rate	×	
	⑦	Third-party auditing system exists for reviewing allocated funds, including financial inspections.	—	
	⑧	Existence of national-level seismic standards	×	
	⑨	Coordination system between central and local government	●	
	⑩	Sufficiency of building administrative technical officials or departments implementing projects	●	
	⑪	Awareness of the importance of seismic retrofitting	×	
Phase2 [Preparation]	①	Regional disaster management plans have been developed, covering building performance (e.g., building performance, etc.)	×	
	②	Formulation of seismic strengthening project plans for each responsible department	×	
	③	Establishment of seismic retrofitting priorities, with inventory databases maintained by responsible departm	×	
	④	Implementation framework for projects, including bidding processes, specifications, and securing highly skilled engineers	—	
	⑤	Identification of necessary funding for seismic strengthening projects	×	
	⑥	Funding availability and procurement status	×	
	⑦	Design methodologies for seismic diagnosis and retrofitting, along with their application and regulatory conformity	×	
	⑧	Design guidelines, manuals, and checklists	×	
	⑨	Development of standard retrofitting methods and prototype designs	△	
	⑩	Sufficiency and roles of architectural administrative technical officials	×	
Phase3 [Implementation]	①	Implementation of seismic retrofitting projects	×	
	②	Third-party evaluation system for seismic diagnosis and retrofitting	×	
	③	Application status of seismic strengthening technologies	×	
	④	Construction / on-site supervision progress	×	
	⑤	Development of construction supervision guidelines and manuals (supervision principles, general standard specifications for construction, etc.)	×	
	⑥	System for revising seismic design standards and manuals	×	
	⑦	Insufficient technical skills and understanding among engineers	×	

[Legend]● : Established △ : In progress / Insufficient × : Not established — : Not confirmed ★ : Bottleneck

Source: Prepared by the JICA Survey Team

Figure 2-21 Bottleneck / Phase Analysis (Existing Public Buildings)

Comparison of Bottleneck and Phase Analysis for 11 Countries (New Public Buildings)

Phase	No.	Item	PHP	IDN	MMR	BGD	NPL	PAK	SLV	ECU	CHL	IRN	TUR
Phase1 [Plan]	①	Positioning of important facilities, disaster prevention base facilities, etc.	●	△	—	—	—	—	×	—	△	—	—
	②	Identification of the administrative authorities responsible for buildings (responsible ministries/agencies, chain of command)	●	△	—	●	—	△	△	△	●	—	—
	③	Specific arrangements for funding mechanisms, subsidy rates, etc.	●	—	—	—	△	—	△	△	●	△	△
	④	Existence of a third-party inspection system, such as audit inspections, for funds invested	●	—	—	—	×	—	●	—	●	—	—
	⑤	Existence of national-level seismic standards	●	●	●	●	●	●	●	●	●	●	●
	⑥	Coordination system between central and local government	●	×	—	△	×	—	△	△	●	—	—
	⑦	Sufficiency of building administrative technical officials or departments implementing projects	●	×	—	●	—	×	×	×	●	△	△
	⑧	Awareness of the importance of seismic retrofitting	●	△	—	—	×	—	×	—	●	—	—
Phase2 [Preparation]	①	System for project implementation (procurement process, specification documents, securing top-level engineers)	—	—	— ★	— ★	— ★	— ★	△	—	●	—	—
	②	Specification requirements at the time of procurement, including facility performance (design standards), importance level, etc.	—	△ ★	— ★	— ★	— ★	△ ★	△ ☆	— ☆	●	—	—
	③	Identification of the budget required for project implementation	●	—	—	●	—	—	△	●	●	—	—
	④	Funding availability and procurement status	●	—	—	△	—	—	●	×	●	—	—
	⑤	Development of design guidelines and manuals	—	—	△	●	△	—	× ☆	△	—	—	△
	⑥	Development of standard drawings and prototypes	△	△	—	—	△	△	×	△ ☆	●	△	—
	⑦	Sufficiency and roles of architectural administrative technical officials	●	×	—	△	—	×	×	△	△	—	—
	⑧	・Regulatory framework for architects and engineers (Architects Act, etc.) ・Contractor qualification frameworks, including construction and demolition business registration (Construction Business Act, etc.)	△	△	△	△	×	—	△	△	△	—	—
Phase3 [Implementation]	①	Establishment of a quality control system (including permanent on-site supervisors)	△ ☆	△ ★	—	△	×	×	△ ☆	× ☆	●	△ ★	—
	②	Third-party review / inspection system	× ☆	×	—	△	×	—	△	×	●	△	△
	③	Design, construction, and supervision (technical / management skills)	△ ☆	△	×	×	×	△	△	×	●	△	×
	④	Development of construction supervision guidelines and manuals (supervision principles, general standard specifications for construction, etc.)	●	△	—	●	—	△	×	—	× ☆	× ★	—
	⑤	Inspection and compliance verification with seismic standards	△	×	△	×	×	×	△	△	●	△	—
	⑥	System for revising seismic design standards and manuals	—	△	—	△	—	—	△	△	△	△	—
	⑦	Insufficient technical skills and understanding among engineers	△	×	×	×	×	△	×	×	—	×	—

Comparison of Bottleneck and Phase Analysis for 11 Countries (Existing Public Buildings)

Phase	No.	Item	PHP	IDN	MMR	BGD	NPL	PAK	SLV	ECU	CHL	IRN	TUR
Phase1 [Plan]	①	Legislation related to existing buildings, such as the Seismic Retrofitting Promotion Act, has been established or official documents have been issued.	●	—	— ★	×	— ★	× ★	× ★	× ☆	△ ☆	— ★	●
	②	Formulation of policies (e.g., Cabinet decisions)	●	× ☆	— ★	—	× ★	× ★	— ★	△ ☆	— ☆	× ★	● ★
	③	Disaster management plans aligned with national policies have been developed, addressing building safety	△	△ ☆	— ★	△	— ★	— ★	△ ★	△ ☆	△ ☆	— ★	△ ★
	④	Identification of the administrative authorities responsible for buildings (responsible ministries/agencies, chain of command)	△	△	—	△	△	—	△	—	△	×	●
	⑤	Designation of critical facilities and emergency response facilities Development of methods for prioritizing seismic retrofitting and establishment of priority lists (e.g., inventory data creation)	△	△	—	△	—	×	△ ★	—	△ ☆	△	●
		Promotion of seismic strengthening for key government buildings, core hospitals, and schools.	△	—	—	△	—	—	△	△	—	△	●
	⑥	Funding systems for seismic retrofitting. Specific arrangements, such as the subsidy rate	△	—	—	×	×	—	×	—	—	—	△
	⑦	Third-party auditing system exists for reviewing allocated funds, including financial inspections.	—	—	—	—	×	—	×	—	—	—	—
	⑧	Existence of national-level seismic standards	—	△	×	●	●	×	×	●	×	×	●
	⑨	Coordination system between central and local government	—	—	—	△	—	—	△	—	—	—	—
	⑩	Sufficiency of building administrative technical officials or departments implementing projects	—	×	—	×	—	—	×	×	—	—	—
	⑪	Awareness of the importance of seismic retrofitting	—	× ☆	—	△	—	—	△	× ☆	× ☆	—	—
Phase2 [Preparation]	①	Regional disaster management plans have been developed, covering building performance (e.g., building performance, etc.)	△	△	—	— ★	—	—	×	×	—	△	●
	②	Formulation of seismic strengthening project plans for each responsible department	△	—	—	△ ★	—	—	△	△	—	×	●
	③	Establishment of seismic retrofitting priorities, with inventory databases maintained by responsible departments	●	—	—	△	—	—	△	—	—	△	●
	④	Implementation framework for projects, including bidding processes, specifications, and securing highly skilled engineers	— ★	△	—	— ★	—	—	△	—	×	—	—
	⑤	Identification of necessary funding for seismic strengthening projects	●	—	—	●	—	—	—	—	●	—	—
	⑥	Funding availability and procurement status	×	×	—	×	—	—	△	—	—	—	△
	⑦	Design methodologies for seismic diagnosis and retrofitting, along with their application and regulatory conformity	—	△	—	△	△	—	△	—	△	●	△
	⑧	Design guidelines, manuals, and checklists	—	△	—	●	△	—	—	△	△	●	△
	⑨	Development of standard retrofitting methods and prototype designs	—	—	—	×	×	—	—	—	×	—	—
	⑩	Sufficiency and roles of architectural administrative technical officials	—	×	—	×	×	—	×	—	×	—	△
Phase3 [Implementation]	①	Implementation of seismic retrofitting projects	△ ★	—	—	△	×	—	×	—	△	—	●
	②	Third-party evaluation system for seismic diagnosis and retrofitting	—	△	—	—	×	—	×	—	△	—	—
	③	Application status of seismic strengthening technologies	— ★	—	—	×	—	—	△	—	—	—	△ ★
	④	Construction / on-site supervision progress	—	△	—	×	—	—	×	—	—	—	△
	⑤	Development of construction supervision guidelines and manuals (supervision principles, general standard specifications for construction, etc.)	—	×	—	●	×	—	×	—	—	—	—
	⑥	System for revising seismic design standards and manuals	—	△	—	—	—	—	—	—	△	—	●
	⑦	Insufficient technical skills and understanding among engineers	—	—	—	△	×	—	×	—	—	—	—

[Legend]● : Established △ : In progress / Insufficient × : Not established — : Not confirmed ★ : Bottleneck

Countries with a gray star mark on the bottleneck represent those that, according to the survey results, are presumed not to consider the promotion of seismic retrofitting important.

(PHP: Philippines, IDN: Indonesia, MMR: Myanmar, BGD: Bangladesh, NPL: Nepal, PAK: Pakistan, SLV: El Salvador, ECU: Ecuador, CHL: Chile, IRN: Iran, TUR: Turkey)

Source: Project Study on Reassessment of Cooperation for Disaster Risk Reduction in the Earthquake Sector and Examination of Future Measures in Critical Areas

Figure 2-22 Comparison of Bottleneck and Phase Analysis for 11 Countries

2.5.2 Analysis of the applicability of Japanese technology

(1) Earthquake-resistant technology, etc.

