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Research Article

EARTHQUAKE DAMAGE ASSESSMENT OF BUILDINGS IN RURAL AREAS (IN THE SAMPLE OF JIZZAKH REGION)

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ABSTRACT
Earthquake damage assessment of buildings in rural areas (in the sample of Jizzakh region) was done. The residential houses in rural areas are not built in accordance with the basic norms of seismic construction. Most of the territory of the Republic falls on seismically active zones, so such constructions cause a great number of losses in case of strong earthquakes.

Keywords*: Building Materials, Seismically Active Zone, Macroseismic Survey, Seismicity, Isocista, GESI_Program Program, Function and Damage Rate*

INTRODUCTION
In recent years, the construction of individual residential complexes in rural areas of the country under typical projects has been developing rapidly. This is evidenced by the following figures: between 2009 and 2016, 69,557 improved houses were built in rural areas with a total area of 9,573,000 square metres in 1,308 neighbourhoods. Such works are being carried out intensively, for example, more than 53 thousand inexpensive houses and apartments have been built and are being built according to the updated standard projects in accordance with the Program of affordable housing construction in rural areas for 2017-2021 years by the Decree of the President. Such concrete and purposeful work serves to improve the architectural appearance of rural settlements, improve living standards and quality of life of the rural population through the construction of individual houses according to standard projects, rapid development of engineering and transport communications, social infrastructure in rural areas.

MATERIALS AND METHODS
The population of the Republic is 33905.8 thousand people (as of January 1, 2020), 49.5% of the total population lives in rural areas. Large-scale housing construction is currently being carried out by the State and the population living in the regions. It should be noted that residential houses in rural areas are not built in accordance with the basic norms of seismic construction (local building materials, unqualified builders, unsupervised construction site, poor quality of the selected project and lack of funding). Taking into account that most of the territory of the Republic falls on seismically active zones, such constructions cause a great number of losses in case of strong earthquakes.
As an example, we can take houses built in rural areas of Jizzak region.
The total area of Jizzak oblast is 21.2 thousand square meters. km. (4.7% of the total area of the country) with a population of 1388.5 thousand people (as of April 1, 2020). 650.3 thousand people live in urban areas (46.8% of the total population) and 738.2 thousand people - in rural areas (53.2%). The population density is 65.2 people per 1 sq. km. There are 12 districts and 1 city in the region. In the region there are 294267 individual and multi-storey houses, consisting of 4 types: cement (large panel), wooden, burnt brick and raw brick (Statistical bulletin of Jizzakh region, 2020). The largest number of houses made of raw bricks in the region is 77%, burnt bricks - 9%, concrete (large panel type) - 12%, bar - 2%.
These values show that raw brick houses in the region constitute 77% of the total number of buildings. Buildings that are classified as untreated bricks are those made of clay, raw brick and straw.

It is known that damage to buildings of different types during earthquakes is carried out as part of macroseismic analysis. The consequences of a strong earthquake have been macroseismically investigated by such famous scientists as T.R. Rashidov, K.S. Abdurashidov, U.S. Shamsiev, S.A. Khakimov, A. Dzhuraev and others. (Tashkent, 1966, Gazli, 1976, 1984; Tovaksay, 1977; Nazarbek, 1980; Kayrakum, 1985; Kon, 2011; Mardjanbulak, 2013 and other earthquakes).

On the basis of the received materials characteristics of damage of individual houses at influence of strong earthquakes are allocated. According to A.Dzhurayev, damage to buildings and structures by the earthquake occurs for 3 reasons: 1) the fact that the foundation of the building does not sink evenly, 2) as a result of resonance and 3) increases the acceleration of soil vibration in strong earthquakes (Juraev *et al.* 2015).

In the country, the most widely used local building materials in the construction of rural settlements are gualac, raw brick and clay, and in some cases synch, koshsinch and burnt bricks. A similar situation is observed in Jizzak oblast. Therefore, in this article we have focused on the seismic resistance of buildings made of guvlaa, raw bricks and clay materials.

Guvala is a granular building material made of melon-shaped clay and dried in the sun. Buildings made of this material are weakly and moderately damaged by earthquakes with seismicity of 6 points. In macroseismic studies, moderate and severe injuries were observed in earthquakes with magnitude 7. Buildings made of rumble in earthquakes with intensity more than 7 points will collapse and fall down. Unprocessed brick (not fired at high temperatures) is a granular building material made of clay and dried in the sun. This grain material comes in two sizes: it is produced in standard shapes and it is produced in non-standard shapes. But both do not differ in density, as they are dried in the sun. The seismic resistance of raw brick buildings has been confirmed by macroseismic studies with several columns higher than a building made of seismic fittings.

