

# Earthquake Risk in Bishkek



Image from <https://hivgaps.org/>

## Seismic Cities Policy Brief

Earthquake Hazards & Risks

COMET/GEM &

Institute of Seismology Partnership

NERC GCRF Global Challenges: Sustainable Cities

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AND COMMUNITIES



increasing resilience to seismic shocks



Damage from an earthquake near Nura in Kyrgyzstan from paper by Kalmetyeva *et al.*, 2009

## Overview

- BISHKEK IS EXPOSED TO MAJOR EARTHQUAKE HAZARDS.
- THERE ARE MANY ACTIVE FAULTS VERY CLOSE TO BISHKEK ON WHICH EARTHQUAKES COULD OCCUR
- WE IDENTIFY THE EXPECTED LOSSES FROM POTENTIAL EARTHQUAKES
- UNREINFORCED MASORNARY BUILDINGS ARE PROJECTED TO PERFORM BADLY
- WE FIND AN EARTHQUAKE ON THE ISSYK ATA FAULT COMBINED WITH THE SHAMSI TUNDUK FAULT, WHICH FORM THE HILLS AND MOUNTAINS VISIBLE TO THE SOUTH FROM BISHKEK, WOULD BE VERY DAMAGING TO THE CITY
- ESTIMATES OF FATALITIES ARE AS LARGE AS **2,400** WITH OVER **7,900** COMPLETELY DAMAGED BUILDINGS



**Make cities and human settlements inclusive, safe, resilient and sustainable**

# Earthquake Risk in Bishkek

## IDENTIFYING NEARBY FAULTS THAT POSE SEISMIC HAZARD AND RISK TO BISHKEK

There have been many earthquakes in Kyrgyzstan that have affected Bishkek, such as in 1885, 1920 and 1992. The hills and mountains to the south of the city, and hills to the north, are formed by active faults on which earthquakes can occur.

Due to the proximity to Bishkek, if earthquakes were to happen on these faults, the damage and losses to the city could be significant. We provide estimates of the expected number of lives lost, residential buildings collapsed and the economic costs from earthquakes should they occur on the most important faults closest to Bishkek.

The most damaging earthquakes would occur on the **Issyk Ata** and **Shamsi Tunduk** fault to the south of the city, and on a newly identified fault under folding to **the north of the city**. Here we present the likely damage and losses for earthquakes that may happen near Bishkek. This information can be useful for future city planning.

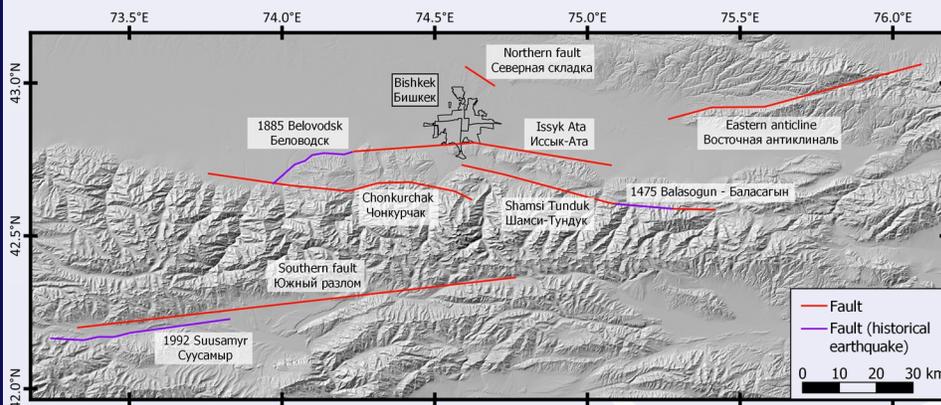
## Risk calculations for your city

SCIENTIFIC RESEARCH TO PROVIDE GUIDANCE ON TARGETING EARTHQUAKE PLANNING IN BISHKEK.

