

# Recommendations for RIGHT+ School Infrastructure at Scale in Tajikistan



Final Report

OCTOBER 2025



**GFDRR**  
Global Facility for Disaster Reduction and Recovery



Administered by  
**THE WORLD BANK**  
IBRD • IDA | WORLD BANK GROUP



# Recommendations for RIGHT+ School Infrastructure at Scale in Tajikistan

Final Report

OCTOBER 2025



**GFDRR**  
Global Facility for Disaster Reduction and Recovery



Administered by  
**THE WORLD BANK**  
IBRD • IDA | WORLD BANK GROUP

**© 2026 International Bank for Reconstruction and Development / The World Bank**

1818 H Street NW, Washington, DC 20433

**Telephone:** +1-202-473-1000;

**Internet:** [www.worldbank.org](http://www.worldbank.org)

**Some rights reserved.**

This work is a product of the staff of The World Bank and the Global Facility for Disaster Reduction and Recovery (GFDRR). The findings, interpretations, and conclusions expressed in this work do not necessarily reflect the views of The World Bank, its Board of Executive Directors, or the governments they represent. The World Bank does not guarantee the accuracy, completeness, or currency of the data included in this work and does not assume responsibility for any errors, omissions, or discrepancies in the information, or liability with respect to the use of or failure to use the information, methods, processes, or conclusions set forth. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment on the part of The World Bank concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

Nothing herein shall constitute or be construed or considered to be a limitation upon or waiver of the privileges and immunities of The World Bank, all of which are specifically reserved.

**Rights and Permissions.** This work is subject to copyright. Because The World Bank encourages dissemination of its knowledge, this work may be reproduced, in whole or in part, for non-commercial purposes as long as full attribution to this work is given.

**Attribution.** Please cite the work as follows: Shmis, Tigran; Wu, Jingzhe; Ustinova, Maria; Fernandez, Rafeal; Sadegh, Jasmin; Brzev, Svetlana; Temurov, Mukim; Tachibana, Mio, 2025. *Recommendations for RIGHT+ School Infrastructure at Scale in Tajikistan*. Washington, DC: World Bank. License: Creative Commons Attribution CC BY 4.0 IGO

**Translations.** If you create a translation of this work, please add the following disclaimer along with the attribution: This translation was not created by The World Bank and should not be considered an official World Bank translation. The World Bank shall not be liable for any content or error in this translation.

**Adaptations.** If you create an adaptation of this work, please add the following disclaimer along with the attribution: *This is an adaptation of an original work by The World Bank. Views and opinions expressed in the adaptation are the sole responsibility of the author or authors of the adaptation and are not endorsed by The World Bank.*

**Third-party content.** The World Bank does not necessarily own each component of the content contained within work. The World Bank therefore does not warrant that the use of any third party-owned individual component or part contained in the work will not infringe on the rights of those third parties. The risk of claims resulting from such infringements rests solely with you. If you wish to reuse a component of the work, it is your responsibility to determine whether permission is needed for that reuse and to obtain permission from the copyright owner. Examples of components can include, but are not limited to, tables, figures, or images.

All queries on rights and licenses should be addressed to the P LE Team, The World Bank, 1818 H Street NW, Washington, DC 20433, USA; e-mail: [physical\\_learning\\_environments@worldbank.org](mailto:physical_learning_environments@worldbank.org).

# Acknowledgments

This report was made possible with the financial support of the Japan-World Bank Program for Mainstreaming Disaster Risk Management in Developing Countries, which is financed by the Government of Japan and receives technical support from the World Bank Tokyo Disaster Risk Management Hub and is managed by the World Bank-led Global Facility for Disaster Reduction and Recovery (GFDRR).

This report is prepared by the World Bank (WB) task team under the project, consisting of Tigran Shmis (Task Team Leader, Senior Education Specialist), Jingzhe Wu (Disaster Risk Management Consultant), Maria Ustinova (Education Consultant), Rafael Fernandez (Disaster Risk Management Consultant), Jasmin Sadegh (Disaster Risk Management Consultant), Dr. Svetlana Brzev (Senior Earthquake Engineer Consultant), Mukim Temurov (Senior Economist Consultant), and Mio Tachibana (Architect Consultant).

The task team would like to extend special thanks to the State Unitary Enterprise, Research Institute of Construction and Architecture (GUP NIISA), for their important inputs. Further, the task team would like to also acknowledge their gratitude for the valuable feedback from the Ministry of Education and Science, especially its team leading the implementation of “Learning Environment – Foundation of Quality Education” (LEARN) project, as well as from WB peer reviewers, including Carina Fonseca Ferreira (Disaster Risk Management Specialist), Diego Ambasz (Senior Education Specialist), Ahsan Tehsin (Senior Disaster Risk Management Specialist).

The team also appreciates the support of the Country Management Unit, including Ozan Sevimli (Country Manager), Rakhymzhan Assangaziyev (Senior Operations Officer), as well as the support of Education Global Practice Rita Almeida (Practice Manager), and Tazeen Fasih (Program Leader, Lead Economist).



# Table of Contents

List of Figures.....	vii
List of Tables.....	ix
Acronyms .....	xi
Executive Summary.....	xiii
1. Introduction .....	1
1.1 Background .....	2
1.2 Scope of Report .....	4
2. Education Infrastructure Policies .....	5
2.1 Education System and Infrastructure Needs .....	6
2.2 Priorities for Education Infrastructure in Tajikistan .....	10
3. School Infrastructure Baseline .....	12
3.1 Overview.....	13
3.2 School Building Types .....	14
3.3 Functional Conditions in Schools .....	20
4. School Infrastructure Financial Environment .....	23
5. Multi-Hazard and Risk Assessment of School Infrastructure .....	29
5.1 Overview of Natural and Climate Hazards in Tajikistan	30
5.2 Earthquake Risk in Schools .....	30
5.3 Flood Hazard and Exposure.....	36
6. Prioritization Framework for RIGHT+ School Infrastructure	39
6.1 Prioritization Framework.....	40
6.2 Case Study .....	43
6.2.1 Intervention and investment needs at national scale .....	43
6.2.2 Prioritization of disaster resilient facilities .....	45
6.2.3 Regional examples .....	47
7. Recommendations on Intervention Strategy for School Infrastructure .....	50

7.1 Disaster Resilient Interventions .....	51
7.1.1 Lines of intervention.....	52
7.1.2 Retrofit recommendations.....	53
7.1.3 Improvements to relevant technical standards and compliance .....	54
7.2 Inclusive interventions .....	57
7.3 Green interventions.....	59
7.4 Healthy interventions .....	60
7.5 Teaching and learning conducive interventions .....	61
8. Outlook on Implementation Pathways.....	63
8.1 Establishing effective implementation framework .....	64
8.2 Adopting strategic solutions .....	64
8.3 Building enabling environment.....	65
8.4 Strengthening implementation capacity .....	66
References .....	67
Annex 1.....	69

## List of Figures

Figure ES1. RIGHT+ framework contributes to learning outcomes .....	xiv
Figure ES2. Estimated lines of intervention for existing school buildings in Tajikistan .....	xiv
Figure ES3. Estimated lines of intervention cost by region ....	xiv
Figure ES4. Cumulative benefit versus intervention cost by Resilient BCR ranking of schools under Program 1: Disaster Resilient Facilities.....	xv
Figure 1. Overview of the report.....	3
Figure 2. Number of schools by region.....	13
Figure 3. Distribution of schools and students by region....	13
Figure 4. Distribution of construction year of buildings from 3484 schools by region.....	15
Figure 5. Statistical extrapolation of school building types from 361 sampled schools to the national school infrastructure baseline .....	18
Figure 6. School building construction types across the country.....	19
Figure 7. School building construction types in Tajikistan ..	19
Figure 8. School building construction types per region.....	20
Figure 9. Number of stories of school buildings by region ..	20
Figure 10. Number of shifts in schools per region.....	21
Figure 11. Access to water in schools per region .....	21
Figure 12. Availability of power supply in schools per region	22
Figure 13. Availability of computer labs in schools per region .....	22
Figure 14. Availability of internet connection in schools per region .....	22
Figure 15. State and education expenditure trends (Million TJS, 2015 prices), 2015-2023 .....	24
Figure 16. Capital expenditure on school infrastructure from republican and local budgets (million TJS, 2015 real value) .....	25
Figure 17. Capital expenditure trends as a percentage of budgeted amount, 2015-2023 (%).....	25
Figure 18. Overall scheme of the probabilistic earthquake risk assessment.....	31
Figure 19. Exposure of schools and students to earthquake in Tajikistan (PGA, 475 return period)	32
Figure 20. Vulnerability curves adopted in the earthquake risk assessment: (a) for fatalities; (b) for economic losses.....	33
Figure 21. Vulnerability functions adjusted by building deterioration conditions .....	34

Figure 22. Normalized average annual student fatalities from earthquake damages by district (% of national total) .....	34
Figure 23. Normalized average annual economic losses from earthquake damages by district (% of national total) .....	34
Figure 24. Average annual fatalities and economic losses per region (as % of national total) .....	35
Figure 25. Average annual fatalities and economic losses by building typology (as % of national total) .....	35
Figure 26. Base flood elevations of 3705 public schools in Tajikistan .....	37
Figure 27. Main source of flood type (pluvial or fluvial) public schools are exposed to by region .....	37
Figure 28. Base flood elevation categories of public schools by region .....	38
Figure 29. Proposed intervention programs identified for schools in Tajikistan .....	43
Figure 30. Estimated distribution of schools per intervention program .....	43
Figure 31. Estimated lines of intervention for existing school buildings in Tajikistan .....	44
Figure 32. Estimated lines of intervention cost by region .....	44
Figure 33. Estimated lines of intervention cost by school building type .....	44
Figure 34. Resilience BCR of schools by district under proposed Program 1: Disaster Resilient Facilities .....	45
Figure 35. Cumulative benefit versus intervention cost by Resilient BCR ranking of schools under Program 1: Disaster Resilient Facilities .....	45
Figure 36. Prioritized school building types to be intervened by investment scenario under Program 1: Disaster resilient facilities .....	46
Figure 37. RIGHT+ framework contributes to learning outcomes .....	51
Figure 38. Logic tree to identify line of intervention for existing schools .....	52
Figure 39. Types of scale-down space .....	59
Figure 40. Examples of multi-functional space combining school square, canteen, auditorium, and learning space for group or individual work .....	62
Figure 41. Wider classrooms offer a variety of furniture layout and learning .....	62
Figure 42. Types of common spaces and their flexible function .....	62

## List of Tables

Table 1.	Educational system of Tajikistan.....	6
Table 2.	Access to education by level of education .....	6
Table 3.	State programs that include school infrastructure component .....	8
Table 4.	Major International Donor-Financed School Construction Programs .....	9
Table 5.	Key priority areas of National Framework for Education Development.....	11
Table 6.	Distribution of construction year of the 361 sampled schools across the country .....	14
Table 7.	Distribution of construction types of the 361 sampled schools across the country .....	15
Table 8.	Typical characteristics and vulnerabilities of school construction types in Tajikistan .....	16
Table 9.	Mapping of financing mechanisms, key stakeholders and relevant roles, responsibilities and scopes.....	26
Table 10.	Distribution of schools with respect to their exposed earthquake hazard level (475-year return period PGA) .....	32
Table 11.	Base flood elevation depth categories, considerations and recommendations.....	36
Table 12.	Base flood elevation categories of public schools by region.....	38
Table 13.	Proposed prioritization framework for RIGHT+ school infrastructure at scale.....	42
Table 14.	Benefit versus cost of investment scenarios under Program 1: Disaster Resilient Facilities .....	46
Table 15.	Typical seismic retrofitting solutions per relevant school building type.....	55
Table 16.	Why do inclusive schools matter? .....	58



# Acronyms

<b>ADB</b>	Asian Development Bank
<b>ASCE</b>	American Society of Civil Engineers
<b>ASSES</b>	Agency for Supervision in the Field of Education and Science under the President
<b>BCR</b>	Benefit cost ratio
<b>CXCF</b>	Complex masonry with concrete framing
<b>DRS</b>	Districts of Republican Subordination
<b>EAHL</b>	Expected Annual Human Losses
<b>EE</b>	Energy Efficiency
<b>EMIS</b>	Education Management Information System
<b>FEMA</b>	Federal Emergency Management Agency
<b>GBAO</b>	Gorno Badakhshan Autonomous Region
<b>GDP</b>	Gross Domestic Product
<b>GEM</b>	Global Earthquake Model
<b>GPE</b>	Global Partnership for Education
<b>GUP NIISA</b>	State Unitary Enterprise, Research Institute of Construction and Architecture
<b>HCI</b>	Human Capital Index
<b>ICT</b>	Information and communication technology
<b>IPF</b>	Investment Project Financing
<b>IsDB</b>	Islamic Development Bank
<b>KfW</b>	Kreditanstalt für Wiederaufbau
<b>LEARN</b>	Learning Environment – Foundation of Quality Education
<b>LED</b>	Light emitting diode
<b>MHM</b>	Menstrual Hygiene Management
<b>MoES</b>	Ministry of Education and Science
<b>NFED</b>	National Framework for Education Development
<b>NSED</b>	National Strategy for Education Development
<b>NSIFT</b>	National Social Investment Fund of Tajikistan
<b>PC1</b>	Precast large panel reinforced concrete wall system
<b>PC2</b>	Precast reinforced concrete frames with exterior precast reinforced concrete wall panels
<b>PGA</b>	Peak Ground Acceleration
<b>PIP</b>	Public Investment Programs
<b>PLE</b>	Physical Learning Environment
<b>PSHA</b>	Probabilistic Seismic Hazards Assessment

<b>PVC</b>	Polyvinyl chloride
<b>RC</b>	Reinforced Concrete
<b>RIGHT+</b>	Resilient, Inclusive, Green, Healthy, Teaching and Learning Conducive, and Effectively Implemented
<b>RSRS</b>	Roadmap for Safer and Resilient Schools
<b>SFD</b>	Saudi Fund for Development
<b>SNiP RT</b>	Construction Norms and Regulations in Republic of Tajikistan
<b>SUS</b>	System Usability Scale
<b>TA</b>	Technical Assistance
<b>TJS</b>	Tajikistani Somoni
<b>UN</b>	United Nations
<b>UNICEF</b>	United Nations Children's Fund
<b>URM2 or URM4</b>	Unreinforced Stone masonry
<b>URM7</b>	Unreinforced masonry
<b>USD</b>	United States Dollar
<b>USGS</b>	United States Geological Survey
<b>VOC</b>	Volatile Organic Compounds
<b>WASH</b>	Water, Sanitation and Hygiene
<b>WB</b>	World Bank

# Executive Summary

**Tajikistan’s school infrastructure faces compounding pressures from rapid enrollment growth, aging and vulnerable building stock, and high exposure to natural hazards.** Enrollment growth has outpaced school construction, with 88% students in double-shift and 5% in triple-shift schools; roughly two-thirds of buildings predate modern seismic codes and more than 50% are highly vulnerable typologies requiring replacement (adobe, Finnish-type, unreinforced stone masonry, unreinforced brick masonry). About 68% of schools are exposed to strong earthquakes ( $PGA \geq 0.3g$  at design level), and roughly a quarter of schools are exposed to fluvial or pluvial floods at design level, while service gaps exist in water, continuous power, WASH, and internet constrain learning, especially outside Dushanbe. Tajikistan’s Human Capital Index remains the lowest in Europe and Central Asia, underscoring the urgency of investing in resilient, inclusive, and learning conducive school environments.

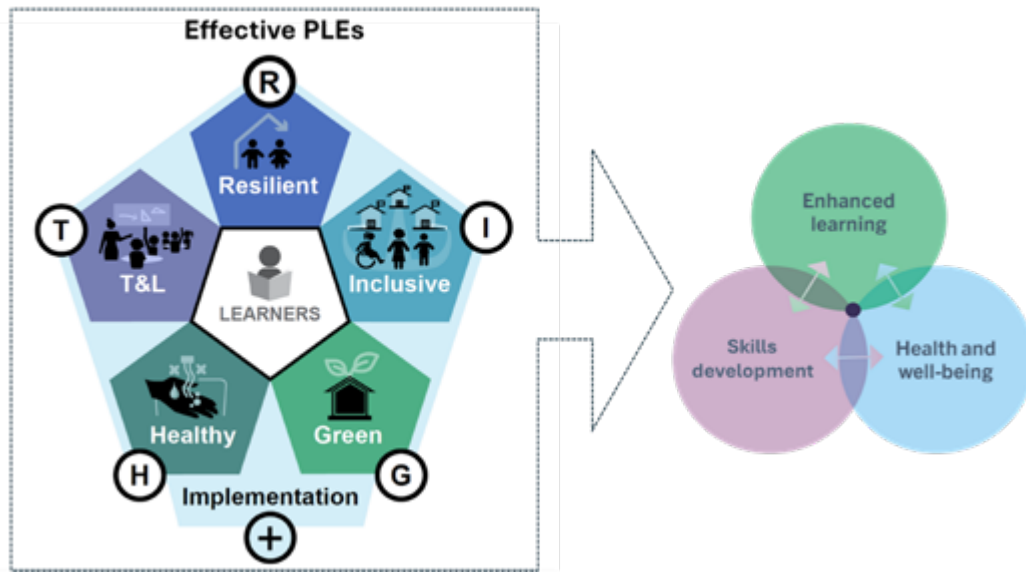
**The proposed approach in this report aligns with national strategies and the World Bank’s RIGHT+ framework and Roadmap for Safer and Resilient Schools to deliver resilient, inclusive, green, healthy, and learning-conducive schools at large scale.** The World Bank’s Resilient, Inclusive, Green, Healthy, Teaching and learning conducive, plus effectively implemented (RIGHT+) framework for physical learning environments (PLEs) outlines six key elements to guide effective education infrastructure, while the Roadmap for Safer and Resilient Schools (RSRS) provides a step-by-step guide to help governments design scalable school intervention and investment strategies. The approach aims to support the National Strategy for Education Development (2021–2030) and the 2025 National Framework for Education Development (NFED), where the ongoing WB investment project financing (IPF) “Learning

Environment – Foundation of Quality Education Project” (P177475) serves as a platform for piloting and facilitating scale-up.

**Through the diagnosis of the education infrastructure policies and baseline as well as the assessment of exposure and risks of schools to earthquake and flood, this report proposes comprehensive intervention strategy for creating RIGHT+ schools in Tajikistan.** The lines of intervention includes relocating, retrofitting and replacing existing school infrastructure stock. While replacement is recommended for non-engineered or highly vulnerable school building types, including adobe, Finnish-type, unreinforced stone masonry and unreinforced brick masonry, the other major school building types could be retrofitted when technically viable and economically feasible (retrofit cost < 70% replacement cost), which includes complex masonry with concrete framing, Precast reinforced concrete frames with exterior precast reinforced concrete wall panels, and Precast large panel reinforced concrete wall system. For all intervention lines, detailed recommendations are provided for implementing comprehensive and integrated solutions to create effective RIGHT+ PLEs that contribute to the learning outcome through enhanced learning, health and well-being and skills development as shown below.

**As part of the intervention strategy, the standards of school design and construction need to be strengthened, especially the seismic design code, to safeguard effective implementation of RIGHT+ PLEs.** With the upcoming activities for implementing the NFED, in particular the physical environment pillar, there are opportunities to update the current seismic design code SNiP RT 22-07-2018 to integrate international best practices, especially to ensure safer ductile design and verifications for

Figure ES1. RIGHT+ framework contributes to learning outcomes



both structural and nonstructural safety with respect to earthquakes. Additionally, standardizing school designs that integrate inclusive, green, healthy and teaching-learning conducive features will further contribute to the objectives of the NFED.

Based on the identified intervention needs, preliminary cost estimation indicates a total USD \$5.65 billion investment needs at national scale, where 55% from replacement and

45% from retrofitting. As shown below, with the replacements needed for non-engineered or highly vulnerable school building types, as well as those not technically viable and economically feasible to retrofit, Dushanbe expects most of existing schools can be improved through retrofitting, while Gorno-Badakhshan Autonomous region expects most of existing schools to be replaced, and other regions expects relatively similar amount of replacement and retrofitting.

Figure ES2. Estimated lines of intervention for existing school buildings in Tajikistan

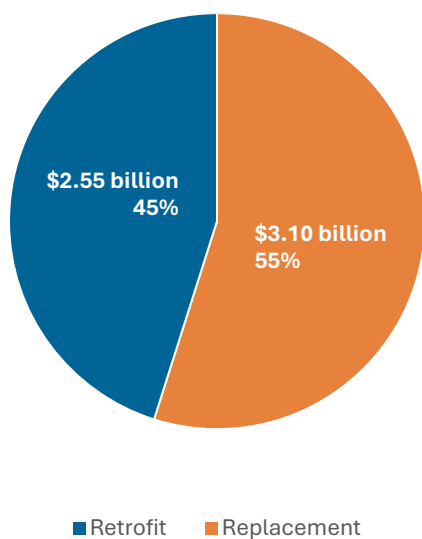
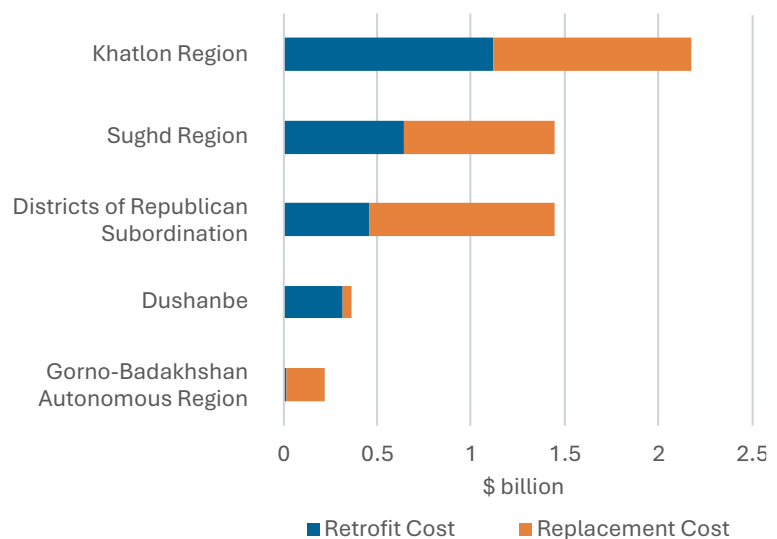


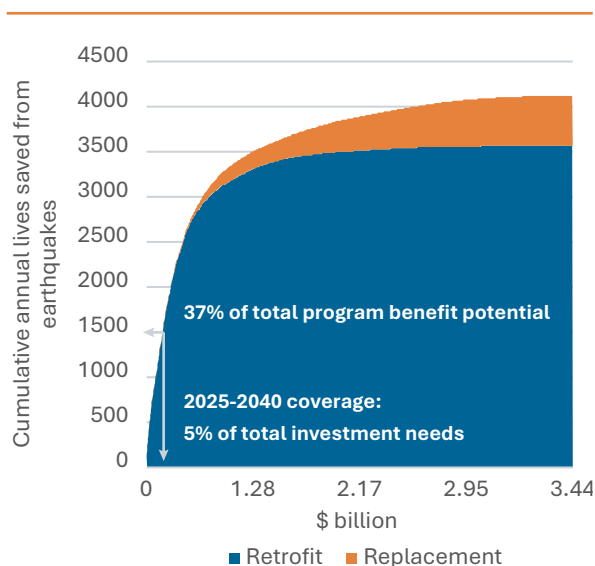
Figure ES3. Estimated lines of intervention cost by region



For an effective and efficient roll-out of the NFED on RIGHT+ physical environment in schools, strategic programming with tailored eligible and prioritization criteria is proposed to ensure RIGHT+ improvements to school infrastructure at large scale. Acknowledging the approach of comprehensive and integrated RIGHT+ intervention solutions, four programs summarized below are proposed based on the draft activities planned by the Ministry of Education and Science (MoES) to strategize the rolling out of NFED at national scale.

**1) Disaster resilient facilities:** It finances replacements/retrofits of schools in high-seismic/flood areas and schools with emergency conditions, and prioritized by a Resilience Benefit Cost Ratio (BCR, lives saved per US\$ million) to maximize the resilience outcome from investment. As demonstrated in the case study results below, through the proposed prioritization criteria based on a resilience BCR, during the planned implementation timeframe of 2025-2040, the coverage of 5% investment needs under the program can already unlock 37% of the total benefit potential of the program.

**Figure ES4. Cumulative benefit versus intervention cost by Resilient BCR ranking of schools under Program 1: Disaster Resilient Facilities**



**2) Inclusive, teaching and learning conducive facilities:** It includes improving the fire safety, accessibility, and flexible learning environment for schools that are relatively overcrowded or located in districts with lower level of socio-economic development, and prioritized by number of students per existing student seat and performance of the school to allow the program maximize the contribution to improving learning outcome of more students.

**3) Green and healthy facilities:** It aims to enhance the provision of energy and water efficient facilities, healthy indoor environments and quality WASH facilities for schools with basic utilities but need renovation, and prioritized by the number of students to maximize the beneficiary under the program.

**4) Provision of basic utilities:** It addresses the gaps of continuous power supply, water supply and internet connection for schools without these basic utilities, and prioritized by the number of students and districts with lower level of socio-economic development.

The financing of NFED implementation can be augmented through strengthened investment strategy with enhanced coordination between central and local levels, as well as multi-sourced financing engaging international development partners and the private sector to accelerate results. Amid the recent growth of public education spending (increased by 68% during 2015–2023), about 72% was from local budget, 19% from the republican budget, and 8.6% from PIP/special funds. When it comes to capital investment in education infrastructure, the local budget demonstrates a comparable role to the republican budget, indicating the importance of enhanced coordination between the central and local levels of capital investment for education infrastructure. In addition, international development partners have been contributing a significant portion to large scale investments on education infrastructure, while the private sector has also been contributing a considerable amount of new school seats. Strategically coordinating and consolidating cen-

tral/local budgets, PIPs, development partners, as well as PPP and innovative instruments (e.g., diaspora bonds, mobile channels) can crowd in resources and smooth multi-year programming for the NFED roll-out on physical environment enhancement in schools.

**This report also highlights key recommendations for comprehensive and strategic implementation pathways of scaling up RIGHT+ school infrastructure for rolling out the NFED.**

This includes the following:

- 1) Establishing effective implementation framework,** including clear and correlated political, institutional and regulatory framework, comprehensive planning and coordination of all relevant financing mechanisms, streamlined school infrastructure baseline data management under the Education Management Information System (EMIS), and robust monitoring and evaluation framework and mechanisms.
- 2) Adopting strategic solutions,** including tailored prioritization criteria to the specific objective of each program, relevant financial instruments linked to specific priorities, and adoption of a phased approach and multi-year programming.
- 3) Building enabling environment,** including well-maintained and up-to-date school infrastructure baseline database, and improved standards as well as standard school designs.
- 4) Strengthening implementation capacity,** including institutional capacity at all government levels for school infrastructure management, technical capacity of school infrastructure managers, architects, and engineers, and awareness raising on climate and disaster risks, preparedness and response for school communities.



# 1. Introduction

## 1.1 Background

Tajikistan faces significant challenges related to its school infrastructure, heavily influenced by the country’s vulnerability to natural disasters and climate change. The Republic of Tajikistan is highly susceptible to floods, mudflows, and earthquakes, which have severely affected rural livelihoods and national food security. Between 1992 and 2016, natural disasters impacted approximately 7 million people and caused economic losses exceeding US\$1.8 billion.<sup>1</sup> Climate projections indicate that by 2050, average annual temperatures in Tajikistan are expected to rise by 2°C, while precipitation may decrease by 5%, leading to drier winters and wetter summers.<sup>2</sup> These changes are likely to increase the frequency of floods, mudflows, and droughts, exacerbating the vulnerability of the population, particularly in rural areas where 72% of the population resides.<sup>3</sup>

The education sector reflects these broader socio-environmental challenges. Despite high access to general secondary education, Tajikistan ranks lowest in the Human Capital Index (HCI) among Europe and Central Asia countries. A child born in 2020 is expected to attend 10.9 years of schooling by age 18; however, when adjusted for learning outcomes, this figure drops to 6.8 years, down from 7.7 years in 2018.<sup>4</sup> Inadequate learning environments contribute significantly to learning poverty: 88.2% of students attend double-shift schools, 5.2% attend triple-shift schools due to insufficient classrooms, nearly 90% of school buildings require major repairs, and only 3% of schools have separate toilets for students with disabilities (CABAR.asia, 2021).

The National Strategy for Education Development (NSED) of the Republic of Tajikistan for 2021–2030<sup>5</sup> is the country’s main policy document guiding education reforms and develop-

ment (Global Partnership for Education, 2020). Its long-term goal is to create an effective, high-quality, and inclusive education system accessible to all throughout life, which contributes to intellectual development, employability, and overall well-being of the population (Schools2030, 2025). The NSED aims to provide the country’s economy with competent workers supported by appropriate infrastructure based on modern and innovative technologies. It aligns with the National Development Strategy and international frameworks such as the Sustainable Development Goals (SDGs) and the Sendai Disaster Risk Reduction Framework. The strategy emphasizes equal access and participation at all education levels, quality and relevance of education, and strengthened governance. It also prioritizes safe, socially inclusive schools that integrate disaster risk management and climate adaptation measures at all administrative levels.

Within this framework, physical learning environments (PLEs) are recognized as vital to improving education outcomes amid the global learning crisis and increasing climate-related risks. Tajikistan has now launched a new National Framework for Education Development (NFED), including a pillar on physical environment aiming for comprehensive learning environment improves. The World Bank’s RIGHT+ framework (World Bank, 2025) for PLEs outlines six strategic pillars to guide effective education infrastructure: building resilient environments that protect safety and ensure continuity; promoting inclusive access; ensuring green, environmentally sustainable facilities; creating healthy spaces that protect well-being; fostering teaching- and learning-conducive conditions; and ensuring effective implementation to maximize impact. Complementing this, the World Bank’s Roadmap for Safer and Resilient

---

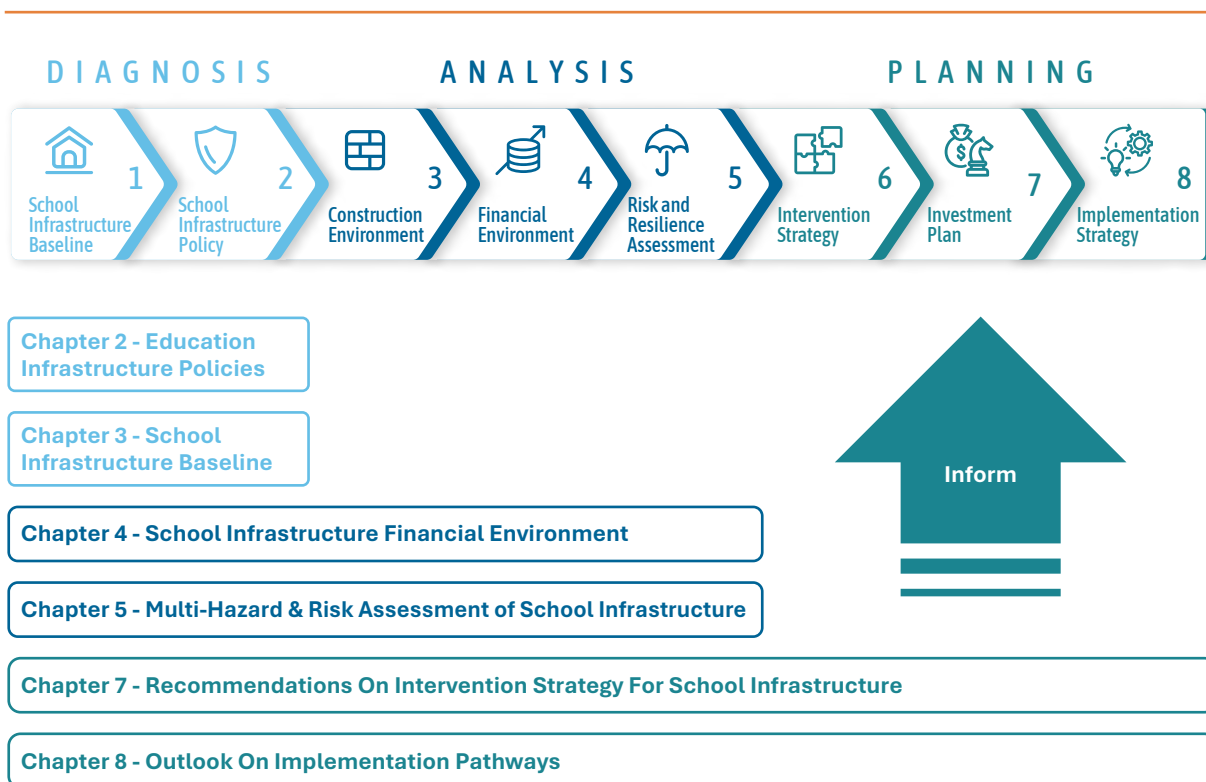
1. EM-DAT: The Emergency Events Database, Université catholique de Louvain (UCL)–CREDES, D. Guha-Sapir, Brussels, Belgium, [www.emdat.be](http://www.emdat.be)  
 2. Institute of water problems, hydropower, and ecology of the national academy of sciences of Tajikistan. <https://www.imoge.tj/en/publication/articles/climate-change-and-temperature-increase-future-forecast#:~:text=During%20this%20period%2C%20average%20annual,whole%2C%E2%80%9D%20concluded%20Nomvar%20Qurbon>  
 3. World Bank Open Data. <https://data.worldbank.org/country/tajikistan>  
 4. World Bank Human Capital Index. <https://databank.worldbank.org/source/human-capital-index>  
 5. Republic of Tajikistan Government. National Strategy for Education Development of the Republic of Tajikistan for the Period Until 2030. Approved 29 Sept. 2020.

Schools (RSRS) (World Bank, 2023) provides a step-by-step guide to help governments design scalable school intervention and investment strategies, including disaster risk reduction as well as recovery and reconstruction of schools (World Bank, 2023). These frameworks offer critical guidance to enhance Tajikistan’s NFED, assisting the Ministry of Education and Science (MoES) in achieving a safe, inclusive, and high-quality education system for the 21<sup>st</sup> century.

In support of this agenda of the Government of Tajikistan, the World Bank’s Investment Project Financing (IPF) "Learning Environment – Foundation of Quality Education Project" (P177475,

referred as LEARN project) with US\$50 investment million aims to enhance the quality of teaching and learning environments general secondary schools, including supporting the establishment of a new national framework for teaching and learning environment. Under the IPF, the technical assistance (TA) "Scaling up resilient school infrastructure in the Republic of Tajikistan," funded by the Japan-World Bank program, aims to inform the MoES in the preparation and implementation of the new NFED, in particular its physical environment pillar, through supporting the development of a roadmap for scaling up RIGHT+ schools nationwide and relevant capacity strengthening.

**Figure 1. Overview of the report**



## 1.2 Scope of Report

The report summarizes the key findings and recommendations from the TA project. It provides a comprehensive assessment of Tajikistan's education infrastructure policies, examining current baseline conditions and pathways toward building RIGHT+ school infrastructure at national scale. The integration of the World Bank's RIGHT+ framework provides a comprehensive approach to improving the physical learning environment, which enhances the disaster resilience of schools as well as providing quality learning environments that are inclusive, green, healthy, teaching and learning conducive.

The study documented in this report has been overall guided by the RSRS. The report is structured in the Chapters discussed below. As illustrated in [Figure 1](#), the study follows the RSRS steps to inform effective large scale intervention strategy, investment planning and implementation for improving RIGHT+ school infrastructure.

- **Chapter 2 - Education Infrastructure Policies:** Reviews the education system, needs and priorities on education infrastructure from the NFED.
- **Chapter 3 - School Infrastructure Baseline:** Assesses the structural characteristics and functional conditions of existing school infrastructure to inform the identification of intervention needs.
- **Chapter 4 - School Infrastructure Financial Environment:** Assesses the financial landscape of Tajikistan's education sector, especially for educational infrastructure. It identified major gaps and recommendations on institutional capacity and financing mechanisms for school infrastructure to inform an effective future investment plan aligned with the National Education Development Framework.
- **Chapter 5 - Multi-Hazard and Risk Assessment of School Infrastructure:** Overviews major natural and climate hazards that the country is exposed to, and particularly evaluates earthquake risk and exposure to flood hazard for schools across Tajikistan.
- **Chapter 6 - Prioritization Framework for RIGHT+ School Infrastructure:** Introduces a systematic approach for identifying intervention programs and prioritizing RIGHT+ school infrastructure investments with case study based on available data for demonstration.
- **Chapter 7 - Recommendations on Intervention Strategy for School Infrastructure:** Provides recommendations on intervention strategy addressing the identified vulnerabilities to improve the physical learning environment comprehensively to be resilient, inclusive, green, healthy, teaching and learning conducive, as well as effectively implemented (RIGHT+).
- **Chapter 8 – Outlook on Implementation Pathways:** Outlines key strategic next steps for stakeholders to consider for the implementation of the National Education Development Framework.

## 2. Education Infrastructure Policies

This Chapter provides an overview of the education system and policy landscape in Tajikistan on education infrastructure, which also highlights the needs and priorities in improving education infrastructure for education development.

## 2.1 Education System and Infrastructure Needs

The education system in Tajikistan is structured across multiple levels and each stage requires specific educational infrastructure in terms of space and equipment. The system includes preschool, primary, basic secondary, upper secondary, vocational/technical, and higher education (see Table 1).

Access to education in Tajikistan has improved over the last decade; however, significant disparities persist across different education levels, particularly affecting rural populations, girls, and low-income households. According to NSED, the greatest accessibility gap is clearly at general education (specifically, upper secondary level), followed by early childhood education. This is supported by the statistical trends (see Table 2).

Table 1. Educational system of Tajikistan

Level	Grades / Age	Compulsory	Description
Preschool Education	Ages 3–6	No	Optional, but increasingly prioritized. Coverage at 15.6% (2023).
Primary Education	Grades 1–4 / Ages 7–10	Yes	Free and universally accessible through public schools.
Basic Secondary Education	Grades 5–9 / Ages 11–15	Yes	Core part of compulsory education. Completion rate: 94.7% (2019).
Upper Secondary Education	Grades 10–11 / Ages 16–17	Yes (since 2024)	Previously optional; now part of compulsory education. Completion rate: 73.8% (2019).
Vocational & Technical Ed.	Post-grade 9+	Yes (alternative)	Offers labor market-relevant skills. Enrollment expected to grow.
Higher Education	Post-grade 11+	No	Limited access due to financial and geographic barriers. Includes universities and institutes.