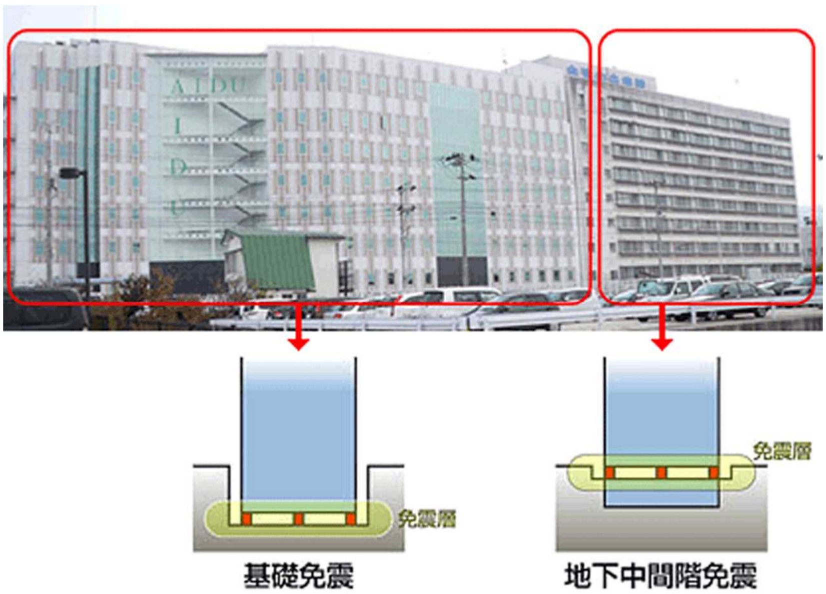
External Frame Retrofitting Method

The external frame method is a method of reinforcing a building structure by adding frames from outside the building without performing large-scale reinforcement work inside the building. This characteristic allows the external frame method to be used while the building is being reinforced.

Seismic Isolation

In Japan, seismic isolation structures are often used in important disaster prevention facilities that are expected to function continuously during and after earthquakes. In particular, seismic isolation is actively used in hospitals, where the shaking of the building's interior must be kept to a minimum and medical services must be continued without interruption, and in municipal government buildings, which serve as disaster response centers.

There are abundant examples in Japan of seismic retrofitting of historical buildings that need to be made more earthquake resistant without compromising the building's appearance, and of seismic retrofitting of existing buildings with insufficient earthquake resistance in the important facilities mentioned above, and thus technology and expertise is being accumulated in this field accumulated in this field. In addition, seismic isolation retrofitting often allows for the continued use of the building due to the characteristics of the construction method, and there is a high possibility that “seismic retrofitting while using the building” can be realized.

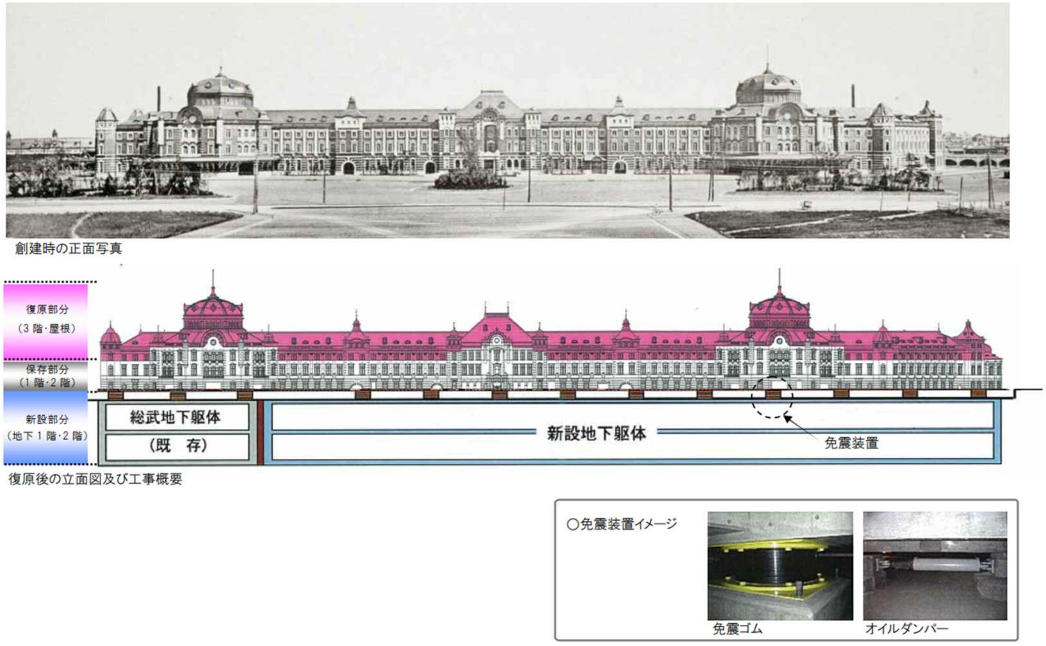


Disaster base hospital (regional disaster medical center)

In the Great East Japan Earthquake of March 11, 2011, the building and seismic isolation system were not damaged, and the nurses' stations in the hospital wards were not scattered.

Source: Aizu Central Hospital, Taisei Corporation

Figure 2-23 Seismic isolation retrofit of Aizu Central Hospital

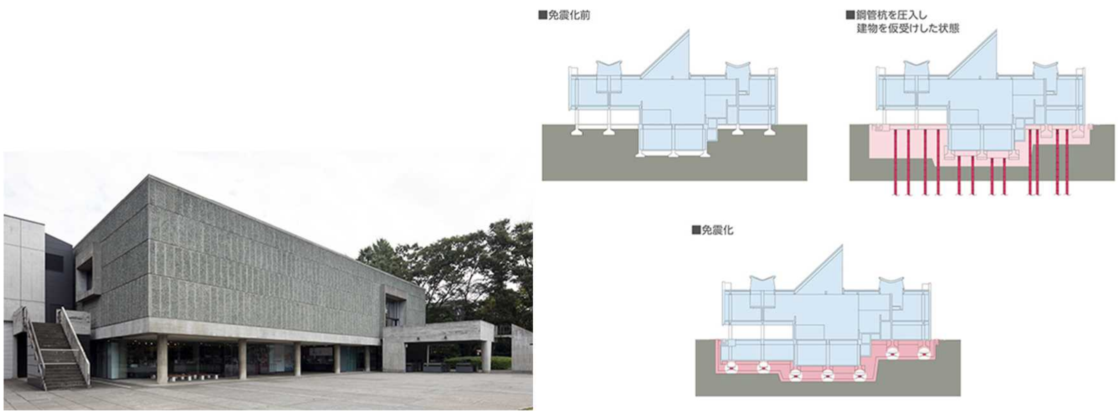


Tokyo Station

Tokyo Station is a major terminal station used by 400,000 passengers per day. Tokyo Station's Marunouchi Station Building (photo above) is a historical landmark built in 1913, and between 2007 and 2012, the exterior of the building was restored to its original appearance and seismic isolation was implemented.

Source: East Japan Railway Company

Figure 2-24 Seismic retrofit of Tokyo Station



National Museum of Western Art

The National Museum of Western Art was inaugurated in April 1959. The main building was designed by Le Corbusier. The 1995 Great Hanshin-Awaji Earthquake triggered a review of earthquake resistance measures, and since it was difficult to maintain the appearance of the original by Le Corbusier using conventional earthquake-resistant construction methods, seismic isolation retrofi" was adopted to make the building earthquake resistant without compromising its exterior (construction completed in 1998). In 2016, “Le Corbusier's Architectural Works - Outstanding Contribution to the Modern Architectural Movement”, which includes the National Museum of Western Art as a component, was listed as a World Heritage Site.

Source: National Museum of Western Art, Shimizu Corporation

Figure 2-25 Seismic Retrofit of the National Museum of Western Art

Seismic Isolation Display Stand

In Japan, many museums and art galleries use display stands and display cases equipped with seismic isolation mechanisms to prevent valuable cultural properties and other exhibits from falling or tipping over due to earthquake shaking and to prevent damage to exhibits.

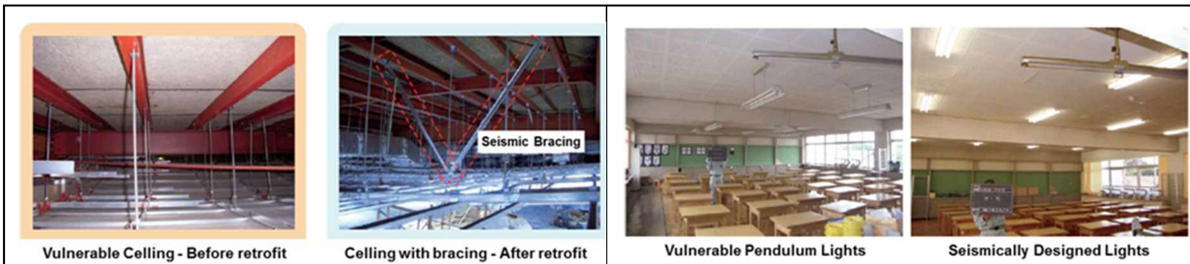
Source: THK Co.

Figure 2-26 Example of seismic isolation display stand

Seismic Strengthening of Non-structural Components

To ensure the safety and continued use of buildings during earthquakes, it is necessary to provide seismic countermeasures for nonstructural components and equipment in buildings. In Japan, for example, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) has established "Guidelines for Seismic Structures of Non-Structural Members of School Facilities" based on past experiences in which vulnerable non-structural members of school buildings were severely damaged during earthquakes and the buildings could not be used immediately after the earthquake.

These Guidelines and Japan's experience and knowledge are useful and applicable in Uzbekistan.



Source: Case studies of seismic countermeasures for nonstructural components of school facilities (Ministry of Education, Culture, Sports, Science and Technology).

Figure 2-27 Examples of seismic strengthening of nonstructural components

Earthquake Early Warning

The concept of earthquake early warning is based on the propagation characteristics of seismic waves. Seismic waves consist of several different types of waves, of which the primary wave (P-wave) arrives first, followed by the second wave (S wave), which is the main component of earthquake tremors.

Earthquake early warning systems detect the initial P wave, estimate the size of the earthquake and the epicenter location before the full-scale earthquake tremor (S wave) arrives, and issue an alarm. Usually, depending on the distance from the epicenter, there are several to several dozen seconds between the P and S waves, during which time people can take appropriate postures and actions to prepare for the earthquake and shut down equipment that may be affected by the earthquake tremors.

(2) Digital Transformation

A major obstacle to seismic retrofitting of existing buildings is the loss of design drawings. It may also happen that the existing design drawings cannot be used as they are due to post-construction additions, renovations, or renewal of facilities. Although it depends on the method of seismic reinforcement, it is essential to restore the drawings after understanding the current condition of the building, such as the existence of openings and piping penetrations, in order to consider the installation of reinforcement members such as seismic walls and braces.

The use of BIM has the advantage of eliminating the need for manual drawing revisions, and changes can be reflected immediately. In addition, the use of BIM for seismic retrofitting allows the design of seismic retrofitting to be based on BIM drawings, which allows the exact placement of columns, beams, and walls to be determined.

3D scanning technology is an important tool for BIM. By acquiring the shape of an existing building as point cloud data and converting it into a BIM model, it not only facilitates data creation, but also speeds up the creation of design and structural drawings required for seismic retrofit design, and prevents re-investigation due to measurement omissions, which is an important aspect of seismic retrofitting. This can also contribute to the prevention of disruption of daily work, which is an important aspect of seismic retrofitting.