### OPENQUAKE & THE GLOBAL EARTHQUAKE MODEL

We use the Global Earthquake Model's (GEM) OpenQuake Engine to explore the contrasting losses to the residential-building stock in the capital through scenario calculations based upon reasonable estimates of potential earthquake sizes on faults near to Bishkek—these faults are shown in red and purple on the map below.

We estimate that the shaking from these faults close to the city will cause thousands of buildings to be damaged and will cause thousands of fatalities.



## Hazard

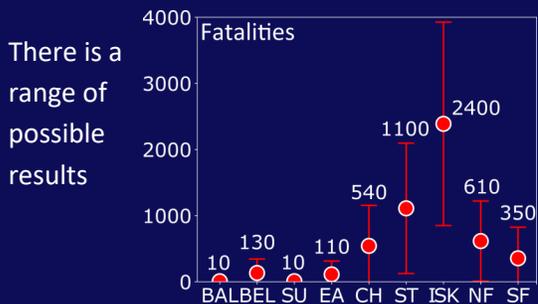
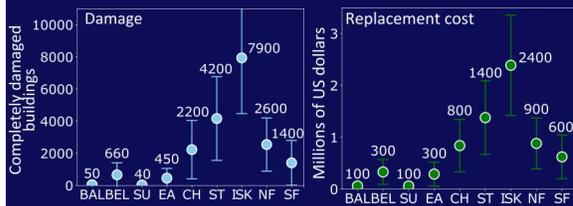
Earthquakes pose a hazard from the ground shaking that results when an active fault breaks suddenly. Faults in Kyrgyzstan can be nearby beneath our feet or further away in the mountains.

## Exposure

The buildings and the people who live in them are exposed to the earthquake ground shaking when they are located in countries with active faults. In Bishkek there are over 1 million people living in over 30,000 buildings exposed to earthquakes.

## Vulnerability & Fragility

Not all buildings are as capable to withstand the ground shaking they are exposed to from an earthquake. Buildings with unreinforced masonry walls are particularly susceptible to damage from an earthquake. Unreinforced masonry is the dominant residential building type in every district in Bishkek. Fragile buildings are more likely to collapse and kill their occupants.