Source: See Education infrastructure financing in Tajikistan.

Table 2. Access to education by level of education

Level of Education	Coverage/Gross enrollment	Access issues
Early Childhood	23.2% in 2024 for children aged 3-6	High, Urban-regional disparity in available preschools - 34.7% are in rural, while urban areas account for 65.3%.
Primary	99% (2024),	Completion rate almost universal, improved gender parity; learning quality issues; minor access challenges in remote regions
Secondary	84% (2024)	Multiple shifts and overcrowding, especially in urban schools, risks of drop-outs
TVET	1,4%	Access highly urban-concentrated, lack of rural dormitories and facilities
Higher Education	34%	Concentrated in Dushanbe and urban centers

Source: UNESCO UIS, ADB Strengthening Technical and Vocational Education in Tajikistan (2020), World Bank. 2025. The Road Home and Abroad: Enhancing TVET for Youth and Migrants in Tajikistan, World Bank Higher Education Project Tajikistan (2022).

**Tajikistan’s general education infrastructure is under growing pressure due to demographics, overcrowded schools and outdated facilities.** While enrollment trends are improving, demographic pressure - Tajikistan has a high population growth rate of 1.9% (2023) - is placing additional strain on primary and secondary school infrastructure. Approximately 85% of schools are located in rural areas, many of which face severe infrastructure deficiencies. Only 16% of schools have internet access, limiting digital learning opportunities, while nearly half of rural schools lack clean piped water—posing health risks and affecting attendance, particularly for girls. Additionally, multi-shift schooling is widespread, with only 15% of schools operating on a single shift and over 84% on double shifts. Regions like Khatlon and Dushanbe face the most severe overcrowding, with student-to-school ratios exceeding 1,400 in some triple-shift urban schools.

**While strong evidence exists for school overcrowding, the publicly available data and existing donor’s reports offer no empirical support for under-utilisation of school infrastructure in rural or remote districts of Tajikistan.** For example, a recent situational analysis of 21 secondary schools across the Khatlon Region, the Districts of Republican Subordination and Dushanbe found the average school enrolment at around 1,394 students, with the largest school exceeding 3,200 students.<sup>6</sup> Classrooms were described as small and overcrowded, and multi-shift operation (two- or even three-shifts) was common.<sup>7</sup> In contrast, the report does not provide data on schools running significantly under capacity. Other sector documentation from statistical agency or other international organisations show various data on school numbers and enrolment, but no publicly available dataset was identified that reports the extent of under-utilisation of school infrastructure (e.g., schools operating significantly under capacity). The analysis of schools under various

shifts completed in the framework of this report, suggests that single-shift schools across all regions consistently have the lowest student-to-school ratios, supporting the notion that they operate under optimal or near-optimal capacity. The exiting EMIS is described as “emerging and requiring modernisation”<sup>8</sup> and might not have such data. The National strategy references school opening and infrastructure expansion, but it does not provide utilisation by school or district. Overall, there might be an evidence gap on under-utilisation of educational infrastructure in rural settings.

**Pupils enrollment has increased rapidly, outpacing infrastructure development and leading to overcrowded classrooms.** Since 1991, student numbers have risen by 72%, while the number of schools has only grown by 26%. From 2020 to 2024 alone, student numbers increased by 19%, while school construction rose just 4%, significantly raising the average student-to-school ratio. Triple-shift schools now accommodate over 1,000 students per building. Despite some improvements, such as better access in remote Gorno Badakhshan Autonomous Region (GBAO), major capacity constraints persist in high-density regions.

**Efforts to expand school capacity through new seat provision have been uneven across regions.** Between 2019 and 2023, 93,765 new seats were added nationwide. Khatlon received the majority—about 63%—in response to its acute infrastructure shortages. However, Dushanbe, despite its extreme overcrowding, experienced inconsistent investment, with some years seeing as few as 600 new seats. Sughd and Districts of Republican Subordination (DRS) also saw moderate expansions, while GBAO received the least. These disparities highlight the need for more equitable, needs-based school planning to address overcrowding and ensure safe, inclusive learning environments.

6. Dean, B. L., Fraidonov, F., Muibshoev, A., & Paishanбиеv, N. (2020). Teaching and learning in schools in Tajikistan: Current realities, future possibilities – Executive Summary. Bishkek: University of Central Asia, Education Improvement Programme. Retrieved from <https://ucentralasia.org/media/3r4kqqtvl/executivesummarytajikistaneng.pdf>

7. Ibid

8. OECD (2024). PISA Capacity Needs Assessment: Tajikistan, Dushanbe. Paris: Organisation for Economic Co-operation and Development. Retrieved from [https://www.oecd.org/content/dam/oecd/en/about/programmes/edu/pisa/publications/cna-and-cbp-reports/TAJ\\_CNA.pdf](https://www.oecd.org/content/dam/oecd/en/about/programmes/edu/pisa/publications/cna-and-cbp-reports/TAJ_CNA.pdf)

To respond to these challenges the Government of Tajikistan has prioritized the development and modernization of educational infrastructure as a central objective to improve access to and the quality of education. This commitment is set in the national legislation, including the Law on Education (2021), which mandates that all educational institutions should comply with standards of accessibility, safety, equity, and quality, supported by coordinated actions between local and national authorities.<sup>9</sup> The National Development Strategy until 2030 further reinforces this objective by emphasizing education as a driver of inclusive socio-economic development and it calls for expanded and upgraded educational infrastructure.<sup>10</sup> To implement it, the National Strategy for Education Development (NSED) until 2030 emphasize the construction of safe, inclusive, and climate-resilient learning environments.<sup>11</sup> Inclusive and equitable access to education is a core principle of both the Edu-

cation Law and National Strategy. Infrastructure standards must accommodate children with disabilities, ethnic minorities, rural populations, and address gender needs. The NSED also aligns infrastructure planning with broader disaster risk reduction and climate adaptation frameworks, recognizing the need for resilient schools in a hazard-prone environment.

**To operationalize these strategic priorities, the Government of Tajikistan is implementing a range of national programs that target specific aspects of the education system, including infrastructure.** Some initiatives focus on cross-cutting reforms, while others address particular components—for example, school feeding programs that support the development of canteens, or digital learning that require classroom-level information and communication technology (ICT) upgrades. An overview of key state programs that include infrastructure elements is presented in Table 3 below.

**Table 3. State programs that include school infrastructure component**

Program / Concept	Summary	Reference
<b>Concept for Transition to Digital Education (to 2042)</b>	Introduce ICT, e-learning, and digital skills across the education system.	Постановление № 439 «О Концепции перехода на цифровое образование до 2042 г.» <sup>12</sup>
<b>Concept and Strategy for Improving School Nutrition (to 2027)</b>	Modernize school canteens, strengthen meal provision, improve hygiene and nutrition.	Госпрограмма развития школьного питания на 2022–2027 гг., утв. постановлением № 205 от 27 апр. 2022
<b>State Programme for Preschool Education Development 2020-2025</b> Note: New program for 2026-2030 is being developed	Expand early childhood education and preschool access.	О Государственной программе развития дошкольного образования в Республике Таджикистан на 2020-2025 годы
<b>State Programme for School Construction, Repair &amp; Reconstruction 2008-2015</b>	Modernize school infrastructure through construction, repairs, and upgrades.	Государственной программы строительства, ремонта и реконструкции школ на 2008-2015
<b>Tajik Government School Construction National Program in Khatlon, 2025–2027</b>	165 school buildings; ~53,300 student places, primarily Khatlon region, rural areas	

Source: Compilation by authors.

9. Law of the Republic of Tajikistan dated December 23, 2021, No. 1835. [http://adlia.tj/show\\_doc.fwx?rgn=140991](http://adlia.tj/show_doc.fwx?rgn=140991)

10. National Development Strategy until 2030. [https://medt.tj/documents/main/strategic\\_national\\_programm/strategic\\_national\\_prog\\_ru.pdf](https://medt.tj/documents/main/strategic_national_programm/strategic_national_prog_ru.pdf)

11. Decree of the Government of the Republic of Tajikistan dated September 29, 2020, No. 526 [http://www.portali-huquqi.tj/publicadliya/view\\_qonunhovview.php?showdetail=&asosi\\_id=23741](http://www.portali-huquqi.tj/publicadliya/view_qonunhovview.php?showdetail=&asosi_id=23741)

12. [http://www.portali-huquqi.tj/publicadliya/view\\_qonunhovview.php?showdetail=&asosi\\_id=26482](http://www.portali-huquqi.tj/publicadliya/view_qonunhovview.php?showdetail=&asosi_id=26482)

The education sector in Tajikistan is characterized by a centralized but regionally varied governance system under the Ministry of Education and Science (MoES). Policy direction, financing, and infrastructure programs are determined by the Government of Tajikistan, with the leadership of MoES and with strong oversight from the Presidential Executive Office and parliamentary approval of sectoral laws:

- **Ministry of Education and Science (MoES):** MoES serves as the central authority responsible for education policy and legal regulation. It develops educational standards, contributes to the development of construction standards with regard to educational facilities, participates in the building approvals, oversees subnational education departments, and manages Education Management Information System (EMIS) for infrastructure planning and school data.<sup>13</sup>
- **Agency for Supervision in the Field of Education and Science under the President (ASSEES):** While not directly involved in the planning and construction of educational facilities, ASSES plays a critical oversight role in verifying compliance with national educational standards. The agency participates in the commissioning of new schools, monitors educational conditions, approve accreditation status of schools and issue licensing for educational institutions.<sup>14</sup>
- **Regional Departments of Education:** Subnational bodies implement MoES policies, oversee local construction and rehabilitation projects, and engage with communities on infrastructure needs.
- **National Social Investment Fund of Tajikistan (NSIFT):** NSIFT functions as the principal implementing agency for a wide range of donor-financed social infrastructure projects across the country, which include educational infrastructure supported by the World Bank, Kreditanstalt für Wiederaufbau (KfW), and the Global Partnership for Education.<sup>15</sup>

Table 4. Major International Donor-Financed School Construction Programs

Implementing Agency / Donor	Scale & Scope	Cost & Timeline	Description
<b>Saudi Fund for Development (SFD)</b> <sup>16</sup>	57 + 19 + additional 11 schools	2022–2028	Secondary schools across multiple provinces
<b>Russian Government</b> <sup>17,18</sup>	5 Russian-language schools	September 2022	~1,200 pupil capacity per school
	New 5 schools	By 2030	
<b>GPE / IsDB / UNICEF grants</b>	Rehabilitation + new builds for ~18,000 students	2024–2028	Dushanbe and Khatlon regions
<b>World Bank (LEARN project)</b> <sup>19</sup>	Modernization and rehabilitation of 65 schools	US\$ 50 mln, 2023-2029	40,000 students and 1200 teachers as beneficiaries

Source: Compilation by authors.

13. <https://egov.tj/site/maorif-ilm?lang=ru>

14. <https://egov.tj/site/nazorat-tj?lang=en>

15. <https://nsift.tj/ru/>

16. <https://asiaplustj.info/en/news/tajikistan/society/20231010/sfd-continues-financing-construction-of-schools-in-tajikistan>  
<https://vestiabad.ru/news/2992/rossiya-vlozhit-200-mln-rublei-v-russkoyazychnye-shkoly-tadzhikistana>

17. <https://ruskiymir.ru/news/328340/>

18. <https://projects.worldbank.org/en/projects-operations/project-detail/P177475>

19. Approved by the Resolution of the Government of the Republic of Tajikistan on 29 September 2020, #526

The operation of regional education departments reflects a mix of centralized and semi-decentralized approaches, structured across three main administrative configurations:

- **Structure A:** Sughd, GBAO, and Dushanbe city – operate under direct centralized control; regional education bodies report to MoES.
- **Structure B:** Khatlon Region – has regional management, with elected or appointed local education authorities exercising more delegated control.
- **Structure C:** 13 districts under Republican Subordination – report directly to MoES, bypassing regional oversight.

This institutional configuration might explain differences in infrastructure planning, funding, coordination, and education service delivery.

In parallel with state-financed initiatives, international donors have played a key role in expanding and upgrading Tajikistan’s school infrastructure (see [Table 4](#)).

## 2.2 Priorities for Education Infrastructure in Tajikistan

The National Strategy for Education Development (NSED) until 2030 identifies school infrastructure development as a key priority to improve access to and the quality of education, particularly for children with disabilities and ethnic minorities. Under Priority Reform Measure 4.2.1, the strategy emphasizes the construction and rehabilitation of general secondary schools that are responsive to the diverse needs of learners. This includes:

- Strengthening collaboration between public and private sectors in construction and renovation;

- Enhancing the adequacy and quality of school infrastructure, including sanitation and hygiene;
- Ensuring full accessibility through ramps, handrails, and other assistive devices.<sup>20</sup>

In addition, the strategy promotes the creation of **adaptive learning environments** that reflect the developmental needs of each student. It also calls for the construction of **talent identification centers with dormitories** to support gifted students, especially from remote regions. To support the transition to a competency-based curriculum, the NSED highlights the need for investments in **modern, flexible learning environments**. It also proposes an institutional review of financing mechanisms to increase **school-level financial autonomy** and expand the availability of both recurrent and capital resources.<sup>21</sup>

To implement strategic priorities identified by NSED, the Government of Tajikistan adopted a National Framework for Education Development (NFED) in January 2025.<sup>22</sup> The key areas of the NFED are structured around the World Bank’s RIGHT+ Framework for Physical Learning Environments (PLEs). These six interconnected pillars organize Tajikistan’s education infrastructure development into thematic priorities. Here’s a summary of the six key areas (see [Table 5](#)).

Tajikistan’s National Strategy for Education Development (2021–2030) and the 2025 National Framework for Education Development set clear priorities to improve school infrastructure across the country. The focus is on making schools safer, more inclusive, healthier, environmentally friendly, and better suited for modern teaching and learning. The NFED also aims to improve how education infrastructure is managed and supported, so that all children – especially those in rural areas or with special needs – can learn in better, more supportive environments.

20. Approved by the Resolution of the Government of the Republic of Tajikistan on 29 September 2020, #526

21. Ibid

22. National Framework of Education Development in the Republic of Tajikistan Approved by the Decree of the Council of the Ministry of Education and Science of the Republic of Tajikistan Dated 29<sup>th</sup> of January 2025 under the No. 2/3 Dushanbe, Tajikistan and the Order of the Minister of Education and Science of the Republic of Tajikistan for its implementation Dated from the 5<sup>th</sup> of February 2025 under the No.133 Dushanbe, Tajikistan.

**Table 5. Key priority areas of National Framework for Education Development**

<b>Key Area</b>	<b>Main Objectives</b>	<b>Examples of Planned Activities</b>
<b>1. Resilient PLEs</b>	Ensure safety and preparedness of schools against natural disasters and emergencies	Earthquake-resilient design and retrofitting- Installation of fire safety systems- Development of emergency preparedness protocols
<b>2. Inclusive PLEs</b>	Promote equity, accessibility, and safety for all learners, including children with disabilities and girls	Disability-accessible facilities (ramps, toilets)- Gender-segregated and Menstrual Hygiene Management (MHM)-friendly Water, Sanitation and Hygiene (WASH)- Awareness programs and inclusive construction planning
<b>3. Green PLEs</b>	Enhance environmental sustainability and energy efficiency	Use of sustainable and local materials- Installation of solar panels and energy-efficient systems- Waste management systems in schools
<b>4. Healthy PLEs</b>	Improve health, hygiene, and environmental conditions in schools	Upgrading school WASH and sanitation- Improving ventilation, acoustics, and heating/cooling- Routine maintenance and inspection protocols
<b>5. Teaching &amp; Learning-Conducive PLEs</b>	Align school infrastructure with modern teaching methods and learner needs	Flexible classroom design- Provision of digital tools and appropriate furniture- Teacher training on learner-centered and inclusive pedagogies
<b>6. Effective Implementation</b>	Strengthen governance, data systems, and institutional capacity	TEACH and System Usability Scale (SUS) tools adapted for Tajikistan- Integration with EMIS and E-Donish- Capacity-building for planners, engineers, inspectors, and teachers

Source: National Framework for Education Development (NFED), 2025.

# 3. School School Infrastructure Baseline

Responding to the policy priorities to improve school infrastructure as highlighted in Chapter 2, this chapter diagnoses the baseline of school infrastructure in Tajikistan, including the distribution of facilities and students across the country, their structural characteristics, functional conditions, and financial environment. The findings summarize herein aim to support the assessments in this study and inform the planning of school infrastructure improvements in the country.

### 3.1 Overview

Under this technical assistance, a baseline data collection and diagnosis has been conducted in collaboration with the State Unitary Enterprise, Research Institute of Construction and Architecture (GUP NIISA), under the Committee on Architecture and Construction of the Republic of Tajikistan. According to this baseline diagnosis, there are a total of 4102 schools (public and private) in the country as of 2025, in which Khatlon Region has the most schools, followed by District of Republican Subordination and Sughd Region (Figure 2). With respect to Urban and Rural settings, based on a recent study

from UNICEF,<sup>23</sup> about 85% of schools are under rural settings as of academic year 2022/23. With further information about number of students under the Learning Environment – Foundation of Quality Education (LEARN) project from the MoES for 3705 public schools, Figure 3 suggests that Khatlon region holds the most students as well as schools across all regions, while Dushanbe holds the least number of schools but more concentrated students and Gorno-Badakhshan Autonomous region holds the least students with more schools.

Figure 2. Number of schools by region

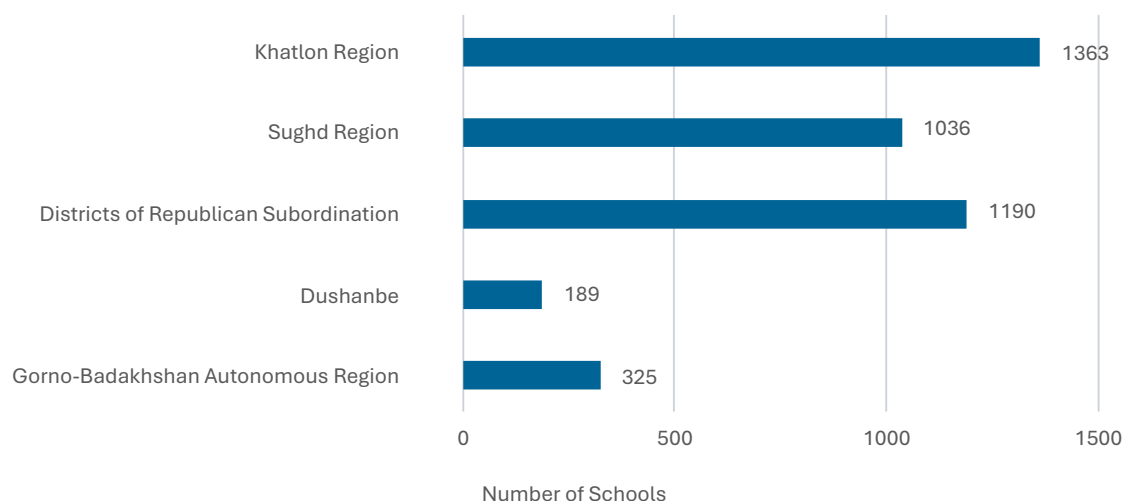
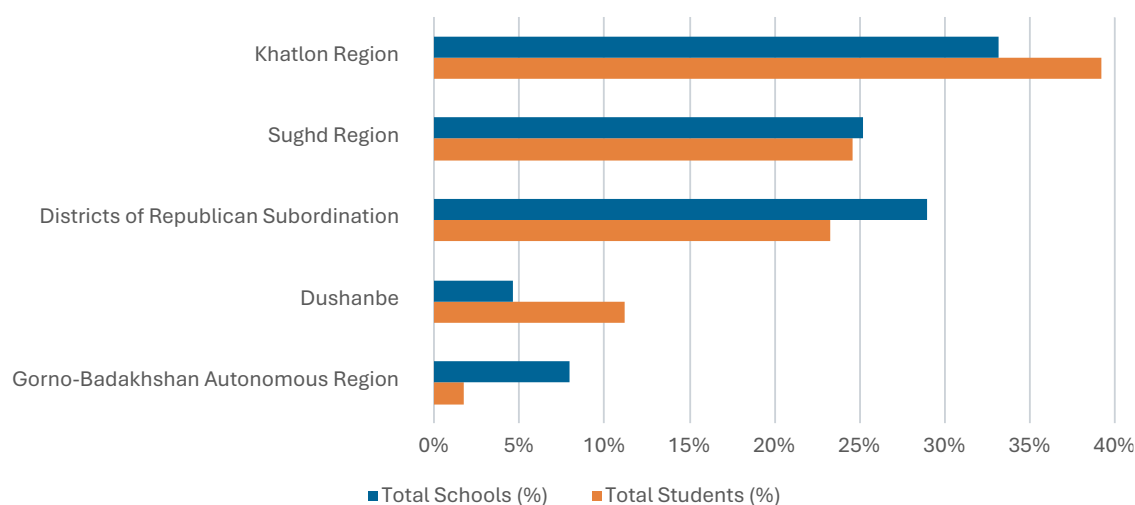


Figure 3. Distribution of schools and students by region



23. UNICEF (2024), Achieving Universal Connectivity for the Education Sector in the Republic of Tajikistan, [https://www.unicef.org/tajikistan/media/7371/file/Achieving%20Universal%20Connectivity%202024\\_en%20final-compressed.pdf](https://www.unicef.org/tajikistan/media/7371/file/Achieving%20Universal%20Connectivity%202024_en%20final-compressed.pdf)

Within the total of 4102 schools, further desktop review and verification of information was conducted on a sample of 361 schools, to understand the typical construction types of schools (discussed in the following section) and the distribution of the age of school buildings. This sample of 361 schools cover various districts across all regions as well as both urban and rural settings. Table 6 summarizes the distribution of construction years of the sample of 361 schools, with respect to some key considerations on the structural safety of the school buildings. The key considerations include: 1) schools built over 50 years (before 1975), for which the lifespan of structure is likely exceeded and requiring replacement; 2) schools built before the first national seismic design code adopted in 1997 after independence, SNiP RT 2.01.09-97 "Construction in seismic areas", with less seismic resilience than after; 3) schools built after the SNiP RT 2.01.09-97 but before the latest up-to-date seismic design code adopted in 2018, SNiP RT 22-07-2018 "Earthquake-resistant construction", with improved but not yet up-to-date seismic resilience; 3) schools built after the adoption SNiP RT 22-07-2018, with up-to-date seismic resilience. The distribution among the 361 sampled schools shows that about 35% of schools are over 50 years old and over 60% of schools were built before the first national seismic design code, which implies considerable potential structural improvement needs for the school facilities in the country for seismic safety.

In addition to the information on construction year of school buildings from the 361 sampled schools reviewed under the TA, further information is complemented by a database collected by the MoES as of 2024 under the World Bank financed Tajikistan Digital Foundations project<sup>24</sup> about information on Information and Communication Technology (ICT) infrastructure of school facilities in Tajikistan (here after referred as the ICT database), which covers 3941 schools in Tajikistan and partially include information on the construction year of school buildings. Also, under LEARN project, there is information collected about 3705 schools. After cross-referencing and merging these databases, the information of construction year of 5548 buildings from 3484 schools across the country is identified and shown in Figure 4 (schools without construction year information are accounted as N/A), which demonstrates similar distribution as from the 361 schools sampled across the country. The distribution suggests that more recent built school buildings are from Khalon region and Dushanbe, while Dushanbe also has higher percentage of school buildings over 50 years of age within the city.

### 3.2 School Building Types

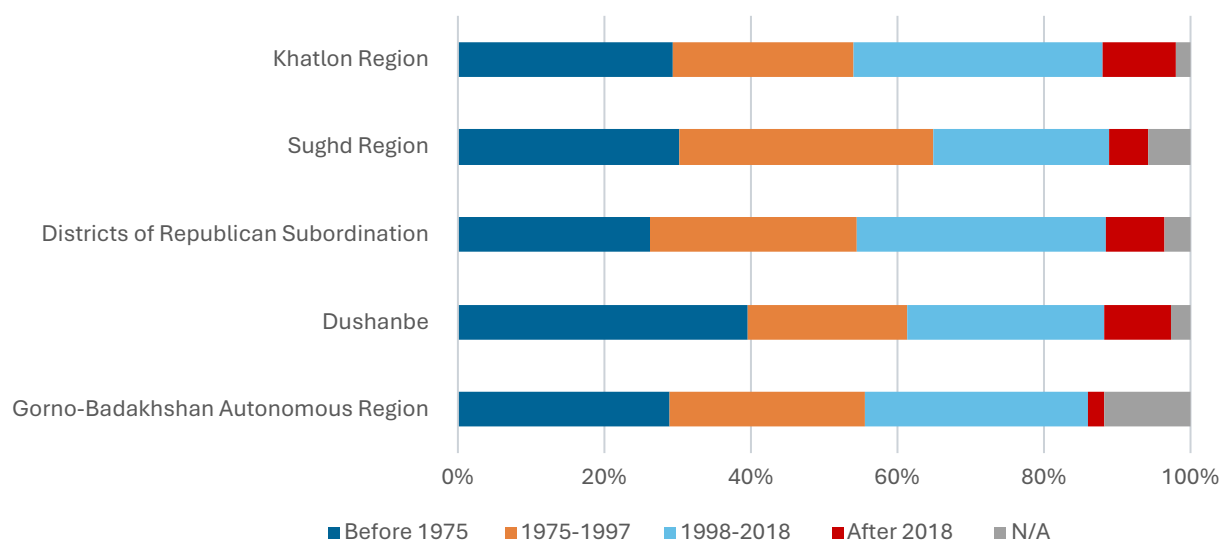
Further based on the desktop review of the sample of 361 schools, typical school construction types are also identified as shown in Table 7. The classification of school construction types is based on the taxonomy of the Global

**Table 6. Distribution of construction year of the 361 sampled schools across the country**

Construction Year	Key consideration	Number of schools	Percentage
Before 1975	Built over 50 years	126	35%
1975 - 1997	Built before 1 <sup>st</sup> national seismic design code	105	29%
1998 - 2018	Built before the up-to-date seismic design code	112	31%
After 2018	Built after the up-to-date seismic design code	18	5%

24. <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099112624105540626>

Figure 4. Distribution of construction year of buildings from 3484 schools by region



Library of School Infrastructure (GLOSI) (World Bank, 2019), which is a classification system for categorizing the vulnerability of school buildings. In addition, field surveys of 10 sampled schools have been conducted under this project to verify the vulnerability characteristics of typical school building types. The findings from the sampled field surveys confirms the similarity in typical deficiencies and vulnerabilities with other school buildings with the same building types in Central Asia region that have been analyzed in detail in previous studies. The sample of 10 schools covers major construction types that need to be verified on their characteristics, except for those already well known for their high seismic vulnerability and the need to be replaced (adobe, Finnish type, unrein-

forced stone masonry, and unreinforced brick masonry). Specific discussions about the identified typical characteristics and vulnerabilities of each construction type are organized in Table 8. The most prevalent school construction type is complex masonry with almost 35% identified among the sample, followed by unreinforced stone masonry and adobe (24% and 19%).

To achieve the understanding of school building types at national portfolio level, a statistical extrapolation process was conducted based on the distributions identified from the 361 sampled schools. Here, the school building type considers both the construction type and the number of stories as the 2 main characteristics for categorizing the vulnerability of the building.

Table 7. Distribution of construction types of the 361 sampled schools across the country

Construction Type	Number of Schools	Percentage
Adobe (A)	67	18.6%
Wooden sheets with earthen materials (Finnish type)	20	5.5%
Unreinforced stone masonry (URM2 or URM3)	86	23.8%
Unreinforced brick masonry (URM7)	48	13.3%
Complex masonry with concrete framing (CXCF)	125	34.6%
Precast reinforced concrete frames with exterior precast reinforced concrete wall panels (PC2)	14	3.9%
Precast large panel reinforced concrete wall system (PC1)	1	0.3%

**Table 8. Typical characteristics and vulnerabilities of school construction types in Tajikistan**

(1/2)



*General education secondary school of №65, Hejborak, Village of Hazorchashma, damaged in the earthquake on April 13, 2025*

**Adobe (A):**

Load bearing masonry structures made of sun-dried adobe bricks (mud bricks) or compressed stabilized soil blocks in mud mortar. These buildings are usually locally constructed by communities (non-engineered constructions) and are highly vulnerable to earthquakes. In the recent earthquake (magnitude 5–6 on the Richter scale) near Rasht and Tojikobod districts, 10 out of 11 damaged schools were adobe buildings.



*General secondary education institution № 16 the Village of Bovud named after Azorabekov Dodarbek*

**Wooden sheets with earthen materials (Finnish type):**

Walls made of wooden sheets and earthen materials in between them to protect the building from cold weather. It is commonly known as “Finnish type”. Most of them were built in the 1960s and 1980s in the remote areas, including GBAO, Sughd mountainous regions and areas of central subordination. These schools are highly vulnerable to earthquakes and fire hazards.



*Source: Global Library of School Infrastructure*

**Unreinforced Stone Masonry (URM2 or URM3):**

Load bearing masonry structures constructed using stone and usually mud mortar. The stone units can be rubble stones that are irregular and vary in size (URM2) or sometimes dressed/semi-dressed into regular shapes and similar sizes (URM3). This construction practice is extremely vulnerable to earthquake effects, especially those with rubble stones.



*General education secondary school of №16, Town Langari Shoh, Village Kuli Kalon, Tojikobod District, damaged in the earthquake on April 13, 2025*

**Unreinforced Brick Masonry (URM7):**

Load bearing masonry structures constructed using burnt clay bricks or concrete blocks and cement mortar. These buildings are vulnerable to earthquake shaking due to absence of reinforcement in masonry walls. In the recent earthquake (magnitude 5–6 on the Richter scale) near Rasht and Tojikobod districts, 1 out of 11 damaged schools was an unreinforced brick masonry building.

Table 8. Typical characteristics and vulnerabilities of school construction types in Tajikistan

(2/2)



GSEI №1, city of Varzob

**Complex masonry with concrete framing (CXCF):**

In Central Asian countries, complex masonry buildings have masonry walls (usually constructed using burnt clay bricks in cement mortar) and vertical RC confining elements (inclusions) located at the wall intersections and at the openings. These inclusions usually have smaller cross-sectional dimensions than masonry walls (wall thickness ranges from 380 to 510 mm). Due to the large spacing of cross walls (more than 8.0 m in some instances) the effect of confinement provided by vertical inclusions is expected to be insignificant, their seismic vulnerability is similar to unreinforced masonry buildings. The masonry walls are usually reinforced with horizontal steel mesh embedded at mortar bed joints.



GSEI № 29 of Dushanbe

**Precast reinforced concrete frames with exterior precast reinforced concrete wall panels (PC2):**

Precast reinforced concrete frame systems consist of beams and columns connected by means of welded connections. The floor/roof structure usually consists of precast hollow core planks or ribbed slabs. There are also exterior precast wall panels which are welded to the exterior columns. This type of precast frame system lacks sufficient transverse reinforcement in columns and brittle welded connections, and therefore highly vulnerable to earthquake effects.



Source: Kyrgyz Republic, World Bank

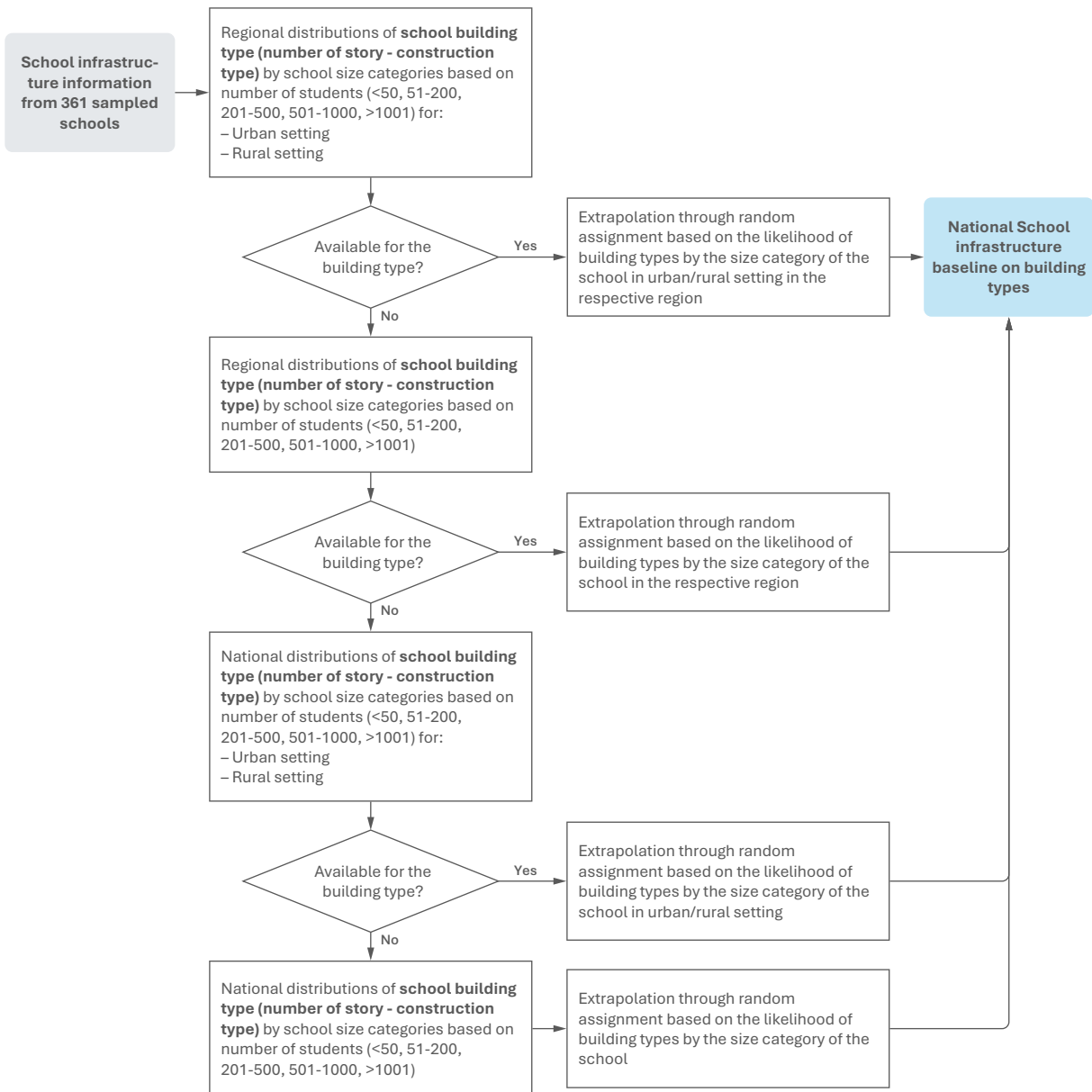
**Precast large panel reinforced concrete wall system (PC1):**

Precast reinforced concrete systems consist of precast concrete wall panels connected to precast floor/roof panels. The room size is usually limited by the size of the precast wall panels. These structures may be vulnerable to earthquake effects due to inadequate strength of wall-to-wall and wall-to-floor connections.

Figure 5 illustrates this statistical extrapolation process based on the distributions of school building types from highest (i.e. by school size category at urban/rural setting in each region) to lowest (i.e. by school size category only) granularity depending on the availability of specific distribution of school building types. The school size information is from the LEARN project and the zoning information cross-referenced from

the ICT database. Through this process, the building types (number of stories – construction type) are extrapolated to the total of 3705 schools at the best granularity possible. Note that such extrapolation provides an approximation of the overall distribution at national and subnational level based on available information, in which uncertainties at school level should be acknowledged.

Figure 5. Statistical extrapolation of school building types from 361 sampled schools to the national school infrastructure baseline



Based on the above, Figure 6 maps the extrapolated school building construction types across the country, and Figure 7 and Figure 8 further shows the distribution of school construction types in the country and per region, respectively. Nationwide, complex masonry with concrete framing is the most prevalent construction type in schools (42%), followed by adobe (28%) and brick masonry (17%). In terms of predominant school construction types by

region, Gorno-Badakhshan Autonomous Region observes unreinforced stone masonry the most, Dushanbe and Sughd Region as well as Khatlon Region observes complex masonry with concrete framing the most, while Districts under Republic Subordination observes adobe the most. Further, Figure 9 suggests that all regions except for Dushanbe expect single-story school buildings the most, while Dushanbe expects three-story school buildings the most.