(3) Other related technologies

Energy-saving Renovation Technology

Building renovations have a variety of purposes, such as improving earthquake resistance, energy efficiency, longevity, and barrier-free accessibility, and there are many cases where common construction work and construction points arise even for renovations with different purposes. By implementing multi-purpose renovations, the costs can be reduced and the construction period shortened compared to implementing each of these separately. Energy-saving retrofit technologies include those that improve the thermal insulation and solar shielding performance of building exterior walls, roofs, and windows, as well as those that target equipment and devices to make them more energy efficient and highly effective. In particular, when insulation retrofitting of exterior walls is implemented for the purpose of improving insulation performance, there are significant advantages to implementing the retrofitting simultaneously, since in many cases work around exterior walls is also performed for seismic retrofitting. This could be an opportunity to promote the simultaneous implementation of seismic retrofitting, triggered by the energy-saving retrofitting of buildings. In this case, Japanese technology can be applied to energy conservation as well.

2.5.3 Action plan for the promotion of earthquake resistance by the Government of Uzbekistan

(1) Outline of the action plans

In a series of presidential decrees on seismic safety issued after 2020, action plans have been developed to promote seismic safety. The following is a list of each presidential decree issued, the major components of the program, and the assumed implementation period.

Presidential Decree No. 4794 of 2020 "On Measures to Fundamentally Improve the System of Ensuring Seismic Safety of the Population and Territory of the Republic of Uzbekistan"

Major program items

Implementation period: 2020-2021

Presidential Decree No. 4794 of 2020.07.30
I. Improvement of legal infrastructure to ensure seismic safety of population
II. Take measures to reduce the level of seismic risk
III. Control of seismic stability of buildings and structures in use and to be commissioned
IV. Control of seismic strength of reservoirs and hydrotechnical structures on located on the territory of the Republic
V. Broad implementation of modern information and communication technologies in the field of seismic safety
VI. Implementation of modern methods and technical means to ensure earthquake safety and durability
VII. Improve scientific basis and technology for seismic safety and stability

Presidential Decree No. 144 of 2022 "On Measures to Further Improve the Seismic Safety System of the Republic of Uzbekistan"

Major program items

Implementation period: 2022-2023

Presidential Decree No. 144 of 2022.05.30
I. Improving the legal framework and construction regulatory documents in the field of ensuring seismic safety
II. Improving earthquake preparedness
III. Experimental testing of the strength of building structures and increasing the seismic strength of buildings and structures
IV. Ensuring the seismic strength of buildings and structures and improving their monitoring
V. Improving methods for calculating and monitoring the seismic strength of bridges, overpasses, and tunnels
VI. Improving control of seismic strength of earth structures, reservoir dams and hydraulic structures
VII. Improvement of the network of seismic prognostic monitoring and seismological observations
VIII. Improving the training of higher education, as well as scientific and scientific-pedagogical personnel in the field of seismology, seismic strength of buildings and structures, and ensuring seismic safety
IX. Development of science in the field of seismology, seismic strength of buildings and structures, and ensuring seismic safety
X. Improving the activities of scientific laboratories in the field of seismology and seismic strength of structures and establishing new scientific and educational laboratories
XI. Expanding work on the creation of a new generation of building materials that increase seismic resistance
XII. Digitalization of the seismic safety sector and widespread introduction of information and communication technologies
XIII. Widespread introduction of space research into the field of seismic safety
XIV. Improving the preparation of modern educational literature in the field of seismology, seismic strength of buildings and structures, and ensuring seismic safety
XV. Advanced training and retraining of personnel abroad in the field of seismology, seismic strength of buildings and structures, and ensuring seismic safety

Presidential Decree No. 158 of 2023 "On Additional Measures to Further Improve the System of Ensuring Seismic Safety of the Population and Territory of the Republic of Uzbekistan"

Major program items

Implementation period: 2023-2025

Presidential Decree No. 158 of 2023.05.16
I. Improvement of legal frameworks and building regulations in the field of seismic safety
II. Broad implementation of seismological and space research in the field of seismic safety
III. Digitization of the field of seismic safety and wide implementation of information and communication technologies
IV. Experimental testing of the strength of building structures and improvement of the seismic strength of buildings and structures
V. Studying foreign experience in the field of seismic safety and improving the skills of staff
VI. Improvement of earthquake preparedness of the population
VII. Ensure seismic stability of buildings and structures

There is a reference to cooperation with Japan in Program Item V of Presidential Decree No. 158.

References to Japan

Program:

V. Studying foreign experience in the field of seismic safety and improving the skills of staff

20. Establishing cooperation in the field of construction of earthquake-resistant buildings and structures on the basis of a memorandum of understanding with relevant Japanese organizations.

[Contact] Ministry of Construction, Housing and Communal Services (B. Zakirov), Academy of Sciences (S. Mirzaev)

- To carry out scientific and research work in the field of earthquake-resistant construction involving the scientists and specialists of Uzbekistan and Japan.
- Conducting mutually beneficial scientific and scientific-methodical conferences, seminars, symposia, roundtable discussions, meetings and exhibitions.
- Exchange of experience in the construction of earthquake-resistant buildings and structures.
- To study and implement in Uzbekistan the experience of determining the personal responsibility of the project chief engineer and the section head of the contracting organization, the internal controller, the author's control of the project organization, the customer's technical control, the state control inspector attached to the object until the end of the building's operation period, in the organization of quality control.
- Implementation and development of seismic isolation technologies and other methods of ensuring seismic stability of buildings and structures in Uzbekistan.

Presidential Decree No. 161 of 2024, "On measures to Increase the Earthquake Resistance of Buildings and Structures andImprove Seismic Risk Monitoring Activities"

Major program items

Implementation period: 2024-2026

Presidential Decree No. 161 of 2024.04.17
I. Improvement of the regulatory framework in the field of seismic safety
II. Strengthen the activity of seismic stations and monitoring of earthquakes
III. Digitization of the field of seismic safety and wide implementation of information and communication technologies
IV. Development of research and development in the field of seismic safety y

V. Studying foreign experience in the field of seismic safety and training, retraining and improving the skills of personnel in the field
VI. Improvement of earthquake preparedness of the population
VII. To increase the seismic strength of buildings and structures, to develop science in the field of ensuring seismic safety
Actions by Region

Among the references to Japan in Presidential Decree No. 161 are the following.

- There is one action "Development of digitized simulation models with extensive use of methodologies created in **Japan**, Turkey, Germany and other countries", under the middle item "To reduce/manage seismic risk in seismically active zones, create digital simulation models that allow assessing the level of damage to areas affected by strong earthquakes (Tashkent City as an example)", under the main item III.
- There is another action "Studying foreign experience (**Japan**, Italy, Turkey) and organizing training courses on the requirements and practice of seismic isolation application by forming a working group", under the middle item "To create calculation methods for seismic isolation application requirements widely used in foreign countries", under the main item VII.

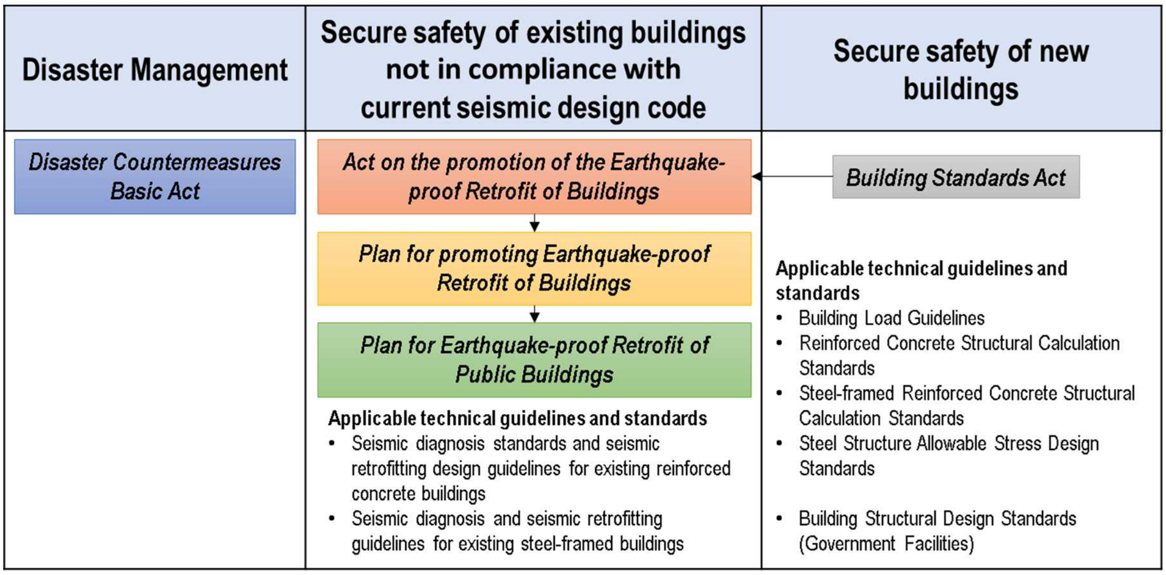
Below are the actions for the City of Tashkent out of the actions for each region.

Implementation of Regional Measures to Ensure Seismic Safety in Tashkent
I. Ensuring the seismic safety of the population and regions and reducing the seismic hazard (risk).
1. Educating all layers of the population of Tashkent region on the rules of action before an earthquake, during an earthquake and after an earthquake and improving their readiness.
2. Organization of training and retraining courses for leading personnel and employees of state bodies on seismic safety through the national electronic platform (hereinafter referred to as the platform) designed to prepare the population for movement in earthquake conditions.
3. Organization of roundtable discussions involving scientists and qualified specialists of research institutes operating in the field of seismic safety in educational organizations of Tashkent region.
II. Increase the earthquake resistance of buildings and structures
4. Plan or select for serial construction with a height of 9 floors or more in the territory of Tashkent region, ensuring their quality and eliminating defects in advance.
5. Instrumental and technical inspection of earthquake resistance during commissioning of newly built III-IV class objects in Tashkent region.
6. Continuous creation of electronic technical passports of all types of newly built buildings and structures in Tashkent region, as well as the structural system of multi-apartment houses, the seismic level of the construction area, and the strength indicators of load-bearing construction materials.
7. Continuous monitoring of the seismic strength of 4,970 existing multi-apartment buildings included in the Pasportbino.uz platform in the Tashkent region.
8. Continuous monitoring of the seismic stability of buildings and structures of 3416 and 5146 schools included in the Pasportbino.uz platform belonging to the existing preschool education organization in the Tashkent region.
9. Monitoring the seismic stability of 427 buildings and structures included in the Pasportbino.uz platform belonging to existing higher education organizations in the Tashkent region.
10. Continuous monitoring of the seismic stability of 1228 buildings and structures included in the Pasportbino.uz platform belonging to healthcare system organizations in the Tashkent region.