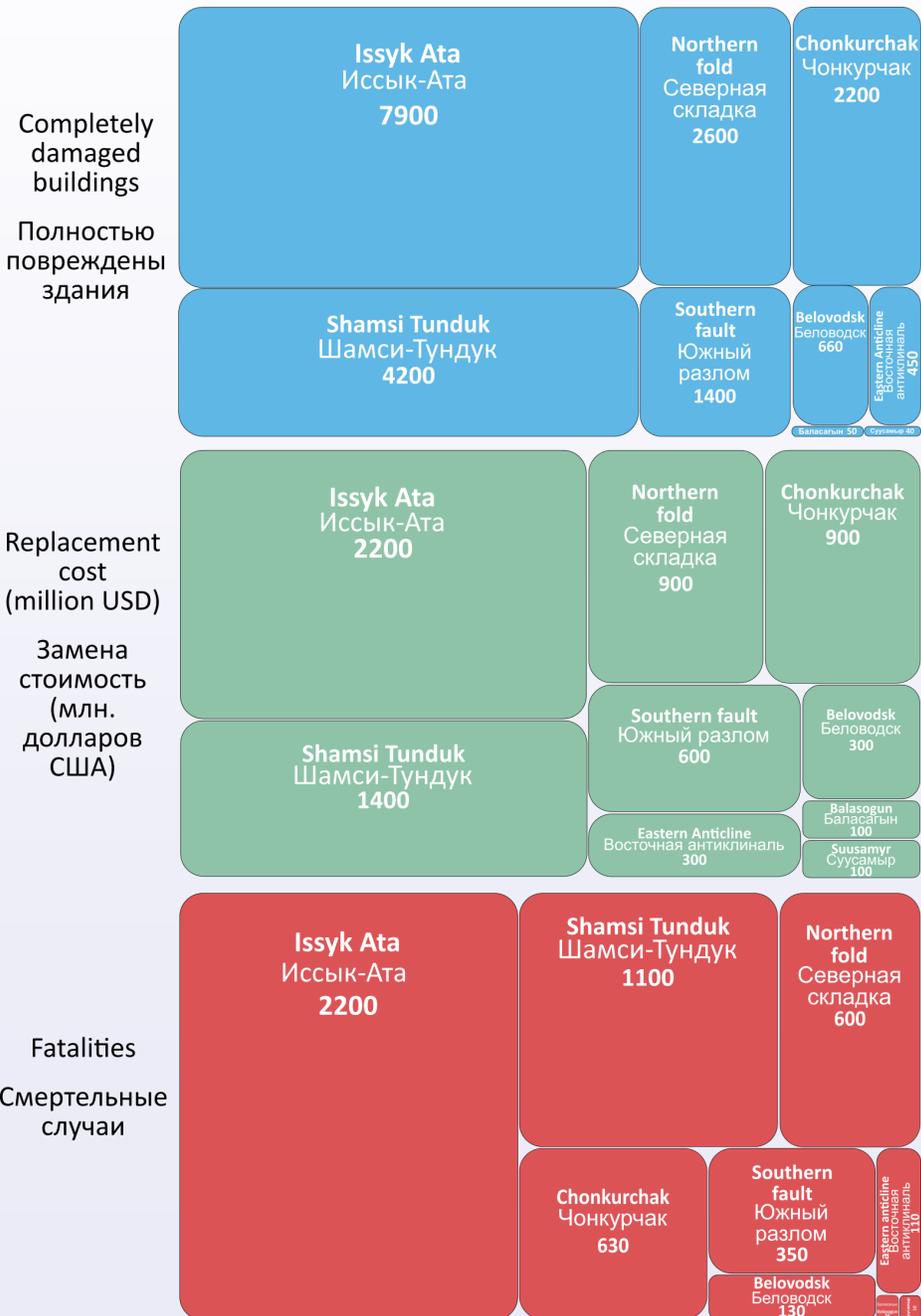


## THE EARTHQUAKE DAMAGE AND LOSSES

We identify particularly damaging earthquake scenarios:

- Issyk Ata 7,900 buildings collapses, 2,400 fatalities
- Shamsi Tunduk 4,200 buildings collapse with 1,100 fatalities
- Northern Fault 2,600 buildings collapse with 610 fatalities
- Chonkurchak 2,200 buildings collapse with 540 fatalities

The Belovodsk earthquake happened in 1885, and if it were to happen again today it would cause at least 660 completely damaged buildings and 130 fatalities.



## ENDNOTES

Expected losses from a Issyk Ata rupture of magnitude 7.5 are over **7,900 buildings collapses**, **\$2400 US dollars million replacement cost** and **2,400 lives lost** from residential buildings alone.

We recommend that buildings in Bishkek be **retrofit** so they are **less likely to collapse** in earthquakes, and to start with **unreinforced masonry buildings**.

New masonry buildings should be made of **reinforced masonry or confined masonry** as these buildings are **stronger than masonry buildings**, so are less likely to collapse in earthquakes.

## REFERENCES

Abdrakhmatov, K., Havenith, HB., Delvaux, D. et al. Probabilistic PGA and Arias Intensity maps of Kyrgyzstan (Central Asia). Journal of Seismology 7, 203–220 (2003). <https://doi.org/10.1023/A:1023559932255>

Amey, Elliott et al., Improving urban risk estimates for Bishkek, Kyrgyzstan, through incorporating recently gained geological knowledge of hazards. Natural Hazards, (2022). <https://doi.org/10.1007/s11069-022-05678-0>

Global Earthquake Model (GEM) Foundation - OpenQuake (OQ) <https://www.globalquakemodel.org/openquake>

There are many active faults near Bishkek, on which earthquakes may occur .



Kalmetyeva, Zoya & Mikolaichuk, Alexander & Moldobekov, Bolot & Meleshko, AV & Jantaev, MM & Zubovich, A. & Havenith, Hans-Balder. (2009). Atlas of Earthquakes in Kyrgyzstan.

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