Figure 6. School building construction types across the country

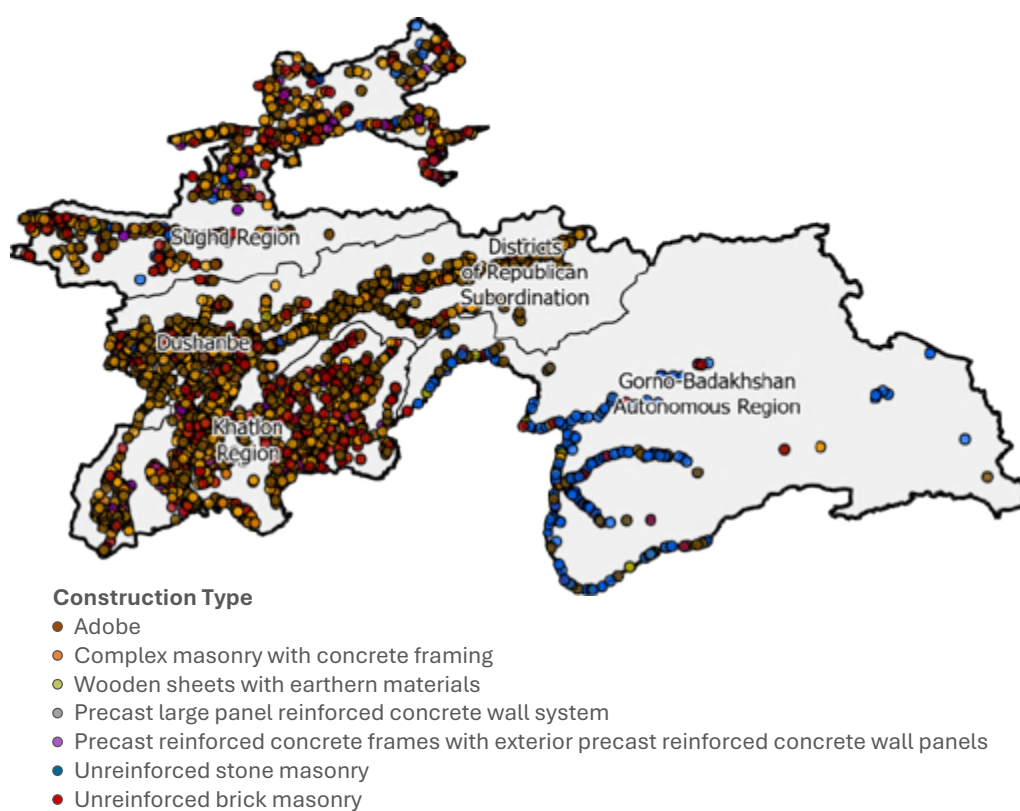


Figure 7. School building construction types in Tajikistan

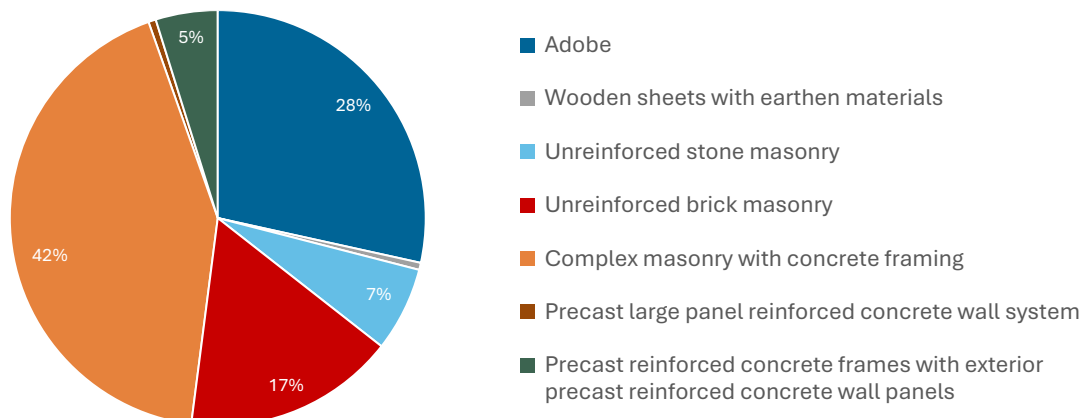


Figure 8. School building construction types per region

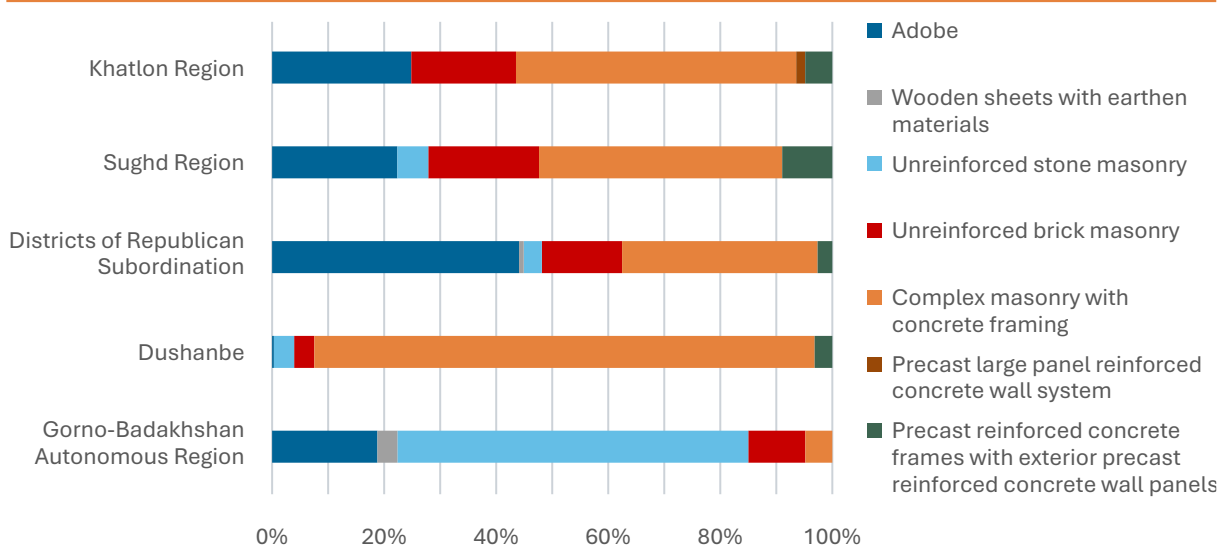
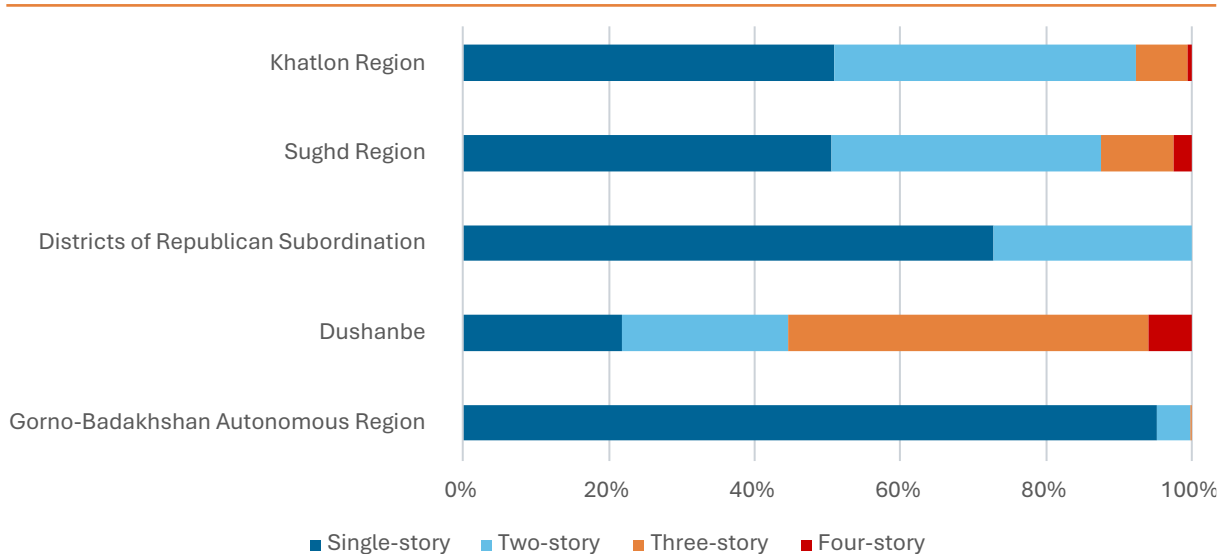


Figure 9. Number of stories of school buildings by region

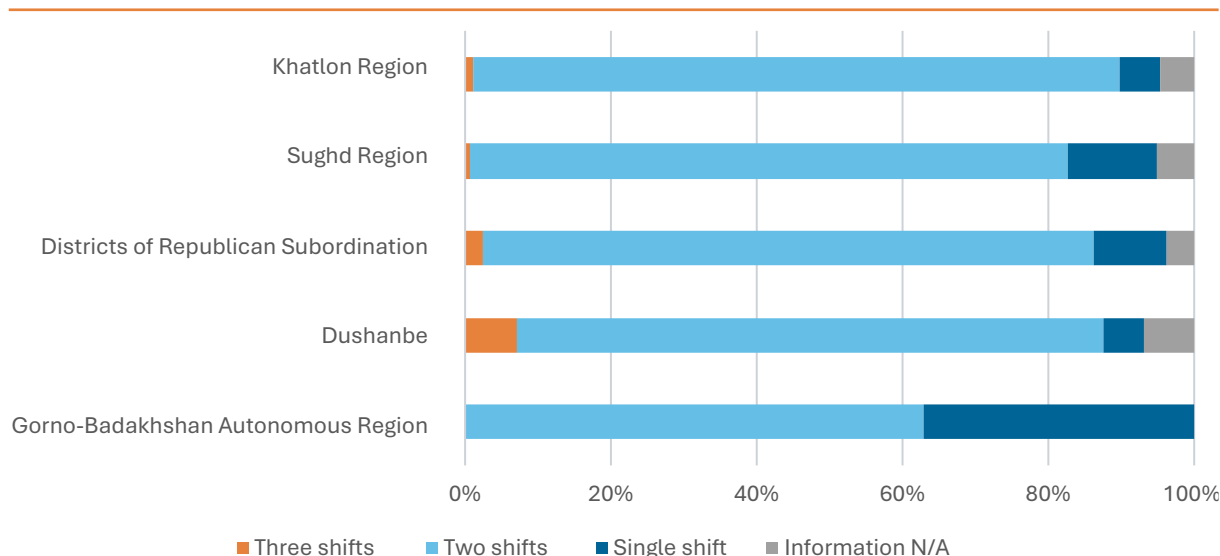


### 3.3 Functional Conditions in Schools

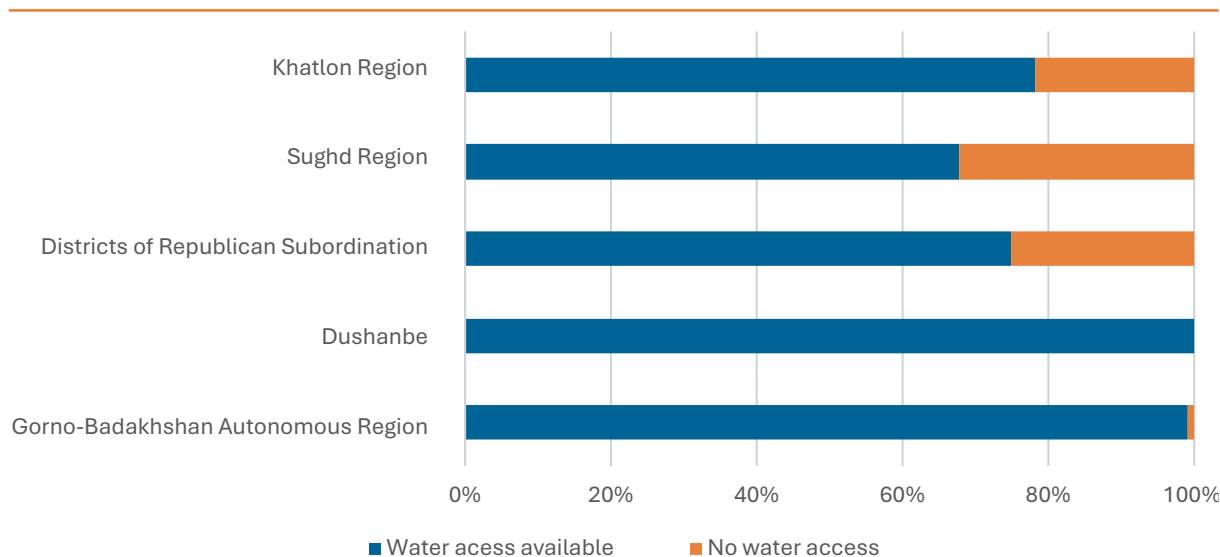
Further, based on the information cross-referenced from the ICT database as well as information collected under the LEARN project, relevant functional conditions are also investigated for the 3705 schools considered under the LEARN project. In terms of the overcrowded conditions across regions, schools in Dushanbe

are more overcrowded with up to three shifts, while schools in Gorno-Badakhshan Autonomous Region are operating more in single shift and potentially underutilized compared with other regions (Figure 10). For water supply access, all schools in Dushanbe have water access, followed by Gorno-Badakhshan Autonomous Region with almost all schools have water access, while Sughd region has more gap in water provision in schools with over 30% schools without water access (Figure 11).

**Figure 10. Number of shifts in schools per region**



**Figure 11. Access to water in schools per region**



In terms of power supply and ICT infrastructure, Dushanbe has nearly full coverage of uninterrupted power supply for all schools, while Sughd region with the least coverage (above 60%) of uninterrupted power supply in schools (Figure 12). However, as shown in Figure 13, Sughd region manages to have the most provision of computer labs in schools, followed by Dushanbe with similar coverage, while Districts under Republic Subordination demonstrates the

least provision of computer labs among regions (above 60%). Further when looking into internet connection in schools, Figure 14 indicates considerable gap in all regions, with Dushanbe showing the best coverage of nearly 40% of schools connected to internet, while regions such as Gorno-Badakhshan Autonomous Region and Districts under Republic Subordination demonstrates only about 5% of schools connected to internet.

Figure 12. Availability of power supply in schools per region

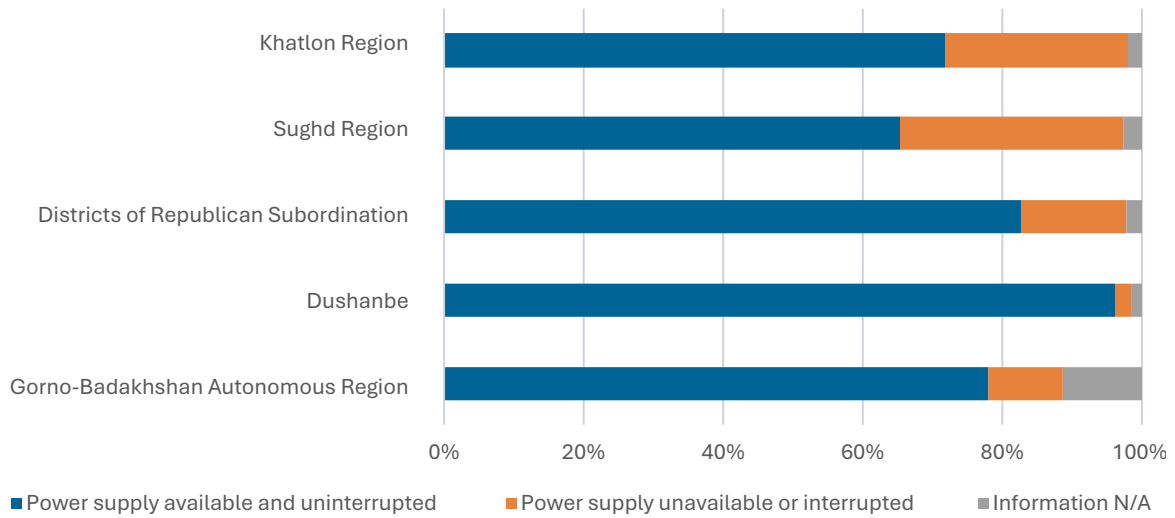


Figure 13. Availability of computer labs in schools per region

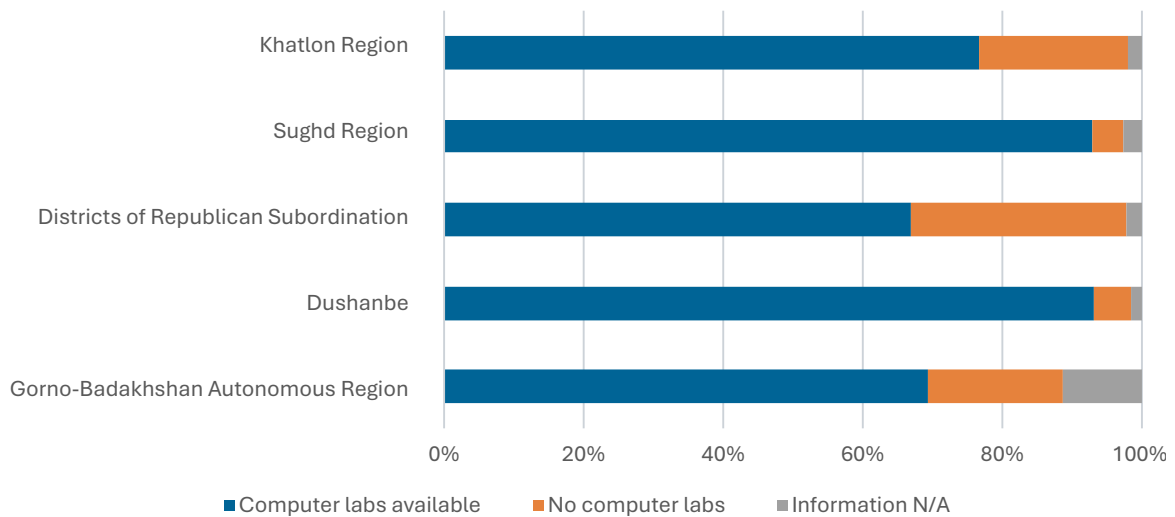
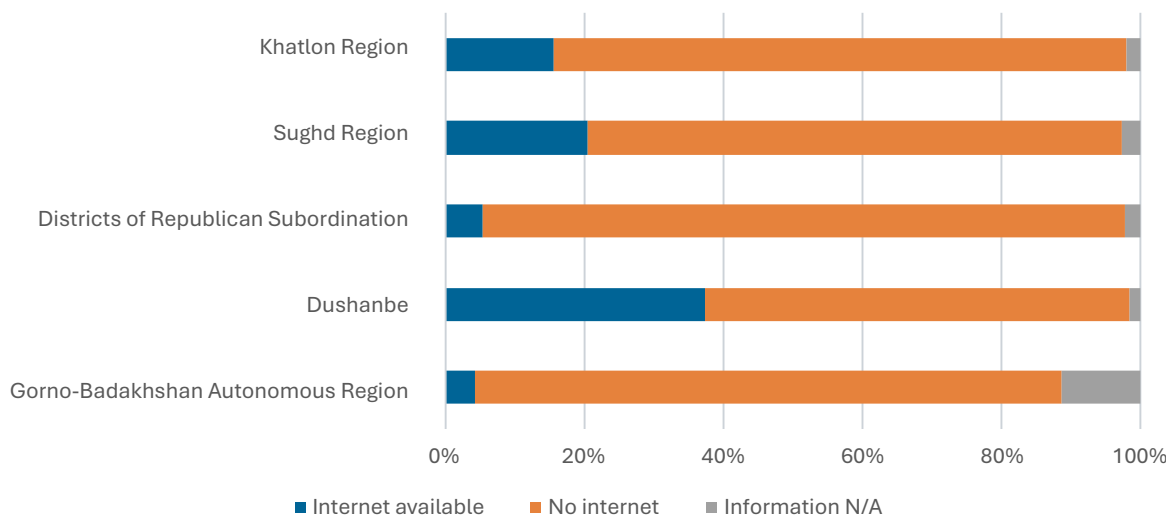


Figure 14. Availability of internet connection in schools per region





# 4. School Infrastructure Financial Environment

With student enrollment outpacing educational infrastructure development, Tajikistan's education system heavily relies on multi-shift operations and faces overcrowded classrooms as discussed under [Section 2.1](#). This calls for strategic investments in new and expanded facilities to provide sufficient learning environment. Based on a desktop review conducted under this study, this chapter highlights the key findings on the financial landscape of Tajikistan's education sector, as well as recommendations identified for the financing mechanisms for school infrastructure to inform future investment plans aligned with the National Education Development Framework. These key findings and recommendations are highlighted as follows.

- **Although there is strengthened financial commitment on Education spending in Tajikistan, especially for secondary education level, capital expenditure is not yet sufficient to keep up with the rising educational infrastructure needs from demographic demand.** From 2015 to 2023, a real increase of approximately 68.4% is observed in education expenditure, outpacing the overall state budget increase of 52.5% ([Figure 15](#)). By 2023, education expenditure reached approximately 5.81% of Gross Domestic Product (GDP), of which 70.3% for secondary education, followed by professional (14.3%) and preschool (6.5%) education among others. Within edu-

cation expenditure (2015-2021), recurrent expenditures (mainly for labor compensation) often account for over 90% of total education spending, leaving capital expenditures (primarily for new construction) often less than 10%.

- **Although local budgets dominate total education spending, both republican and local budgets play key roles in capital expenditure on school infrastructure, supplemented by Public Investment Programs (PIP) or Special Funds.** According to 2023 data, 72% of the public education financing is from local budgets, while 19.4% from republican budget and 8.6% from PIP and special funds. In terms of capital expenditure in real values as shown in [Figure 16](#), during 2015 to 2023, 811 million TJS from local budgets and 517 million TJS from republican budget have been spent on capital investment for school infrastructure, while local spending demonstrated high volatility (e.g. 137.96 million TJS in 2017, 142.12 million TJS in 2022, 24.27 million TJS in 2016, 42.78 million TJS in 2020) and republican budget stays relatively stable (40-80 million TJS). Additionally, private sector investment and local community financing have been playing a growing role in creating new school seats, for example contributing to 44.4% of new seats created and 72 out of 130 new school buildings built in 2019.

Figure 15. State and education expenditure trends (Million TJS, 2015 prices), 2015-2023

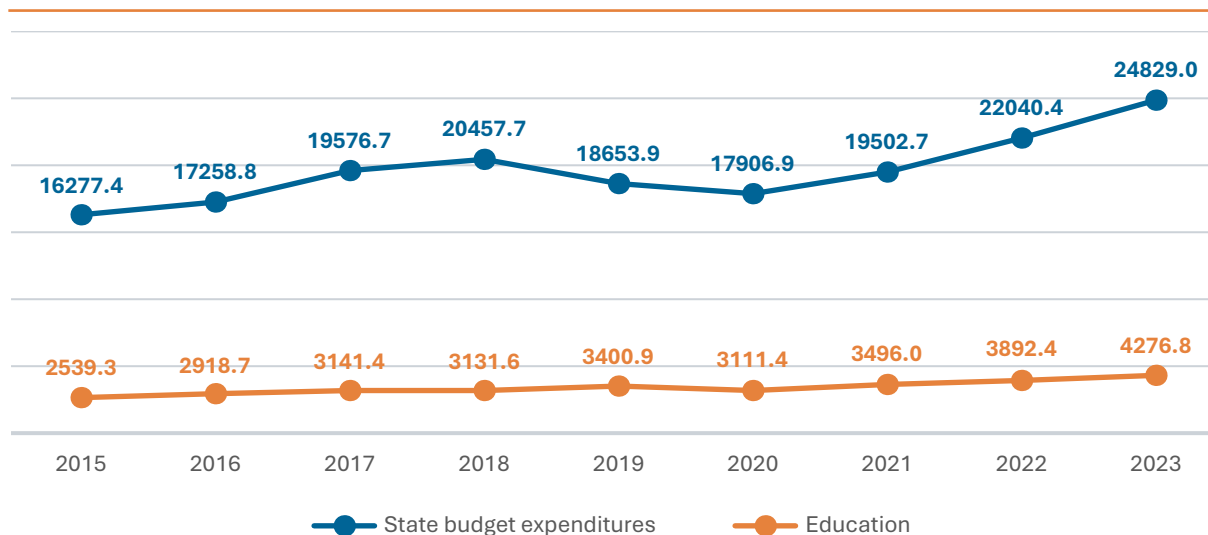
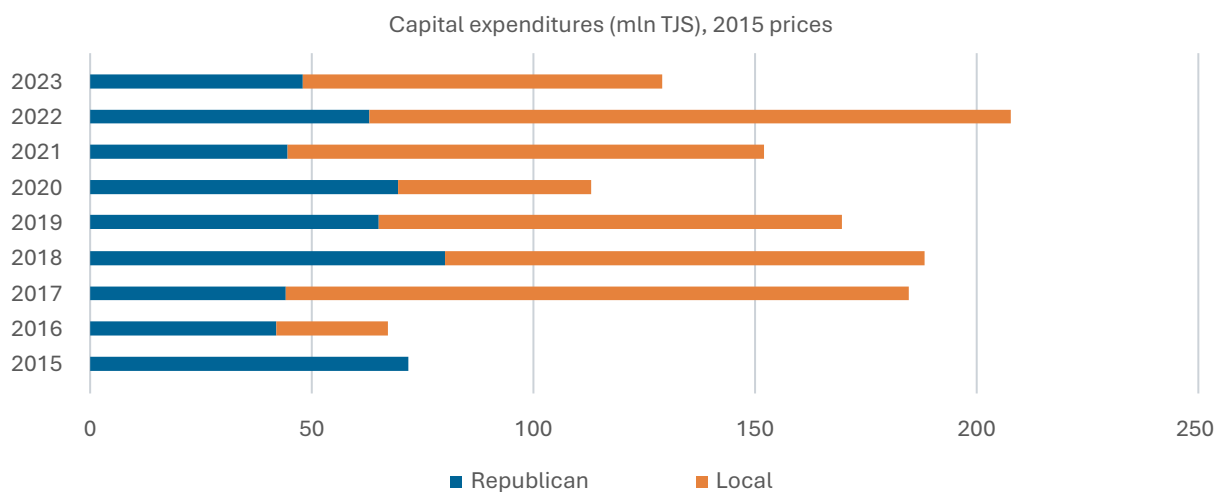


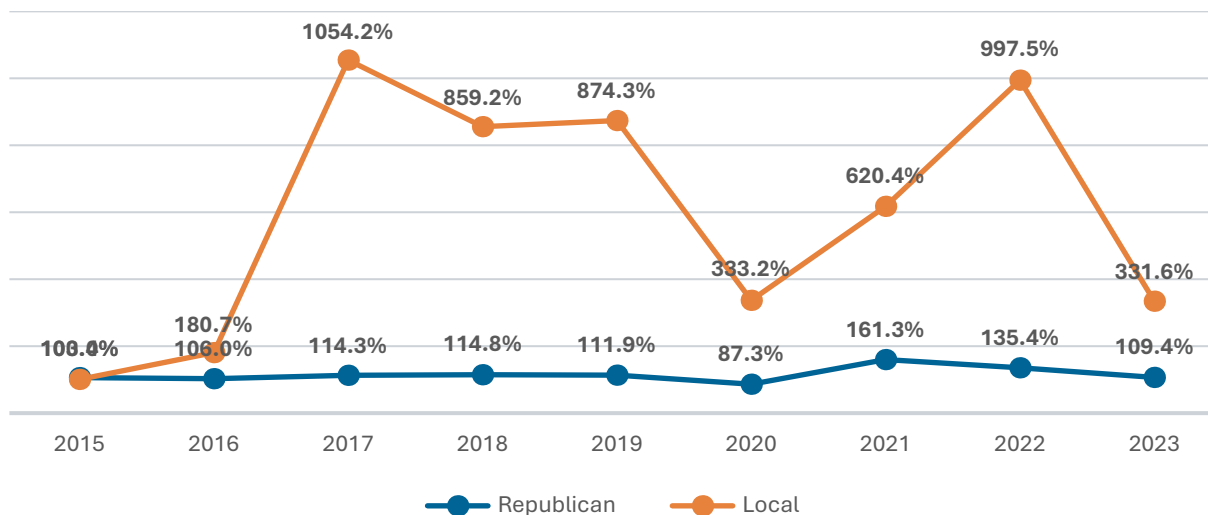
Figure 16. Capital expenditure on school infrastructure from republican and local budgets (million TJS, 2015 real value)



• **With the comparable roles on capital expenditure for school infrastructure at republican and local levels, it is instrumental to strengthen strategic planning to improve coordination and efficiency of investment in the long term and enhance capacity at all levels.** While the budget execution rates remain high at both central and local levels in recent decade (overall 94%-100% during 2015-2023), as discussed before and shown in Figure 17, the local expenditures demonstrate high volatility in terms of up to 1054.2% spending of annual budget, revealing a lack of local budgeting capacity to comprehensively

reflect actual needs and potential funding streams. Further, through well coordination with local budgets, republican budget can be strategically deployed to fund critical national priorities, address systemic inequalities, and support innovation that benefits the entire education system. Last but not least, the efficiency of capital investment can be enhanced through prioritization exercise (see Chapter 6 for further recommendations) and multi-year capital plans, especially for secondary education where the largest share of the budget is being utilized, to maximize learning outcomes and support student progression.

Figure 17. Capital expenditure trends as a percentage of budgeted amount, 2015-2023 (%)



**Table 9. Mapping of financing mechanisms, key stakeholders and relevant roles, responsibilities and scopes**

Financing Mechanism	Financing Source	Level	Key Stakeholder	Relevant Roles, Responsibilities and Scopes
<b>Domestic</b>	Republican budget	National	Ministry of Finance (MoF);	<ul style="list-style-type: none"> <li>Provide oversight, set national policies and priorities, and coordinate with international donors and development partners.</li> <li>Primarily funds vocational and higher education, as well as the overall administration of the education sector, and larger-scale national educational initiatives including on infrastructure.</li> <li>The financing on educational infrastructure is often limited, and major infrastructure projects are often supported by international development partners.</li> </ul>
	Local budget	Subnational	Regional/district governments	<ul style="list-style-type: none"> <li>Manages the implementation of national education policies at the regional and district levels.</li> <li>With the decentralized public expenditure, the local budgets primarily fund pre-school and general (primary and secondary) education expenditures.</li> <li>Plays an equivalent role on financing educational infrastructure as republican budget.</li> </ul>
<b>External</b>	World Bank	International	International development partners	<ul style="list-style-type: none"> <li>Provides major grants and financing for various education projects, including educational infrastructure.</li> <li>Since 1996, over USD \$2.72 billion in total assistance has been provided to Tajikistan, including a significant portion towards education sector development.</li> </ul>
	Global Partnership for Education (GPE)			<ul style="list-style-type: none"> <li>Provides grants to support Tajikistan's education sector reforms.</li> <li>Since 2005, over USD \$86.8 million has been provided to Tajikistan's education sector.</li> <li>Key focus areas include equitable and inclusive education financing, early childhood education, teacher professional development, and enhancement of educational infrastructure.</li> </ul>
	Asian Development Bank (ADB)			<ul style="list-style-type: none"> <li>Provides grants and financing to strengthen specific areas of education system in Tajikistan, such as strengthen STEM education, integrate climate change awareness, promote girls' education, TVET, etc.</li> </ul>
	Islamic Development Bank (IsDB)			<ul style="list-style-type: none"> <li>Provides grants and financing to support Tajikistan's education sector development.</li> <li>Recently has co-financed with GPE and OPEC to support the implementation of the National Education Development Strategy by 2030.</li> </ul>
	OPEC Fund for International Development			<ul style="list-style-type: none"> <li>Provides loans to support education development.</li> <li>With cooperation dating back over two decades, the OPEC Fund has approved 17 projects in Tajikistan across various sectors since at least 2007, with education being a significant beneficiary.</li> </ul>
	Other bilateral and multilateral donors			<ul style="list-style-type: none"> <li>Contributions to education financing are often through specific projects or technical assistance.</li> <li>For example, UNICEF has contributed approximately US \$7.6 million on digital learning since 2020, and potentially bilateral donors such as Germany has allocated €10 million for healthcare projects that may indirectly support education-related health initiatives within schools.</li> </ul>
<b>PPP</b>	National / Subnational / International	Private sector	<ul style="list-style-type: none"> <li>Emerging models where private investors contribute to school construction and maintenance in exchange for government incentives.</li> <li>Although there are established PPP laws, their application within the education sector remains underdeveloped, often due to a lack of clear, education-specific policies and incentives.</li> </ul>	

- **While Tajikistan's main education financing mechanisms include domestic public funding and external assistance, potential opportunities can be promoted with public-private partnerships (PPPs) as well as other innovative avenues to strategically leverage all available instruments.** [Table 9](#) summarizes the major landscape of financing mechanisms, key stakeholders and relevant roles responsibilities and scopes for education sector and educational infrastructure. While the domestic public funding is yet sufficient to keep up with the rising educational infrastructure needs and acknowledging the lack of budgeting capacity especially at local levels as discussed above, it will be essential to strategically leverage a range of instruments, including both financial and technical assistance from international development partners in addition to domestic public funding. Further, partnerships with international development partners may be instrumental in supporting the country to mobilize private investment in the education sector and to establish financially sustainable PPPs. While formal PPPs are limited, there are substantial opportunities for private sector involvement in infrastructure, digital learning, and vocational training. Innovative financing strategies from international experience, such as diaspora bonds and mobile money for school fees, also offer potential avenues for Tajikistan to diversify its education funding including school infrastructure financing. To address existing financing and institutional capacity gaps as discussed above.
- **To support long-term strategies and mobilizing further investment for education infrastructure, a strengthened investment plan aligns with national and international education goals is essential, and a complete roadmap is necessary to guide efficient and effective preparation and implementation.** With the above discussed needs to strategically leverage wide range of available financing mechanisms – domestic and international, as well as public and private, effective financial planning builds confidence among potential investors by demonstrating

transparent budgeting, clear prioritization, and accountability. A well-developed investment plan not only optimizes the use of existing resources but also reduces perceived risks and helps attract new investment by providing clarity on how funds will be used and what outcomes are expected. Such investment plan includes key elements such as alignment with NFED and UN Sustainable Development Goal 4 (SDG4), thorough school infrastructure assessment for needs identification, clear and consistent prioritization framework for maximizing benefits from interventions, and realistic and diversified investment strategy leveraging various financing instruments (government allocation, international financing, PPPs, etc.). It also needs a phased implementation plan for different priorities and lines of interventions, alongside continuous capacity building and community engagement. For effective implementation, a robust Monitoring & Evaluation (M&E) system with regular impact assessments is also recommended to ensure accountability and effective implementation. Further discussions on outlook of implementation pathways for an investment plan on education infrastructure are included under [Chapter 8](#).



## Recommendations for RIGHT+ School Infrastructure at Scale in Tajikistan

# 5. Multi-Hazard and Risk Assessment of School Infrastructure

This chapter presents a comprehensive overview of the risk analysis conducted as part of this project to assess the potential impacts of earthquakes and floods on Tajikistan's education sector. Drawing on historical data and previous events, earthquakes and floods have been prioritized in this assessment due to their significant potential to cause human, economic, and educational losses nationwide. Risk perception and response are policy decisions that can vary across countries. In this report, however, assumptions regarding risk severity and recommended actions are grounded in internationally recognized standards. Where appropriate, relevant technical references are provided to support these approaches. It should be noted that, in addition to the direct impacts assessed in this analysis, there are also relevant indirect effects. For instance, school closures resulting from disruptive events can lead to learning losses among students due to missed instructional time. However, these indirect impacts were not explicitly quantified in this study, primarily due to limitations in the availability and quality of relevant data.

## 5.1 Overview of Natural and Climate Hazards in Tajikistan

Tajikistan is exposed to multiple natural and climate hazards, such as earthquakes, floods, landslides, droughts, and extreme heat, among others (World Bank, 2016). The country risk profile of Tajikistan developed under the Central Asia Regional Economic Cooperation (CAREC) Program estimates the combined impacts from floods, earthquakes, and droughts in the past 3 decades have affected 4.6 million people and caused over \$1.1 billion in damage (CAREC, 2022).

Within the risk profile of the country, earthquake and floods are being prioritized for the assessment of this project considering their high impacts. Since 1900, major earthquakes demonstrated the high impacts of low frequency earthquake events, including the 1907 Karatag earthquake (M 7.4) caused about 14,000 fatalities and almost USD \$200 million in damage, the 1949 Khait earthquake (M 7.4) caused about 3,500 fatalities and subsequent landslide causing about 12,000 fatalities, as well as the 1989 Sharora and Gissar earthquake (M 5.3) caused 274 fatalities (World Bank, 2015; GEM, 2023). According to a recent regional assessment conducted by the World Bank, almost USD \$238 million in damage and 250 fatalities are estimated in terms of the average annual loss from earthquakes in the country (World Bank, 2023). In terms of flooding, the most devastating flood occurred in 1992 in the southwest of the country caused over 1,300 fatalities and about \$500 million in damage, with 15% of the population displaced. The recent regional assessment estimates about USD \$177 million in damage and 71 fatalities are estimated in terms of the average annual loss from fluvial floods with undefended assumption (World Bank, 2023). Zooming into education sector in Tajikistan, according to the Global Baseline of School Infrastructure (World Bank, 2019), about USD \$13.4 million in damage and 5 fatalities are estimated in terms of the average annual loss from earthquakes, with the estimated annual affected school population more than 275,000.

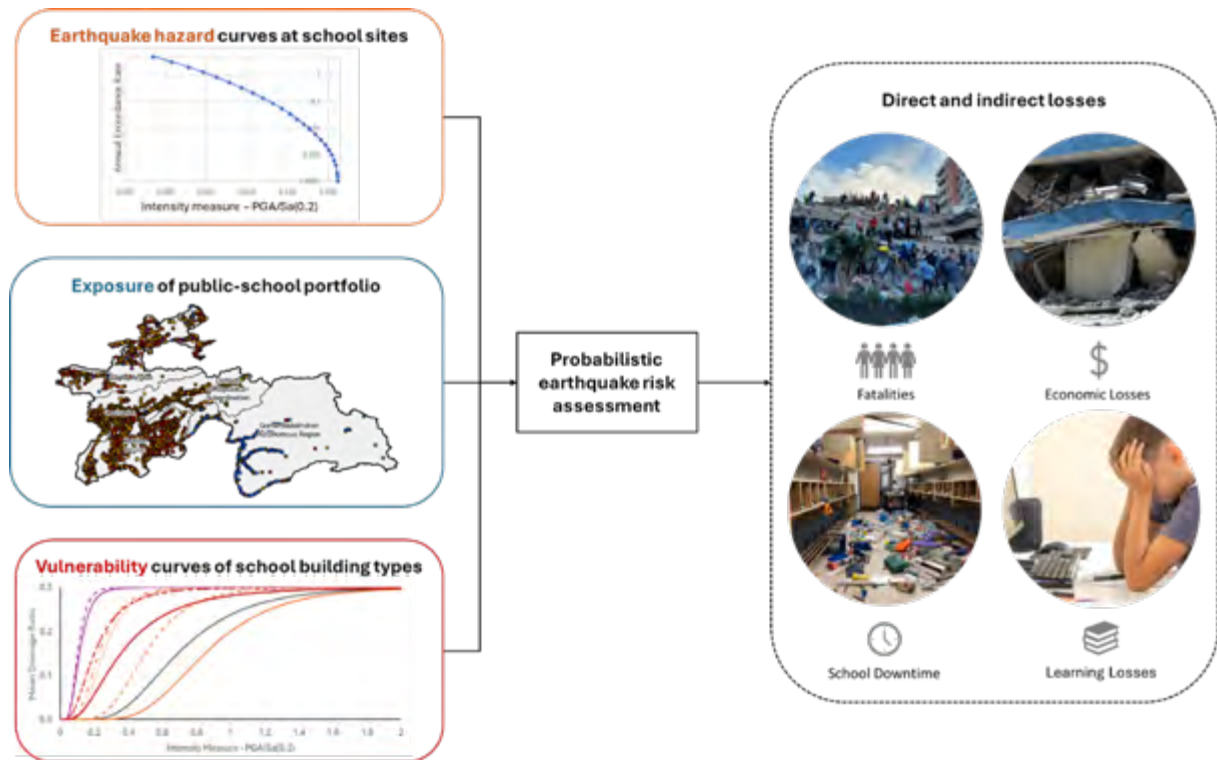
Further with climate change, extreme heat is another hazard calling attention in Tajikistan. The annual mean temperatures have been increasing by 0.1-0.2°C per decade between 1940 and 2012 and are expected to continue increasing, with the warming rates accelerated since the late 1970s. Recent summers in Tajikistan have seen temperatures exceeding 45°C (AVESTA, 2025), with warnings issued by the Hydrometeorology Agency and UNICEF highlighting health risks for children. Global evidence shows that heatwaves are one of the leading causes of learning loss (World Bank, 2024; Park, Goodman, Hurwitz, & Smith, 2020). Such impact to learning can be more detrimental in overcrowded classrooms. Although the specific impact of extreme heat to physical learning environment in the country is not analyzed under this project due to lack of relevant data, it is worth highlighting extreme heat as an educational risk and the need to integrate heat-resilient design and operational measures into the disaster risk management agenda. Under this project, some relevant recommendations have been included as part of the intervention strategy discussed under [Chapter 7](#).