11. Taking measures to rehabilitate and strengthen artificial structures (bridges, tunnels, overpasses, railway bridges, etc.) in Tashkent region that are under repair and in an unusable state.
III. Carrying out seismic prognostic monitoring and studying the experience created in our country in the field of seismic safety with the participation of employees in the regions and improving the skills of staff
12. Monitoring of earthquakes in the territory of the republic and their scientific analysis, as well as identification of regions with a strong earthquake risk expected in the near future through the movements of active tectonic cracks.
13. Conducting a presentation on the use of the national system of early warning about strong earthquakes and the mobile application "Warning from a strong earthquake" in the republic.
14. Presentation of the electronic platform for conducting seismological observations in water reservoirs.
15. Conducting a presentation on the use of the system of continuous space monitoring of the earthquake resistance of reservoir dams, their safety assessment.

(2) Gaps in the action plans

This section analyzes the gaps in Uzbekistan's current action plan, comparing it with the framework and examples of measures in Japan. Figure 2-28 show the Japanese framework for promoting seismic retrofitting.



Source: Prepared by the JICA Survey Team

Figure 2-28 Japan's framework for promoting seismic retrofitting

In Uzbekistan, the Republican Law No. 790 of 2022 “On the protection of the population and territories from natural and man-made emergencies" has been enacted as the basic law on disaster management, and the general framework in the field of seismic safety is provided in Republican Law No. 713 of 2021 “On ensuring seismic safety of the population and territories of the Republic of Uzbekistan”. Seismic design norms are in place, although there are restrictions on the size of buildings to which it can be applied. On the other hand, the development of a framework to promote seismic retrofitting has lagged behind, and seismic diagnosis and retrofitting of public buildings have not progressed.

An overview of examples of Japanese policies for the promotion of seismic diagnostics is shown below. (Table 2-20)

Table 2-20 Examples of Japanese measures to promote earthquake resistance

<table>
<tr><th rowspan="2"></th><th colspan="3">Phase</th></tr>
<tr><th>Planning</th><th>Preparation</th><th>Implementation</th></tr>
<tr><td>Policy and Legislation</td><td>• Enactment of Law to Promote Seismic Retrofitting
• Formulate a plan to promote seismic retrofitting based on the Law for the Promotion of Seismic Retrofitting
• Urban planning that takes disaster prevention into consideration (e.g., projects to develop disaster-resistant districts)</td><td>• Development of seismic diagnosis criteria and design guidelines for seismic retrofitting
• Mandatory seismic diagnosis of specified buildings, etc.</td><td>• Income tax and property tax deductions for implementation of seismic retrofitting of homes
• Setting earthquake insurance premium rates according to risk
• Certification of buildings that have undergone seismic retrofitting</td></tr>
<tr><td>Fund</td><td colspan="2">• Subsidies for earthquake resistance diagnosis expenses
• Low-interest loans for seismic diagnostics</td><td>• Subsidies for seismic retrofitting costs
• Low-interest loans for seismic retrofitting (local governments, Japan Housing Finance Agency)
• Reverse Mortgage Type Seismic Retrofit Loan</td></tr>
<tr><td>Technology</td><td>• Free dispatch of earthquake-proof advisors and free simple earthquake-proof diagnosis
• Training of earthquake resistance advisors</td><td>• Establishment of Seismic Retrofit Support Center</td><td>• Development of low-cost seismic retrofit technology</td></tr>
<tr><td>Information</td><td>• Establishment of a consultation service for seismic diagnosis and retrofitting</td><td>• Creating a database of seismic retrofit techniques and case studies</td><td>• Elimination of unscrupulous builders
• Registration System for Excellent Constructors</td></tr>
<tr><td>Recognition</td><td>• Educational activities related to earthquake risk
• Publication of earthquake hazard maps and earthquake damage estimates</td><td>• Educational activities related to the seismic performance of buildings
• Educational activities related to seismic retrofitting
• Publication of the results of seismic diagnosis for buildings for which seismic diagnosis is mandatory, such as specified buildings</td><td>• Labeling system for certification of seismic retrofitting
• Performance indication by seismic retrofit (seismic rating)</td></tr>
</table>

Source: Prepared by the survey team

In response to various examples of measures implemented in Japan, the following is a summary of what seems to be lacking in Uzbekistan's action plan, particularly in terms of earthquake resistance of public buildings.

[Legislation and Policy]

- Although the expansion and development of technical standards for building seismic resistance (seismic norm) is mentioned, the development of seismic diagnosis and seismic retrofit design norm for existing buildings has not been pursued.
- There is no explicit provision for a legal and policy framework to promote seismic diagnosis and seismic retrofitting of existing nonconforming buildings (buildings that do not conform to current

seismic codes).

- The approach from urban planning is not sufficient.
- There is no goal or roadmap for the development of earthquake resistant technology, and the direction of technological development is not clear (what is lacking is not clear).

[Funds]

- The lack of clarity on how to carry out seismic inspections and diagnoses of public buildings has prevented progress of seismic diagnoses, and the budget allocation for such inspections has not been taken into account.
- It is not specified that seismic retrofitting is to be implemented for buildings with inadequate seismic resistance as a result of seismic diagnosis, and no financial allowance for this purpose is taken into account.

[Technology]

- The development of screening and seismic assessment technologies to select buildings for seismic assessment has not been established.

[Information]

- A system for collecting, organizing, storing, and sharing information on seismic safety has not been adequately examined.

[Recognition]

- The focus has been on capacity building of government officials and some other stakeholders, and not enough consideration has been given to public access to information and knowledge about seismic safety and its widespread dissemination to the general public.
- Insufficient consideration has been given to the publication of research results and their dissemination to the general public.
- Insufficient activities to contribute to public awareness of seismic safety.

(3) Items to be included in the action plans

Considering the results of the bottleneck analysis and the gaps mentioned above, the first priority would be to establish a system for conducting seismic inspections and diagnoses, but the current action plan does not adequately take this into account. Based on this understanding, items that should be included in, or strengthened by, Uzbekistan's action plan are summarized below.

- Build a method for evaluating seismic performance based not only on building evaluation based on building attributes (e.g., year of construction, structural type, number of floors, etc.) and visual inspection of the building, but also on structural calculations using information from building structural design drawings and physical inspection (e.g., rebar exploration and concrete strength testing), i.e., seismic diagnosis.
- In order to study seismic diagnosis methods and reinforcement methods suitable for Uzbekistan,

analysis and experiments should be conducted by modeling the typical structural types of the existing buildings.

2.5.4 Direction of required assistance

In this section, we will examine the direction of what support is required for each support scheme, taking into account actions related to seismic safety in Uzbekistan and the challenges and needs in promoting investment in earthquake disaster risk reduction in advance of a disaster.

(1) ODA loan projects

The public building stock includes older buildings that do not conform to current seismic design norms, and it is assumed that there are a significant number of public buildings that may not have sufficient seismic capacity relative to the current seismic design norms and the latest seismic hazard assessments.

The Government of Uzbekistan is actively promoting the seismic safety of buildings as part of its legal measures. As the number and scale of buildings in need of seismic retrofitting become clearer, it is anticipated that there will be a need to provide not only technical assistance but also financial support for the cost of seismic retrofitting of public buildings. By improving the earthquake resistance of public buildings through the ODA Loan Projects, it is expected that the losses that could occur in future earthquakes (restoration costs of damaged buildings) can be significantly reduced, thereby preventing financial pressures in the event of a disaster. In addition, the project is expected to foster domestic industry and revitalize the economy through the consignment of design and construction work to domestic engineering and construction companies for seismic diagnosis, seismic retrofit design, and seismic retrofit construction, and through the active use of domestic building materials and other resources.

Depending on the size and use of the building, the cost of seismic retrofitting each building is estimated to be in millions of dollars. This is not that large compared to the scale of a typical yen loan project, and it is desirable to implement projects that are not necessarily restricted to a single building or even a single competent ministry of public buildings. Therefore, it is also expected to consider the implementation of cross-sectoral projects such as sector loans.

As an example, “Strengthening Earthquake Disaster Risk Reduction Capacity in Tashkent Project” may carry out seismic diagnosis, seismic retrofit design, and seismic retrofit work on public buildings (schools, hospitals, government buildings, etc.) that are important for disaster risk reduction in Tashkent. The following items are envisioned for implementation.

- Formulation of manuals for seismic diagnosis and retrofit design
- Research and experiments to understand the seismic performance of typical structural types of each era
- Seismic diagnosis and conceptual design of seismic retrofit for buildings that have not been designed and constructed according to current seismic design norms
- Seismic retrofit detailed design

- Seismic retrofit works
- Design and construction work that can be implemented at the same time for other purposes such as energy-saving, barrier-free, etc.

When implementing seismic retrofitting of public buildings, it is desirable to simultaneously implement energy conservation and barrier-free improvements as needed to solve complex issues. Conversely, it is also expected that opportunities for energy-saving, barrier-free, and large-scale renovations will be seized to encourage the simultaneous implementation of seismic retrofitting.

(2) ODA grant projects

Uzbekistan corresponds to a country with a relatively high-income level, and grant aid projects need to be highly effective in terms of urgency and speed, humanitarian needs, wide-area characteristics, and response to global-scale issues. In general, disaster prevention projects are considered to contribute to these aspects. In particular, it is desirable to consider providing necessary equipment and materials in the fields of research and education to resolve the shortage of human resources and capacity related to earthquake resistance, which is considered to be one of the disincentive factors for the promotion of earthquake resistance and investment disaster risk reduction in Uzbekistan. For example, the following could be considered.

- Provision of measuring and inspection equipment for building surveys
- Provision of laboratory facilities and equipment to research and educational institutions

(3) Technical cooperation projects

As already mentioned, Uzbekistan urgently needs to establish methods for seismic diagnosis and seismic retrofit design, train and strengthen the capacity of personnel involved in seismic resistance of buildings, and improve their understanding and awareness of seismic safety. The most effective way to solve these issues is to strengthen the capacity of relevant ministries and agencies through training in Japan and technical cooperation projects.

Assuming the Ministry of Construction as the implementing agency, a project such as the “Project to Promote Seismic Retrofitting of Existing Public Buildings” can be implemented, in which a guide for seismic diagnosis and retrofit design is prepared and a pilot project for seismic diagnosis and retrofit is conducted using the guide. Through the project, methods for seismic diagnosis and seismic retrofit design could be established, and human resource development and capacity building related to seismic resistance could be promoted.

In the potential project “Project for Mainstreaming Investment in Earthquake Disaster Risk Reduction”, the Ministry of Emergency Situations, as the implementing agency, would be responsible for establishing a comprehensive disaster prevention system that includes both proactive and preventive disaster risk management, formulating a disaster risk reduction plan and promoting investment in disaster risk reduction measures, including ensuring the seismic performance of existing and new infrastructure facilities and public buildings, promoting seismic resistance in urban development and redevelopment, promoting seismic resistance in energy conservation projects, solving seismic problems in evacuation planning, and improving the understanding and awareness of citizens and decision makers.