## 5.2 Earthquake Risk in Schools

In terms of earthquakes, this study conducted probabilistic risk assessment for the whole public-school portfolio in the country, which quantifies the potential damage and losses that may arise from prospective events. The aim is to understand the areas and schools that are more at risk than the others to inform planning of school infrastructure investment (see [Chapter 6](#)). [Figure 18](#) illustrates the overall scheme of the probabilistic earthquake risk assessment followed in this study.

The earthquake risks are usually evaluated as potential consequences in terms of direct or indirect losses, where direct losses are immediate, physical consequences, while indirect losses are secondary economic and social impacts. For school infrastructure, the losses can be fatalities, economic losses, school downtime, and learning losses. Under this study, given the data availability, direct fatalities and economic

Figure 18. Overall scheme of the probabilistic earthquake risk assessment



losses are selected to be evaluated. Here, the probabilistic earthquake risk assessment evaluates the likelihood and potential consequences of earthquakes at various intensities by combining three key inputs discussed below.

### 1) Earthquake hazard curves at school sites

An earthquake hazard curve depicts the relationship between different earthquake intensities and their annual probability of exceedance. It is derived from a Probabilistic Seismic Hazard Analysis (PSHA), which analyzes the likelihood of various earthquake intensities occurring at a specific site over time. In this study, the probabilistic earthquake hazards were referenced from the Central Asia model of the Global Mosaic of Hazard Models from Global Earthquake Model (GEM)<sup>25</sup> due to the lack of workable Probabilistic Seismic Hazards Assessment (PSHA) maps from local sources during the study. The hazard curves

per school locations were further generated using OpenQuake Engine<sup>26</sup> from GEM based on its Central Asia model and the Global Vs30 Mosaic<sup>27</sup> from United States Geological Survey (USGS) to account for approximate site conditions. The earthquake intensity measures used include the peak ground acceleration PGA and the spectral acceleration at short period  $S_a(0.2)$ .

### 2) Exposure of public-school portfolio

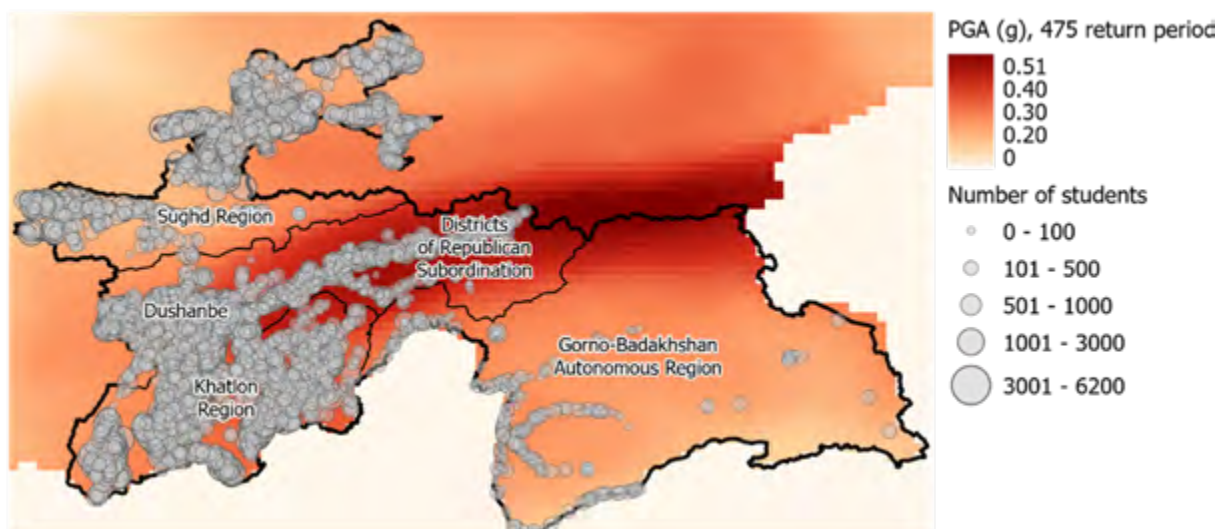
An earthquake exposure model describes the location, characteristics (e.g. construction type, number of stories), and occupants of the built environment within a defined geographical area. In this study, the exposure is taken the total portfolio of 3,705 public schools with number of students information from the LEARN project, the coordinates cross-referenced from the ICT database, and the construction types and number of stories extrapolated as discussed in Section 3.2

25. <https://www.globalquakemodel.org/product/central-asia-hazard>

26. <https://github.com/gem/oq-engine>

27. <https://earthquake.usgs.gov/data/vs30/>

Figure 19. Exposure of schools and students to earthquake in Tajikistan (PGA, 475 return period)



and shown in Figure 6. Figure 19 shows the exposure of students from the 3705 public schools to the 475-year return period earthquake hazard (PGA, peak ground acceleration) in the country, which is usually considered as design-level earthquake.<sup>28</sup> It can be seen that a considerable number of schools and students are located in high seismicity (design-level PGA above 0.4g) areas of the country, especially along the Sarez–Karakul fault zone. Table 10 further summarizes the distribution of schools exposed to different intensity levels of earthquake hazard, which suggests about 68% of schools exposed to a design level earthquake of 0.3g or more.

### 3) Vulnerability curves of school building types

An earthquake vulnerability curve shows the relationship between the hazard intensity (e.g. PGA, Sa(0.2)) and the estimated mean level of damage (loss) to an asset, system, or community. Specifically for school infrastructure, as shown in Figure 18 and discussed before, the losses evaluated in this study includes direct fatalities and economic losses from damages. Here, based on the findings from desktop reviews and sampled field surveys as discussed in Section 3.2 as well as inputs from local engineers, the vulnerability curves were identified through similar school building types from previous study in Central Asia region (World Bank, 2019) as well as the GLOSI (World Bank, 2019). Among the construction types identified for school buildings in Tajikistan, Adobe and Finnish type school buildings are both highly vulnerable and recommended to be demolished and replaced with a new building, therefore the same vulnerability curve Adobe (A) is considered for both. Similarly, unreinforced stone masonry and unreinforced brick masonry are also at similar levels of vulnerability compared to others and more cost-effective to

Table 10. Distribution of schools with respect to their exposed earthquake hazard level (475-year return period PGA)

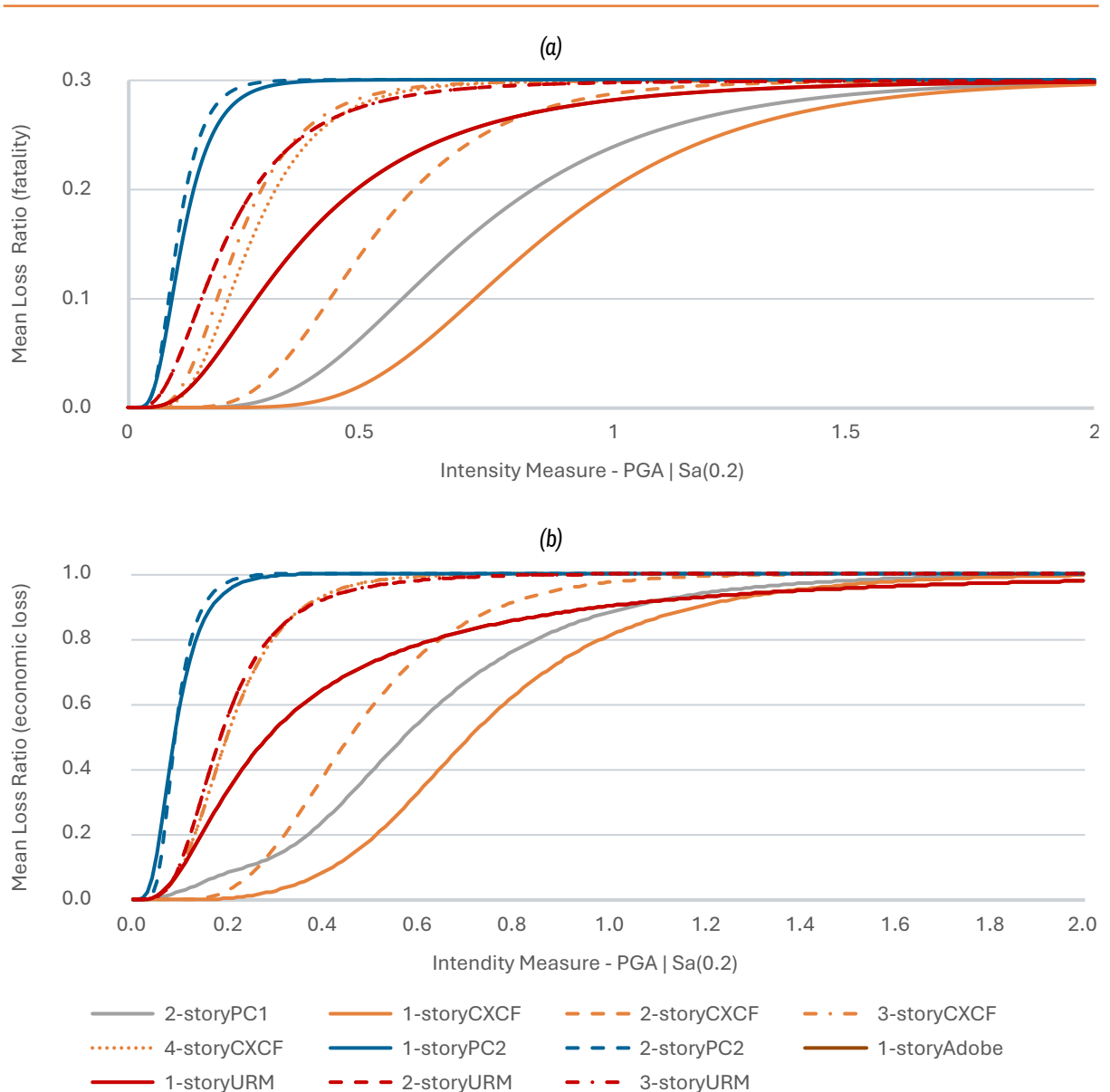
PGA (g) 475-year return period	Percentage of exposed schools
0.2 - 0.3	33%
0.3 - 0.4	52%
0.4 - 0.51	16%

28. A design level earthquake is the specified intensity of earthquake for which a structure is designed to ensure a certain performance, typically preventing collapse and ensure public safety. It serves as a standard against which potential damage and structural performance can be evaluated to ensure buildings can safely withstand expected seismic forces.

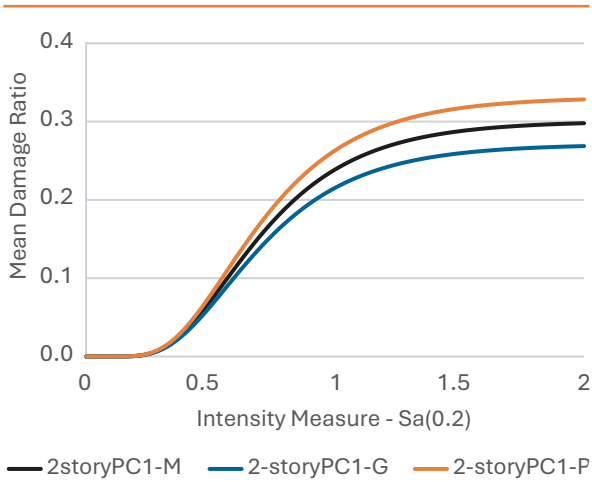
demolish and replace with a new building, for which an average vulnerability curve unreinforced masonry (URM) is assigned for both. To illustrate the relative vulnerability of the school building types, Figure 20 presents the vulnerability curves adopted in this study for fatalities and economic losses, which demonstrates that PC2 is the most vulnerable school building types, followed by Adobe, URM and CXCF with higher number of stories. The curves are associated with school building types in the format of “X-story-TYPE-C”, where “X-story” refers to X number

of stories, “TYPE” refers to the construction type discussed in Section 3.2, and C to the condition of the building, classified as Poor (P), Medium (M), and Good (G). The condition accounts for the deterioration level of the building: buildings built before 1970 are assumed with Poor condition, while those built in 2010 or after are considered in Good condition, and all the others as Medium condition. The Medium condition is the baseline curve, while the Poor and Good are adjusted by 10% more or less vulnerable, as presented in Figure 21.

Figure 20. Vulnerability curves adopted in the earthquake risk assessment: (a) for fatalities; (b) for economic losses



**Figure 21. Vulnerability functions adjusted by building deterioration conditions**

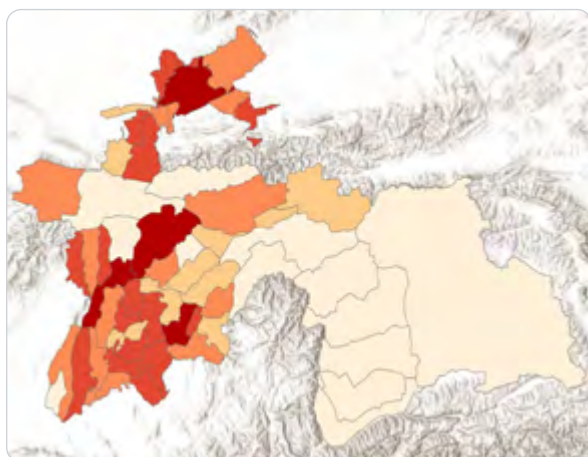


With the above discussed three key inputs, the probabilistic earthquake risk assessment integrates hazard, exposure and vulnerability to estimate the direct fatalities and economic losses considered in this study. Here the specific risk metric used is the average annual losses for

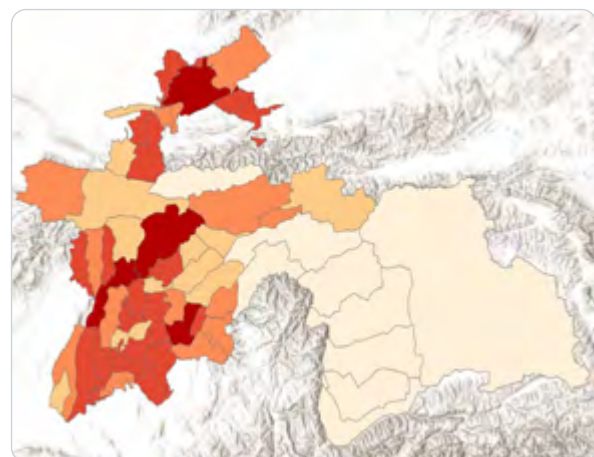
student fatalities and economic losses, which is evaluated in number of students or monetary terms of USD. However, for the objective of informing prioritization and planning (see [Chapter 6](#)), the risks are normalized across the country to understand where the highest risks are located geographically. [Figure 22](#) and [Figure 23](#) shows the normalized risk maps at district level in terms of percentage of estimated national total average annual losses, for student fatalities and economic losses from earthquake damage respectively. These can be used to inform the identification of the most critical districts for school infrastructure investment to reduce earthquake risk, which will be further discussed under [Chapter 6](#).

Further, [Figure 24](#) compares earthquake risks by region, suggesting that majority (about 45% of national total) of the risks (both student fatalities and economic losses from earthquake damages) are concentrated in the Khatlon region, followed by Sughd region (around 23% of national

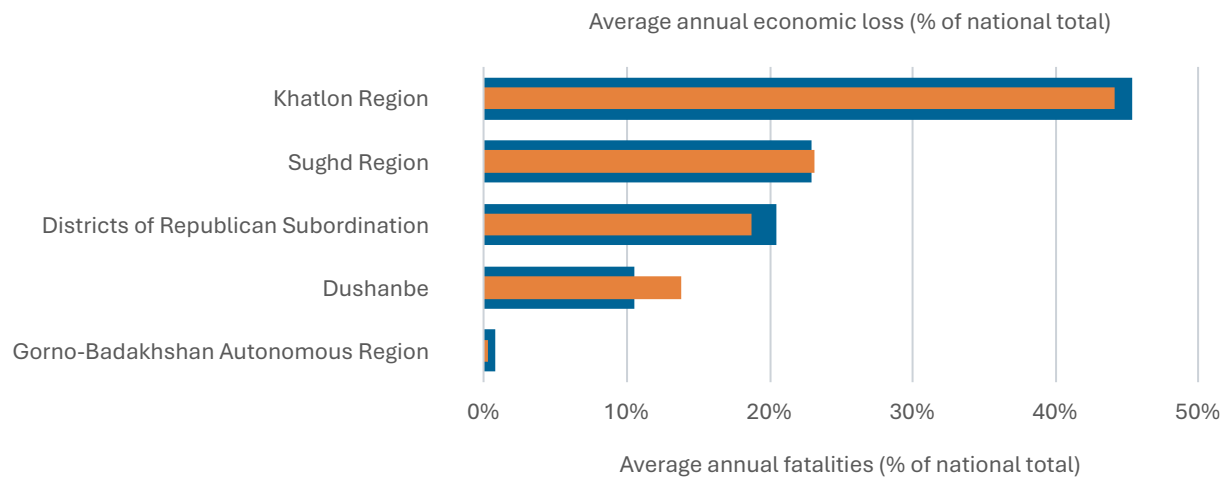
**Figure 22. Normalized average annual student fatalities from earthquake damages by district (% of national total)**



**Figure 23. Normalized average annual economic losses from earthquake damages by district (% of national total)**



**Figure 24. Average annual fatalities and economic losses per region (as % of national total)**

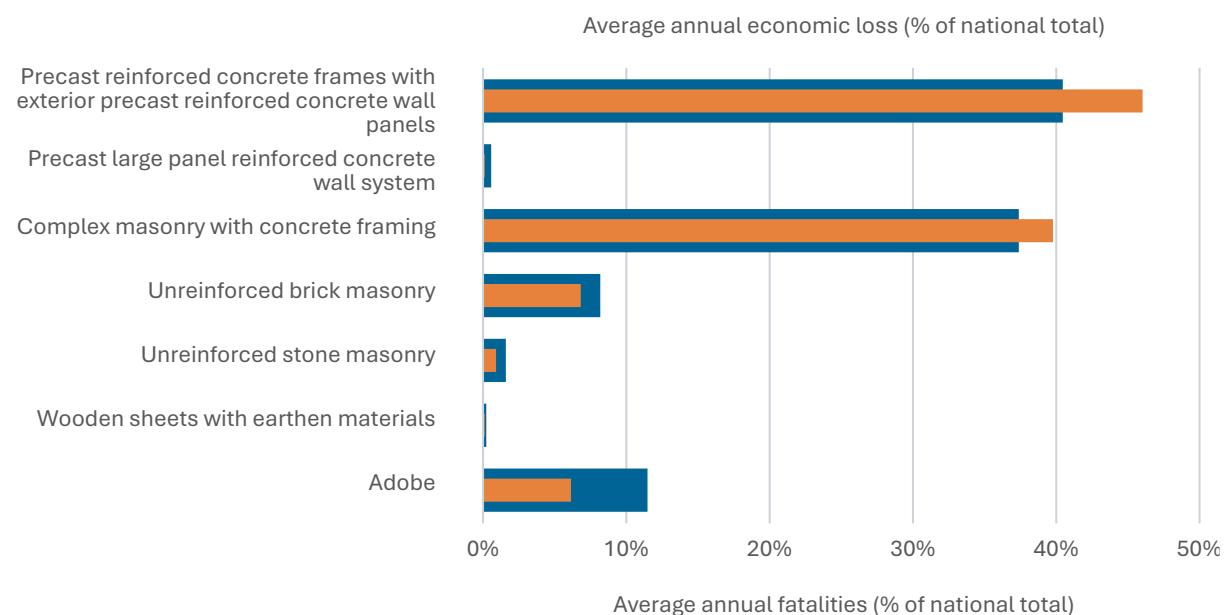


total) and District of Republican Subordination (around 20% of national total). Dushanbe presents higher risk of student fatalities comparing to economic losses under earthquakes, due to the concentrated student population per school in Dushanbe city.

Finally, the risk results can be aggregated by building typology, as presented in Figure 25, which can inform the identification of critical building types contributing to the highest level of risk for developing targeted programs for risk reduction. For instance, it is clear that schools with PC2 (Pre-

cast reinforced concrete frames with exterior precast reinforced concrete wall panels) buildings need to be prioritized for risk reduction based on its highest contribution to earthquake risks (both student fatalities and economic losses) in the national public school portfolio, especially for the life safety of students (more than 45% of the national total risk). In addition, schools with CXCF buildings (complex masonry with concrete framing) need also be considered as priority for risk reduction interventions with almost 40% contribution to the national total earthquake risks (both student fatalities and economic losses).

**Figure 25. Average annual fatalities and economic losses by building typology (as % of national total)**



### 5.3 Flood Hazard and Exposure

For the considered exposure of 3705 public schools with coordinates available, their exposure to fluvial (river) and pluvial (caused by heavy rainfall) floods is also investigated. Fathom global flood map 3.0<sup>29</sup> with resolution of 30cm is referenced to evaluate schools’ exposed base flood elevation (100-year return period) under baseline scenario without considering future climate change effect. The base flood elevation of 100-year return period flood is the widely used benchmark for determining the design flood level. According to FEMA 551<sup>30</sup> and FEMA 424,<sup>31</sup> the base flood elevations at school locations are evaluated with respect to the flood depth categories defined in Table 11, with corresponding considerations and recommendations provided.

The base flood elevations identified for the schools are shown in Figure 26, which will inform the prioritization for resilient school facilities

that will be further discussed in Chapter 6. In terms of the main type of floods the schools are exposed to, Figure 27 suggests that across all regions, most of flood exposure is due to pluvial flood and about 25-30% of the schools across regions are identified with possible exposure to various flood depth if a 100-year event (design level flood) occurs, with Gorno-Badakhshan Autonomous region having more of their schools exposed to pluvial or fluvial floods comparing to other regions. In terms of the extent of flood exposure at design level (100-year return period), Figure 28 and Table 12 further suggests that Gorno-Badakhshan Autonomous region have more of their schools at risk of major (90cm – 150cm) and deep flooding (more than 150cm), with 6% and 2% of the schools in the region respectively. This is followed by Sughd region and District of Republican Subordination. For these regions with schools at risk of major and deep flooding, the importance of flood mitigation measures and emergency planning needs to be highlighted for relevant school sites.

**Table 11. Base flood elevation depth categories, considerations and recommendations**

Base Flood Elevation	Considerations and Recommendations
(100-year return period)	Shallow flooding. Minor water damage and minimal structural impact. Flood site hazard can be mitigated up to 40cm by using temporary flood protection barriers (e.g., sandbags or other temporary protection barriers that are locally available).
No more than 30cm	Moderate flooding. The damage to the structure should be manageable, with likely electrical and content loss. Typical masonry walls can usually withstand the water pressure up to about 90cm. However, depending on the velocity of the flood water, damage to masonry walls could happen when flood depth is below 90cm. It is important to consider relevant mitigation measures depending on the site feasibility and cost efficiency, such as drainage improvements, dry floodproofing, etc.
30cm – 90m	Deep flooding. Significant structural and content damage. When flood depth exceeds 90cm, unreinforced masonry walls are more likely to crack or collapse. Relevant mitigation measures should be considered based on site feasibility and cost efficiency, such as drainage improvement, wet floodproofing, elevation, etc. Emergency planning is recommended.
90cm – 150cm	Major flooding. Building will become inaccessible and have total loss of functionality, with likely collapse and life safety at risk. Emergency planning should be considered, as well as mitigation measures based on the site feasibility and cost efficiency, including elevation or relocation (especially if known to be damaged by past flood events).

29. <https://www.fathom.global/product/global-flood-map/>

30. [https://www.fema.gov/sites/default/files/2020-08/fema\\_551.pdf](https://www.fema.gov/sites/default/files/2020-08/fema_551.pdf)

31. [https://www.fema.gov/sites/default/files/documents/fema\\_p-424-design-guide-improving-school-safety.pdf](https://www.fema.gov/sites/default/files/documents/fema_p-424-design-guide-improving-school-safety.pdf)

The base flood elevations identified for the schools are shown in Figure 26, which will inform the prioritization for resilient school facilities that will be further discussed in Chapter 6. In terms of the main type of floods the schools are exposed to, Figure 27 suggests that across all regions, most of flood exposure is due to pluvial flood and about 25-30% of the schools across regions are identified with possible exposure to various flood depth if a 100-year event (design level flood) occurs, with Gorno-Badakhshan Autonomous region having more of their schools exposed to pluvial or fluvial floods comparing

to other regions. In terms of the extent of flood exposure at design level (100-year return period), Figure 28 and Table 12 further suggests that Gorno-Badakhshan Autonomous region have more of their schools at risk of major (90cm – 150cm) and deep flooding (more than 150cm), with 6% and 2% of the schools in the region respectively. This is followed by Sughd region and District of Republican Subordination. For these regions with schools at risk of major and deep flooding, the importance of flood mitigation measures and emergency planning needs to be highlighted for relevant school sites.

Figure 26. Base flood elevations of 3705 public schools in Tajikistan

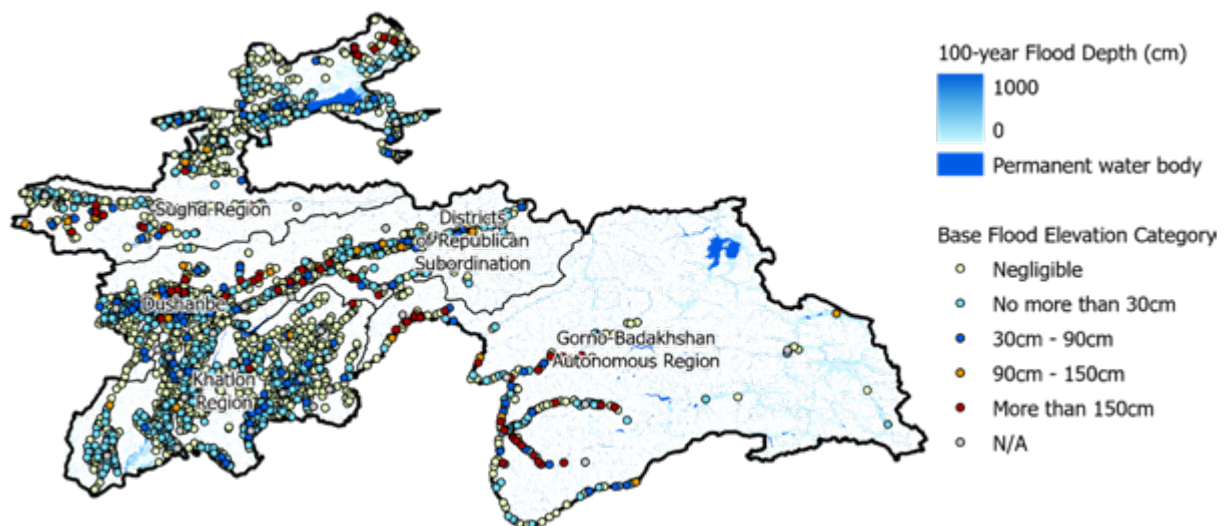


Figure 27. Main source of flood type (pluvial or fluvial) public schools are exposed to by region

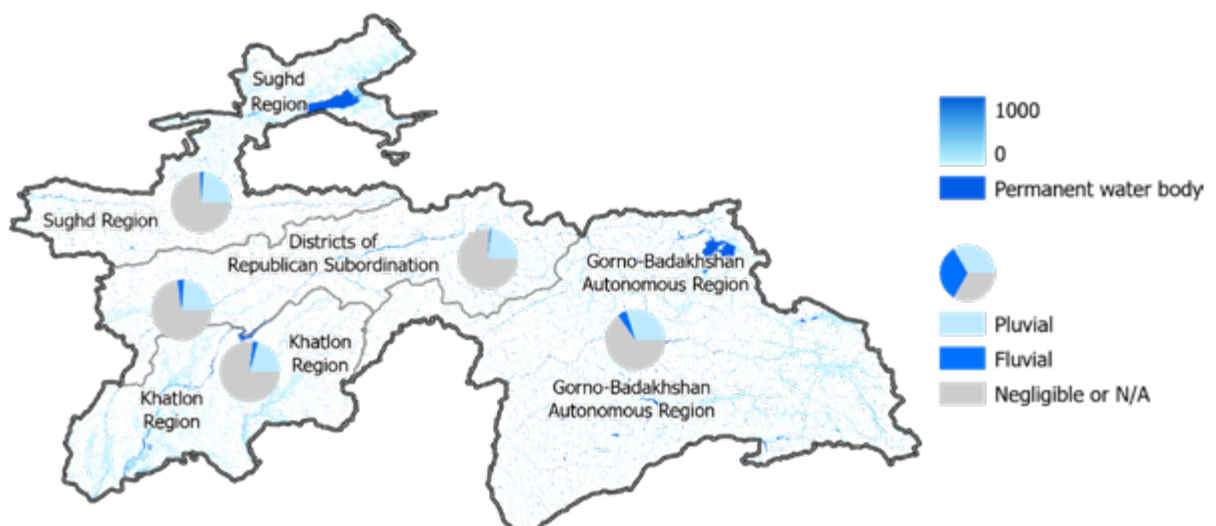


Figure 28. Base flood elevation categories of public schools by region

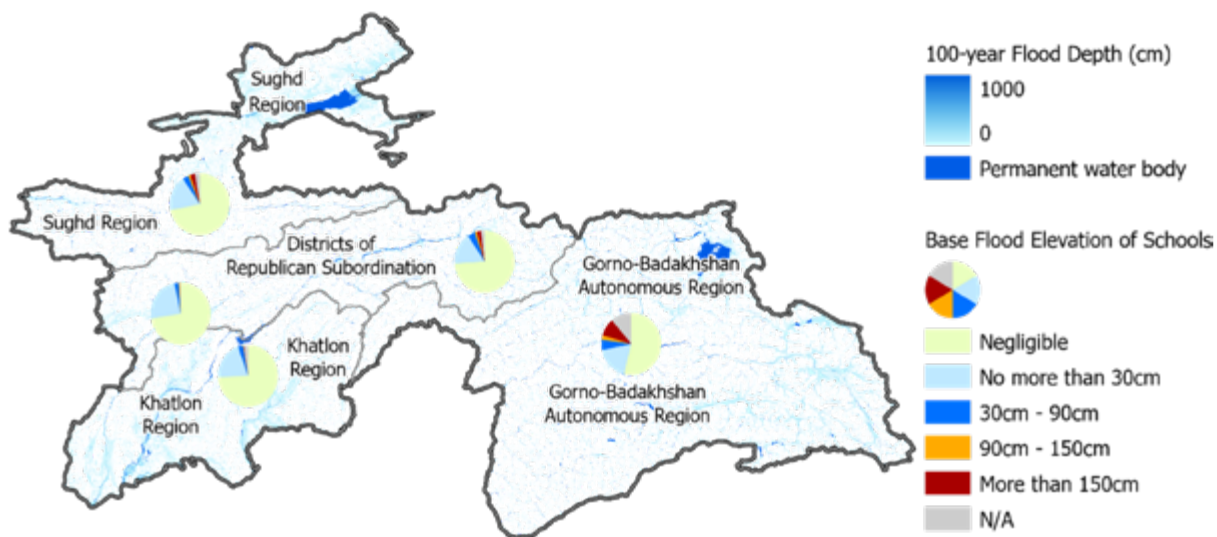


Table 12. Base flood elevation categories of public schools by region

Region	Negligible	No more than 30cm	30cm - 90cm	90cm - 150cm	More than 150cm	N/A
Gorno-Badakhshan Autonomous	54%	18%	6%	2%	9%	11%
Dushanbe	74%	22%	1%	1%	0%	2%
Districts of Republican Subordination	73%	17%	4%	1%	2%	2%
Sughd	72%	18%	3%	1%	2%	3%
Khatlon	75%	20%	3%	0%	0%	2%

# 6. Prioritization Framework for RIGHT+ School Infrastructure

Building upon the risk assessment results discussed in Chapter 5, this Chapter proposes a prioritization framework for resilience school infrastructure, based on previous prioritization criteria adopted under the LEARN project as well as key priorities highlighted for physical learning environment by the NFED.

## 6.1 Prioritization Framework

To facilitate the effort in addressing the priorities on improving the physical environment highlighted by the National Education Development Framework, this study proposes a hierarchy prioritization framework building upon some of the prioritization criteria adopted under the LEARN project as well as the draft action and financial plan for 2025-2040 from MoES as of July 2025. [Table 13](#) presents this proposed prioritization framework, including 4 potential programs with different main objective covering relevant RIGHT+ emphasis for implementing the activities related with school infrastructure investment from MoES’ draft action and financial plan for 2025-2040. These activities are organized in terms of components under each program, with the timeframe defined by the MoES. This framework proposes two levels of criteria responding to the main objective of each program, including eligible criteria and prioritization criteria as explained below.

### 1) Eligible Criteria

These proposed criteria aim to identify priority groups of schools with specific main needs and/or enabling conditions corresponding to the objective under the program. It is suggested to identify schools that meet one of the criteria listed to be considered as the eligible group of schools to be considered under respective program.

### 2) Prioritization Criteria

The prioritization criteria aim to inform the final ranking and selection of schools to be financed under respective program, so that the outcomes and benefits from available school infrastructure investment can be maximized with respect to the main objective. As proposed in [Table 13](#), these criteria can be defined by the benefits or beneficiaries of the scope of investment under relevant programs, as well as benefit-cost analysis if cost estimations are available. In this study, intervention solutions and indicative cost estimates will be discussed under [Section 7.1.2](#) and be used for the benefit-cost analysis here.

Specifically, the 4 proposed implementation programs with relevant components addressing different objectives are discussed as follows. It is worth noting that although the programs have different main objectives implying different main scopes of interventions, it is always recommended to consider integrated solutions that holistically improve the physical learning condition for all RIGHT+ aspects, based on the specific intervention needs in each school. Also, while the programs groups schools with different priority intervention needs, they are recommended to be implemented in parallel.

### *Program 1: Disaster resilient facilities*

This program aims to improve disaster resilience by financing schools with high life safety risks from natural hazards and poor structural health conditions to be upgraded for disaster resilience. Note that for the effectiveness and sustainability of physical learning environment investment, the schools identified under this program should not be considered for other programs unless the safety risks are addressed. Also, to achieve full RIGHT+ learning environment, integrated solutions need to be implemented to improve not only resilience, but also other aspects of RIGHT+. The scope of interventions under this program expect both new construction and major structural retrofitting.

#### *Eligible criteria:*

- **Schools in emergency condition or needing repair; or**
- **Schools located in high seismic risk districts as discussed under [Section 5.1](#); or**
- **Schools at high flood hazard sites as discussed under [Section 5.2](#).**

#### *Prioritization criteria:*

A resilience benefit cost ratio (BCR) has been proposed to maximize the disaster resilience benefit from investment, by ranking the eligible schools from the highest resilience BCR to the lowest. The resilience BCR is defined as follows.

$$\text{Resilience BCR} = \frac{\text{annual lives saved from future earthquakes by intervention}}{\text{intervention cost}}$$

**Program 2: Inclusive, teaching and learning conducive facilities**

This program aims to create inclusive, teaching and learning conducive physical environment in schools by financing interventions that mainly contribute to those aspects. Schools identified with safety risks with respect to natural hazards should not be considered under this program (they are to be addressed under Program 1), unless their safety risks will be addressed as part of the program intervention. While acknowledging that integrated solutions need to be considered for comprehensive RIGHT+ aspects, the scope of interventions under this program mainly expects new construction and non-structural rehabilitation, unless structural improvements are deemed necessary in specific cases during feasibility studies.

**Eligible criteria:**

To allow this program to achieve more social benefits by providing inclusive, teaching and learning conducive physical environment to more students in need and boost learning outcomes through improved learning environment, it is suggested to consider relatively overcrowded schools (current or future) and/or districts that are less privileged, in terms of schools that have:

- **Number of students per student seat > 1; and**
- **Demographic projection positive; and**
- **Land plot allows for extensions; or**
- **Located in districts with lower socio-economic development level.**

**Prioritization criteria:**

It is proposed to maximize the social benefit under this program by ranking the eligible schools from the highest number of students per existing student seat to the lowest.

**Program 3: Green and healthy facilities**

This program aims to promote greener and healthier physical environment in schools by financing interventions that mainly contribute to those aspects. Schools identified with safety risks with respect to natural hazards should not be considered under this program (they are to be addressed under Program 1), unless their safety risks will be addressed as part of the program intervention. While acknowledging that integrated solutions need to be considered for comprehensive RIGHT+ aspects, the scope of interventions under this program mainly expects new construction and non-structural rehabilitation, unless structural improvements are deemed necessary in specific cases during feasibility studies.

**Eligible criteria:**

To allow this program to finance the schools with the most relevant intervention needs, as well as with the enabling condition for those interventions, it is proposed to consider schools that are:

- **Without renovation for over 10 years; and**
- **With basic utilities (continuous power, water supply and internet connection) available.**

**Prioritization criteria:**

It is proposed to maximize beneficiary of this program by ranking the eligible schools from the highest number of students to the lowest, and taking into consideration the performance of the school for the program to help lower performed schools improve students' learning outcome through improved learning environment.

### Program 4: Provision of basic utilities

This program aims to provide basic utilities, including stable power supply, water supply and internet connection to those who do not have these basic utilities in place. Schools identified with safety risks with respect to natural hazards should not be considered under this program (they are to be addressed under Program 1), unless their safety risks will be addressed as part of the program intervention. While acknowledging that integrated solutions need to be considered for comprehensive RIGHT+ aspects, the scope of interventions under this program mainly expect interventions to connect schools with the power grid and water supply as well as internet, unless structural improvements are deemed necessary in specific cases during feasibility studies.

#### Eligible criteria:

To allow this program to finance the schools with the most relevant intervention needs, it is proposed to consider schools that have:

- **No continuous power supply; or**
- **No water supply; or**
- **No internet connection.**

#### Prioritization criteria:

It is proposed to maximize beneficiary of this program by ranking the eligible schools from the highest number of students to the lowest, and prioritize those in the districts with lower level of socio-economic development to benefit those most in need.

**Table 13. Proposed prioritization framework for RIGHT+ school infrastructure at scale**

RIGHT+ Emphasis	Programs (recommended)	Timeframe	Components	Eligible Criteria (recommended, schools meet one of the listed criteria)	Prioritization Criteria (recommended from highest to lowest if not indicated otherwise)
R	Disaster resilient facilities	2025 - 2040	Upgrade educational facilities for disaster resilience	<ul style="list-style-type: none"> <li>• Emergency condition or needing repair</li> <li>• High seismic risk districts</li> <li>• High flood hazard sites</li> </ul>	BCR (annual lives saved per million USD)
R	Inclusive, teaching and learning conducive facilities	2025-2029	Planning firefighting systems	<ul style="list-style-type: none"> <li>• Relatively overcrowded schools: number of students per student seat &gt; 1; demographic projection positive; and land plot allows for extensions</li> <li>• Districts with lower level of socio-economic development</li> </ul>	Number of students per existing student seat and Performance of the school (lowest to highest)
I			Accessibility		
T			Flexible learning environments		
I		2025-2040	Gender-friendly facilities		
G	Green and healthy facilities	2025-2040	Energy and water efficiency	<ul style="list-style-type: none"> <li>• Without renovation for over 10 years, and basic utilities (continuous power, water supply and internet connection) available</li> </ul>	Number of students
H			Indoor environmental quality		
H			WASH facilities		
H	Provision of basic utilities	2025-2040	Basic utilities	<ul style="list-style-type: none"> <li>• No continuous power supply</li> <li>• No water supply</li> <li>• No internet connection</li> </ul>	Number of students and Socio-economic development level of the district (lowest to highest)

## 6.2 Case Study

Based on the proposed prioritization framework discussed in Section 6.1, as well as the baseline information and risk assessment results discussed in Chapter 3 and 5, a case study is shown here to demonstrate the implementation of the proposed prioritization framework based on available information for the schools in the country under this study. Note that the case study results reflect the recommendations based on available information and assumptions discussed under Chapter 3, 5 and 7, which should be updated upon more or refined baseline information become available to better inform school infrastructure planning in the country.

### 6.2.1 Intervention and investment needs at national scale

Based on the proposed intervention programs under Section 6.1 and available baseline information at the time of this study (see Chapter 3), schools are identified for Program 1: Disaster resilience facilities and the other programs proposed, as shown in Figure 29. Figure 30 further suggests that about 59% of public schools need to be considered under Program 1: Disaster resilient facilities while 41% considered under other programs (Program 2: inclusive, Program 3: teaching and learning conducive facilities; Program 4: green and healthy facilities; provi-

sion of basic utilities), indicating that among the RIGHT+ intervention needs, resilience is a major need for the school infrastructure portfolio in the country.

In terms of the lines of intervention estimated for existing school buildings in the country (see Chapter 7 for details, note that here the line of retrofit also include any non-structural rehabilitation needed to address the comprehensive RIGHT+ aspects with integrated solutions), Figure 31 shows that an estimation of about 56% of the school buildings would expect the need to be replaced with new buildings, sharing about 55% of the total estimated intervention investment needs for the national portfolio of public schools when comprehensive RIGHT+ interventions are considered for all schools. Figure 32 investigates the estimated lines of intervention for schools in different regions, suggesting that Gorno-Badakhshan Autonomous region would expect most of the schools needing replacement, followed by Districts of Republican Subordination; while most of the school buildings are feasible and effective to be retrofitted in Dushanbe, with the other two regions expects comparable investment needs for retrofit and replacement of school buildings. Figure 33 breaks down the cost of estimated intervention lines by school building types, indicating that most of complex masonry with concrete

Figure 29. Proposed intervention programs identified for schools in Tajikistan

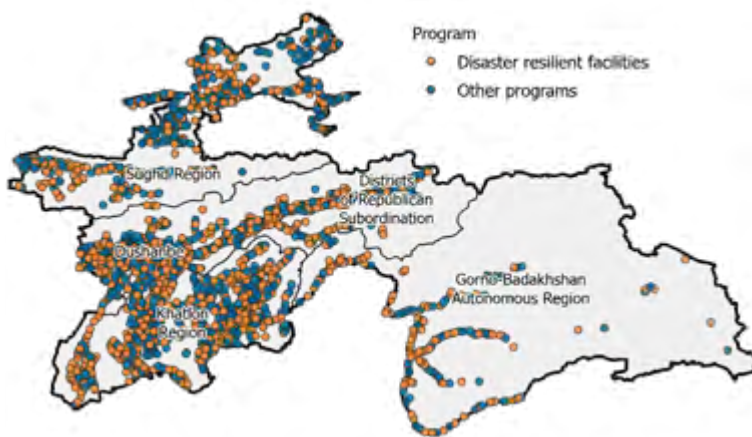


Figure 30. Estimated distribution of schools per intervention program

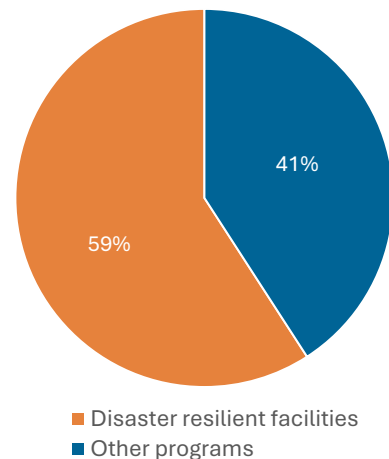


Figure 31. Estimated lines of intervention for existing school buildings in Tajikistan

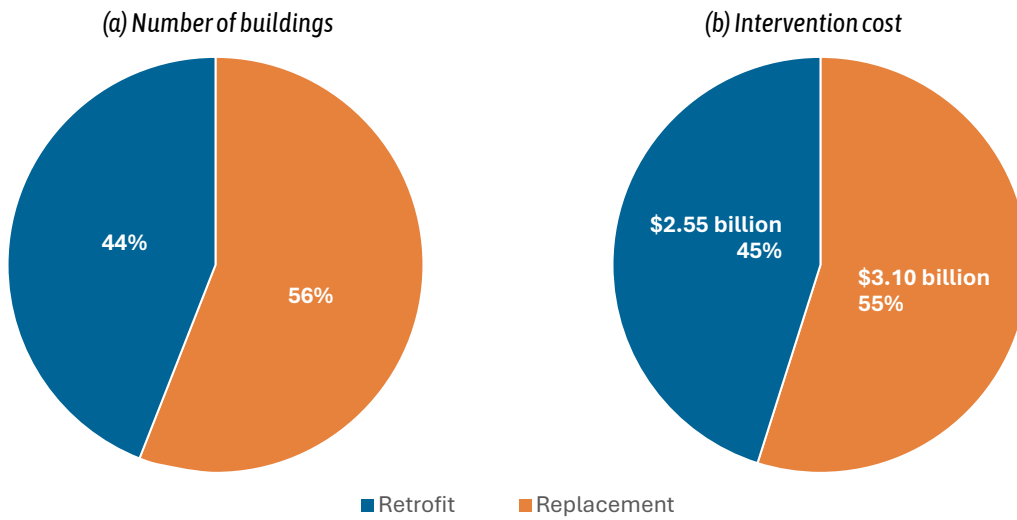


Figure 32. Estimated lines of intervention cost by region

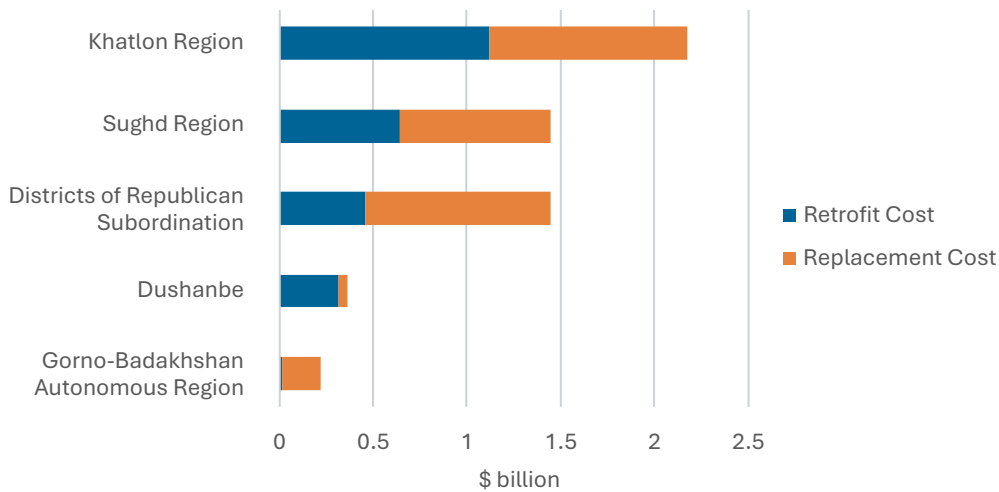
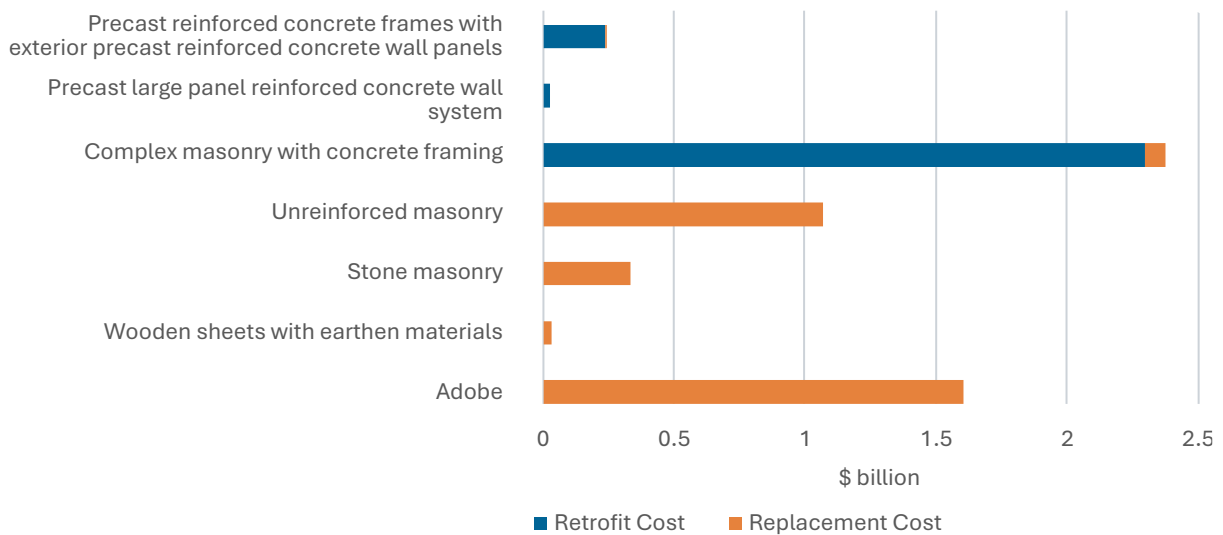


Figure 33. Estimated lines of intervention cost by school building type



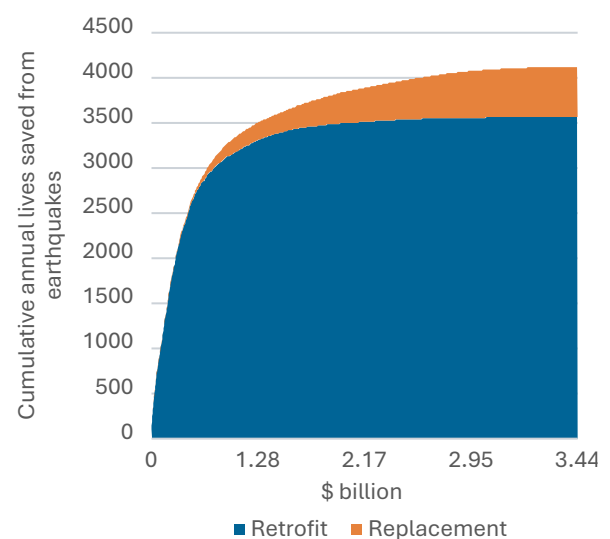
framing, precast reinforced concrete frames with precast reinforced concrete wall panels, and precast large panel reinforced concrete wall system are expected to be feasible to improve learning environment through retrofit, while the other school building types (e.g. Adobe, Finnish type, etc.) will have to be replaced with new buildings as discussed under Section 7.1.

### 6.2.2 Prioritization of disaster resilient facilities

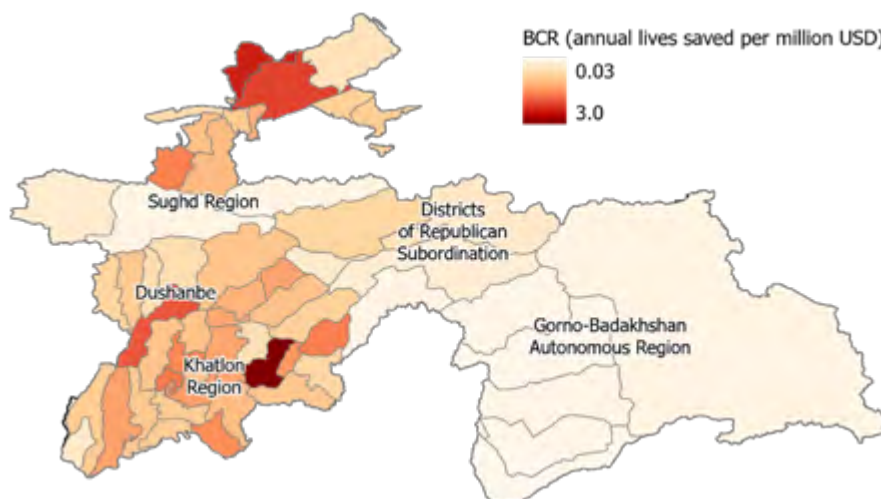
Given the baseline data availability, this case study demonstrates the prioritization under Program 1: Disaster Resilient Facilities as an example. Based on the proposed prioritization criteria and BCR discussed under Section 6.1 and the seismic risk assessment results under Section 5.1, BCRs of the schools meeting the eligible criteria to be considered under this program are calculated to inform the ranking and selection of schools to be financed under the budget of this program, which could be by ranking of district or direct ranking of schools. The aggregated Resilience BCR by district is shown in Figure 34. Such ranking by district from the highest BCR to the lowest could be considered when a more geographical approach is preferred to prioritize financing of schools by district. On the other hand, the ranking of BCR directly by schools provides a more targeted approach to allocate resources for the maximized benefit. Figure 35

demonstrates the cumulative resilience benefit versus intervention cost estimated for the identified schools to be considered under Program 1: Disaster resilient facilities. Based on the seismic risk assessment under Section 5.1, the benefit here is estimated in terms of annual lives saved from earthquakes by investing in school infrastructure interventions. The curves showcase more efficient investment at higher rankings which would achieve more risk reduction benefit than lower rankings.

**Figure 35. Cumulative benefit versus intervention cost by Resilient BCR ranking of schools under Program 1: Disaster Resilient Facilities**



**Figure 34. Resilience BCR of schools by district under proposed Program 1: Disaster Resilient Facilities**



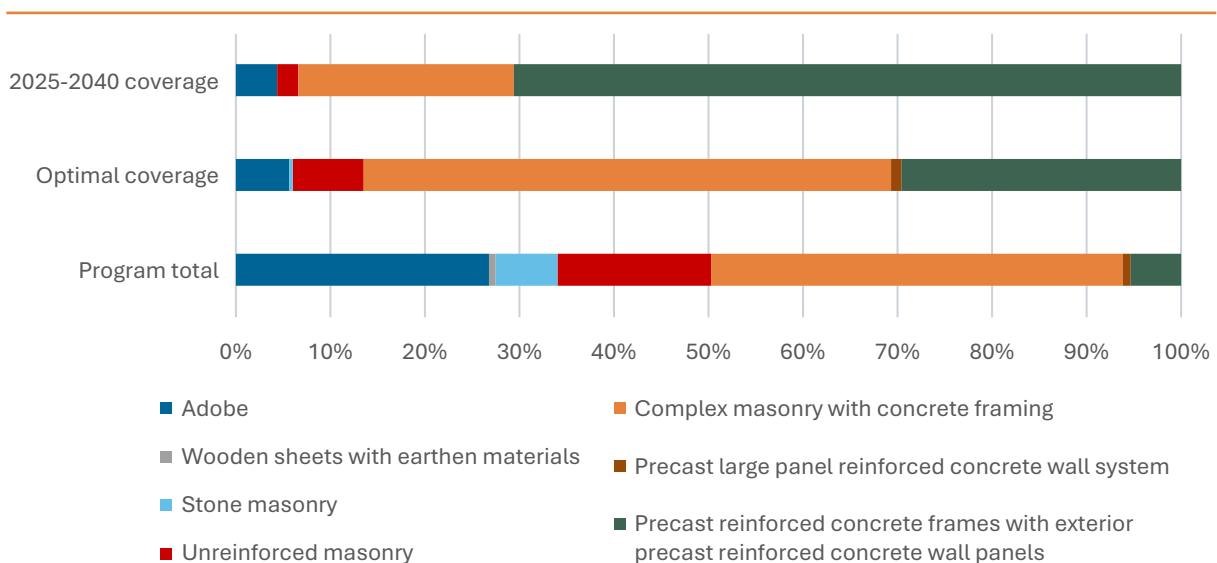
Based on such school level prioritization ranking exercise, investment scenarios can be analyzed to understand the expected benefit per available budget, as well as the optimal coverage of investment need that will be cost-efficient (i.e. financing beyond the optimal coverage will be not as effective). As presented in Table 14, it is estimated that for the planned budget (\$160 million USD) of the draft program from MoES, it covers about 5% of the total investment needs of all the schools can be considered under this program, but following the prioritization ranking can already achieve 37% of the total resilience benefit potential of the program (as if all the schools under this program are intervened). In addition, the prioritization ranking identifies the optional coverage is about 20% of the total investment needs, which will achieve 73% of the total resilience benefit potential of the program.

Under different investment scenarios of the program, the school building types that need to be prioritized for intervention can also be understood. Figure 36 suggests that with the planned 2025-2040 budget coverage, one of the main school building types prioritized to be intervened is precast reinforced concrete frames with exterior precast reinforced concrete wall panels. Although it is only estimated to be about 5% among the national school portfolio, its high seismic vulnerability as discussed in Section 5.1 as well as the fact that it is usually large buildings with large numbers of students, contributes to its high priority for intervention. Under the identified optimal coverage, much more complex masonry with concrete framing school buildings are expected to be intervened, while the total program overall expects similar distribution of school building types as in the national portfolio as discussed in Section 3.2.

**Table 14. Benefit versus cost of investment scenarios under Program 1: Disaster Resilient Facilities**

Disaster resilient facilities - Scenario	Percentage of total investment needs	Percentage of total benefit potential
2025-2040 coverage	5%	37%
Optimal coverage	20%	73%

**Figure 36. Prioritized school building types to be intervened by investment scenario under Program 1: Disaster resilient facilities**



### 6.2.3 Regional examples

To demonstrate the practical implementation and results of similar large-scale intervention programs and investment plans in the region, two country examples are discussed below.

#### Building Safer, More Resilient Schools in Türkiye

(World Bank, 2024)

##### Why it matters?

Türkiye faces one of the highest seismic risks in Europe and Central Asia region. The February 2023 twin earthquakes (M7.8/M7.5) caused an estimated \$34.2 billion in direct physical damage, with recovery and reconstruction needs exceeding \$81 billion. About 5% of educational buildings in affected areas were severely damaged or destroyed – highlighting the stakes for resilient school infrastructure.

##### Resilient intervention at scale

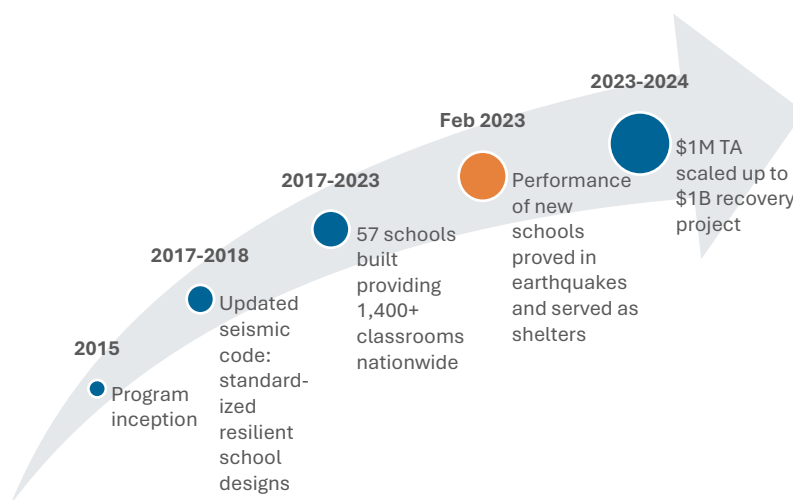
Since 2015, the Government of Türkiye, Global Facility for Disaster Reduction and Recovery (GFDRR), the World Bank, and partners have advanced a national program to reduce seismic risk in education infrastructure and mainstream resilient, energy-efficient, and accessible school design and construction. Led by the Ministry of National Education, since 2017, standardized designs and procurement have been implemented to build 57 schools (over 1,400 classrooms) complying with the updated 2018 Turkish seismic code and associated regulations for land-use planning, energy efficiency, fire protection, workplace safety, and disability access, ensuring quality and repeatability for resilient education infrastructure at scale. This has benefited more than 40,000 people (about 50% female) across the country.

##### Building back better proven in the 2023 earthquakes for scaling up

During the February 2023 twin earthquakes, zero structural failures occurred in new school assets: All 24 newly built schools located within the affected zone survived without even minor cracks. Many served as temporary shelters and hubs for essential services – demonstrating functional resilience beyond life safety. Applying modern seismic standards alongside multi-criteria compliance (energy, fire, occupational safety, accessibility) for integrated and comprehensive building-back-better delivered robust and future-proof assets. With the technical foundation established through a \$1 million GFDRR grant (notably under the Japan Program) financed technical assistances via USAID, including risk diagnostics, safer schools program design, and international expertise exchange, a \$1 billion Türkiye Earthquake Reconstruction and Recovery Project was facilitated post the 2023 earthquakes.

##### Transferable lessons

- ✓ Resilience pays: In the 2023 Türkiye earthquakes, new schools' performance contrasts sharply with broader sector damage, underscoring the importance of code-compliant and resilient construction.
- ✓ Integrated and comprehensive intervention goes beyond safety for service continuity: The multi-criteria compliance (energy, fire, occupational safety, accessibility) of new schools ensured the service continuity and delivery of functions, including their doubled function as community shelters and service hubs post-earthquake, which multiplied the social returns.
- ✓ Standardize to scale: National design standards, streamlined procurement, and clear compliance pathways enable rapid and replicable delivery at scale.



## Building a Resilient Future: Strengthening School Infrastructure in the Kyrgyz Republic

(World Bank, 2019)

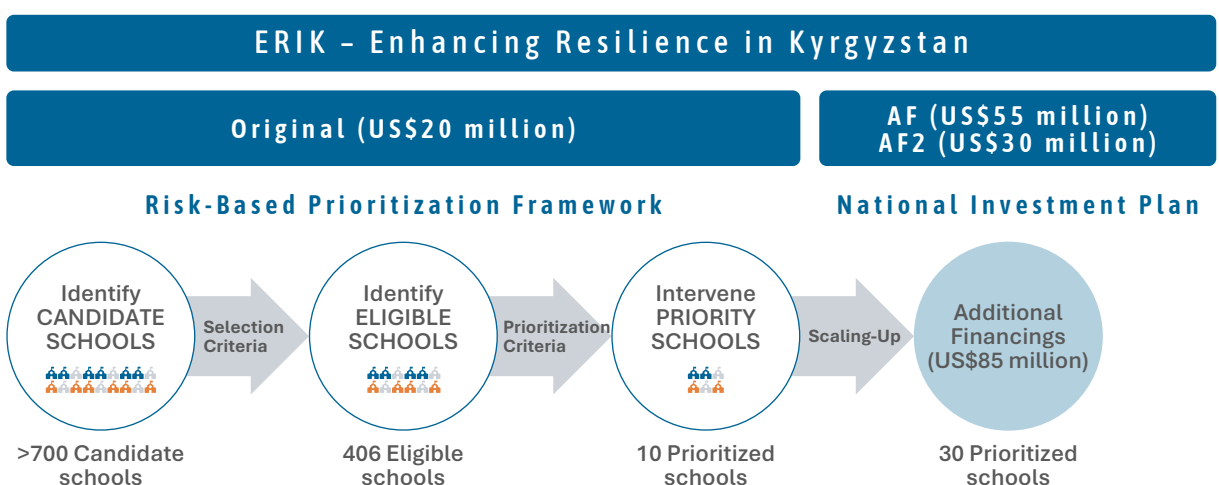
### Education at risk

In the mountainous terrain of the Kyrgyz Republic, where earthquakes are a frequent hazard, nearly 30 % of school buildings are over 50 years old—and more than 80 % are likely to be unsafe. The urgent challenge of protecting students from seismic risks while ensuring access to quality education has become increasingly urgent. According to nationwide assessments,<sup>32</sup> school buildings are the most vulnerable assets to earthquakes in the country. With nearly 4,000 schools and preschools serving over 1 million students exposed to earthquakes, the potential impact is significant. In a major earthquake scenario, the education sector could face economic losses of approximately \$390 million – about 26% of its \$1.5 billion infrastructure portfolio. This represents disproportionately high losses compared to other sectors.<sup>33</sup>

Beyond seismic risks, schools face numerous infrastructure challenges. Overcrowding, particularly in urban areas such as Osh City and Bishkek, forces many schools to operate in multiple shifts. Basic infrastructure deficiencies are also widespread: more than half of all schools lack centralized water supply, over 80% lack proper sewage systems, and more than 70% rely on coal for heating. These issues underscore significant functional and environmental challenges across the school system.

### Strategic solutions to build RIGHT+ future

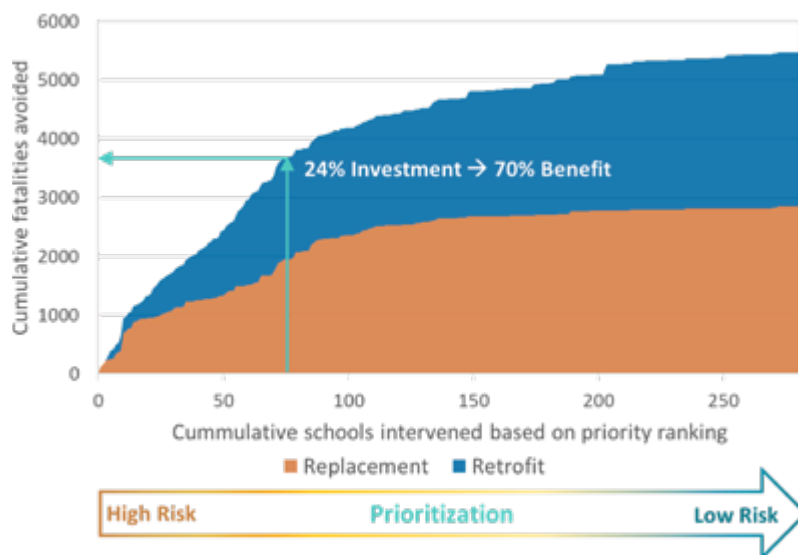
A World Bank financed project “Enhancing Resilience in Kyrgyzstan (ERIK)” is helping the government address complex challenges through a comprehensive approach combining technical expertise, strategic planning, and sustainable solutions. Supported by technical assistance grants from the Global Facility for Disaster Reduction and Recovery (GFDRR), the project amounts to a total of \$105 million. Guided by GFDRR's Roadmap for Safer and Resilient Schools (World Bank, 2023), and under the leadership of the Ministry of Emergency Situations, ERIK project has been also closely engaging key stakeholders including Ministry of Education and Science and the Ministry of Architecture, Construction, Housing and Communal Services for institutional and sustainable long-term impacts. Through strategic and risk-based prioritization framework, a phased approach was undertaken: its original financing of \$20M has been scaled up with two additional financings (AFs) of \$55M and \$30M,



32. The State Program on Safer Schools and Preschools of the Kyrgyz Republic 2015–2024 was established by the Government in 2015; this work was based on a countrywide vulnerability assessment of schools conducted with the support of the United Nations Children’s Fund (UNICEF).

33. World Bank. 2017. Measuring Seismic Risk in Kyrgyz Republic: Seismic Risk Reduction Strategy. Washington, DC: World Bank. <http://documents.worldbank.org/curated/en/689251517034023101/Measuring-seismic-risk-in-Kyrgyz-Republic-seismic-riskreduction-strategy>.

invested in the new construction and/or retrofitting of 40 prioritized schools, maximizing both resilience and social benefits with safer, energy efficient, accessible and inclusive facilities. The project also informed the preparation of a National School Infrastructure Plan, a School Infrastructure module under Education Management Information System (EMIS), and special design criteria, setting a robust foundation to further scale up quality school infrastructure improvements nationwide.



### Transferable lessons

- ✓ Strategic prioritization framework for maximized benefits: Using a strategic prioritization framework, consisting of election criteria and risk-based prioritization criteria, the project narrowed down to 40 schools for immediate intervention, allowing the greatest number of children protected from future earthquakes per investment.
- ✓ Integrated solution for quality learning environment beyond safety: Both new construction and retrofitting financed under the project improves the learning environment comprehensively in line with the RIGHT+ framework, addressing seismic resilience, energy efficiency, adequate water sanitation and hygiene facilities, as well as accessible and inclusive features of the learning environment.
- ✓ Special design criteria and updated standard school designs to ensure scalable quality: The State Institute of Earthquake Resistant Construction and Engineering Design has developed special design criteria to bridge implementation gaps of the latest seismic design codes in the country, and also updated standard school designs with the higher standards adopted under the project.
- ✓ Streamlined and data-driven approach for school infrastructure management: The Ministry of Education with support from the ERIK project, has upgraded the Education Management Information System (EMIS) with a School Infrastructure Module to incorporate existing baseline infrastructure data and manage annual data collection at local levels, supporting future school infrastructure planning, investment, operations, and maintenance.
- ✓ Development of a National School Infrastructure Plan: With the above technical foundation established under ERIK Project, the Ministry of Education with support from the Ministry of Emergency Situations, is undertaking the preparation of a national plan to further scale up comprehensive school infrastructure improvements beyond the ERIK project.



# 7. Recommendations on Intervention Strategy for School Infrastructure

Learning environments encompass the entirety of physical, social, and pedagogical conditions where the learning process unfolds. This includes Physical Learning Environments (PLEs) such as classrooms, libraries, and hallways where educational activities occur, as well as the broader physical environment including toilets, canteens, and other external areas. In the context of the global learning crisis, climate change, and increasing disasters, PLEs play an important role as “the third teacher” in increasing education outcomes, especially in the most vulnerable populations (Malaguzzi, 1993; Shmis, Ambasz, & Ustinova, 2019). The significance of PLEs lies in their capacity to enhance educational outcomes by providing safe, inclusive, and conducive spaces for students to learn both autonomously and collaboratively.

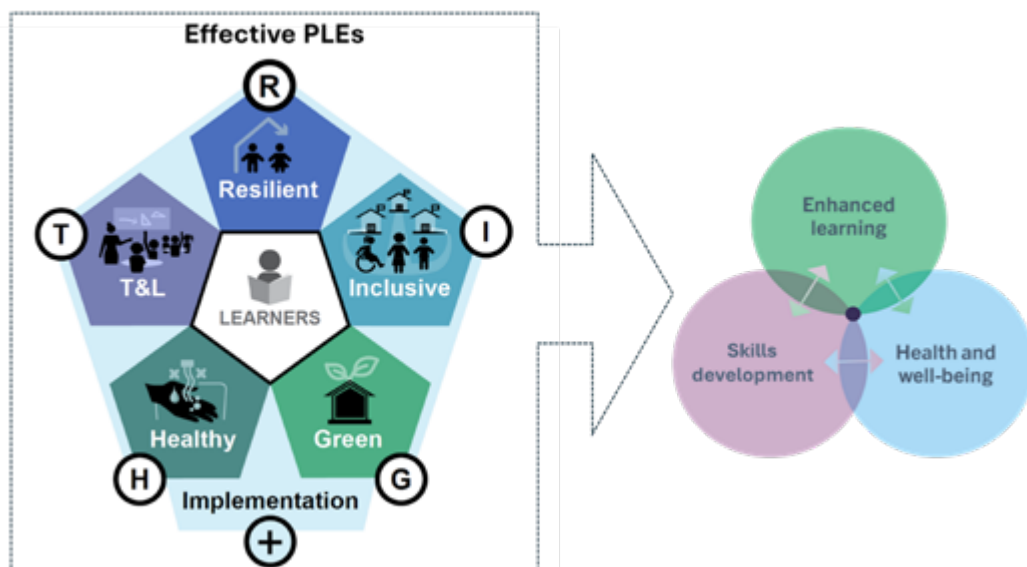
To contribute to enhancing the learning outcomes in Tajikistan through improving PLEs as “the third teacher” and inform the design and implementation of interventions following the prioritization framework discussed in Chapter 6, this Chapter provides recommendations for the intervention strategy for the school infrastructure in Tajikistan in line with the requirements on PLE highlighted in the NFED, as well as aligned with the World Bank’s RIGHT+ framework. The RIGHT+ framework provides a clear framework to analyze PLEs and design solutions that max-

imize their impact on students’ learning outcomes. As shown in Figure 37, it contributes to enhanced learning, skills development and health and well-being of students, through integrated solutions to create effective PLEs that are resilient, inclusive, green, healthy, teaching and learning conducive, as well as effectively implemented. This entails a system-wide transformation agenda to reduce learning poverty, improve equity, and enable safe and supportive environments for all children. The intervention recommendations are organized by RIGHT+ elements, which are identified based on desktop analysis of representative school designs shared by the Ministry of Education and Science and the local engineering firm GUP NIISA, as well as regional and international best practices.

### 7.1 Disaster Resilient Interventions

Guided by the RIGHT+ framework and considering the natural hazards the schools in Tajikistan exposed to as discussed in Chapter 4, disaster resilience is one of the foundational elements as part of integrated intervention for school infrastructure to safeguard students’ life safety as well as education continuity for learning outcomes. This section recommends the aspect of intervention strategy for resilient school infrastructure in the country. The recommendations

Figure 37. RIGHT+ framework contributes to learning outcomes

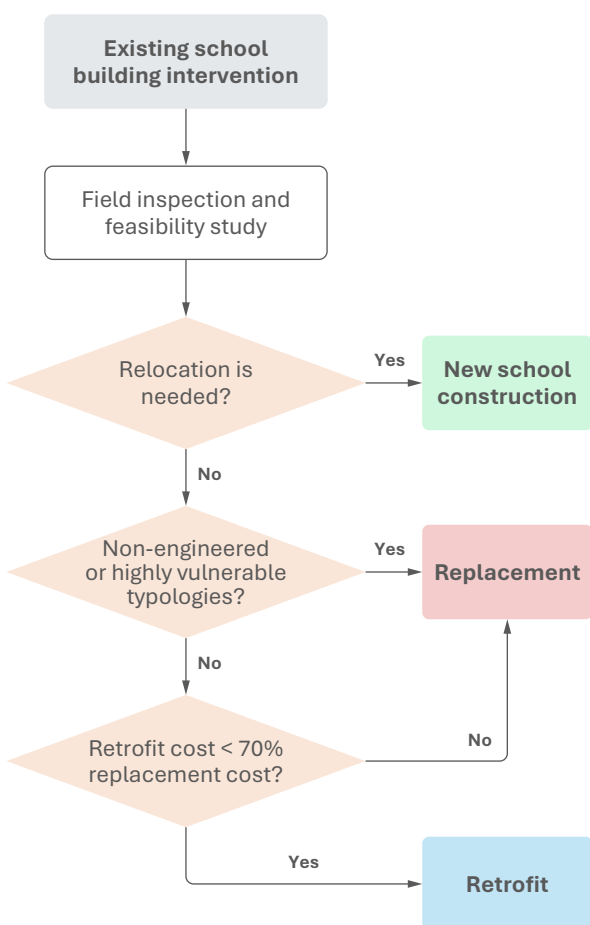


include lines of intervention, retrofit recommendations for existing school construction types, and improvements on relevant technical standards and compliance.

### 7.1.1 Lines of intervention

For intervening existing schools, it is necessary to conduct field inspection and feasibility study first, to identify which line of intervention should be conducted for the school, including full new school construction through relocation, and replacement<sup>34</sup> and retrofit of existing building/s on the same site. This decision-making process shown in Figure 38 involves three main factors to be considered as discussed below.

**Figure 38. Logic tree to identify line of intervention for existing schools**



34. Replacement includes demolition of existing structures and construction of new buildings that accommodate all students adequately and comply with the latest building codes and relevant requirements as laid out in the Chapter of physical environment under the National Framework for Education Development.

## 1) Relocation needs

This is to identify if there are any constraints regarding the current location of the existing school that would require relocation. The constraints that need to be considered include the following.

- **Unsafe location:** Refers to sites that are prone to natural hazards - such as landslides, floods, and other risks - where mitigation measures may not be feasible. For example, flood prevention measures might require raising the ground floor, improving stormwater drainage, or installing flood-proofing and rainwater harvesting systems; landslide mitigation could involve constructing retaining walls. In addition to natural hazards, unsafe locations also encompass technological threats, including proximity to high-voltage networks, high-risk industrial activities, and areas susceptible to chemical contamination.
- **Environmental restrictions:** location has use and occupation restrictions as stipulated in environmental legislation. This typically refers to ecological reserve zones, protected areas, regulated water resource areas, and others.
- **Land use regulations:** conditions imposed by urban planning and land use regulations at municipal level.
- **Legal constraints:** restrictions associated with land use and property rights, such as mining zones, indigenous reservations, concession areas, and others.

In the case of relocation is needed, intervention to the existing school will be a full new school construction, including location selection taking into account occupancy, urban and demographic conditions, accessibility, connectivity with critical services (e.g. fire station, hospital), and other factors within overall planning of school infrastructure network.

## 2) Technical viability of retrofitting

This is to identify the typologies that are technically viable to be retrofitted. Based on the understanding of the school building types discussed under [Section 3.2](#), non-engineered or highly vulnerable typologies, including adobe, wooden sheets with earthen materials (Finnish type), unreinforced stone masonry and unreinforced brick masonry are recommended for replacement, since retrofitting is typically unviable considering their high vulnerability and retrofitting costs.