The annex to Presidential Decree No. 5611 of 2019 "On additional measures for the accelerated development of tourism in the Republic of Uzbekistan", entitled "Concept of the Development of the Tourism Sector in the Republic of Uzbekistan in 2019- 2025", aims to transform the tourism sector into a strategic sector of the national economy by 2025, raising its share from 2.3% of GDP in 2017 to 5% in 2025.[1]

Once a major earthquake strikes, the tourism industry in the affected areas will be severely affected due to direct and indirect damage. Damage to historical and cultural heritage sites, which are tourism resources, will require a long period of time to recover, and the number of tourists may continue to decline for a long period of time.

In Uzbekistan, having a large number of historical and cultural heritage sites that support its tourism industry, the protection of historical buildings, which are also valuable cultural heritage and tourism resources, is an important issue. Therefore, the lack of awareness and knowledge of earthquake disasters among related organizations is a problem. In particular, when it comes to earthquake resistance of the building structures, building survey methods and seismic diagnosis methods that match the structural characteristics and conditions of historical buildings are required, as well as reinforcement methods that take into consideration the impact on the exterior appearance when retrofitting. In this regard, a project such as the "Capacity Development for the Protection of Historic Buildings with Seismic Safety" can be considered, with the Cultural Heritage Agency as the implementing agency.

2.5.5 Proposal of candidate projects

Based on the results of this study, a summary list of candidate projects is prepared for ODA Loan Projects, ODA Grant Projects, and Technical Cooperation Projects.

(1) ODA loan projects

The items to be included in the summary table of the ODA Loan projects are as follows:

1. Project name: Provide a project name that describes the contents of the candidate project.
2. Project Summary: Provide a summary of the project.
3. Implementing agency: List the relevant organizations in Uzbekistan that will implement the project.
4. Type: Describes a method of earthquake resistance of a building.
5. Estimated cost: List the project cost required to implement the project.
6. Implementation period: Indicate the period of time required to implement the project in question.
7. Assumed funding sources: Describe the source of funds to carry out the project.
8. Survey Team Comments: Based on the results of this survey, the survey team's comments on the

[1] Source: Data Collection Survey on Tourism Industry Promotion in the Central Asia Region, 2019, JICA.

candidate projects are described.

9. Related Organization Comments: Based on the results of this survey, provide comments from related organizations on the candidate projects.
10. Superior Related Plan: Describe the plan that will provide the legal basis for the implementation of the project.
11. Maturity: Describe the needs of Uzbekistan with regard to the project and the status of efforts to date.

The following is a summary table of the compiled ODA Loan projects. (Table 2-21)

Table 2-21 Project Summary Table (ODA Loan Projects)

No.	1-1	**Type**	Earthquake-resistant construction
Project Name	Seismic reinforcement of hospital buildings	**Estimated cost**	5.94 million USD
Implementation Agency	Tashkent City, Ministry of Health, Ministry of Construction	**Implementation Period**	2026-2029
Upper related plan	Presidential Decree 2024-161.	**Assumed Funding Sources**	Ministry budget
Project Summary	The project is to upgrade a group of hospitals in Tashkent City to earthquake resistance by construction while staying in the building (i.e. "retrofitting while using building").		
Survey Team Comments	Since the building is extremely important as a base building in the event of a disaster, it is an urgent issue to make it earthquake resistant. Earthquake-resistant construction costs are calculated as 30% of new construction costs. Of the 12 general hospitals and 45 specialized hospitals, a total of 3 buildings (2 general hospitals and 1 specialized hospital) that are judged to be in need of repair will be targeted.		
Related Organization Comments	Currently, we only evaluate buildings visually and would like to confirm the adequacy of repairs and reinforcement.		
Maturity	Listing of buildings has been conducted in Tashkent and buildings in need of restoration have already been extracted. Building assessment based on a presidential decree determined that 84 buildings in the country are vulnerable. Plans call for rebuilding and repairing 94 buildings by 2025.		
No.	1-2	**Type**	Earthquake-resistant construction
Project Name	Seismic retrofitting of schools and kindergartens	**Estimated cost**	1.122 billion USD (Schools: approx. 570 million USD, Kindergartens: approx. 550 million USD)
Implementation Agency	Tashkent, Ministry of Education, Ministry of Construction	**Implementation Period**	2026-2029
Upper related plan	Presidential Decree 2024-161.	**Assumed Funding Sources**	Ministry budget
Project Summary	Earthquake-resistant construction for school and kindergarten facilities in Tashkent, applying the "retrofitting while using building" construction method.		
Survey Team Comments	Since it is extremely important as an evacuation site in the event of a disaster and to ensure the safety of children, earthquake resistance is an urgent issue. The cost of earthquake-resistant construction was calculated as 25% of the cost of new construction. The project will cover 325 school buildings, 30 schools and 32 kindergartens that have been judged to be in good condition (490 kindergartens).		
Related Organization Comments	Currently, we only evaluate buildings visually and would like to confirm the adequacy of repairs and reinforcement.		
Maturity	Listing of buildings has been conducted in Tashkent and buildings in need of restoration have already been extracted. A building assessment based on a presidential decree found 59 buildings in the country to be vulnerable.		

Source: Prepared by the survey team

As described in the previous section, we emphasized the advantages of a cross-sectional approach with the City of Tashkent as the implementing agency, rather than implementing the project vertically by ministry, when upgrading public buildings in Tashkent. In the table above, hospitals and schools are listed as separate projects, because the level of importance and priority may differ depending on the use of the building, and because it is assumed that the flow of funds for seismic retrofitting will go through various ministries. It is recommended that these projects be implemented as a single project including two packages of projects 1-1 and 1-2.

In addition, to effectively implement the above ODA Loan projects 1-1 and 1-2, it is necessary to establish technical standards or norms for seismic diagnosis and seismic retrofit design in Uzbekistan. However, at present, the norm for seismic diagnosis and retrofit design has not been established, and there is little experience and track record in seismic diagnosis, retrofit design and retrofit work. In order to smoothly implement Projects 1-1 and 1-2, the following Technical Cooperation is proposed as an ancillary project. (Table 2-22)

Table 2-22 Project Summary Table (ODA Loan Account Technical Assistance)

No.	**1-3**
Name	(Tentative) Ministry of Construction Support Project for Seismic Retrofitting of Existing Buildings
Objectives	Establish methods and technologies for detailed building surveys, seismic diagnosis, seismic retrofit design, and quality control of retrofitting work necessary to implement seismic retrofitting of existing buildings, with a view to applying them to projects to retrofit schools and hospitals. The results will be compiled into technical manuals, etc., and tools (diagnostic and design software, etc.) will be developed and maintained to contribute to the development of legislation and technical standards for seismic retrofitting in Uzbekistan. It also aims to promote the seismic retrofitting of existing public buildings by strengthening the framework and system for promoting seismic retrofitting through the development of seismic retrofitting promotion plans and seismic retrofit plans. In particular, when establishing methods and technologies, care will be taken to ensure that they are appropriate for Uzbekistan by conducting structural experiments, etc.
Implementation agency	Ministry of Construction, Academy of Sciences
Period	5 years
Outputs	Output 1: Administrative and technical capacity for seismic diagnosis and retrofit design will be improved. Output 2: Tools for seismic diagnosis and retrofit design will be developed. Output 3: Administrative and technical capacity for quality control supervision in seismic retrofit construction will be improved. Output 4: Mechanisms to promote seismic retrofitting of public buildings are strengthened.
Inputs	Japanese side: Dispatch of JICA experts, training in Japan, equipment and materials (inspection equipment, laboratory equipment) Uzbekistan side: counterpart personnel from the Ministry of Construction and the Academy of Sciences, facilities and equipment (office space for JICA experts, venue for training and workshops, etc.), necessary materials and equipment, and project operation costs

Survey Team Comments	The establishment of methods for seismic diagnosis and design of seismic retrofitting, the development of human resources and capacity building for seismic resistance, and the improvement of understanding and awareness of seismic resistance are urgent issues that are bottlenecks in the promotion of seismic resistance in buildings. The Ministry of Construction, under the presidential decrees on Seismic Safety, has implemented various measures to improve the seismic safety of buildings, but admits to a lack of technical knowledge and experience. It also highly appreciates Japan's knowledge and experience in earthquake resistance and is eager to receive Japan's technical assistance. In particular, they are short of funds to procure experimental equipment and devices for the new experimental facility to be built under the presidential decree on seismic safety, and are hoping for the provision of experimental equipment and devices as well as the dispatch of Japanese experts.

Source: Prepared by the survey team

One option would be to implement this ancillary project as an independent technical cooperation project prior to Projects 1-1 and 1-2. In that case, the degree of coordination with Projects 1-1 and 1-2 may be reduced, but the advantage would be that the technical basis could be established prior to implementing a large number of seismic retrofits.

(2) ODA grant projects

The following is a summary table of the ODA Grant projects proposed in this survey. (Table 2-23)

Table 2-23 Project Summary Table (ODA Grant Projects)

No.	Item	Summary	Implementation and maintenance agency
2-1	Structural testing equipment and inspection equipment	Actuator for structural experiments Provision of inspection equipment (Schmidt hammer (approx. 70,000 yen/unit), rebar probe (approx. 100,000 yen/unit), ultrasonic concrete strength measuring machine (2 million yen/unit), etc.)	Ministry of Construction
2-2	Earthquake simulation vehicle	Provision of earthquake-driven vehicles (approx. 65 million yen/unit)	Ministry of Emergency Situations
2-3	Seismic isolation display stand	Provision of seismic isolation display stand (400,000 yen/unit)	Cultural Heritage Agency

Source: Prepared by the survey team

Equipment provision proposed as an ODA Grant project may also be considered effective support to be implemented as part of a Technical Cooperation project. Please note that proposals for Technical Cooperation projects proposed herein may include the provision of equipment similar to that described here.

(3) Technical Cooperation Projects

The following is a summary table of the technical cooperation projects proposed in this study. (Table 2-24)

Table 2-24 Project Summary Table (Technical Cooperation Projects, etc.)