## 3) Economic feasibility of retrofitting

The economic feasibility check is recommended to only retrofit the building when the cost is below 70% of the replacement cost, considering the cost-efficiency of retrofitting the building (i.e. both structural and functional performance of a retrofitted building will not be able to reach a new building). Based on cost estimations of new school designs from GUP NIISA, the estimated unitary cost for new school buildings is about 750 USD/sqm.

Regardless of new school construction, replacement or retrofit of existing buildings, the design must comply with relevant regulations for safety and resilience as listed in the Chapter of Physical Environment of NFED.<sup>35</sup> In addition, they need to also create modern and effective learning environments for students following the guidance of the NFED, for which further recommendations are discussed under [Section 5.2](#).

### 7.1.2 Retrofit recommendations

The retrofit line of intervention aims to improve infrastructure safety and functionality to provide adequate and safe physical learning environments for children. The scope of retrofit should not only improve structural safety, but also essential functional aspects including Energy Efficiency, Water Sanitation and Hygiene, and other learning environment aspects. This section will focus on the retrofit recommendations for seismic safety, and other functional and

learning environment related aspects will be further discussed under [Section 5.2](#).

Seismic retrofitting of existing buildings aims to correct possible structural defects and provide the structure with an adequate combination of rigidity, resistance, and ductility to guarantee its adequate behavior during seismic events. In Tajikistan, seismic retrofits must satisfy the strength requirements and minimum design details for new buildings established by the latest SNiP RT 22-07-2018 "Earthquake-resistant construction". Excluding non-engineered and highly vulnerable typologies as recommended to be replaced with new buildings in the previous section, school building types that shall be assessed and considered for retrofitting include complex masonry with concrete framing (CXCF), precast reinforced concrete frames with exterior precast reinforced concrete wall panels (PC2), and precast large panel reinforced concrete wall system (PC1).

Typical structural defects and vulnerabilities identified for these school building types that are widely observed in most of the existing school buildings in the Central Asia region (especially those built during Soviet era) are summarized below by typology.

- Complex masonry with concrete framing (CXCF)
  - Inadequate lateral capacity of masonry walls
  - Lack of positive connections between masonry walls and floor or roof diaphragms parallel to floor and roof hollow core planks
  - The roof and floor diaphragms with precast concrete hollow core plank system lack concrete topping, which is required to ensure integrity of floor/roof structure under horizontal seismic actions.
  - Inadequate lateral capacity of nonstructural masonry partitions

35. The National Framework for Education Development was approved by Resolution No.2/3 dated January 29, 2025 of the Council of the Ministry of education and Science of the Republic of Tajikistan.

- Precast reinforced concrete frames with exterior precast reinforced concrete wall panels (PC2)

- Inadequate strength, stiffness, and displacement capacity of the columns. The column failure is expected to be shear-critical, since the columns are inadequately confined with ties and were not detailed for flexure-dominant ductile behavior.
- The frame structure is at risk of collapse due to a soft story mechanism at the first story level, due to relatively small and lightly reinforced columns (typically 300 mm square), and deeper beams (typical depth 480 mm), and brittle beam-column connections
- The roof and floor diaphragms with precast concrete hollow core plank system lack concrete topping, which is required to ensure integrity of floor/roof structure under horizontal seismic actions.
- The beam to column connections rely on field welding of steel components (bars and plates), which may be prone to brittle failure.
- Inadequately anchored exterior precast wall panels. These panels were detailed to not participate in the lateral system.
- Exterior panels between windows are interlocked above and below, with a cementitious key. The displacement capacity of such panels appears to be limited, and the interlocking connections appear brittle.
- Inadequate lateral capacity of nonstructural masonry partitions, which appear to be weak, brittle, and poorly connected.

- Precast large panel reinforced concrete wall system (PC1)

- Potential inadequate connections between wall panels and between wall and floor panels.

- If any masonry partitions exist, their lateral capacity is usually inadequate.

To address these typical structural defects and vulnerabilities of relevant typologies in existing school buildings, [Table 15](#) summarizes potential typical structural retrofitting solutions per typology and indicative unitary cost estimation based on relevant studies conducted in the region (Nikolic-Brzev & Begaliev, 2018; World Bank, 2019) as well as inputs from local engineers from GUP NIISA. Note that the specific scope of retrofitting for individual buildings should be identified based on the site-specific feasibility studies for the specific condition of the building, and the typical solutions here are recommended to be considered for addressing common structural deficiencies of relevant school building typologies. The indicative unitary cost of retrofitting includes only structural retrofitting, and the costs are summarized for buildings with height (number of stories) observed in the school infrastructure baseline of Tajikistan (see [Section 3.1](#)). To further evaluate the economic feasibility for identifying the appropriate type of intervention for existing buildings (retrofit or replacement), the costs of EE, WASH and learning environment interventions should be further added, which can be indicatively estimated based on number of classrooms and past project costs in the region when planning at portfolio level. These indicative unitary costs aim to provide reference for the estimation of investment needs at portfolio level as well as inform relevant prioritization that will be further discussed in [Chapter 6](#). More details on the retrofitting solutions considered by relevant typologies can be found in the technical report of the reference study in Central Asia region (World Bank, 2019). And recommendations on EE, WASH and learning environment interventions are further discussed under [Section 5.2](#).

Table 15. Typical seismic retrofitting solutions per relevant school building type

Typology	Typical Structural Retrofitting Solutions	Indicative Unitary Cost
<b>CXCF</b> – Complex masonry walls and concrete frames	<ul style="list-style-type: none"> <li>Reinforced concrete (RC) jacketing (minimum 60 cm thickness) for load bearing walls (full wall and piers)</li> <li>Strengthening of seismic belts and their connections to floors/roof</li> <li>Strengthening of connections between transverse walls and seismic belts</li> <li>Grid beams for interior walls</li> <li>RC toppings for hollow core precast RC floors</li> <li>Strengthening of footings beneath the walls</li> <li>Partitions to be either braced with RC skin or replaced with light gage steel framing with gypsum board sheathing</li> </ul>	1-story: 6 USD/sqm 2-story: 311 USD/sqm 3-story: 293 USD/sqm 4-story: 275 USD/sqm
<b>PC2</b> – Precast reinforced concrete frames with exterior precast reinforced concrete wall panels	<ul style="list-style-type: none"> <li>RC jacketing of columns and beams and strengthening of their connections OR construction of new RC shear walls and exterior wall piers or steel braces</li> <li>Supplemental belt reinforcement</li> <li>Reinforced concrete toppings for hollow core precast reinforced concrete floors</li> <li>Secure exterior precast panels with walls and diaphragm</li> <li>Partitions to be either braced with RC skin or replaced with light gage steel framing with gypsum board sheathing</li> </ul>	1-story: 214 USD/sqm 2-story: 185 USD/sqm
<b>PC1</b> - Precast large panel reinforced concrete wall system	<ul style="list-style-type: none"> <li>Strengthening of the connections between precast RC wall panels, and also between the wall and floor panels</li> <li>RC jacketing of wall panels (as needed)</li> <li>Partitions (if any) to be braced with RC skin or replaced with light gage steel framing with gypsum board sheathing</li> </ul>	45 USD/sqm

### 7.1.3 Improvements to relevant technical standards and compliance

A desktop review was conducted under this study on representative school designs shared by the Ministry of Education and Science and the local engineering firm GUP NIISA, as well as relevant local technical standards, including seismic design code SNiP RT 22-07-2018, codes related to structural design of RC structures (SNiP RT 52-03-2020) and masonry structures (SNiP RT 51-01-2013). Detailed analysis and findings of this desk top review are attached in [Annex 1](#) for further information. Below summarizes the key recommendations identified for future improvements to technical standards for seismic resilience of schools.

- Seismic design approach according to SNIP RT 22-07-2018 (Cl.21-35) is based on linear elastic seismic analysis of structures that are not considering nonlinear material behavior; though the code highlighted the necessity to avoid brittle failure through designing for inelastic deformations, additional criteria and procedures for verification of seismic safety will be needed, especially for designing irregular buildings and evaluating/retrofitting existing buildings whose ductility is limited. For example, seismic coefficient values (e.g.  $K_2$ ) in Cl.21 reflecting the expected ductility of various structural systems can be reconsidered, different ductility levels for the same structural system (e.g. RC frame) in Cl.21 can be

introduced with prescribed seismic detailing requirements, and inter-story displacement limits (Cl.31) can be revised to account for the effect of ductile seismic behavior on lateral displacements.

- **Additional strength verifications for both structural and nonstructural elements can be introduced for improved seismic safety.** Seismic provisions are important for not only structural elements which directly contribute to the life safety of occupants, but also non-structural elements (e.g. ceilings, partitions, furniture, equipment, etc.) which could cause injuries with their failures as well. The additional verifications could be introduced include, for example, for the lateral strength of floor diaphragms and their connections (Cl.58), the diaphragm stiffness (rigidity) under lateral loads (Cl.58), and the strength of partitions and their connections under out-of-plane seismic loading (Cl.76 and 77).
- **The capacity design approach and specific refined provisions can be introduced to improve the seismic resilience of monolithic reinforced concrete (RC) frame and wall structures, by ensuring ductile seismic behavior.** The refined provisions could include, for example, a design procedure to avoid shear failure of RC short columns (Cl.92, Section 4.4.2), further specify the fraction of the total seismic load resisted by the shear walls in a frame-wall system (Cl.101, Section 4.4.3), seismic analysis of buildings with torsional irregularity (Section 4.4.3), revised minimum reinforcement requirements (size and spacing) for RC shear walls including boundary elements (Cl. 97, 131 and 133, Section 4.4.4).
- **Additional requirements and guidance can be introduced for enhanced seismic resilient analysis and design of masonry structures.** These could include, for example, seismic detailing requirements for transverse reinforcement (ties) in vertical RC inclusions of complex masonry buildings to prevent shear failure (Cl.155), guidance on the modelling of complex masonry structures

for seismic analysis and design, guidance on the seismic design of hybrid structures with RC frames at the ground floor and complex masonry structure at upper floors which may induce soft stories (Cl.157).

- **Nonlinear static analysis (pushover analysis) from international best practices (e.g. ASCE 41-23 and Eurocode 8, Part 3) can be introduced for seismic evaluation of existing buildings.** Application of pushover analysis enables the designer to better understand the performance (expected extent of damage) of a building subjected to specific seismic hazard (earthquake intensity), in terms of deformations (e.g. lateral displacement, rotation, etc.), which will guide more effective retrofitting design.
- **Acceptance Criteria on seismic performance of different structural elements can be introduced for more effective seismic retrofitting design.** In international codes, these acceptance criteria are defined based on possible failure mechanisms of structural elements, including deformation-based criteria on ductile behavior (e.g. permitted lateral drifts or rotations) and force-based criteria on brittle behavior (e.g. the maximum permitted shear force in a beam or a column).
- **An update and design guidance are needed for the different types of structural and non-structural interventions and the corresponding strategies listed in SNIP RT 22-07-2018.** It is essential to provide appropriate definitions and expected effects on structures from different types of structural and nonstructural interventions, especially note the differences between restoration/repair and seismic retrofitting/strengthening, where the latter enhances one of more of the seismic capacities (e.g. stiffness, strength, ductility) of existing structure while the prior does not. With seismic retrofitting solutions continuously evolving, the current list in SNIP RT 22-07-2018 (Table 15) needs to be updated. It is worth noting that retrofit solutions are usually designed for lower seismic safety (depending on occupancy type, could be 75%

or 80% of the code specified seismic design forces in some international codes) compared to new buildings (100% of those forces). Further, the provision of relevant design guidance will ensure effective implementation of retrofitting designs.

- **Enhanced guidance on the target level of seismic safety for different building occupancy type (e.g. schools, hospitals, residential buildings, etc.) would be beneficial.** As one of the critical public facilities, schools can aim for immediate occupancy or rapid recovery performance beyond life safety, considering their dual role as education facilities and potential community shelters. In addition to occupancy type, more advanced international codes (e.g. ASCE 41-23) consider seismic safety/performance also depend on the level of seismic hazard (e.g. more damage allowed in less frequent severe earthquakes than more frequent minor earthquakes).
- **For post-disaster scenario, technical guidelines on rapid structural assessment can be introduced.** While there are general requirements for safety and environmental protection, multi-phase rapid visual screening protocol and technical guidelines for post-disaster (e.g. earthquake) building usability and safety can be introduced from international best practices, such as from Japan and US. This will enhance disaster response and recovery planning effectiveness and efficiency.
- **To ensure the scaling up of seismic resilient new construction and retrofitting of schools, it is essential to have effective mechanisms to enforce quality implementation and compliance of code requirements, as well as strengthen the technical capacity of the engineering community.** Enforcement mechanisms need to consider stronger inspection, quality control, and accountability in construction. Technical resources can also be developed, such as technical manuals with examples of seismic analysis and design of different structural systems. A national accreditation and continuous training program could be developed

for engineers, contractors, and inspectors engaged in school design and retrofitting. Further, short courses and trainings on advanced topics for both new construction and evaluation and retrofitting of existing buildings for the engineering community, as well as updating university curriculum for relevant majors will contribute to enhancing effective implementation of seismic resilient designs.

## 7.2 Inclusive interventions

**Inclusive school learning environments need to guarantee, that all students - including those with disabilities, from remote areas, low socio-economic or marginalized backgrounds – can equally and easily access learning, actively participate and successfully complete education.** The World Bank’s RIGHT+ framework emphasizes that schools must be designed and located in ways that remove barriers to participation. This means that architects, urban planners and engineers need to:

- analyze and ensure an adequate geographical distribution of schools and classrooms, so children from remote and rural areas can reach schools safely and without excessive travel time;
- create gender-sensitive infrastructure, including WASH facilities that respond to the specific needs of female students; and
- integrate universal and disability-inclusive design, making school buildings, classrooms, and school outdoor environments accessible for all users—students, teachers, parents, and community members.

If such barriers remain unaddressed, from an educational perspective, they can result in reduced or irregular attendance, lower learning engagement, and less effective time spent in school for children and even teachers.

**In addition to the RIGHT+ Inclusive design measures outlined above, international guidance—including the World Bank’s Technical Note on Accessibility (World Bank, 2022) –**

Table 16. Why do inclusive schools matter?<sup>36</sup>

<b>Reduce inequality in access to school</b>	<ul style="list-style-type: none"> <li>• Universal design features (e.g., ramps, curb cuts, wide doors) benefit not only students with disabilities but also girls, younger children, parents with strollers, and older adults</li> </ul>
<b>Enhance resilience during emergency</b>	<ul style="list-style-type: none"> <li>• Accessible design elements—such as clear signage, wayfinding system, level exits, and visual/audible alarms—improve evacuation safety for all users during earthquakes, fires, or flood</li> </ul>
<b>Cost efficiency</b>	<ul style="list-style-type: none"> <li>• Adding inclusive features during design and construction phase increases project costs by less than one percent, while retrofitting those same features later could increase project costs from two percent to 20 percent.</li> </ul>
<b>Benefit for local community</b>	<ul style="list-style-type: none"> <li>• Schools often serve as community hubs and emergency shelters. Accessible facilities therefore support not only students but also teachers, parents, and local residents</li> </ul>

highlights, that designing an inclusive school environment brings additional economic, social, and resilience benefits (see Table 16).

Moreover, embedding the principles of the Convention on the Rights of Persons with Disabilities (CRPD)—particularly Article 9 on Accessibility and Article 24 on Education—into Tajikistan’s school infrastructure strategy ensures that inclusive physical learning environments in school will be not only aligned with the World Bank’s RIGHT+ framework, but also fulfill international human rights commitments.

**Drawing on regional and international best practices, the Government of Tajikistan need to promote and apply at central and local level following approaches and recommendations:**

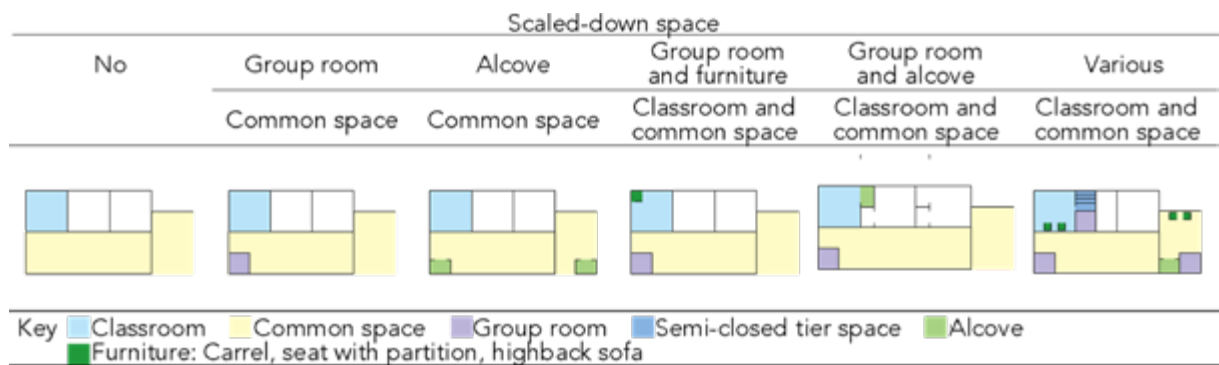
- Architects in cooperation with urban planners and local disability experts need to conduct a **comprehensive needs assessment during the design phase**, examining geographic accessibility of school, existing transport routes, gender considerations, and disability-related needs to ensure equitable infrastructure planning.
- To conduct such needs assessments, the architects and urban planners need to use special **inclusive design checklists** and involve **local disability Civil Society Organizations (CSOs)** in design planning, technical supervision or even post-occupancy evaluation

stages to ensure comprehensive accessibility.

- Based on identified barriers, the architects and engineers need to integrate elements of **assistive technologies appropriate for diverse functional difficulties (mobility, seeing, hearing, concentration, cognitive, self-care)**, ensuring all learners have access to the school building and outdoor areas, as well as have the tools to participate in education process fully.
- Architects and engineers need to embed elements of **barrier-free environment** at the design stage, especially ramps, hand-rails, WASH facilities, including toilets, level entrances and exits, and elevators so that children with disabilities and without disabilities can learn together.
- Based on the needs assessment, the architects need to design and furnish **sound-absorbing material and scale-down spaces**. This would be important for children with underdeveloped selective hearing, especially with autism. [Figure 39](#) shows different types of scale-down space for reference (e.g., alcoves, carrels, semi-closed tiered areas, quiet common zones with comfortable seating). Note that group work requires more sound adjustment than instruction for space.

36. Authors compilation based on World Bank’s Technical Notes on Accessibility, 2022; ADA National Network, 2025 (ADA National Network, 2025) and Lelegems, E., Vanrie, J, 2024 (Lelegems & Vanrie, 2024).

Figure 39. Types of scale-down space



Sound-absorbing material (under construction)



Group room next to common space



Hi-back sofa in the common space



Semi-closed tier space



Alcove in the classroom



Carrels in the classroom

- Architects and engineers need to introduce **accessible toilets and gender-sensitive WASH facilities**. It will support not only children with disabilities but also girls, female teachers, and community members.

**In addition to the recommendations above, the Government of Tajikistan can also focus on capacity building of local architects, planners, civil engineers and building commissioning experts on universal design and accessibility.** It can include professional training and re-skilling in universal design techniques, revision and harmonization of national construction standards in line with best international practices and the CRPD norms, as well as fostering cooperation with local disability CSOs and establishing communities of practice to share lessons in inclusive school design across country.

### 7.3 Green interventions

Green learning environment should reduce negative environmental impacts and avoid exacerbating future climate risks, by promoting energy efficiency and sustainability in both the school infrastructure and education curriculum. Key recommendations identified from regional and international best practices include:

- Energy efficient designs:** The environmental impact of facilities needs to be reduced throughout their life cycle and creating facilities that coexist with nature. This shall be mainly enabled through energy efficient designs of relevant components of school infrastructure, including the following relevant components and typical solutions from regional best practices.

- Ventilation: Clean ducts for natural ventilation and operable windows. Enthalpy heat exchangers are a better solution compared to mechanical ventilation to reduce the environmental impact of facilities.
- Lighting: energy efficient LED bulbs to meet lighting standards, with motion sensors and controls responding to daylight if feasible.
- Heating: Instead of coal heating that has adverse environmental impact, opt for electric heaters meeting the required energy efficiency classification. Use iron radiators where district heating is available.
- Roofing: Sloped design, which could be done without dismantling of soft roof, sealing to fix and prevent leaks, additional 100 mm of insulation, and enhanced rainwater drainage at roof level.
- Flooring: Energy efficient and waterproof, incorporating backfill, screed, 50 mm foam and covering.
- Windows: PVC or metal profiles featuring 4-5 chambers and minimum double glazing.
- Main entrance door: double-door (tambour) design.
- Other doors: Insulated versions.
- Walls: depending on the climate zone, fitted with minimum 5 cm insulation, featuring rainwater drainage at floor level.
- Orientation: to have classrooms preferably facing southeast, with windows opening in that direction to enable quality natural light, facilitating energy efficiency as well as students' circadian rhythm and cognitive performance.
- Solar Integration<sup>37</sup>: Installation of photovoltaic panels on rooftops or school grounds integrated with retrofitted electrical systems.
- **Water efficiency:** This can be improved through measures such as low-flow faucets, and rainwater harvesting and greywater reuse systems for non-potable use.
- **Environmentally friendly landscaping:** This should be done according to SNIP RT-31-03-2018 "GENERAL EDUCATIONAL INSTITUTIONS", such as planting shade trees and vegetation around schools to improve the microclimate, reduce dust, and provide an outdoor learning space.
- **Facilitate green user behavior:** Energy consumption also depends on user behavior. The physical learning environment can also provide teaching material for environmental education, such as in projects, science, social studies, life environment studies, and home economics class.
- **Retrofit and renovation over replacement when feasible:** Comparing to replacement and new construction, when feasible, retrofit and renovation of existing buildings can reduce environmental impact and improve learning environments at the same time.
- **Waste management:** Such facilities should be in place along with construction activities in schools, such as waste separation bins and composting sites.

## 7.4 Healthy interventions

Healthy learning environments should protect students' and teachers' health and well-being, through provision of adequate Water, Sanitation, and Hygiene (WASH) facilities, interior environment and basic services. Key recommendations identified from regional and international best practices include:

- **Healthy WASH facilities:**
  - Water supply and backup water tanks should be sufficient with adequate quality for the total number of students and teach-

37. According to the order of the Committee for Architecture and Construction under the Government of the Republic of Tajikistan, buildings, corridors, refrigerators, elevators or smart boards, at least during a power outage, must be powered by solar panels.

ers in the school, including both non-potable and potable water. The school need to be connected to a centralized potable water system or with adequate filtration system when it is supplied with well water; otherwise, ensure non-potable water backup tanks with scheduled truck water delivery meeting quality standards.

- Sewage service requires proper indoor connections, resorting to indoor plumbing or septic tanks if a centralized sewage system is unavailable.
- Toilets should be sufficient for the number of students and teachers in the school following local regulations and need to be indoor flush models connected to a functioning plumbing system.
- Grey water management needs to involve wetland management or connection to centralized sewage.
- Handwashing sinks must be sufficient to serve the number of students and teachers in the school following local regulations.
- Water tanks for firefighting purposes should be covered and kept clean and functional.
- **Adequate service provision:**
  - Kitchen with the necessary equipment should be provided in school for hot meal provision.
  - Medical room/s should be provided in school for the wellbeing of students.
- **Healthy indoor environment:**
  - Efficient and effective natural and mechanical ventilation is essential for the health of students and teachers. All the classrooms are recommended to be mechanically ventilated regardless of whether the heating is installed or not.

- Use of low-VOC materials in schools for paints, adhesives, and finishing materials to improve air quality.
- It is important to maintain comfortable room temperature and humidity for the wellbeing and learning of students.

## 7.5 Teaching and learning conducive interventions

Teaching and learning conducive physical environments support and enhance effective teaching and learning approaches, through learning-oriented site planning, area and function of spaces, and design of classrooms and common spaces. Key recommendations identified from regional and international best practices include:

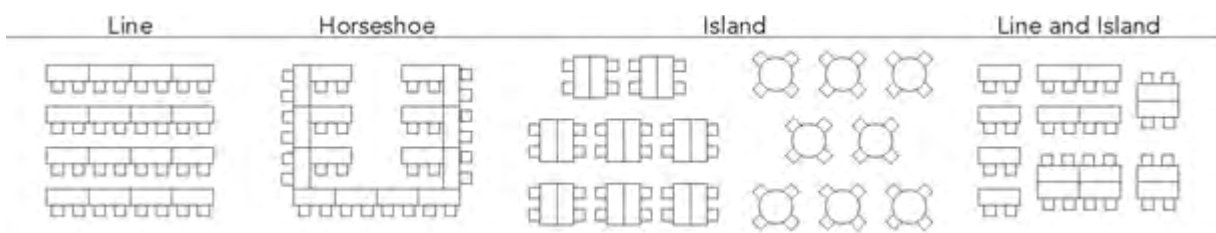
- **Adequate learning space:** In overcrowded existing schools, it is necessary to provide additional classrooms to ensure sufficient learning space per student following local regulations and enable no more than 2 shifts for education.
- **Sound insulated classrooms:** Adequate sound insulation could be achieved by integrating soundproofing panels into walls and ceilings to improve the learning environment.
- **Integrated functions through site planning:** For example, outdoor space can be developed as both a recreation and a learning place (e.g. gardens can be used for recreation as well as science field for relevant classes), especially at primary school.
- **Promoting multi-functional and flexible spaces:** This would increase effective space per student for various spatial functions. For example, canteen and common space can be integrated as multi-functional space and also potentially function as learning space (e.g. group work). [Figure 40](#) shows some relevant examples.

Figure 40. Examples of multi-functional space combining school square, canteen, auditorium, and learning space for group or individual work



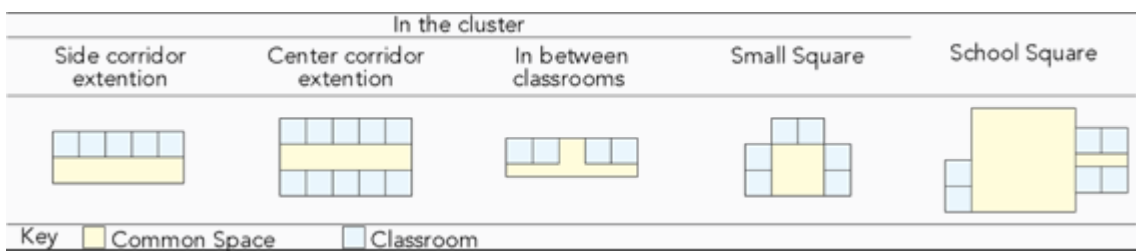
- **Wider classrooms:** Classrooms can be designed to be wider to enable children's movement and interaction, and flexible arrangements of furniture. Sufficient width of classrooms would allow for a variety of activities, which would increase students' engagement and provide more flexible settings for learning, discussion, or relaxation, instead of frontal lessons only (Figure 41).

Figure 41. Wider classrooms offer a variety of furniture layout and learning



- **Well-defined common space with furniture and learning materials:** This will facilitate the flexible function of common spaces to enable a variety of learning styles (Figure 42).

Figure 42. Types of common spaces and their flexible function



Well-defined common space furniture



Learning materials in common space

# 8. Outlook on Implementation Pathways

Building upon the findings identified in this study, this Chapter summarizes the key takeaways and recommendations for next steps on implementation pathways to scale up RIGHT+ school infrastructure in Tajikistan as follows.

## 8.1 Establishing effective implementation framework

**Clear and correlated political, institutional and regulatory framework serves as the foundation to scale up RIGHT+ school infrastructure and govern effective implementation.** Education policies, in particular the NFED, should guide the full school infrastructure investment cycle, including planning, design, implementation, as well as operation and maintenance. Institutional framework needs to clearly specify roles and responsibilities of government agencies at both national and local levels in the full school infrastructure investment cycle. Further, the regulatory framework defines the legal provisions within the public investment system, building codes, and relevant education sector instruments.

**Comprehensive planning and coordination of all relevant financing mechanisms and sources are essential for strategically planning and augmenting the financing of RIGHT+ school interventions, including both domestic and external, public and private, and central and local levels.** As discussed under Section 4, in addition to Republican budget and external assistance as the main financing source for school infrastructure, the role of local budget and private sector cannot be neglected. With comparable or even more capital expenditure on school infrastructure over 2015-2023, local budget needs to be part of the strategic planning and be coordinated for the investment on physical learning environment improvement under the NFED. Additionally, it will be beneficial to consider the growing contributions from PPPs, as well as potential opportunities through other innovative channels such as diaspora bonds and mobile money for school fees.

**Using the Education Management Information System (EMIS) to support and manage the implementation of RIGHT+ school interventions under the NFED will enable streamlined management of baseline data and project monitoring and evaluation.** EMIS could provide the one-stop platform for holding and maintain-

ing the school infrastructure baseline database considered in the preparation and planning stages, as well as the monitoring and evaluation of the progress and results of all intervention programs and components during the implementation stage under the NFED. Such a streamlined approach will improve both efficiency and transparency for the preparation, planning and implementation of school interventions.

**Robust monitoring and evaluation framework and mechanisms will facilitate successful implementation of investments for results.** It is suggested to define a result framework specifying objectives, targets, indicators, verification procedures and responsible actors in line with the National Framework, which could be also considered under the implementation of the Assessment part of the NFED. The results framework could propose a set of outcomes and output indicators to quantify and verify the progress of school infrastructure projects over a period over short-, medium-, long-term at both national and subnational levels, which can also be integrated into EMIS to facilitate monitoring and evaluation at all levels. Outcome indicators usually measure the impact of school infrastructure improvement on various aspects, while output indicators measure the actual improvements addressing different existing challenges. These result indicators could also be coordinated with the prioritization criteria under different programs and components.

## 8.2 Adopting strategic solutions

**With the NFED aiming to improve comprehensive RIGHT+ elements of physical learning environments, tailored prioritization criteria to the specific objective of each program in its action plan will enhance the efficiency of implementation and facilitate transparency of decision making.** As proposed in [Chapter 6](#), specific prioritization criteria of each program need to reflect its objective through measurable benefits or beneficiaries, as well as its cost efficiency. Such data-driven criteria will enhance the transparency of the selection of schools for financing and will facilitate the communication

of results. These criteria will need to yield the availability of data and feasibility of any additional data collection needed, which need to be jointly considered in the Assessment part of the NFED.

**Linking relevant financial instruments to specific priorities and adopting a phased approach would make the financing and implementation strategies more actionable and sustainable.** As proposed under [Chapter 6](#), implementing a school infrastructure programming responding to the key priorities in line with the NFED would be most efficient when financing instruments are channeled to the relevant objectives. For example, in addition to state budget, external funds regarding climate change adaptation or WASH facilities could strategically contribute to a program focusing on green and healthy facilities, as proposed under [Chapter 6](#). Further, a phased approach to implement school interventions in batches over the total program timeframe would allow an interactive process for the implementation to address any gaps and capacity building needs identified in previous batch and improve the implementation quality in later batches. Such phased approach and grouping of schools in batches could be guided by the prioritization criteria proposed under [Chapter 6](#) to allow schools, districts or school construction types with higher priority to be addressed earlier.

**To allow adequate resources and time allocation for implementing school intervention projects under the NFED, it is suggested to prepare multi-year programming under the action plan of the NFED.** The cycle of the project for intervening schools ranges from the preparation of feasibility study to detailed architectural and engineering designs to implementation (initiation of civil works). The completion of those stages could require more than one fiscal year, and the estimated time will depend on the size of the school and the scope of the interventions. Therefore, it could pose risks in terms of delayed or even incomplete projects if the financing follows an annual budget. Therefore, it is proposed to prepare multi-year budgeting under the action plan of NFED to facilitate the efficiency of imple-

mentation and completion of committed interventions in schools.

### 8.3 Building enabling environment

**To support effective and efficient planning of school infrastructure investment under the NFED, it is essential to develop and maintain an up-to-date school infrastructure baseline database.** As discussed under [Chapter 3](#), the analysis under the current study had to adopt some assumptions and statistical proxies for the school infrastructure baseline given the limited data available on the infrastructure characteristics for all the schools in the country. To further refine the accuracy of the identification of intervention needs of all schools in the country, complete baseline database reflecting the current comprehensive conditions of school infrastructure on the ground is necessary. This requires a review of the existing databases with respect to comprehensive RIGHT+ aspects of school facilities to identify data gaps, and further steps to fill the data gaps by establishing sustainable data collection channels and maintaining period data updates, which usually involved engagement of school level administrations.

**To safeguard effective implementation of RIGHT+ school interventions at scale, relevant standards and norms must be reviewed and improved, including standard school designs.** As discussed in Section 7.1.3, there are a few aspects that can be improved in the current design codes in the country for sufficient seismic resilience, which is suggested to be considered under the action plan of the NFED. Further, there are opportunities to also introduce international best practices on inclusive, green, healthy, and teaching and learning conducive school designs through complementary design guidelines and norms, as well as upgrading existing standard school designs which will be replicated at large scale. Bringing standard school designs up to international standards will be instrumental in ensuring scalable development of RIGHT+ school infrastructure in the country.

## 8.4 Strengthening implementation capacity

**Strengthening the capacity at all government levels for school infrastructure management would be another priority for implementing RIGHT+ school interventions under the NFED.**

It is highly advisable to conduct an institutional capacity assessment to identify weaknesses and strengthening needs in all government agencies involved in planning, programming, preparation, procurement, implementation, monitoring, and operation phases. The assessment needs to focus on the human, fiscal and technical capacity and the management capabilities of those agencies. For example, as discussed under Section 4, there is capacity strengthening opportunities on local budget planning capacity. The capacity assessment needs to include in-house capacity (e.g., number of staff, their profiles and expertise, training opportunities, and experience), and the availability of other resources, such as information and communication technologies, protocols, and monitoring and reporting systems. The evaluation needs to be applied to all central, regional and district, and local governments levels.

**The capacity of school infrastructure managers (directors, head teachers, staff), architects, and engineers also need to be strengthened to facilitate successful implementation of RIGHT+ school infrastructure at scale.** Relevant training can be conducted to build capacity among technical staff to ensure school designs improve the comprehensive RIGHT+ learning environment in schools. As part of the capacity building activities, school infrastructure managers and engineers will understand architectural and engineering design options, seismic vulnerabilities in existing typical school building types, cost-efficient solutions per building type, potential improvements for energy efficiency and WASH facilities, as well as ways to improve data collection tools, database management, and monitoring and supervision mechanisms needed during civil work. This capacity strengthening process can be facilitated by disseminating relevant technical knowledge, technical workshops, and training courses targeted at technical staff.

Raising awareness on climate and disaster risks, preparedness and response for school communities also need to be considered as part of capacity building needs to ensure sustainable RIGHT+ school infrastructure at scale. Awareness raising activities and materials reaching the community level will not only equip school community with the knowledge and skills to proactively manage climate and disaster risks for enhanced safety and wellbeing, but also improve the sustainability of investments in RIGHT+ school infrastructure which will be supported by informed and engaged communities. Integrating relevant awareness raising material into the curriculum could also be considered. Such awareness and preparedness initiatives are essential for operating, maintaining, adapting, and optimizing the physical learning environments from community level, especially amid climate challenges.

## References

- ADA National Network. (2025). Is it expensive to make all newly constructed places of public accommodation and commercial facilities accessible?
- AVESTA. (2025). Tajikistan expects new heat wave: temperature to rise to 46 degrees. Source: <https://en.avesta.tj/2025/07/19/tajikistan-expects-new-heat-wave-temperature-to-rise-to-46-degrees/> Avesta.tj - All rights reserved. Retrieved from AVESTA Information Agency: <https://en.avesta.tj/2025/07/19/tajikistan-expects-new-heat-wave-temperature-to-rise-to-46-degrees/>
- CABAR.asia. (2021). Tajikistan is Highly Vulnerable to Climate Change Impacts. Retrieved from <https://cabar.asia/en/tajikistan-is-highly-vulnerable-to-climate-change-impacts/>
- CAREC. (2022). Country Risk Profile Tajikistan. Central Asia Regional Economic Cooperation (CAREC) Program. Retrieved from [https://www.carecprogram.org/uploads/CAREC-Risk-Profiles\\_Tajikistan-EN.pdf](https://www.carecprogram.org/uploads/CAREC-Risk-Profiles_Tajikistan-EN.pdf)
- GEM. (2023). Global Seismic Risk Profiles v2023.0.0. Global Earthquake Model Foundation. Retrieved from [https://downloads.openquake.org/countryprofiles/v2023.0.0/Central\\_Asia/tajikistan.pdf](https://downloads.openquake.org/countryprofiles/v2023.0.0/Central_Asia/tajikistan.pdf)
- Global Partnership for Education. (2020, Dec 18). Tajikistan National Strategy for Education Development 2021-2030. Retrieved from <https://www.globalpartnership.org/content/tajikistan-national-strategy-education-development-2021-2030>
- Lelegems, E., & Vanrie, J. (2024). The cost of universal design for public buildings: exploring a realistic, context-dependent research approach. *Archnet-IJAR*, 18(4), 719-736.
- Nikolic-Brzev, S., & Begaliev, U. (2018). Practical Seismic Design and Construction Manual for Retrofitting Schools in The Kyrgyz Republic. World Bank. Retrieved from <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/765151593525566669>

Park, R. J., Goodman, J., Hurwitz, M., & Smith, J. (2020, May). Heat and Learning. *American Economic Journal: Economic Policy*, 12(No. 2), 306-39. Retrieved from <https://www.aeaweb.org/articles?id=10.1257/pol.20180612>

Schools2030. (2025). Tajikistan - Schools2030. Retrieved from <https://schools2030.org/country/tajikistan/>

World Bank. (2015). Europe and Central Asia (ECA) Risk Profiles - Tajikistan. World Bank. Retrieved from <https://www.gfdrr.org/sites/default/files/Tajikistan.pdf>

World Bank. (2016). Retrieved from Think Hazard: <https://thinkhazard.org/en/report/239-tajikistan>

World Bank. (2019). Global Baseline of School Infrastructure. Retrieved from <https://gpss.worldbank.org/en/GLOSI>

World Bank. (2019). Global Library of School Infrastructure: Catalogues of Building Types. Retrieved from <https://gpss.worldbank.org/en/glosi/building-catalogue-types>

World Bank. (2019). Safety Prioritization of School Buildings for Seismic Retrofit using Performance Based Risk Assessment in the Kyrgyz Republic. World Bank. Retrieved from <http://pubdocs.worldbank.org/en/950831559924776336/Safety-Prioritization-of-School-Buildings-for-Seismic-Re>

World Bank. (2022). Technical Note on Accessibility. Washington, D.C. Retrieved from <https://thedocs.worldbank.org/en/doc/2c15b0291da3107e-5a324e8d261c674b-0320012022/original/WBG-TECHNICAL-NOTE-PART-1.pdf>

World Bank. (2023). Earthquake and Flood Risk Assessment in Central Asia. World Bank. Retrieved from [https://datacatalogfiles.worldbank.org/ddh-published/0064118/3/DR0091047/Task6\\_Risk\\_Report\\_r6\\_EN.pdf](https://datacatalogfiles.worldbank.org/ddh-published/0064118/3/DR0091047/Task6_Risk_Report_r6_EN.pdf)

World Bank. (2023). Roadmap for Safer and Resilient Schools. World Bank. Retrieved from <https://openknowledge.worldbank.org/entities/publication/c60b1875-b68c-51fe-9ebe-c053b6cc4a63>

World Bank. (2023). Roadmap for Safer and Resilient Schools E-learning Course. Retrieved from <https://wbg.edcast.com/insights/roadmap-for-safer-and-resilient-schools>

World Bank. (2024, January). Building safer, more resilient schools in Türkiye. Retrieved from <https://www.gfdrr.org/en/feature-story/building-safer-more-resilient-schools-turkiye#:~:text=Since%202015%2C%20T%C3%BCrkiye%20has%20partnered,and%20more%20resilient%20to%20disaster.>

World Bank. (2024). The Impact of Climate Change on Education and What to do About it. World Bank. Retrieved from <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099043024150036726/p180005171cc7c0c91a8b011d03080e9086>

World Bank. (2025). RIGHT+ Framework for Physical Learning Environments. Retrieved from <https://openknowledge.worldbank.org/server/api/core/bitstreams/b0132704-a781-41b6-8f80-6ac9f87ac8e6/content>

World Bank. (2025) Tajikistan - Taking a Socially Inclusive Approach to Climate Change. <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/1234567890>

UN Development Coordination Office. (2025). Tajikistan: A Unified Approach to Tackling Climate Risks. <https://undco.un.org/tajikistan-unified-approach-climate-risks>

# Annex 1. Guidance note on the minimum requirements for seismic safety and resilience of school infrastructure in the Republic of Tajikistan

## 1. Background

As a part of the World Bank-funded project Learning Environment – Foundation of Quality Education Project (P177475)” (LEARN) in the Republic of Tajikistan, Technical Assistance (TA) program “Scaling up resilient school infrastructure in the Republic of Tajikistan” was launched to support the Ministry of Education and Science (MoES) to develop the new National Framework for Learning Environments, which incorporates key elements for improving the capacity of schools to adapt to and mitigate the impacts of natural disasters and climate change.

The Republic of Tajikistan is located in the region of high seismic hazard, and has experienced several major earthquakes in the past, including the 1907 Karatag earthquake (magnitude 7.3) and the 1949 Khait earthquake (magnitude 7.4) in the 20th century. Based on the current seismic hazard map, 74% of the territory is exposed to seismic intensity of 8 balsa and higher, while 50% of the territory is exposed to seismic intensity of 9 balsa. Recently, the April 13, 2025 earthquake affected the Rasht and Tojikobod districts and damaged some of the masonry school buildings.

The school inventory in the country consists of more than 4100 schools of different vintages and building typologies. A sample of more than 350 schools was recently analyzed and the following building typologies were found to be prevalent:

complex masonry (35%), stone masonry (24%), unreinforced clay brick masonry (13%), adobe (earthen) (18.6%), and Finnish-style (wooden panels with thermal insulation, 5.5%) buildings. On the other hand, new schools in the country are constructed as monolithic reinforced concrete (RC) frame structures, and in some cases complex masonry is also used for school construction.

The principal objective of this document, developed as a part of the TA, is to identify areas for improving seismic resilience of school infrastructure by providing specific recommendations related to seismic design and construction practices for new schools and seismic retrofitting of existing schools. The focus is on RC and masonry construction technologies.

To gain an understanding of local structural design and construction practices for schools, the consultant has reviewed the relevant technical documentation. It should be noted that the available documentation was primarily related to the design of new schools in Tajikistan, including representative construction drawing packages for architectural and structural design of different school sizes. The consultant has reviewed school photos collected by the Bank’s consultants in the period from 2021 to 2024, and the National Education Development Framework of the Republic of Tajikistan (2025), which contains relevant information (especially Chapter IV). The consultant has also reviewed relevant design codes, including seis-

mic design code (SNIP RT 22-07-2018), as well as the codes related to the design of reinforced concrete structures (SNiP RT 52-03-2020) and masonry structures (SNiP RT 51-01-2013). Finally, the consultant has also reviewed the documents prepared by GUP NIISA as a part of this TA, including a detailed survey of 10 existing school buildings from Tajikistan. The focus of this desktop review was related to both the design of new school buildings and also seismic evaluation and retrofitting of existing schools.

This document contains a guidance note, which presents a review of the current state of the national seismic design code SNIP RT 22-07-2018, and the recommendations for future improvements of the code as related to design of new buildings and seismic retrofitting of existing ones.

## 2. Review of typical school designs

A review of standard school designs was performed, and it was limited to representative construction drawing packages for architectural and structural design of 9 schools which were different in terms of the student capacity: 144, 240, 320, 480, 624, 640, 1176, 1280, and 2500 seats. The majority of schools were designed using RC frame system, however a few smaller schools were designed using complex masonry construction technology. For example, the schools for 144 and 240 student seats were designed as complex masonry with RC frames.

Based on the review of construction drawings for typical school designs, a detailed description of structural aspects of these designs will be presented for schools with a monolithic RC frame system and a complex masonry construction. It should be noted that the design of these schools was completed in 2018, and that the applicable codes for structural design of RC and masonry structural elements were not specified on the drawings. Seismic design code (2007 version) was referenced on the drawings, as well as a few other construction-related standards. For that reason, it was not possible to verify whether the detailing shown on construction drawings was in compliance with the design code provisions.

### 2.1 Reinforced concrete frame construction

#### Building description

The design of a new school, planned to accommodate 640 students, was completed in 2018. The school has L-shaped plan configuration and consists of two rectangular building blocks (A and B) separated by a construction joint. Block A is 4-story high and has plan dimensions 51 m x 17.5 m, while block B is 3-story high and has plan dimensions 30 m x 15.6 m. Typical story height is 3.3 m.



*Rendering of a new school (640 seats) with a reinforced concrete frame structural system*

Structural system for both building blocks is RC frame with masonry infill walls. Column layout is in the form of 6 m x 6m grid. The building is located in the seismic intensity zone 8, and was designed according to the 2007 national seismic design code MKC 4T22-07-2007 “Earthquake-Resistant Construction”. The foundation design was performed according to SNIP 3.02.01-87.

Concrete class B20 was used for construction of beams, columns, and slabs, while B15 concrete was used for the foundations.

Steel class AIII was used for longitudinal reinforcement and class AI for transverse reinforcement (stirrups and ties).

Structural drawing package for this design consists of 54 sheets in total (Sheets 1-54), and has served as the basis for the review.

## **RC structural elements: dimensions and detailing**

### **Foundations (Sheet 3)**

RC strip footings are provided at the base of the building, to support RC columns and masonry walls. The footings are 1.6 m wide and 2.2 m deep. Longitudinal wall reinforcement is extended to the bottom of the footings.

### **Columns (Sheets 7-11)**

Columns have a square cross-section with 400 mm size, and are reinforced with 8 longitudinal bars (20 or 22 mm diameter). Transverse reinforcement consists of 8 mm diameter closed ties (including exterior and interior ties), with the spacing varying from 100 to 200 mm. Closer spacing (100 mm) is provided within the critical regions in the columns (top and bottom at each floor level - 700 mm length). It was not required for the ties to have 135 degree hooks.

### **Beams (Sheets 19-28 for Block A)**

Beams are provided in both orthogonal directions along the column gridlines. Beam dimensions are: 400 mm width and the depth ranges from 400 to 450 mm. The beams are reinforced with 4 longitudinal bars, both top and bottom. The beams with the longest span (6 m, beam P<sub>ГМ-1</sub>) are reinforced with 22 mm diameter bottom bars and 20 mm diameter top bars. Four-legged stirrups are provided, with 8 mm diameter and the spacing ranging from 100 mm to 200 mm. Stirrups are in the form of a closed loop, with 180 degree hooks at the top of exterior stirrup legs, and horizontal crossties connecting the vertical legs with 180 degree hooks. A closer stirrup spacing (100 mm) is provided at the beam end zones, e.g. within 1.4 m length at each end zone of a 6 m span.

### **Floor structure (Sheets 21-37)**

Floor structure is in the form of a two-way RC slab with beams in both directions. The slab is 160 mm thick, and is reinforced with horizontal reinforcement in both directions. Two reinforcement layers are specified (top and bottom). The reinforcement

is in the form of 12 mm diameter bars at 200 mm spacing.

### **Masonry infills (Sheets 12-18)**

Masonry infills enclose interior spaces between the classrooms and are also provided at the building exterior. The walls are 380 mm thick and are constructed using clay brick masonry, with class 75 bricks and mortar M50. Vertical RC inclusions are provided at larger openings, and the width is either 130 mm (with 2 vertical reinforcing bars) or 250 mm (with 4 vertical reinforcing bars); note that the other cross-sectional dimension matches the wall thickness (380 mm). Horizontal RC seismic belt is provided along the gridlines where RC beams are not present, e.g. gridline "E" (sheet 13). The seismic belt is reinforced with 6 horizontal bars (14 mm diameter), and 6 mm stirrups at 200 mm spacing (see detail O<sub>61</sub>, sheet 13). Horizontal reinforcement, in the form of welded wire mesh, is provided at the interface between masonry infills and adjacent RC columns. The reinforcement consists of 4 longitudinal horizontal bars, with 5 mm diameter and 1000 mm long, and transverse bars, with 5 mm diameter and 300 mm spacing (see detail Cr-1, sheet 13).

### **Roof structure (Sheets 42-54)**

Both building blocks have a hipped roof. The roof structure consists of steel trusses with welded connections and wooden trusses. The trusses are placed in transverse direction, while purlins connect the trusses in longitudinal direction. The roof structure is covered by metal sheets (see Sheet 44).

## **2.2 Complex masonry construction**

### **Building description**

The design of a new school, planned to accommodate 144 students, was completed in 2018. The school is a 2-story building, with rectangular plan shape and dimensions 20 m x 15.8 m. Typical story height is 3.0 m, and the overall building height is 7.0 m.

Structural system is a complex masonry wall system with interior RC frames. The building is

located in the seismic intensity zone 9, and was designed according to the 2007 national seismic design code MKC ЧТ22-07-2007 “Earthquake-Resistant Construction”.



*Rendering of a new school (144 seats) with a complex masonry structural system*

Concrete class B15 was used for the construction of foundations and other RC structural elements, except for floor slabs (where B20 concrete was used). Steel class AIII was used for longitudinal reinforcement and class AI for transverse reinforcement (stirrups and ties).

Structural drawing package consists of 46 sheets in total (Sheets 1-46), which served as the basis for this review.

### **Structural elements: dimensions and detailing**

#### **Foundations (Sheets 2-8)**

RC strip footings are provided at the base of the building, to support the masonry walls and RC columns of an interior frame. The footings are 1.0 m wide, 0.4 m thick, and 1.5 m deep. Longitudinal reinforcement in vertical RC inclusions and RC columns is extended to the bottom of the footings.

#### **Loadbearing masonry walls (Sheets 10-20)**

Masonry loadbearing walls are provided in both directions of the building plan. There are two exterior longitudinal walls and two interior walls at 6.4 m spacing. Transverse walls are aligned both at the exterior and the interior, at the spacing of 7.0 to 8.4 m. The walls are 380 mm thick and are constructed

using clay brick masonry, with Class 75 bricks and mortar M50.

Vertical RC inclusions are provided at wall intersections and at larger openings. The locations of vertical inclusions at wall intersections are presented on foundation drawings (see Кпϕ-1 and Кпϕ-2, Sheet 4). These inclusions have 320 mm square reinforcement cage, and are reinforced with 4 longitudinal bars with 16 mm diameter. Transverse reinforcement is in the form of closed ties (loops), with 6 mm diameter bars at 200 mm spacing (see Кϕ-1 and Кϕ-2, Sheets 7 and 8). The anchorage of ties is in the form of 90 degree hooks. Vertical RC inclusions are also provided at larger openings (СМ2, locations shown on Sheet 10), are 130 mm wide x 380 mm long (matching the wall thickness), and are reinforced with 2 vertical bars 16 mm diameter and 6 mm diameter transverse reinforcement at 200 mm spacing (see Sheet 15 for reinforcement details). Vertical inclusions are continuous within a floor level. For example, vertical anchors are embedded in the second story floor beams, and are overlapped (spliced) with vertical bars in the inclusions (label KC-3, see wall elevation and detail, Sheet 14).

Horizontal reinforcement is provided at the intersection between masonry walls and vertical RC inclusions, see labels СМ-1 and СМ-2 on the floor plan (Sheet 10) and wall elevations (Sheets 14-17). The reinforcement is embedded in horizontal mortar joints and is in the form of welded wire mesh, see details on Sheet 13. The horizontal reinforcement extends by 1.5 m on each side of a vertical inclusion (wall intersection) while the spacing is 500 mm or 700 mm.

#### **RC frame elements (Sheets 10 and 21-25)**

Interior RC frames are specified along gridlines B and Γ, and between gridlines 3 and 4 (PM-1 and PM-2, Sheet 10). Also, RC frames are provided at the school entrance, between gridlines 3 and 4 in transverse direction, and gridlines A and A\* in longitudinal direction (PM-3 and PM-4). Columns are 380 mm square (to match the wall thickness), while the beams are 380 mm wide and 400 mm deep. Columns are reinforced with 4 longitudinal bars 16 mm diameter, and with 6 mm ties at 100-200

mm spacing. Closer tie spacing is provided within the column end zones (600 mm length at the top/bottom of a floor). Beams are reinforced with 2 longitudinal bars (20 mm diameter) at the bottom and the same bars at the top for PM-1, while the beams in PM-2 and PM-3 have 4 longitudinal bars at the bottom and 2 bars at the top (bar diameter ranges from 12 mm to 22 mm). Transverse reinforcement (stirrups) in the beams have 6 mm diameter and the spacing ranges from 100 mm (end zones) to 200 mm (midspan). Frame PM-4, located at the school entrance, has a different design, with circular columns and an arched structure.

### Floor structure (Sheets 26-31)

Floor structure is in the form of a monolithic two-way RC slab with beams in both directions. The beams are provided on top of masonry walls in longitudinal direction (380 mm width to match the wall thickness), but secondary beams are also provided in transverse direction (400 mm width). The beams in transverse direction are spaced at 3.5-4.6 m. Edge beams are provided only in longitudinal direction, along the gridlines A and Г. The edge beams are 520 mm deep, and are reinforced with four 16 mm diameter longitudinal bars at the bottom and 2 bars of the same size at the top. The ties have 6 mm diameter and are provided at 200 mm spacing. Secondary RC beams in transverse direction are 250 mm deep. The slab is 150 mm thick, and is reinforced with horizontal reinforcement in both directions (Sheets 26 and 27). Two reinforcement layers are specified on the drawings (top and bottom). The reinforcement is in the form of 10 mm diameter bars at 200 mm spacing.

### Roof structure (Sheets 41-46)

The building has a hipped roof. The roof structure consists of wooden trusses, which are connected to masonry walls by means of steel anchors AC-3 (see details, Sheets 33 and 44). The roof structure is covered by metal sheet roofing.

## 3. Review of relevant technical regulations

The review is focused on legally adopted technical regulations (codes and standards) relevant for

school construction in Tajikistan, especially related to structural and seismic design. The most relevant codes are a dedicated seismic design code SNiP RT 22-07-2018, and the codes related to structural design of RC structures (SNiP RT 52-03-2020) and masonry structures (SNiP RT 51-01-2013). Codes for design of steel and timber structures are also in place but were not reviewed in detail since they are not deemed relevant for construction of new school buildings.

National standards specifically related to schools are also relevant. The first national standard KMD RT 2.01.04-2014 "Norms and rules for the design of educational institutions" was published in 2014, followed by the 2018 standard GNiP RT 31-03-2018 "General education institutions". These standards address various planning and design considerations for schools, including architectural planning, sanitation, safety, energy efficiency and local climatic conditions, fire resistance requirements, etc. In the past, standards from the Soviet Union such as SNiP II-64-80 "Schools" were used.

It is believed that the seismic design code SNiP RT 22-07-2018 is most relevant for this assignment, because it contains general provisions related to seismic and structural design concepts, plus specific provisions related to design and detailing of reinforced concrete, masonry, steel, timber and adobe buildings (and other types of engineered structures). It is important to recognize that the original seismic design codes for Tajikistan were developed in the Soviet Union, dating back to 1957 (SNiP II-A.12-62). The first national seismic design code of Tajikistan was developed in 1997 (SNiP RT 2.01.09-97), followed by the 2007 code MKC ЧТ22-07-2007 "Earthquake-Resistant Construction". Finally, the current code SNiP RT 22-07-2018 "Earthquake-Resistant Construction" was officially issued on February 1, 2019. The code was compiled by the "Research Institute of Construction and Architecture" of the Republic of Tajikistan, on the basis of the State Research and Innovation Norms of the Republic of Tajikistan published in 2015, with amendments and additions. Although the national seismic design code has evolved since 1997 and the provisions are adapted to local conditions, its organization and content (to certain extent) are similar to the 1982 seismic design code

from the Soviet Union (SNIP II-7-81), that is, Part II of the “Basic Norms and Rules for Civil and Structural Engineering”.

A detailed review of the current national seismic design code SNiP RT 22-07-2018, including the provisions for design and detailing of RC and masonry structures, is presented next. Specific comments are included for the provisions which may need revisions in future code updates, followed by a summary of the key recommendations.

## 4. Seismic design of new buildings according to SNIP RT 22-07-2018: current status and recommendations for future updates

### 4.1 Background

SNIP RT 22-07-2018 includes 8 sections related to new and existing structures, which are organized into subsections and clauses related to specific topics (291 clauses in total). The following sections are deemed relevant for the seismic design of new schools and seismic evaluation and retrofitting of existing schools: 2. Basic provisions, 3. Seismicity of the area and construction site, 4. Seismic impact calculations, 5. Residential, public, industrial buildings and structures (including various types of reinforced concrete and masonry structures), and 8. Rehabilitation, strengthening, and reconstruction of buildings and structures.

Although SNIP RT 22-07-2018 includes provisions for relevant aspects of seismic analysis and design of buildings, these provisions are mostly generic and read like guidelines rather than a code which needs to serve as a basis for seismic design of structures. Normative content, that is, specific criteria and procedures for verification of seismic safety of building structures, is not included for several important topics.

This section presents a review of the selected SNIP RT 22-07-2018 provisions which are deemed relevant for seismic design and retrofitting of school buildings in Tajikistan. The focus is on RC and masonry structures, which constitute a major fraction of the

existing school inventory in the country. Provisions related to seismic design of prefabricated large panel buildings (Section 5, subsection 7), steel frame structures (Section 5, subsection 6, Cl.112-117), and low-strength masonry (adobe/earthen) structures (Section 5, subsection 10) are beyond the scope of this document, since these materials and construction technologies are likely not used for construction of new schools in Tajikistan.

It should be noted that the approach for assessing seismic hazard for specific areas/sites, which is addressed in Section 3 of the code. In the context of seismic resilience it is important to acknowledge that most of the territory of Tajikistan is located in the region of very high seismic hazard (intensity 9 bals), hence schools and other types of facilities throughout the country may be exposed to strong earthquakes during their service life. For that reason, adequate seismic design and detailing of built infrastructure is critical for controlling the extent of damage and preventing collapse of built infrastructure due to future earthquakes.

### 4.2 Basic provisions (Section 2)

#### Desirable seismic behavior (Cl. 6)

According to the listed item no. 6 in this clause, it is necessary to create opportunity for development of inelastic deformations in certain structural elements, and to exclude chances of brittle failure; however, the code does not contain specific guidance (approach) on how this objective could be accomplished in the context of RC and masonry structures.

#### Comments:

Seismic design of ductile RC, steel, masonry, and timber structures according to international codes is performed by following the Capacity Design approach, which aims at avoiding a brittle shear failure in RC structural elements (beams, columns, walls), and ensuring ductile behavior governed by flexure. A similar statement is included as a comment related to Cl.85 in the context of RC structures.

### 4.3 Seismic analysis procedures (Section 4)

Seismic design approach according to SNIP RT 22-07-2018 (Cl.21-35) is based on linear elastic seismic analysis of structures and is referred to as “force-based seismic design approach”. To account for ductile seismic behavior of structures, applied elastic seismic forces are scaled down, and the corresponding scaling coefficients are selected based on the judgement and experience of code writers, as well as experimental research studies and observed performance in past earthquakes. Seismic design provisions based on a force-based seismic design approach usually include prescriptive requirements related to detailing of structural elements to ensure ductile seismic performance in line with the design assumptions.

Force-based seismic design approach may be feasible for buildings that have sufficient resistance to remain nearly elastic when subjected to the design earthquake demands, and/or buildings with regular geometries and stiffness and mass distributions. For all other buildings, estimations of earthquake-induced forces and displacements obtained from the linear analysis may be inaccurate (FEMA 274, 1997). Force-based design approach may not be appropriate for seismic evaluation of existing buildings, due to their limited ductility and complex seismic behavior, which cannot be captured by applying the same behavior coefficients as for new buildings.

An alternative approach, called “performance-based design”, has been increasingly used for seismic evaluation and retrofit of existing buildings, as well as for design of new buildings. The objective of performance-based design approach is to base seismic design on the target performance at the predefined seismic hazard level. The performance is quantified through deformations (e.g. rotations and displacements) attained in the structural and non-structural elements. There are several variants of performance-based design approach in international seismic design codes. A primer on the performance-based seismic design is presented in Brzev and Begaliev (2018).

### Design coefficients for seismic analysis of ductile structures (Cl.21)

SNIP RT 22-07-2018 prescribes the Spectral Method, also known as Response Spectrum Analysis (RSA), as the basic seismic analysis procedure for buildings. The method assumes linear elastic behavior of materials and structural elements. First, a modal analysis is performed to determine various mode shapes, while the influence of local seismicity for different modes is considered through dynamic coefficient  $\beta$ . The responses for various modes are combined to determine the structural response (forces and displacements). Lateral seismic force  $S_{ik}$  for mode  $i$  and level (floor)  $k$  takes into account allowable damage for different building occupancies (coefficient  $K_1$ ), type of structural system (coefficient  $K_2$ ), building height (coefficient  $K_3$ ), and the mode-dependent seismic force  $S_{oik}$ .

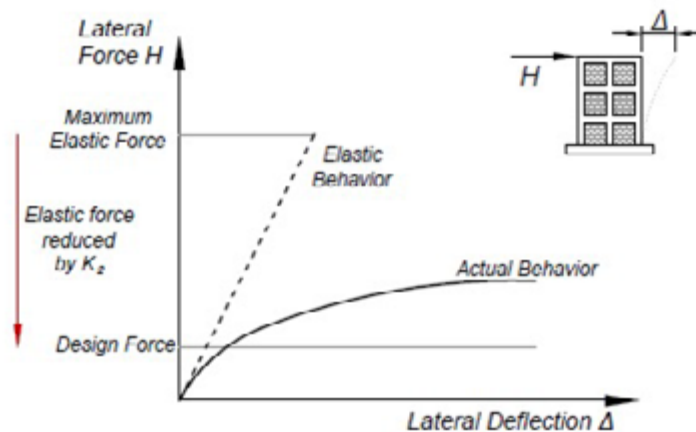
Coefficient  $K_1$  has been assigned the values ranging from 0 to 1.0 (Table 3 of the code), where 1.0 denotes that no damage is acceptable, while kindergartens and school buildings (as well as higher education facilities) are assigned the value of 0.35 (indicating that damage is acceptable). Residential and administrative buildings are assigned a lower value than schools (0.25).

Coefficient  $K_2$  has been assigned the values ranging from 1.0 to 1.6, depending on the structural system (Table 4 of the code). The lowest values are assigned to structural systems which are expected to demonstrate a high seismic resilience, such as steel structures, large panel buildings, and monolithic RC wall structures, while low-strength masonry buildings are assigned the highest value (1.6). Monolithic RC structures (various structural systems) are assigned  $K_2$  value in the range of 1.1 to 1.3. Complex masonry structures are assigned  $K_2$  value of 1.35, while unreinforced masonry structures are assigned  $K_2$  value of 1.45.

Coefficient  $K_3$  depends on the building height (number of stories) and is determined from a code equation. The values range from 1.0 to 1.5. For low-rise buildings (5-storey high or less)  $K_3 = 1.0$ .

**Comments:**

It is widely accepted that ductile seismic response of building structures in damaging earthquakes is very important, since it ensures that a partial or total building collapse is avoided. Coefficients  $K_1$  and  $K_2$ , used to determine seismic force  $S_{ik}$ , are related to the expected ductility of various structural systems and materials, hence the values of these coefficients and their product will be reviewed in the context of international seismic design codes and practices. The  $K_1$  value of 0.35 is assigned to school buildings, while the  $K_2$  value ranges from 1.1 to 1.3 for monolithic RC structures, and from 1.35 to 1.45 for complex and unreinforced masonry structures, respectively. As a result, the ratio  $K_2/K_1$  ranges from 3.14 to 3.70 for monolithic RC structures, and from 3.86 to 4.14 for masonry structures (average value 0.49). A lower  $K_2/K_1$  value indicates a higher expected ductility for a structure. International codes usually express the expected ductility level through a force modification factor ( $R$ ) (also referred to as a behavior factor in some codes), which is used as a means of reducing the elastic seismic force to account for a ductile seismic behavior. The  $R$  factor can be assigned different values, ranging from 1.0 (for elastic behaviour of brittle materials, e.g. unreinforced masonry) to 3.0 (or higher) for ductile behavior (e.g. RC or steel structures); note that this trend is different than the one adopted in the code, where a higher  $K_2$  value is related to lower expected ductility.



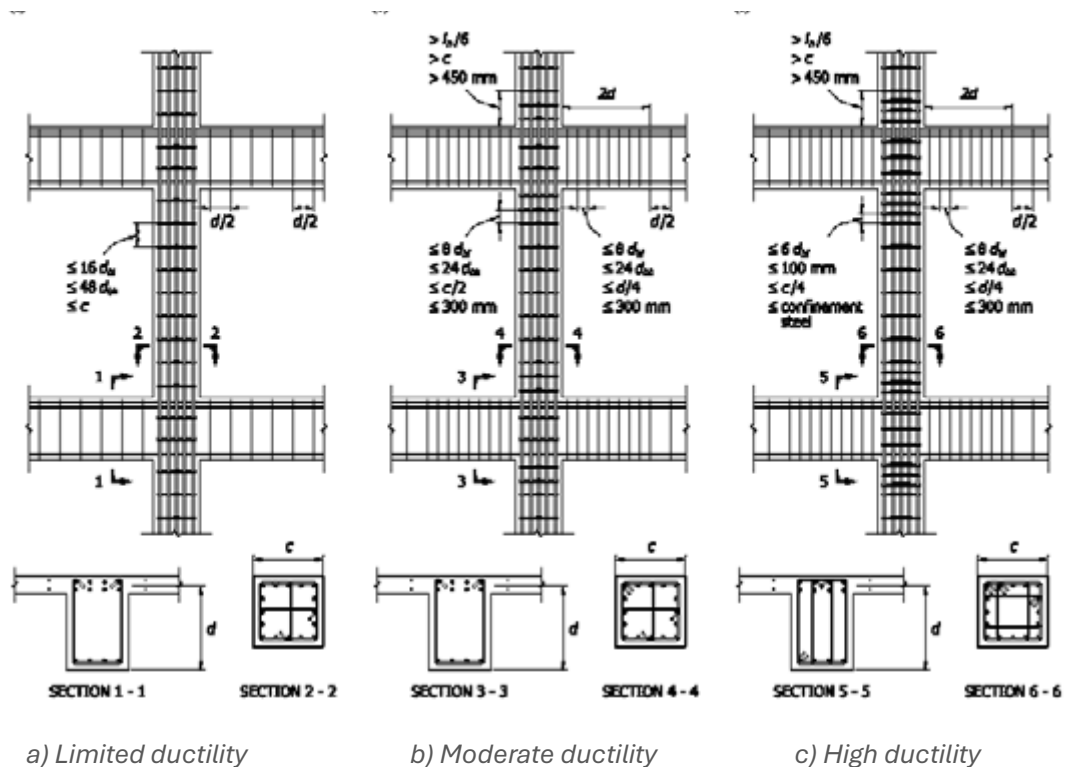
*Elastic seismic force and design (reduced) seismic force to account for ductile seismic behavior (Brzev and Begaliev, 2018)*

The following comments are related to the current values of coefficients:

1. Coefficient  $K_1$  has been assigned the value of 0.35 to schools, and 0.25 to residential buildings. Different values may be justified due to different building occupancies, and are reflective of different importance of these buildings. Residential buildings are usually assigned an importance factor of 1.0 (regular importance), while schools are designed using a higher importance factor (e.g. 1.2) due to their important role to preserve student lives during an earthquake and serve as a community shelter after an earthquake. According to SNIP RT 22-07-2018, the ratio of  $K_1$  factor for schools and residential buildings is  $0.35/0.25=1.4$ , corresponding to 40% higher  $K_1$  value for school buildings.
2. International seismic design codes assign different force modification factors for structures which are constructed using different materials and technologies (e.g. unreinforced masonry, complex masonry, RC, steel) and structural systems (wall, moment-resisting frame, dual frame-

wall system, etc). According to SNIP RT 22-07-2018 (Table 4, row 3), different  $K_2$  values are assigned for monolithic RC structures, ranging from 1.1 to 1.3. It was noted that moment-resisting RC frame (bare frame) system is assigned the  $K_2$  value of 1.2, while dual frame-wall system is assigned the value of 1.1; this difference is deemed to be very small (less than 10%), and does not reflect expected improvement in seismic behavior of a frame-wall system. Note that the lowest  $K_2$  value (1.0) is assigned to monolithic RC wall structures.

3. International codes also recognize difference in ductility for different structural systems (e.g. a higher  $R$  value is assigned to RC wall structure than moment-resisting frame), however the  $R$  value also depends on detailing of reinforcement in structural elements (e.g. spacing of ties in RC columns, overlapping of reinforcement, etc.). Structures which contain more extensive and more stringent seismic detailing requirements are assigned a higher  $R$  value. SNIP RT 22-07-2018 does not contain detailing provisions for different ductility levels in the same structural system (e.g. RC frame), such as Ordinary, Intermediate, and Special (as designated by the ACI318 code).



Reinforcement detailing for different classes of RC frame elements (with increasing ductility from left to right) according to the Canadian concrete design code CSA A23.3-04 (Mitchell et al., 2003)

4. It is expected that RC and masonry structures would demonstrate different seismic behaviour, which should be reflected through different  $K_2$  values. However, the  $K_2$  value for a complex masonry structure (1.35) is similar to that for a monolithic RC structure, e.g. a RC frame system ( $K_2=1.2$ ) - the difference is only 12.5%. It is expected that masonry structures, even complex masonry structures which are expected to demonstrate significantly better seismic performance compared to unreinforced masonry structures, would demonstrate a significantly lower ductility than properly designed and detailed RC structures; this should be reflected in the  $K_2$  values.

**Lateral displacement limits (Cl.31)**

The code sets the maximum permitted interstory displacement ratios (drifts) for buildings, depending on the material and structural system. The limits are included in Table 6. The lowest value (1/350) has been set for monolithic RC wall structures, while for RC frame structures the corresponding value is 1/150. The maximum permitted displacements for masonry structures are 1/400.

**Comments:**

It should be noted that the code-prescribed limits correspond to elastic lateral displacements (drifts) due to the design seismic forces, and that inelastic displacements caused by ductile seismic behavior (reflected through  $K_2$  coefficient) are not taken into account. Actual design interstory displacements (which account for both elastic and inelastic displacements) can be determined by multiplying the currently prescribed code values by  $K_2$ .

*Elastic displacement  $\Delta_e$  corresponding to a reduced seismic force  $V_d$ , and design displacement  $\Delta_d$  determined by increasing the elastic displacements by the coefficient  $K_2$ .*

**Dynamic analysis (Cl.38)**

Direct dynamic analysis (also known as time history dynamic analysis) is a seismic analysis procedure permitted by SNIP RT 22-07-2018 as an alternative to the Spectral Method. This procedure is applied when a numerical model of the structure is subjected to the acceleration vs time record of an actual or artificial earthquake. According to SNIP RT 22-07-2018 it is required to consider nonlinear deformations of structures and soils in this type of analysis. It appears that it is not permitted to apply a direct dynamic analysis procedure by considering elastic behavior of materials and structures.

**Comments:**

Nonlinear dynamic analysis is an advanced analysis procedure and is usually applied for seismic analysis of special structures, such as tall buildings, bridges, dams, etc. It is unlikely that a direct dynamic analysis procedure would be used for seismic design of new school buildings.

**4.4 Residential, public, industrial buildings and structures (Section 5)**

**4.4.1 Subsections 1 to 4 (including General provisions, Stairs, and Partitions)**

**Diaphragms (Cl.58)**

SNIP RT 22-07-2018 prescribes measures to ensure the strength of prefabricated RC hollow core floors (diaphragms) under horizontal seismic actions. Such floor systems were used for construction of school buildings in the past. These provisions are prescriptive and state that the connections of hollow core floors with RC seismic belts need to be provided, that the space (gap) between hollow core planks needs to be filled with concrete, and that shear keys need to be provided at the interfaces between hollow core planks.

**Comments:**

The code does not include a procedure for checking whether the lateral rigidity of a diaphragm is adequate and/or a strength verification check of a prefabricated floor system and its connections under lateral loads, as discussed below.

1. The code does not include a procedure for determining lateral stiffness of diaphragms under seismic actions and for determining whether a diaphragm could be considered as rigid or flexible for seismic design purposes. Stiffness of a diaphragm significantly influences its seismic behavior and the manner in which seismic forces are distributed to individual vertical structural elements at each story level. Structures with rigid diaphragms are more affected by torsional effects compared to the ones with flexible diaphragms.

2. Lateral strength of floor diaphragms is critical for seismic safety, since failure of a floor system could cause partial or total building collapse, as evidenced in the 2019 Durres, Albania earthquake. SNIP RT 22-07-2018 (Cl.58) does not include an approach which could be followed to verify shear strength of prefabricated hollow core floor structure or any other type of RC floor system. A strength check would need to be performed according to the structural design code for RC structures (e.g., SNiP RT 52-03-2020), while a procedure to determine design seismic forces for strength check of diaphragms would need to be included in SNIP RT 22-07-2018.

According to some of the leading international seismic design codes, e.g., Eurocode 8 in Europe and ACI318 in the United States, prefabricated hollow core floor system is permitted to be used in construction at sites prone to earthquakes only when a RC layer (topping) is constructed on top of a precast hollow core floor. Most international codes prescribe at least 50 mm thick concrete topping, while steel reinforcement must be provided in two orthogonal horizontal directions. The required thickness of concrete layer and the amount of steel reinforcement are to be determined based on engineering calculations.

**Partitions (Cl. 72-77)**

SNIP RT 22-07-2018 prescribes that partitions can be in the form of large RC panels, frames, or constructed using lightweight materials or masonry (Cl.72). It is required that partitions are attached to vertical structural elements and also to floor structures (if their length exceeds 3 m). It is required to verify the strength of partitions and their connections by engineering calculations (Cl. 73).

Cl. 76 and 77 include provisions related to masonry partitions, including reinforcement requirements (horizontal reinforcement embedded in mortar joints, and/or reinforced plaster layers attached to the wall surface). The solution will depend on the masonry adhesion strength and seismic intensity.

**Comments:**

Although SNIP RT 22-07-2018 includes the requirements for verifying strength of partitions and their connections under lateral seismic loads, it is not clear how the loads are determined, particularly out-of-plane seismic loads which could cause severe damage or collapse of partitions.

Provisions related to masonry partitions (Cl. 76 and 77) prescribe reinforcing arrangements which may result in increasing the strength of partitions for out-of-plane seismic loading, however it is not clear how partitions are connected to adjacent floor structures (top and bottom).

**Decorative elements and cornices (Cl. 83)**

SNIP RT 22-07-2018 does not recommend installing decorative elements, sculptures, cornices and parapets in residential buildings.

**Comments:**

Failure of nonstructural components such as cornices etc. could pose a threat to students and staff in schools, therefore school buildings also need to be mentioned in this clause.

**Parapets (Cl.84)**

SNIP RT 22-07-2018 prescribes the requirements for reinforcing parapets in complex masonry structures by constructing vertical RC elements at maximum 2 m spacing.

**Comments:**

This clause does not contain requirements for reinforcing/securing parapets in other types of structures, e.g. monolithic RC wall structures.

**4.4.2 Subsection 5. Reinforced concrete structures - general requirements**

This subsection contains general provisions related to the detailing of RC structures, including frame and wall systems. Some of these provisions are presented in more detail in Subsections 6, 7, and 8.

**Seismic behavior (Cl.85)**

SNIP RT 22-07-2018 states that a required behavior of RC structural elements under seismic actions is as follows: i) predominantly flexural behavior until the load-resisting capacity has been reached, ii) buckling of reinforcement should be avoided in structural elements subjected to compression, and iii) integrity of structural elements should be maintained even in case of a significant damage, and failure should be avoided.

**Comments:**

The objectives stated in Cl. 85 aim to achieve a desirable, ductile seismic behavior of structural elements. Unfortunately, it is not clear how design according to SNIP RT 22-07-2018 can prevent undesirable seismic behavior/performance, such as shear failure in RC beams or columns, or a soft story collapse in RC frame buildings. Seismic design of RC structures according to international codes (e.g. ACI318-19, Chapter 18 and Eurocode 8, Part 1) is performed by following the Capacity Design approach, which aims at avoiding a brittle shear failure in RC structural elements (beams, columns, walls), and ensuring a ductile behavior governed by flexure. Several new clauses would need to be included in SNIP RT 22-07-2018 to introduce the Capacity Design approach for seismic design of structural elements.

### Transverse reinforcement (tie) requirements (Cl.90 and 91)

Prescriptive requirements related to tie spacing in RC beams and columns are prescribed by Cl.90. Tie spacing should be determined based on the calculations. Maximum permitted tie spacing depends on the steel yield strength (400 or 450 MPa), seismic intensity, and reinforcement ratio in columns (e.g. larger than 3%). The limits are expressed in millimeters (e.g. 300 or 400 mm) and in terms of the diameter of longitudinal reinforcement ( $d$ ), e.g.  $10d$  or  $15d$ .