No.	**3-1**
Name	(Tentative) Project for Mainstreaming Investment in Earthquake Disaster Risk Reduction
Objectives	The Ministry of Emergency Situations is responsible for providing ministries, local governments, and citizens with necessary information, education, and awareness on how to respond to disasters, including earthquakes. While the Ministry has focused on emergency response after disasters occur and on preparing for disasters in advance, efforts to promote investment in disaster risk reduction in advance have not been sufficient. This project will build a comprehensive disaster management system, including proactive and preventive actions, in line with the Sendai Framework for Disaster Risk Reduction, through supporting the formulation of disaster risk reduction plans by ministries, agencies, and local governments.
Implementation Agency	Ministry of Emergency Situations, Local Government
Period	3 years
Outputs	Output 1: The capacity of the Ministry of Emergency Situations to support the development of earthquake disaster risk reduction plans in central and local government ministries and agencies is improved. Output 2: Training programs for central and local government officials on earthquake disaster risk reduction will be developed. Output 3: Educational programs in schools on earthquake disaster risk reduction will be developed. Output 4: Capacity to conduct public awareness activities on earthquake disaster risk reduction will be improved.
Inputs	Japanese side: Dispatch of JICA experts, training in Japan, equipment and materials (earthquake simulation vehicle) Uzbekistan side: counterpart personnel from the Ministry of Emergency Situations and pilot cities, facilities and equipment (office space for JICA experts, venue for training and workshops, etc.), necessary materials and equipment, and project operation costs
Survey Team Comment	Uzbekistan has not experienced any major earthquakes in recent years, and the general public and government officials have low awareness and recognition of seismic risk and are not well prepared for earthquakes, including earthquake resistance in existing buildings. Major earthquakes are infrequent but high-impact events, and it is essential to disseminate correct information, promote understanding, and raise awareness on an ongoing basis. The Ministry of Emergency Situations is also focusing on providing information to the public by installing earthquake experience devices at its Emergency Simulation Center, and by focusing on educating and raising awareness among the public and establishing an earthquake early warning system. They also hope to introduce a mobile system (like a quake simulation vehicle) so that people in rural areas can experience the earthquake simulation device. They are also highly appreciative of Japan's support to date and have submitted various requests, so their interest is considered to be high.

No.	**3-2**
Name	(Tentative) Project for Capacity Development for the Protection of Historic Buildings with Seismic Safety
Objectives	To protect historical buildings, which are also valuable tourism resources, from earthquake disasters and to ensure the safety of tourists, the project will promote the earthquake resistance of historical buildings. The structural forms of historical buildings vary widely, and some are already unstable after a long period of time. Various and sophisticated methods of earthquake reinforcement are required to ensure that the exterior and interior appearance of historic buildings are not damaged. The purpose of this project is to typify such historic buildings, understand their characteristics, find the most appropriate seismic strengthening methods, and apply them to pilot projects for typical historic buildings, so that they can be used for the protection of a variety of historic buildings.
Implementation Agency	Cultural Heritage Agency
Period	4 years
Outputs	Output 1: The ability to understand the structural form of historic buildings will be improved. Typification of structural types, identification of representative buildings by construction date and structural type, and field survey of buildings (including geophysical inspection and exploration), digitization of buildings by 3D scanning, etc. Output 2: Capacity for evaluation of seismic resistance and design of seismic retrofitting of historic buildings will be improved. Structural testing, implementation of pilot projects, analytical modeling and evaluation of seismic resistance, development of seismic retrofitting methods Output 3: Capacity for seismic retrofitting of historic buildings will be improved. Implementation of pilot projects, study of construction methods and feasibility of building reinforcement work, and implementation of reinforcement work.
Inputs	Japanese side: Dispatch of JICA experts, training in Japan, equipment and materials (inspection equipment, seismic isolation display stand, etc.) Uzbekistan side: counterpart personnel from the Cultural Heritage Agency, facilities and equipment (office space for JICA experts, venue for training and workshops, etc.), necessary materials and equipment, and project operation costs
Survey Team Comment	Uzbekistan has a large number of historical and cultural heritage sites, which are valuable tourism resources. It is considered to be an asset that can be actively utilized as part of the country's economic and development strategy. The protection of historical and cultural heritage is considered a high priority project, not only because of its cultural significance but also because of its economic significance. The Cultural Heritage Agency is aware that they do not have a sufficient understanding of earthquake disasters, and they believe earthquakes that cause extensive damage to historical heritage do not occur. On the other hand, they also recognize that they do not have sufficient knowledge of earthquakes and hope to learn from Japan's knowledge and experience. They are also keenly aware of measures to prevent deterioration of their heritage due to moisture, etc. If awareness of the problem on seismic safety can be fostered, it is expected that they will take a more proactive stance toward earthquake countermeasures.

No.	3-3
Name	(Tentative) Training for Uzbekistan on Earthquake Disaster Risk Reduction and Seismic Resistance of Buildings (country-specific and subject-specific training)
Target group	Administrative officers for disaster management, building administration, facilities and building management in the central and local governments of Uzbekistan (Ministry of Emergency Situations, Ministry of Construction, Ministry of Education, Ministry of Health, City of Tashkent, Academy of Sciences, etc.)
Objectives	To improve the capacity of disaster management administrations to develop and implement earthquake disaster prevention and risk reduction plans to reduce human suffering and economic damage caused by earthquakes. In particular, the training aims to strongly promote seismic disaster risk reduction through proactive disaster risk reduction investments, focusing on the development of a framework to promote seismic retrofitting of public buildings and buildings of disaster management importance, as well as an understanding of technical elements.
Period	4 weeks
Program Outline	• Lectures by Japanese government officials and experts on earthquake disaster prevention and earthquake resistance measures • Visits to disaster prevention-related facilities in Japan • Lectures and site visits on the theory and practice of seismic diagnosis, seismic retrofit design, and seismic retrofitting in Japan • Exercise in formulating plans to promote seismic retrofitting and plans for seismic retrofitting of public buildings

Source: Prepared by the survey team

What will be essential in promoting investment in advance disaster prevention, or disaster risk reduction, against earthquake disasters is to help relevant ministries and agencies, local governments, and citizens understand the effectiveness and importance of investment in disaster risk reduction and to encourage behavioral change. From this perspective, we propose Technical Cooperation Project 3-1.

As mentioned in the previous section, protecting historical buildings, which are valuable historical heritage and important tourism resources, from earthquake disasters is considered an important issue in Uzbekistan, and we therefore propose the above Technical Cooperation project 3-2.

We also propose Country-specific and Issue-specific Training 3-3. The fault tree analysis in Section 2.5.1 showed that low awareness and recognition of earthquake hazards in Uzbekistan is one of the disincentives for promoting earthquake resistance of buildings. It is expected that a cross-sectoral training program for central and local government administrators involved in seismic administration will make a significant contribution to the development of seismic human resources in Uzbekistan.

2.5.6 Recommendations for future support policies

This survey was conducted to determine the current status, issues, and needs for investment in disaster risk reduction against earthquake disasters in Uzbekistan, particularly in the seismic upgrading of public buildings, and to examine the direction of JICA's future support for resolving these issues. In terms of legislation and technical standards, there are no seismic codes for buildings above 16 stories, which prevents the development of high-rise urban areas; there are no standards for seismic diagnosis and retrofit design, which prevents the conversion of existing buildings to earthquake-resistant buildings; there are no design standards for advanced technologies such as seismic isolation, which prevents the introduction and diffusion of advanced technologies; there are no design standards for advanced technologies such as seismic isolation, which prevents the introduction and diffusion of advanced technologies. Another major challenge is the lack of sufficient awareness and understanding of the dangers and risks of earthquakes, due in part to the fact that, compared to Japan and other countries, there are fewer sensible earthquake occurrences, and no major earthquakes have occurred in recent years. This has led to a lack of research and human resource development related to earthquake resistance of buildings, and the lack of accumulated knowledge and experience has further hindered the promotion of awareness and understanding, creating a vicious cycle.

In general, earthquake disasters are low-frequency, high consequence events, and as the saying goes, "natural disasters are often forgotten". To promote preparedness and investments for such disasters, it is important to promote a proper understanding of disasters and to continue to disseminate information on their effects and possible countermeasures. The government has a responsibility to ensure the continuity of government functions and public services in the event of a disaster through seismic retrofitting of public buildings, and to ensure the safety of citizens through various measures.

The Government of Uzbekistan has recently issued a series of presidential decrees pertaining to earthquake safety and has just launched a seismic safety initiative. The Government of Uzbekistan appreciates Japan's knowledge and experience in this effort and is looking forward to technical assistance. In light of the current situation in Uzbekistan and Japan's experience, the following elements should be considered as priorities for future assistance policy.

(1) Policies to Promote Earthquake Resistance

The Great Hanshin-Awaji Earthquake of 1995 marked a major turning point in the promotion of seismic retrofitting of existing buildings in Japan. Since 1995, about 30 years of knowledge on the measures and their results have been accumulated, and it is expected that this knowledge will be applied in Uzbekistan. In particular, with a view to mainstreaming investment in disaster risk reduction against seismic hazards, the following items should be considered.

- Resilience of cities against earthquake disasters through development and redevelopment promotion and development regulations that take earthquake disaster risk reduction into account in development planning and urban planning.
- Facilitate the development and implementation of disaster risk reduction plans in central and local governments
- Introduction of subsidy and incentive/disincentive programs for seismic diagnosis and retrofitting

(2) Earthquake-resistant Technology

Japanese seismic diagnosis and retrofit design methods have already been introduced to other countries through JICA Technical Cooperation projects (e.g., Mongolia, Bangladesh, El Salvador) and can be used in Uzbekistan. To introduce such technologies, it is essential to enhance in-country research and experiments, develop tools such as analysis and design software, and train human resources. In addition, depending on the conditions, functions, and roles of the target buildings, the introduction of advanced earthquake-resistant technologies such as seismic isolation and vibration control structures should be considered. There is a wealth of applicable Japanese technology for such earthquake-resistant technology, which can be introduced and applied in Uzbekistan. Japan also has abundant knowledge and experience in energy-saving renovation, and it is desirable to use the opportunity of seismic retrofitting to simultaneously implement other renovation work, such as energy-saving renovation, in order to solve complex problems. Key points to consider are summarized below.

- Establishment of detailed building surveys, seismic diagnosis, and seismic retrofit design methods
- Improvement of research environment and expansion of experimental facilities related to earthquake resistance of buildings
- Development of specialist personnel related to earthquake safety and resistance of buildings
- Utilization of Japanese technology and experience related to earthquake resistant technology, etc.
- Solving complex problems by simultaneously implementing seismic retrofitting and energy-saving retrofitting, etc.

(3) Disaster Prevention Education and Awareness

Ongoing efforts to maintain and raise awareness of disasters, including earthquake disasters, are needed. In Japan, for example, there are various efforts to promote understanding of disasters and to remember the lessons of past disasters, such as regular disaster drills and education at schools and workplaces, disaster information programs by the mass media, disaster experience facilities, disaster monuments and memorial facilities, distribution of disaster maps and disaster prevention maps by local governments, community disaster prevention activities, etc. These experiences and knowledge have been utilized in many of JICA's cooperation projects, and it is expected that Japan's experience will be shared in Uzbekistan as well.

- Disaster Prevention Education in Schools
- Educational activities to promote correct understanding of earthquake risk (e.g., disaster drills, public relations activities, organizing events, public relations activities, community disaster management, media strategies, etc.)