Smaller tie spacing is permitted within the lap splice region (if bars are not welded), e.g.  $5d$ .

Also, there are special detailing requirements for the critical regions of RC beams and columns (close to the ends of a span or a height), which depend on the seismic intensity (7 bays and higher). The code prescribes closer tie spacing for sites exposed to high seismic intensity, e.g. maximum 80 mm for seismicity higher than 9 bays. Additional spacing criteria are related to larger dimension of the beam/column cross-section ( $h$ ), e.g.  $h/4$ , and diameter of longitudinal reinforcement, e.g.  $10d$ .

Transverse reinforcement must have 135 degree hooks.

Cl. 91 contains additional requirements for tie spacing in columns in multi-story buildings with a seismicity of 8 bays or more, depending on the presence of walls. For frames without walls tie spacing should not exceed  $0.5h$ , while for frame-wall structure this limit is  $0.75h$ .

#### Comments:

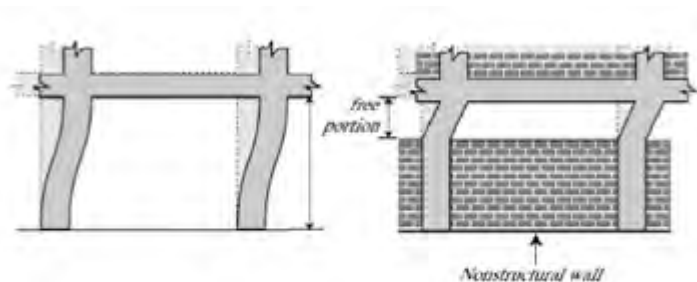
Maximum tie-spacing limits contained in Cl.90 and 91 are prescriptive, and the values are generally in line with international codes and practices. It is important that the code prescribes closer tie spacing for RC frame structures located at regions of higher seismic intensity, and also within critical regions of beams and columns. This is a positive comment.

### Short columns (Cl. 92)

Reinforcement detailing provisions related to short columns (with height/depth ratio of less than 5) include maximum 100 mm tie spacing to prevent the buckling of longitudinal reinforcement.

#### Comments:

Seismic design provisions for short columns are very important, since these columns are common in school buildings with RC frame structural system and often experience damage or failure in earthquakes. Since shear failure of short columns is a common failure mechanism, one of the critical requirements is to determine a design shear force for seismic design based on the Capacity Design approach. For more information refer to Garcia and Guevarra (2005).



*A regular RC column (left) and a short RC column (right) - significantly larger deformations develop in a short column over a smaller height, causing larger shear forces (Garcia and Guevarra, 2005)*

### Minimum wall reinforcement requirements (Cl.97)

Both concentrated and distributed reinforcement (minimum 0.05% reinforcement ratio) are required in RC structural walls (also known as shear walls).

**Comments:**

There are no requirements related to the detailing of concentrated vertical reinforcement (boundary elements) and the related transverse reinforcement. The minimum ratio for distributed horizontal and vertical reinforcement (0.05%) is rather low compared to international codes, which is usually 0.1% to 0.2%. As far as the concentrated reinforcement is concerned, the minimum amount (0.05% of the boundary element cross-section) is also considered to be low, usually the minimum ratio is not less than 1% (similar to RC columns).

### 4.4.3 Subsection 6. Frame structures

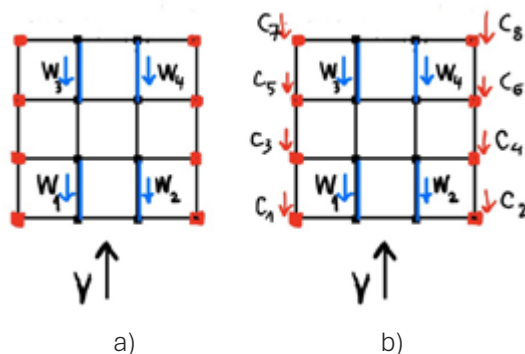
This subsection covers seismic design of monolithic RC frames, with and without RC walls or masonry infills, and also steel frames (which are outside the scope of this document).

#### Classification of frame systems (Cl.101)

The frame systems are classified into four categories: i) spatial frame, ii) spatial frame with infills, iii) frame with vertical braces, diaphragms (shear walls) and stiffeners (elevator cores), and iv) frame without beams (flat slab system). Frame with diaphragms (dual frame-wall system) is defined as a system in which at least 60% of vertical loads are resisted by the walls, and most horizontal loads are resisted by the walls. The frame is practically not engaged in resisting the horizontal loads.

**Comments:**

Definition of frame-wall system per SNIP RT 22-07-2018 is different from most international codes. It is a common practice that frame elements (columns) partially resist horizontal loads in a frame-wall system, e.g. 20-25% of the total seismic force, as illustrated on the sketch below. Note four walls (W1 to W4) shown on the floor plan (blue color), and 8 columns (C<sub>1</sub> to C<sub>8</sub>), shown in red color. SNIP RT 22-07-2018 prescribes that four walls resist entire seismic force V, as shown on the sketch (a), while international codes prescribe that seismic load is resisted both by the walls and the columns (sketch b). The columns (C<sub>1</sub> to C<sub>8</sub>) are expected to jointly resist 0.2V to 0.25V (depending on the code), while the walls resist the remaining seismic force (0.75V to 0.8V).



*Seismic force distribution in RC dual frame-wall system: a) SNIP RT 22-07-2018 provision and b) provisions of international seismic design codes*

Based on the code definition there is no difference in terms of horizontal load resistance between a frame-wall system and a wall system - walls resist all horizontal loads in both systems. However, these two systems have a notably different K<sub>2</sub> value: 1.0 for wall structures and 1.2 for a frame-wall system.

### Structural irregularities (Cl.103)

It is permitted to have up to 20% difference in lateral stiffness between adjacent floors. It is required to consider torsional effects due to the eccentricity of mass and stiffness in a building.

#### Comments:

Current code provisions related to structural irregularities are incomplete. Some important types of irregularities, such as weak story and other irregularities in plan and elevation are not addressed by the code. For each irregularity it is required to provide the corresponding criterion (to determine under which conditions such an irregularity may occur), and whether a particular irregularity is permitted. Torsional effects are mentioned in the clause, however there is no criterion related to torsional irregularity; also, accidental torsional effects (which are included in international seismic design codes) are not included. Refer to Eurocode 8, Part 1 for more details related to provisions for buildings with structural irregularities.

### Continuity (splicing) of longitudinal reinforcement (Cl.106)

The code prescribes splicing requirements for longitudinal reinforcement in beams, columns and walls. It is permitted to ensure the continuity of longitudinal reinforcement, either by welding or by overlapping bars.

#### Comments:

Provisions related to ensuring continuity of longitudinal reinforcement (e.g. vertical reinforcement in columns and walls) do not specify permitted locations for splicing, which is critical for satisfactory seismic performance of RC structural elements. For example, locations within a column where maximum bending moments are expected are considered to be critical, and it is very important to avoid splicing of reinforcement (by welding or overlapping bars) at such locations.

### Masonry infills (Cl.108)

Infills in RC frame structures are permitted to be constructed either as separate panels or as masonry walls constructed using clay or concrete masonry elements. Masonry infills can be separated from the frame by a 20 mm gap; alternatively, they can act jointly with the frame (without a gap). If an infill acts jointly with the frame it needs to be modelled as a wall for seismic analysis purposes.

#### Comments:

The code prescribes a possibility of an isolated infill (separated from the frame), but it is not clear how lateral seismic displacements due to out-of-plane seismic forces are prevented.

Also, it is not clear how infills are included in a numerical model of the building, by simulating connections at the interface with adjacent frame members.

#### 4.4.4 Subsection 8. Monolithic RC wall structures

This subsection discusses seismic design of buildings with monolithic RC walls, which resist both gravity and lateral seismic loads.

##### Floor structures (Cl.127)

It is permitted to use either monolithic RC floors or prefabricated hollow core floor system in RC wall structures. Provisions related to stiffness of hollow core floors are included in Cl.58 (previously discussed in this document).

##### Comments:

The code prescribes a possibility of an isolated infill (separated from the frame), but it is not clear how lateral seismic displacements due to out-of-plane seismic forces are prevented.

Also, it is not clear how infills are included in a numerical model of the building, by simulating connections at the interface with adjacent frame members.

##### Minimum wall reinforcement requirements (Cl.131 and 133)

Provisions related to distributed wall reinforcement contained in Cl.131 were also included in Cl.97, however concentrated reinforcement was not mentioned in Cl.131.

Cl.133 prescribes requirements for concentrated reinforcement at wall intersections and openings. The reinforcement is provided in the form of a cage, consisting of vertical bars and transverse reinforcement (ties). Minimum size of vertical bar is 10 mm and the tie size is 3-4 mm, with the spacing of up to 500 mm.

##### Comments:

Cl.133 prescribes reinforcement which is similar to boundary elements at wall ends, however international codes would usually require larger longitudinal and transverse reinforcement and closer tie spacing (e.g. 100-150 mm as opposed to 500 mm). Also, confinement of transverse reinforcement (closed ties) and anchorage (135 degree hooks) should be specified.

#### 4.4.5 Subsection 9. Seismic design of unreinforced and complex masonry structures

This subsection (Cl.138-161) contains the seismic design provisions for loadbearing masonry structures (unreinforced masonry, reinforced and complex masonry) and for RC frames with masonry infills (Cl.138).

##### Material requirements (Cl.139-142)

Different masonry elements are permitted, including clay bricks (with holes up to 25% of the gross cross-section area) of class 75 or higher, and lightweight concrete blocks. Cement-based mortar, class M50 or higher, is permitted.

##### Seismic loading (Cl.143)

It is required to consider simultaneous action of horizontal and vertical seismic loads. Vertical seismic load is expressed as a fraction of the vertical static load (gravity load) and depends on seismic intensity, ranging from 15% for seismic intensity 7-8 bales to 50% for seismic intensity of more than 9 bales.

##### Height restrictions (Cl.145)

There are no restrictions related to the overall building height, however the maximum floor height has been restricted depending on the seismic intensity. For example, for unreinforced masonry buildings maximum permitted floor height for the highest intensity zone (9 bales) is 3.5 m, while for reinforced and complex masonry structures the permitted floor height is 4.5 m. The maximum slenderness (floor height-to-thickness) ratio is set to 12.0.

##### Amount and layout of walls (Cl.146-148)

These requirements depend on the masonry system. For unreinforced masonry buildings it is required to provide external longitudinal walls, plus at least one interior longitudinal wall (Cl.146). These longitudinal walls need to be connected with transverse walls, and also need to be continuous up the building height.

Maximum spacing of transverse (cross) walls is prescribed in Cl.147. Wall spacing should be determined by the design, however the maximum permitted spacing is prescribed by the code. For the 1st category of masonry, maximum spacing of transverse walls should not exceed 9m for the highest seismic intensity (more than 9 bales), and the value can be increased by 30% for complex masonry buildings (provided that the seismicity is in the range from 7-9 bales).

The code also prescribes the limits for dimensions of wall elements, however the actual dimensions should be determined by calculations (Cl.148). The limits are related to the walls with openings, and the maximum limits are specified for opening sizes, e.g. maximum 2 m wide opening for seismicity of more than 9 bales.

##### RC seismic belts (Cl.149 and 150)

Design provisions related to seismic belts specify that longitudinal reinforcement of the belt needs to be continuous. The minimum required amount depends on the seismicity, ranging from four 10 mm diameter bars for seismicity of 7 bales to four 14 mm diameter for seismicity of more than 9 bales. The required amount of reinforcement should be determined by calculations.

## Approaches for increasing seismic resistance of masonry walls (Cl.152)

The code prescribes the following approaches for increasing the seismic resistance of unreinforced masonry walls: i) installing horizontal reinforcement in mortar joints, ii) constructing external reinforced concrete (shotcrete) layers attached to the wall surface (complex masonry), iii) constructing monolithic RC horizontal and vertical elements (complex masonry), and iv) constructing an internal RC layer in the middle of the wall section (creating a composite wall section with two exterior masonry wythes and an internal RC layer).

### Horizontal wall reinforcement (Cl.151)

The minimum amount of horizontal wall reinforcement, which is embedded in mortar joints, depends on the wall thickness, and ranges from 0.7 cm<sup>2</sup> for 250 mm thick walls to 1.3 cm<sup>2</sup> for 510 mm thick walls. The reinforcement should be at least 1.5 m long (extending from the wall intersection), and should be provided up the wall height at the spacing that depends on the seismic intensity (ranging from 300 mm for seismicity of more than 9 bals to 700 mm for seismicity of 7-8 bals).

### External reinforced concrete (shotcrete) layer attached to the wall surface (Cl. 154)

It is prescribed to construct RC layers on both exterior and interior wall surfaces. The thickness of concrete layer should be 25-40 mm, and it can be constructed using a low-strength concrete (B2.5) or mortar (M100) (Cl.152). Steel anchors (min 6 mm diameter) should be installed to attach RC layer to the wall, at the maximum spacing of 600 mm (in a staggered manner).

### Complex masonry structure with vertical RC inclusions (Cl.155)

Vertical RC inclusions should be connected to RC seismic belts, and the horizontal reinforcement from the belt should be continuous through the inclusions. Vertical inclusions should be provided at wall intersections, at door and window openings, and within the walls that are longer than 6 m. Concrete class B15 should be used, and the vertical reinforcement ratio should be at least 0.45%.

### Complex RC frame and masonry systems (Cl.153)

The code permits a construction technology which consists of RC frame and masonry walls, where masonry walls at each floor level are constructed first,

before the concrete is poured in RC columns, that is, masonry serves as formwork for RC columns. Horizontal RC elements (beams) are constructed on top of masonry walls. Horizontal and vertical frame elements should be designed with rigid connections, and masonry walls are intended to act as infills.

### Parapets (Cl.156)

It is required to provide reinforcement in the parapets which are more than 400 mm high. The reinforcement should be in the form of vertical RC inclusions which are anchored into a seismic belt. Note that Cl.84 prescribes that spacing of vertical inclusions in parapets should not exceed 2m.

### Open ground floor (Cl.157)

The code requires that, when ground floor in a masonry building is used for shops or requires a large open space, it should be constructed as RC or steel frame structure.

**Comments:**

SNIP RT 22-07-2018 includes relevant provisions related to seismic detailing of unreinforced and complex masonry structures. It is commendable that RC seismic belts are required even in unreinforced masonry buildings. Provisions related to the complex masonry buildings are mostly focused on restrictions regarding the layout and dimensions of structural elements, and the amount of reinforcement. A few important provisions are missing from the current code, as discussed below.

1. The code does not provide specific seismic detailing requirements for transverse reinforcement (ties) in vertical RC inclusions, which would include the size, spacing, and anchorage (hooks) (Cl.155). These requirements are very important because vertical RC inclusions have important role in preventing the collapse of complex masonry buildings in severe earthquakes. It is recommended to provide closer spacing of ties within the end zones (top and bottom) at each floor level.
2. The code does not provide any guidance related to modelling of complex masonry buildings for seismic analysis purposes. Seismic behaviour of complex masonry buildings is influenced by the presence of vertical RC inclusions, which are integrated with masonry walls. These inclusions act as ties (resisting tension and compression forces), and do not act as columns in a RC frame structure. Connections between vertical RC inclusions and horizontal RC seismic belts act like hinges in a truss structure.
3. The code permits the construction of hybrid systems, in which a ground floor is designed using a frame system, while upper floors are a loadbearing structure (Cl.157). Further guidance is needed related to the seismic design of such a system, due to a possible soft story collapse at the ground floor level, as evidenced in the 2008 Wenchuan, China earthquake and the 2019 Durres, Albania earthquake. The design provisions are mostly related to the ground floor structure, since it needs to sustain higher seismic forces and be sufficiently robust to compensate for the absence of walls at that level.

#### 4.5 Recommended code revisions: a summary

These recommendations have been developed based on the review of relevant codes and practices for design of new school buildings in Tajikistan. A few selected international codes, which are considered to reflect the state-of-the-art in seismic analysis and design, were selected as a reference for the concerned government institutions and future code development committees in Tajikistan. It is also recommended to review a recent global report on the status of technical regulations, with the focus on structural/seismic resilience (and also includes green design and universal accessibility codes) (Sakoda et al., 2025); note that selected codes from Tajikistan were also reviewed and the review results are presented in the study. Seismic loading and

analysis procedures are addressed in detail by ASCE/SEI 7-22 code in the USA (ASCE, 2022) and Eurocode 8, Part 1 in Europe (EN 1998-1:2004, 2004). Seismic design of RC structures is addressed by the ACI 318 code in the USA (ACI, 2019), which has been also adopted by several other countries, and Chapter 5 of Eurocode 8, Part 1 in Europe. Structural and seismic design of masonry structures are addressed by Eurocode 6 (EN 1996-1-1:2022, 2022) and Chapter 9 of Eurocode 8, Part 1.

The proposed code updates are related to the topics which were previously discussed in this section (see the Comments boxes), such as seismic analysis, seismic design - general requirements, seismic design of RC and masonry structures, and are summarized below.

**4.5.1 Seismic analysis recommendations (Section 4.3)**

1. To permit the application of nonlinear static (pushover) analysis procedure as a tool for performance-based seismic design and evaluation of school buildings.
2. To review the seismic coefficient values in Cl.21, especially the coefficient  $K_2$  which reflects the expected ductility of various structural systems.
3. To introduce different ductility levels for the same structural system (e.g. RC frame) in Cl.21, and prescribe the corresponding seismic detailing requirements.
4. To revise interstory displacement limits (Cl.31) and take into account the effect of ductile seismic behavior on lateral displacements.

**4.5.2 Seismic design - general recommendations (Section 4.4.1)**

1. To include provisions for verifying the lateral strength of floor diaphragms and their connections through design calculations (Cl.58). Prefabricated RC hollow core floor systems are particularly vulnerable, as evidenced by building collapses in past earthquakes.
2. To include verification of the diaphragm stiffness (rigidity) under lateral loads (Cl.58), since it influences the distribution of lateral loads to the vertical structural elements in a building.
3. To include a design procedure for verifying the strength of partitions and their connections under out-of-plane seismic loading (Cl.76 and 77).

**4.5.3 Seismic design and detailing of RC structures - recommendations**

1. To introduce the Capacity Design approach for seismic design of monolithic RC frame and wall structures (Cl.85), to ensure a ductile seismic behavior of RC structures and minimizes the chances of a sudden and brittle failure of structural elements and entire structure (Section 4.4.2).

2. To include a design procedure in Cl.92 for ensuring that shear failure of RC short columns is avoided by applying the Capacity Design approach (Section 4.4.2).
3. It is important to clearly specify fraction of the total seismic load which is to be resisted by the shear walls in a frame-wall system (Cl.101) (Section 4.4.3).
4. Current code provisions related to structural irregularities are incomplete (Cl.103), since some important types of irregularities are not included. Also, more guidance is needed related to the seismic analysis of buildings with torsional irregularity (Section 4.4.3).
5. Current code provisions related to the minimum reinforcement requirements for RC shear walls need to be revised (Cl. 97, 131 and 133). The minimum reinforcement ratios are very small. Reinforcement detailing provisions for boundary elements (concentrated reinforcement at wall ends) need to be revised to specify the transverse reinforcement requirements (size and spacing) (Section 4.4.4).

**4.5.4 Seismic design and detailing of masonry structures (Section 4.4.5)**

1. To include seismic detailing requirements for transverse reinforcement (ties) in vertical RC inclusions of complex masonry buildings (Cl.155). Transverse reinforcement is critical for preventing shear failure of vertical RC inclusions under seismic actions.
2. To include guidance related to the modelling of complex masonry structures for seismic analysis purposes, which is necessary to ensure realistic seismic analysis and design of these buildings.
3. To provide guidance related to the seismic design of hybrid structures, with RC frames at the ground floor and complex masonry structure at upper floors (Cl.157). Inadequately designed hybrid structures are at risk of damage or collapse in earthquakes.

## 5. Seismic evaluation and retrofitting of existing buildings according to SNIP RT 22-07-2018: current status and recommendations for future updates

### 5.1 Seismic vulnerability of common school building typologies in Tajikistan

Based on the review of drawings for existing school buildings and design code provisions, as well as the outputs of a study performed by GUP NIISA, it was possible to identify key deficiencies of various school building typologies leading to their seismic vulnerability. These deficiencies are summarized in the following text.

#### 1. Unreinforced masonry buildings (URM7):

- Shear resistance (capacity) of loadbearing masonry walls in moderate to high seismic hazard areas is insufficient due to low masonry compressive and shear strength.
- These buildings are more vulnerable in longitudinal direction due to the large openings in exterior walls, and are characterized by excessively small wall areas for resisting lateral in-plane seismic forces.
- Floor structures are usually in the form of precast hollow core RC planks which are lacking connections between the planks, and are vulnerable to horizontal seismic actions.
- Nonstructural walls (usually masonry partitions) are vulnerable to out-of-plane seismic actions.

#### 2. Complex masonry with concrete framing (CXCF):

- Shear resistance (capacity) of loadbearing masonry walls in areas is insufficient due to low masonry compressive and shear strength; vertical RC inclusions are not very effective in school buildings due to large spacing of transverse walls;
- These buildings are more vulnerable in longitudinal direction due to the large openings in exterior walls, and are characterized by excessively small wall areas for resisting lateral in-plane seismic forces.

- Floor structures in existing schools are usually in the form of precast hollow core RC planks without any connections between the planks, and are vulnerable to horizontal seismic actions.
- Components of RC frames (columns and beams) may also be vulnerable due to the absence of ductile seismic design and detailing, but these frames primarily resist gravity loads due to large stiffness of masonry walls.
- Nonstructural walls (usually masonry partitions) are vulnerable to out-of-plane seismic actions.

#### 3. Precast RC frames with exterior precast RC wall panels (PC2):

- Precast RC frames are vulnerable due to welded column-to-beam connections, which are expected to perform in a brittle manner in an earthquake, and may cause partial or total building collapse in a damaging earthquake.
- Columns and beams were not designed for ductile seismic behavior, and are likely going to experience a brittle shear failure and possibly collapse of entire columns.
- Exterior precast RC panels are non-structural elements, however they are at risk of failure due to welded panel-to-column connections, and are expected to experience a brittle failure, which may lead to panel collapse.
- Floor structures are usually in the form of precast hollow core RC planks without any connections between the planks, and are vulnerable to horizontal seismic actions.

#### 4. Precast large panel reinforced concrete wall system (PC1):

- Precast large panel buildings may be vulnerable due to the wall panel connections, which are achieved either by means of welding or via shear keys; alternatively, the capacity of wall panels to resist earthquake-induced shear forces may be inadequate due to insufficient horizontal reinforcement, small panel thickness, etc.
- Floor structures are usually in the form of solid precast concrete panels connected either by means of welded connections or shear keys, and may be vulnerable due to possible connection failure.

## 5.2 Overview of the relevant provisions on restoration, retrofitting and reconstruction of buildings

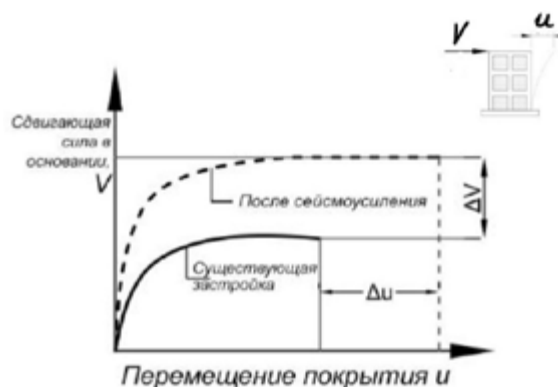
The provisions for structural interventions in existing buildings, such as restoration, retrofitting and reconstruction, are included in Section 5, Subsection 8 (Cl.280-293), and address the topics such as the applicability of structural interventions, criteria/level of interventions, condition assessment (survey), techniques for repair and strengthening (retrofitting), etc. Provisions related to the seismic analysis procedures are presented in Section 4 (Cl.13).

### Comments:

The code specifies various structural interventions, including restoration, retrofitting, and reconstruction, however there is no guidance regarding the effectiveness of these interventions with regards to seismic resilience of a building. Difference between the restoration and retrofitting in terms of their impact on structural/seismic safety is significant and it is important to provide appropriate definitions and expected effects on structures.

Restoration (also known as *repair*) refers to actions that improve the functionality of a defective/deteriorated/damaged structure or structural element(s). It should be noted that repair may not be intended to completely restore the original capacity of the structural elements or entire structure, and it does not result in enhanced seismic safety. Restoration includes interventions such as grouting of cracks, sealing of joints, etc.

Seismic retrofitting (also known as *seismic strengthening*) refers to interventions that lead to enhancement of one or more seismic response parameters (e.g. stiffness, capacity, ductility) of an existing, usually undamaged, structure or structural element, and is expected to increase seismic resilience of a structure to the desired level. Seismic retrofitting of an existing building may be performed either by performing structural interventions on existing structural elements (e.g. columns or beams), or by adding new structural elements (e.g. RC shear walls). The effectiveness of seismic retrofitting is illustrated below. Note that behavior of a building that has undergone restoration would be represented by a solid line (same as the original building).



Difference in the seismic response for an existing building subjected to seismic force  $V$  before the retrofit (solid line) and after seismic retrofitting (dashed line)

**Seismic analysis and design**

According to Cl.14, the same seismic analysis procedures are applicable for seismic design of new buildings and seismic evaluation and retrofitting of existing buildings.

According to Cl.290, assessment of loadbearing capacity of the structure needs to take into account spatial behavior of structural elements, interfaces between the frames and infills, and the influence of plastic deformations on force distribution.

According to Cl.282, structural elements with insufficient load-resistance are to be identified through analysis, by applying the same procedures as for new buildings (see also Cl.13).

According to Cl.288 load-bearing capacity of a structure should be determined based on the survey results, as well as the material strengths determined through testing.

According to Cl.289, the goal of restoration is to preserve the existing structure as much as possible, and to avoid solutions that deteriorate the uniformity and integrity of the structure. It is also important that the loadbearing capacity of rehabilitated structure is adequate.

**Comments:**

The code does not prescribe application of nonlinear static analysis (pushover analysis), a well established procedure for seismic evaluation of existing buildings. Pushover analysis procedure is prescribed by international codes, such as ASCE 41-23 and Eurocode 8, Part 3. Nonlinear static analysis procedure and its application for seismic evaluation and retrofitting of existing school buildings in Kyrgyzstan are available in Chapter 2 (Brzev and Begaliev, 2018). Application of pushover analysis enables the designer to better understand the performance (and the corresponding extent of damage) of a building subjected to specific seismic hazard (earthquake intensity), in terms of deformations (lateral displacements, rotations, etc.).

**Condition assessment (survey) (Cl.285 and 287)**

It is required to assess condition of the structure in order to establish the extent of damage (Cl.285).

Structural interventions should be designed based on the results of survey of structural elements and foundations (Cl.287).

**Applicability of structural interventions (Cl.280)**

These provisions are applicable to earthquake-damaged buildings, and/or buildings constructed without seismic provisions, an/or buildings under reconstruction.

**Criteria for interventions (Cl.281 and 285)**

Cl.281 prescribes the following criteria for undertaking structural interventions: i) change of use of the building, ii) increasing seismic resistance to the current code level, iii) an increase of the applied loads, and iv) the standard service life has expired.

According to Cl.285, a decision related to structural interventions needs to be made by taking into account the building condition (extent of deterioration), and the socio-economic feasibility of structural interventions.

**Level of structural interventions (Cl.283, 284, and 286)**

According to Cl.283 it is permitted that structural interventions on existing buildings do not fully comply with the code requirements for new buildings, but the adopted level of interventions needs to be justified based on the economic feasibility and the required service life of building.

Cl.284 permits the following levels of reconstruction: i) to restore the structure to the original condition, ii) to increase seismic weight, and iii) to upgrade the structure to the current code level.

According to Cl.286, the level of intervention is to be set by the owner (client) depending on the building importance and occupancy/function, and also based on the results of survey (assessment).

**Comments:**

1. The code does not prescribe seismic design criteria for structural interventions intended for enhancing seismic safety in existing buildings (Cl.286). It is important to provide guidance regarding the target level of seismic safety for different building occupancies, e.g. schools, hospitals, residential buildings, etc. Some international codes accept retrofit solutions which are designed for lower seismic safety compared to new buildings, which need to fully comply with the requirements of applicable seismic code. For example, it may be acceptable for existing buildings to be retrofitted to 75% or 80% of the seismic design forces specified by the code, while new buildings need to be designed for 100% of these forces. However, infrastructure facilities of special importance in post-earthquake situation usually need to fully comply with the code requirements. More advanced codes (e.g. ASCE 41-23 in the USA) specify different seismic performance levels depending on the seismic hazard, i.e. buildings are retrofitted to show better performance (less damage) at less intense earthquakes and more extensive damage is expected in case of a severe earthquake.

2. Some international codes for existing buildings (e.g. ASCE 41-23 in the USA) prescribe the Acceptance Criteria for seismic performance of structural elements in different structural systems (e.g. RC beams and columns), depending on possible failure mechanisms, e.g. flexure (bending) and shear, amount of reinforcement, level of axial stress (in columns), etc. The criteria recognize that some failure mechanisms are ductile (e.g. flexural failure), hence the acceptance criteria are deformation-based (e.g. permitted lateral drifts or rotations). On the other hand, other mechanisms (e.g. shear failure) are brittle, hence the criteria are force-based (e.g. the maximum permitted shear force in a beam or a column).

**Strategies/techniques for structural interventions (Cl.287 and 290)**

Cl.287 prescribes several technical solutions for structural interventions, which are aimed at increasing the strength and rigidity of structural elements, e.g. reinforcement of walls and frame elements, increasing the rigidity of floor diaphragms, etc. It is also recommended to repair RC structural elements by injecting cracks with a cementitious emulsion.

The most common reconstruction techniques are summarized in Table 15 (see Cl.290).

**Comments:**

Although different types of structural interventions and the corresponding strategies are included in the code, no guidance is provided related to structural/seismic design of various retrofit solutions. Also, seismic retrofitting solutions are continuously evolving, and the list contained in Table 15 may be outdated. A detailed discussion on seismic retrofitting techniques for RC and masonry structures is presented in Brzev and Begaliev (2018).

**5.3 Recommended code revisions: a summary**

SNIP RT 22-07-2018 includes general provisions related to the structural interventions in existing buildings, however guidance regarding the seismic evaluation and retrofitting of existing buildings is insufficient. A few international codes are dedicated to seismic evaluation and retrofit of existing buildings, including ASCE 41-23 (ASCE, 2023) in the USA and Eurocode 8, Part 3 (EN 1998-3:2005, 2005). in Europe, etc. These codes are important for considering content of future updates for the SNIP RT 22-07-2018 provisions related to existing buildings.

The proposed code updates are related to the topics which were previously discussed in this section (see the Comments boxes), and are summarized below.

1. To prescribe specific criteria related to the required level of seismic safety for seismic retrofitting of different building occupancies (e.g. schools, hospitals, residential buildings, etc).
2. Nonlinear static analysis (pushover analysis) from international best practices (e.g. ASCE 41-23 and Eurocode 8, Part 3) can be introduced for seismic evaluation of existing buildings.
3. Acceptance Criteria on seismic performance of different structural elements can be introduced for more effective seismic retrofitting design.
4. An update and design guidance are needed for the different types of structural interventions and the corresponding strategies listed in SNIP RT 22-07-2018.

## 6. Recommendations for the next steps

A review of the national seismic design code SNIP RT 22-07-2018 presented in this guidance note is expected to serve as a valuable resource for implementing action plan for the National Education Development Framework, particularly as related to the activities under “Earthquake safety standards and protection from natural disasters”. The proposed code updates will require a comprehensive review of the international seismic design codes and the supporting documents (commentaries, manuals, etc.). Major changes in the current seismic analysis and design approaches are needed to improve the understanding of building performance and possible failure mechanisms in earthquake, and prevent undesirable mechanisms (e.g. brittle shear failure of RC and masonry structures) from occurring during severe earthquakes by means of seismic analysis, design and detailing of new and existing school buildings in Tajikistan.

Based on the detailed review of local structural/seismic design codes and practices related to school buildings, various activities and initiatives can be proposed for improving seismic resilience of new and existing school buildings

in Tajikistan. A few important activities that may contribute to enhancing seismic resilience of school buildings (and other buildings) in Tajikistan and could be incorporated in the National Education Development Framework, are discussed in this section.

### 1. Seismic design of new school buildings

Specific recommendations related to the revisions of the seismic design code provisions for new buildings were discussed in Chapter 4, however it is also recommended to develop technical resources to support the effective code implementation. For example, technical manuals could be developed to present examples illustrating seismic analysis and design of various structural systems and materials, including RC frame and wall structures, masonry structures, steel structures, etc. Examples of such publications exist in the USA, for example publication FEMA P-2006 which contains design examples to illustrate the application of the ASCE 41-13 code for existing buildings (FEMA, 2018) is available online and free of charge.

It is also important to ensure that standard school designs are reviewed and updated periodically, as needed.

### 2. Seismic evaluation and retrofitting of existing school buildings

Based on the code review and evidence from other countries in the region it can be expected that and experience related to seismic evaluation and retrofitting of existing buildings in Tajikistan is very limited. Given a large inventory of existing seismically vulnerable buildings in Tajikistan, including school buildings, it is needed to update the current code (as discussed in Chapter 5), and in the process consider provisions of leading international codes for seismic evaluation and retrofitting of existing buildings. It is also recommended to develop manuals for seismic assessment of buildings, as well as seismic retrofitting, to illustrate application of seismic retrofitting on RC and masonry buildings and consider various context-appropriate technical solutions.

### 3. Capacity building of engineers and academics

It is important to strengthen technical capacity of various stakeholders, including engineers involved in school design and construction, engineers engaged in the government institutes and ministries responsible for the development of seismic design codes, academics, etc. A few recommended capacity building activities are outlined below:

- a) Short courses on advanced topics related to seismic analysis and design of buildings

These courses would be focused on earthquake engineering topics, including advanced seismic analysis and design methods and procedures which are currently not included in the local seismic design codes. The students would gain required knowledge through practice assignments and a final exam. Technical resources for these courses would include lecture notes presenting theoretical concepts and illustrative examples.

- b) Training programs related to the seismic evaluation and retrofitting of existing buildings

Short courses would be organized to present the approaches for seismic evaluation and retrofitting of existing buildings, various seismic retrofitting techniques, case studies of seismic evaluation and retrofitting for RC and masonry buildings, etc.

- c) Updating curriculum of structural engineering courses at universities and colleges

There is a need to adapt university curriculum for structural engineering courses at undergraduate and graduate level to incorporate advanced seismic analysis and design concepts and provisions of national and leading international seismic design codes.

## Annex 1 references:

ACI (2019). Building Code Requirements for Structural Concrete (ACI 318-19). American Concrete Institute, Farmington Hills, MI, USA.

American Society of Civil Engineers (ASCE) (2022). Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE/SEI 7-22) <https://www.asce.org/publications-and-news/asce-7>

American Society of Civil Engineers (ASCE) (2023). Seismic Evaluation and Retrofit of Existing Buildings, Standard (ASCE/SEI 41-23), American Society of Civil Engineers, Reston, VA, USA.

Brzev,S., Begaliev,U. (2018). Практическое пособие «Проектирование и конструирование сейсмоусиление зданий школ в Кыргызской Республике», Всемирного Банка URL: <https://documents1.worldbank.org/curated/en/765151593525566669/pdf/Practical-Seismic-Design-and-Construction-Manual-for-Retrofitting-Schools-in-The-Kyrgyz-Republic.pdf>

EN 1996-1-1:2022 (2022). Eurocode 6 — Design of masonry structures — Part 1-1: General rules for

reinforced and unreinforced masonry structures, European Committee for Standardization, Brussels, Belgium.

EN 1998-1:2004 (2004). Eurocode 8: Design of Structures for Earthquake Resistance – Part 1: General Rules, Seismic Actions and rules for buildings, European Committee for Standardization, Brussels, Belgium.

EN 1998-3:2005 (2005). Eurocode 8: Design of Structures for Earthquake Resistance – Part 3: Assessment and Retrofitting of Buildings and Bridges, European Committee for Standardization, Brussels, Belgium.

FEMA (2018). FEMA P-2006, Example Application Guide for ASCE/SEI 41-13 Seismic Evaluation and Retrofit of Existing Buildings; with Additional Commentary for ASCE/SEI 41-17. Federal Emergency Management Agency, USA. URL: [https://www.fema.gov/sites/default/files/2020-08/fema\\_application-guide-seismic-eval-retrofit\\_p-2006\\_6-18.pdf](https://www.fema.gov/sites/default/files/2020-08/fema_application-guide-seismic-eval-retrofit_p-2006_6-18.pdf)

Guevara LT, García LE. (2005) The Captive- and Short-Column Effects. *Earthquake Spectra*, 21(1):141-160. [https://www.researchgate.net/publication/249872895\\_The\\_Captive\\_and\\_Short-Column\\_Effects](https://www.researchgate.net/publication/249872895_The_Captive_and_Short-Column_Effects)

Mitchell, D., et al. (2003). Seismic force modification factors for the proposed 2005 edition of the National Building Code of Canada. *Canadian Journal of Civil Engineering*, Vol.30, p308-327.

RoT (2025). National education development framework of the Republic of Tajikistan, Ministry of Education and Science of the Republic of Tajikistan.

Sakoda, K., Campos Garcia, A., Kawasoe, Y. and Mengote-Quah, D. (2025). A Global Assessment of Building Regulation for Resilience Building Codes : Current Status and Evolving Needs to Promote Resilient, Green and Inclusive Buildings. Washington, D.C. : World Bank Group URL: <http://documents.worldbank.org/curated/en/099060625081568157>

SNIP RT 22-07-2018 Earthquake-Resistant Construction (Сейсмостойкое строительство), Gosstroy Tajikistan, Republic of Tajikistan.

SNiP RT 52-03-2020 Concrete and reinforced concrete structures (Бетонные и железобетонные конструкции), Gosstroy Tajikistan, Republic of Tajikistan.

SNiP RT 51-01-2013 Masonry and reinforced masonry structures (Каменные и армокаменные конструкции), Gosstroy Tajikistan, Republic of Tajikistan.





© 2026 International Bank for Reconstruction and Development / The World Bank

1818 H Street NW, Washington DC 20433

Telephone: 202-473-1000

Internet: [www.worldbank.org](http://www.worldbank.org)