(4) Wide Area Support

Unlike Japan, which is surrounded by the sea, Uzbekistan is a landlocked country with other countries adjacent to it on land. A major earthquake in the country, especially near its borders, could affect neighboring countries, and Uzbekistan could be affected by an earthquake originating in a neighboring country. In particular, Uzbekistan shares borders with Kyrgyzstan and Tajikistan around the Fergana tectonic basin, where active faults are concentrated, and seismic hazard is high. A major earthquake in the area could affect not only Uzbekistan but also the two countries mentioned above. Therefore, when considering earthquake disasters, it is desirable to consider simultaneous multilateral assistance targeting Uzbekistan, Kyrgyzstan, and Tajikistan.

- Multinational (Uz, Kz, Ta) simultaneous support for the area surrounding the Fergana tectonic basin

Appendices

Appendix-A: Survey Schedule

The JICA Survey Team conducted this survey according to the workflow as defined in the Work Plan as follows:

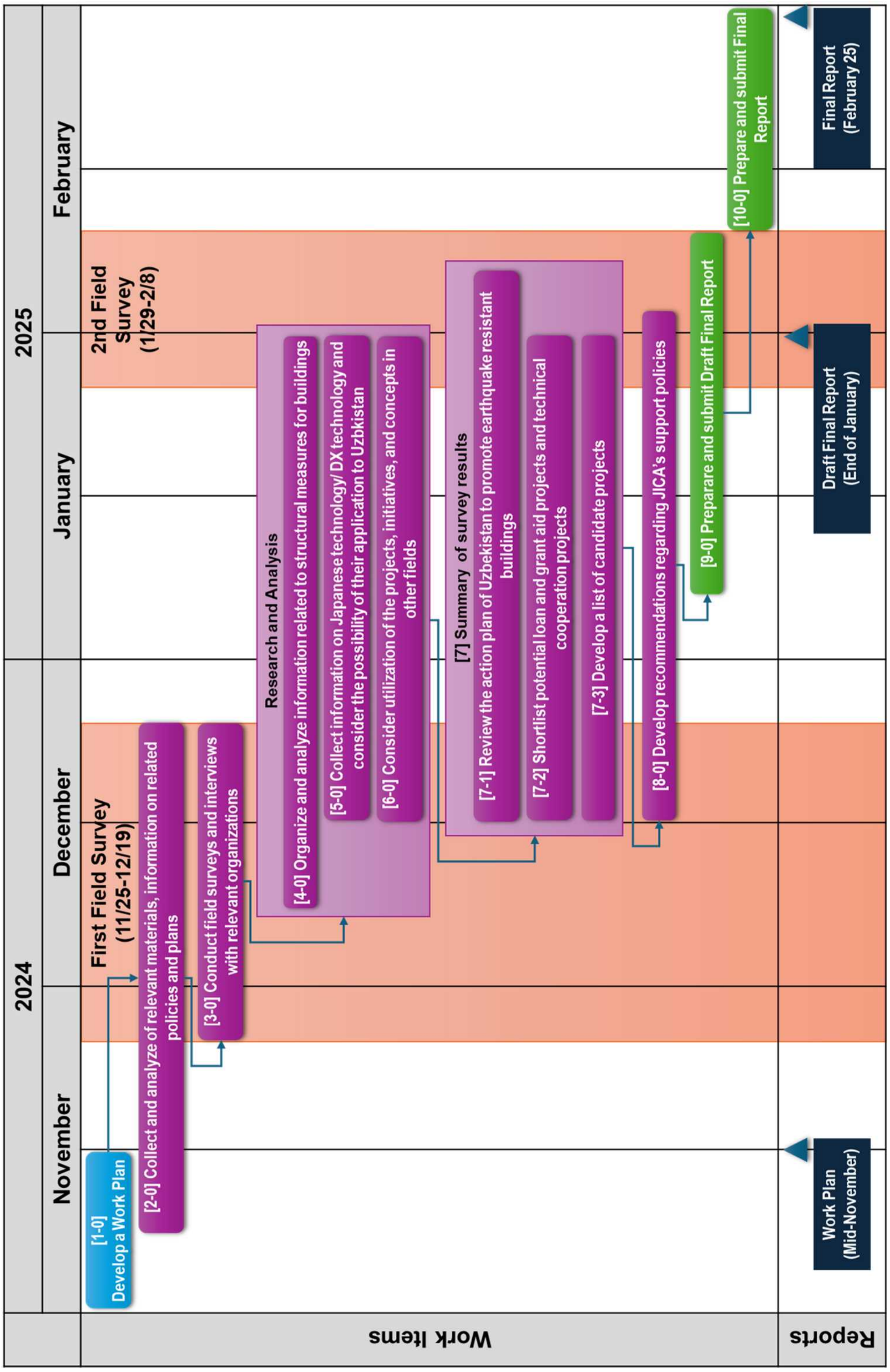


Figure A-1: Survey Workflow

The detailed schedule of the first Field Survey was as follows:

	Date		Masanori Kobayashi (Team Leader/ Plan for the Promotion of Seismic Retrofitting of Buildings) Seiichiro Fukushima (Seismic-Resistant Building (Seismic Technology)) Yasuhiro Amano (Assistant of the Plan for the Promotion of Seismic Retrofitting of Buildings)
			Itinerary
1	11/27	Wed	OZ 107D 27NOV NRT-ICN (09:00-11:35) OZ 573D 27NOV ICN-TAS (16:35-20:40)
2	11/28	Thu	Internal Meeting (AM) JICA Uzbekistan Office (15:40~16:40)
3	11/29	Fri	Uzbek-Japan Innovation Center of Youth (UJICY) Yanagida Expert (10:30~11:30)
4	11/30	Sat	Day off
5	12/1	Sun	Day off
6	12/2	Mon	Ministry of Construction, Housing and Communal Services (10:00~12:00)
7	12/3	Tue	Khokimiyat - Tashkent City Administration (10:00~12:00)
8	12/4	Wed	Institute of Seismology of the Academy of Sciences (10:00~12:00) Institute of Mechanics and Seismic Stability of Structures the Academy of Sciences (15:00~17:00)
9	12/5	Thu	Tashkent University of Architecture and Civil Engineering (TAQU) (10:00~12:00) Turin Polytechnic University in Tashkent (15:00~17:00)
10	12/6	Fri	UZ Standard (15:00-17:00)
11	12/7	Sat	Day off
12	2/8	Sun	Day off
13	12/9	Mon	Work at hotel (data review & analysis)
14	12/10	Tue	Ministry of Preschool and School Education (11:00~13:00) ToshuyjoyLITI (14:00~16:00)
15	12/11	Wed	ToshuyjoyLITI (10:00~10:30) Ministry of Health (12:00~14:00) Ministry of Higher Education, Science and Innovation (15:00~17:00)
16	12/12	Thu	Ministry of Sports (10:00~10:45) Ministry of Culture / Cultural Heritage Agency (11:00~13:00) Ministry of Emergency Situations (15:00~17:00)
17	12/13	Fri	TAQU (14:00~16:00)
18	12/14	Sat	Day off
19	12/15	Sun	Day off
20	12/16	Mon	Ministry of Economy and Finance (14:30~16:30)
21	12/17	Tue	Ministry of Investment, Industry and Trade (10:00~12:00 Online) ToshuyjoyLITI (13:00~18:00)

	Date		Masanori Kobayashi (Team Leader/ Plan for the Promotion of Seismic Retrofitting of Buildings) Seiichiro Fukushima (Seismic-Resistant Building (Seismic Technology)) Yasuhiro Amano (Assistant of the Plan for the Promotion of Seismic Retrofitting of Buildings)
			Itinerary
22	12/18	Wed	Agency for Management of State Assets (10:00~11:00) United Nations Development Programme (12:00~12:30 Online) World Bank (14:00~15:00) Asian Development Bank (15:00~15:30 Online) Khokimiyat - Tashkent City Administration (16:00~18:00)
23	12/19	Thu	Ministry of Construction, Housing and Communal Services (15:00~17:00)
24	12/20	Fri	JICA Uzbekistan Office (14:30~15:30) OZ 574D 20DEC TAS-ICN (22:20-08:15 21DEC)
25	12/21	Sat	OZ 104D 21DEC ICN-NRT (12:50-15:05)

The detailed schedule of the second Field Survey was as follows:

	Date		Masanori Kobayashi (Team Leader/ Plan for the Promotion of Seismic Retrofitting of Buildings) Seiichiro Fukushima (Seismic-Resistant Building (Seismic Technology)) Yasuhiro Amano (Assistant of the Plan for the Promotion of Seismic Retrofitting of Buildings)
			Itinerary
1	1/29	Wed	Kobayashi & Fukushima OZ 107D 29JAN NRT-ICN (09:00-11:35) OZ 573D 27NOV ICN-TAS (16:35-20:40)
2	1/30	Thu	Emergency Simulation Center of Ministry of Emergency Situations (10:00~12:00) Internal Meeting (PM)
3	1/31	Fri	Internal Meeting Submission of the Draft Final Report
4	2/1	Sat	Day off
5	2/2	Sun	Day off
6	2/3	Mon	Ministry of Digital Technologies (11:00~12:00) Ministry of Transport (16:00~17:00) Amano OZ 141D 3FEB NRT-ICN (11:35-14:35) OZ 573D 3FEB ICN-TAS (16:35-20:40)
7	2/4	Tue	On-site survey at the construction sites, the hospital, the school and the kindergarten (AM, PM) Uzsuvtaminot (16:00~17:00)

	Date		Masanori Kobayashi (Team Leader/ Plan for the Promotion of Seismic Retrofitting of Buildings) Seiichiro Fukushima (Seismic-Resistant Building (Seismic Technology)) Yasuhiro Amano (Assistant of the Plan for the Promotion of Seismic Retrofitting of Buildings)
			Itinerary
8	2/5	Wed	Cultural Heritage Agency (11:00~12:00) Khokimiyat - Tashkent City Administration (15:00~16:00)
9	2/6	Thu	Ministry of Construction, Housing and Communal Services (11:00-12:00) Earthquake Monitoring Center of Ministry of Emergency Situations (15:00~17:00)
10	2/7	Fri	State University of Transport (10:00-12:00) JICA Uzbekistan Office (15:00-16:00) OZ 574D 8FEB TAS-ICN (22:20-08:15 8FEB)
11	2/8	Sat	OZ 104D 8FEB ICN-NRT (12:40-14:55)

Appendix-B: List of References

Title	Year	Source / Author
Reports, Research Papers, Position Papers etc.		
MSK Intensity Scale as Compared with JMA Intensity Scale	1971	Takuzo Hirano and Kaoru Sato
Seismic hazard, seismic risk, principles of optimization of rehabilitation of existing dwelling stock building	2000	Shamil A Khakimov and Rustam S Ibragimov
Stress State of the Earth's Crust, Seismicity, and Prospects for Long-Term Forecast of Strong Earthquakes in Uzbekistan	2001	T.U. Artikov et al.
Seismic Code of Uzbekistan	2004	Nadira Mavlyanova et al.
Assessment of seismic risk in Tashkent, Uzbekistan and Bishkek, Kyrgyz Republic	2005	M. Erdik et al.
Reducing Vulnerability of School Children to Earthquakes	2009	UNCRD
Probabilistic seismic hazard assessment for Central Asia	2015	Shahid Ullah et al.
Central Asia earthquake catalogue from ancient time to 2009	2015	Natalya N. Mikhailova et al.
An overview on the seismic microzonation and site effect studies in Central Asia	2015	Marco Pilz et al.
中央アジア・コーカサス・モンゴル防災分野　情報収集・確認調査　ファイナル・レポート Information Collection Survey on Disaster Risk Management in Central Asia, Caucasus, and Mongolia: Final Report	2016	JICA
中央アジア地域　高度産業人材育成に係る情報収集・確認調査　ファイナル・レポート Information Collection Survey on the Development of Highly Skilled Industrial Human Resources: Final Report	2017	JICA
Seismic Renovation and Reconstruction of Schools in Uzbekistan	2017	Global Alliance for Disaster Risk Reduction in the Education Sector
Assessment of Seismic Vulnerability of Historic Buildings Based on their Current Condition Captured by Laser Scans and Retrofit Strategies	2017	Shakhzod Takhirov et al.
Identification of expected seismic activity areas by forecasting complex seismic-mode parameters in Uzbekistan	2018	T.U. Artikov et al.
Disaster Risk Finance Country Note: Uzbekistan	2018	World Bank
Contemporary Seismic Code of Russia and Other Countries of Former Soviet Union	2019	Nadira Mavlyanova
Complex of general seismic zoning maps OSR-2017 of Uzbekistan	2020	Turdali Usmanalievich Artikov et al.
Comprehensive Program on Structural Assessment of Bridges in Uzbekistan	2020	T. Rashidov et al.
United Nations Common Country Analysis: Uzbekistan	2020	UNDP
Regularities of Seismicity of Western and Central Uzbekistan (Southwestern Part of Western Tien-Shan Region)	2021	Makhira T. Usmanova and Abdusattor M. Sattarov
Relationship between Strong Earthquakes and Activation of Deep Faults in Central Asia (Uzbekistan): Numerical Simulation of Stress Field Variations	2021	I. U. Atabekov et al.
Mitigation of Seismic Risk in Urban Zones of Uzbekistan as Path for Strengthening of Sustainable Development of Region	2021	Mashrap Akhmedov and Rustam Abirov
Methods and results of long-term strong earthquakes forecast in the Uzbekistan territory	2021	T. U. Artikov et al.

Title	Year	Source / Author
中央アジア地域における観光開発分野に係る情報収集・確認調査ファイナル・レポート Information Collection Survey on Tourism Development in Central Asia: Final Report	2022	JICA
プロジェクト研究 地震分野の防災協力の再評価と重点分野の今後の方策検討 業務完了報告書 Project Research: Re-evaluation of cooperation in the field of earthquake disaster prevention and examination of future measures in priority fields: Completion Report	2022	JICA
Country Partnership Framework for the Republic of Uzbekistan for the period of FY2022-FY2026	2022	World Bank Group
Resilient Tashkent Inputs into Urben Resilience Strategy and Investment Program	2022	World Bank
Country Risk Profile Uzbekistan TA-9878 REG: Developing a Disaster Risk Transfer Facility in the Central Asia Regional Economic Cooperation Region	2022	Central Asia Regional Economic Cooperation Program
Narrowing the disaster risk protection gap in Central Asia	2022	ADB
Inclusive insurance and risk financing in Uzbekistan Snapshot and way forward 2022	2022	UNDP
Comparison of Seismic Hazard Assessments Obtained with the Probabilistic and Probabilistic-Deterministic Approaches for the Territory of Uzbekistan	2022	R. S. Ibragimov et al.
ウズベキスタン共和国 JICA 国別分析ペーパー JICA Country Analysis Paper for the Republic of Uzbekistan	2023	JICA
Global Earthquake Model v2023.0.0: Uzbekistan	2023	GEM
Harmonizing seismicity information in Central Asian countries: earthquake catalog and active faults	2023	Valerio Poggi et al.
Regional seismic risk assessment based on ground conditions in Uzbekistan	2023	Vakhitkhan Alikhanovich Ismailov et al.
Road map to developing a regional risk transfer facility for CAREC	2023	ADB
Seismic resistance evaluation of multi-story buildings using the modern LIRA-SAPR SP	2023	K.D. Salyamova et al.
Assessment of possible damages of residential buildings in the Fergana Valley of Uzbekistan	2023	Vladimir Kondratiev et al.
ウズベキスタンの建築基準規制 2024 年 1 月時点 Uzbekistan Building Standards Regulations as of January 2024	2024	国土交通省 Ministry of Land, Infrastructure, Transport and Tourism of Japan
Comparison of current and expired norms for the development of methods for checking and monitoring the seismic resistance of buildings	2024	Shodiljon Umarov et al.
ADB Country Partnership Strategy: Uzbekistan, 2024–2028	2024	ADB
Uzbekistan 2024 IFRC network country plan	2024	Red Crescent Society of Uzbekistan
Seismic risk assessment in the countries of Central Asia	-	Sergey Tyagunov et al.
Risk Assessment for Central Asia and Caucasus Desk Study Review	-	Central Asia and Caucasus Disaster Risk Management Initiative
Priority areas of activities to reduce the risk of natural disasters in the Republic of Uzbekistan	-	Ministry of Emergency Situations, Uzbekistan
Strengthening disaster resilience and accelerating implementation of Sendai Framework for Disaster Risk Reduction in Central Asia 2019-2023 Final Report	-	UNDRR
Strengthening disaster risk management capacities in Uzbekistan	-	UNDP

Title	Year	Source / Author
Laws and Regulations of the Republic of Uzbekistan		
Law of the Republic of Uzbekistan #713: On ensuring seismic safety of the population and territory of the Republic of Uzbekistan	2021	Laws and regulations of Uzbekistan
Law of the Republic of Uzbekistan #790: On the protection of the population and territories from natural and man-made emergencies	2022	Laws and regulations of Uzbekistan
Law of the Republic of Uzbekistan #1015: About telecommunications	2024	Laws and regulations of Uzbekistan
Decree of the President of the Republic of Uzbekistan #1378: On the establishment of the Ministry of Emergency Situations of the Republic of Uzbekistan	1996	Laws and regulations of Uzbekistan
Resolution of the President of the Republic of Uzbekistan #3857 On measures to increase the efficiency of the preparation and implementation of projects with the participation of international financial institutions and foreign government financial organizations	2018	Laws and regulations of Uzbekistan
Resolution of the President of the Republic of Uzbekistan #4794: On measures to fundamentally improve the system of ensuring seismic safety of the population and territory of the Republic of Uzbekistan	2020	Laws and regulations of Uzbekistan
Decree of the President of the Republic of Uzbekistan #60: On the development of strategy of New Uzbekistan for 2022-2026	2022	Laws and regulations of Uzbekistan
Decree of the President of the Republic of Uzbekistan #144: On measures to further improve the seismic safety system of the Republic of Uzbekistan	2022	Laws and regulations of Uzbekistan
Resolution of the President of the Republic of Uzbekistan #241 On additional measures for the development of preschool and school education	2022	Laws and regulations of Uzbekistan
Decree of the President of the Republic of Uzbekistan #158: On the Uzbekistan - 2030 Strategy	2023	Laws and regulations of Uzbekistan
Resolution of the President of the Republic of Uzbekistan #158: On additional measures to further improve the system of ensuring seismic safety of the population and territory of the Republic of Uzbekistan	2023	Laws and regulations of Uzbekistan
Resolution of the President of the Republic of Uzbekistan #161: On measures to increase the earthquake resistance of buildings and structures and improve seismic risk monitoring activities	2024	Laws and regulations of Uzbekistan
Resolution of the Cabinet of Ministers #558: On the state system of prevention and action in emergency situations of the Republic of Uzbekistan	1997	Laws and regulations of Uzbekistan
Resolution of the Cabinet of Ministers #455: On the classification of emergency situations of man-made, natural and environmental nature	1998	Laws and regulations of Uzbekistan
Resolution of the Cabinet of Ministers #71: On approval of the state program for forecasting and preventing emergency situations	2007	Laws and regulations of Uzbekistan
Resolution of the Cabinet of Ministers #208: On approval of a comprehensive program for preparing the population for action in emergency situations (natural and man-made) caused by earthquakes	2011	Laws and regulations of Uzbekistan
Resolution of the Cabinet of Ministers #4703: On measures to radically improve the personnel training system in the transport sector	2015	Laws and regulations of Uzbekistan
Resolution of the Cabinet of Ministers #299: On measures to implement the "Sendai Framework for Disaster Risk Reduction 2015-2030" In the Republic of Uzbekistan	2019	Laws and regulations of Uzbekistan
Resolution of the Cabinet of Ministers #754: On improving the procedure for preparing the population for emergency situations and civil protection	2019	Laws and regulations of Uzbekistan

Title	Year	Source / Author
Resolution of the Cabinet of Ministers #846: On approval of the national list of real estate objects of tangible cultural heritage	2019	Laws and regulations of Uzbekistan
Resolution of the Cabinet of Ministers #681: On the organization of the activities of the Fund for Support of the Field of Seismology, Seismic Stability of Structures and Seismic Safety under the Cabinet of Ministers of the Republic of Uzbekistan	2020	Laws and regulations of Uzbekistan
Resolution of the Cabinet of Ministers #603: On the introduction of a procedure for issuing scientific conclusions on seismic resistance for buildings and structures of hazard category iv planned for construction in seismically active zones of the republic	2022	Laws and regulations of Uzbekistan
Resolution of the Cabinet of Ministers #362 On the development and effective implementation of a national action plan on climate change and natural disaster risk	2023	Laws and regulations of Uzbekistan
Norms and Technical Standards of the Republic of Uzbekistan		
KMK2.01.03-1: Construction in seismic areas	2019	Normative documents of Uzbekistan
SNHQ 1.04.01-23 On approval of urban norms and rules “procedure for studying and monitoring the technical condition of buildings and structures”	2024	Normative documents of Uzbekistan

In addition, the following data and information were made available during this survey.

- Presentation material of Institute of Mechanics and Seismic Stability of Structures
- Presentation material of ToshuyjoyLITI
- List of pre-school and school buildings in Tashkent City (provided by Tashkent City Municipality)
- List of hospital buildings in Tashkent City (provided by Tashkent City Municipality)
- Supplementary explanatory documents from the Ministry of Emergency Situations