Clay - shapeless material that can be brought to the level of sticky (plastic) consistency as a result of treatment (mixing) and compaction of healthy soil (lyoss). Metal formwork is used to lift the walls of the building from this material, or the 40 cm thick wall is raised manually and dried in its natural state, and this process is repeated. Macroseismic research has only been done in 7-point zones (Nazarbeck earthquake, 1980). According to the study, buildings with straw roofs have higher seismic resistance than buildings with pointed roofs and untreated brick structures.

The territory of Jizzak oblast is located in the central part of the republic and is located in the transition zone from the Tien Shan orogenic epiplatform to the Turan platform. Seismicity of the area is connected with modern tectonic movements in the region. There are seismogenic zones Mogiltau-Pistalitau, South Fergana, Besapa-Nurata and North-Kuluktau-Turkestan in the area (Nurmatov and Yusupjanova, 2016; and Artikov *et al.*, 2014).

RESULTS AND DISCUSSION

Depending on seismic potential, these seismogenic zones have different indices (Fig.1).

According to the results of macroseismic study of the consequences of the earthquake in Marjanbulak, the degree of damage to individual buildings made of local raw materials in the region varies depending on seismic parameters. For example: damage of buildings in the epicenter zone by raw brick and straw is distributed as follows: buildings with roofs of 4-5 levels; buildings made of raw brick - 3-4 levels, brick - 2-4 levels (figure 2). Of course, the degree of damage to any building depends not only on its building materials, but also on its size, quality of construction, compliance and control. The degree of damage to buildings is determined mainly on the basis of MSK-64 scale or its modern interpretation EMS-98. Depending on these results, i.e. on the degree of damage, the strength and intensity of the earthquake is assessed. Figures 3, 4 and 5 below show buildings affected by the Marjanbulak earthquake built of raw bricks and according to standards.

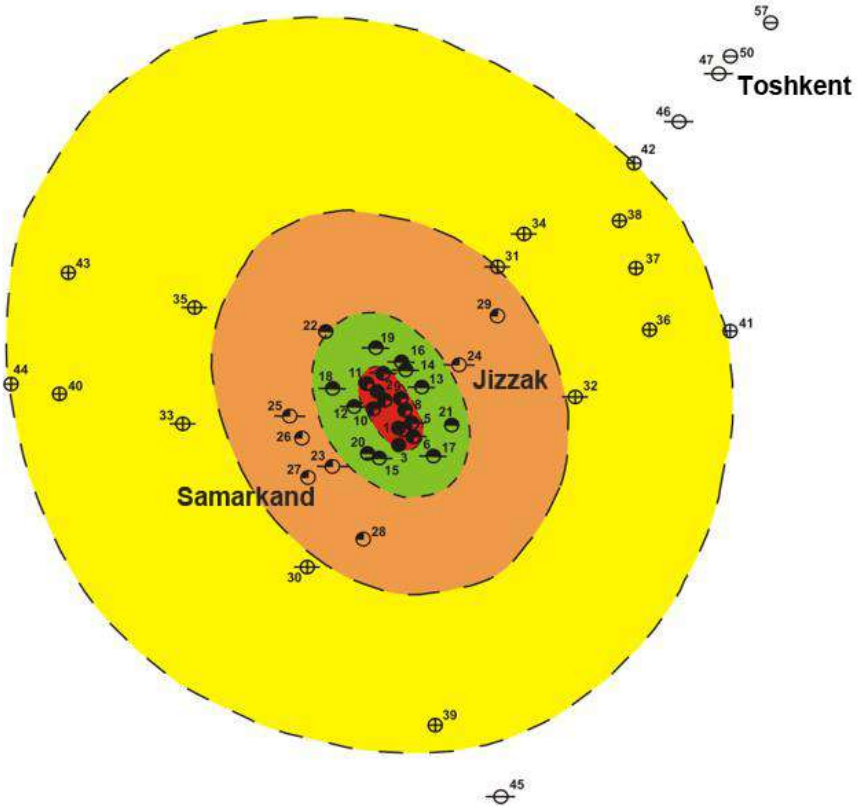


Figure 1: Hypocenter map of the strong earthquakes [3, 4].

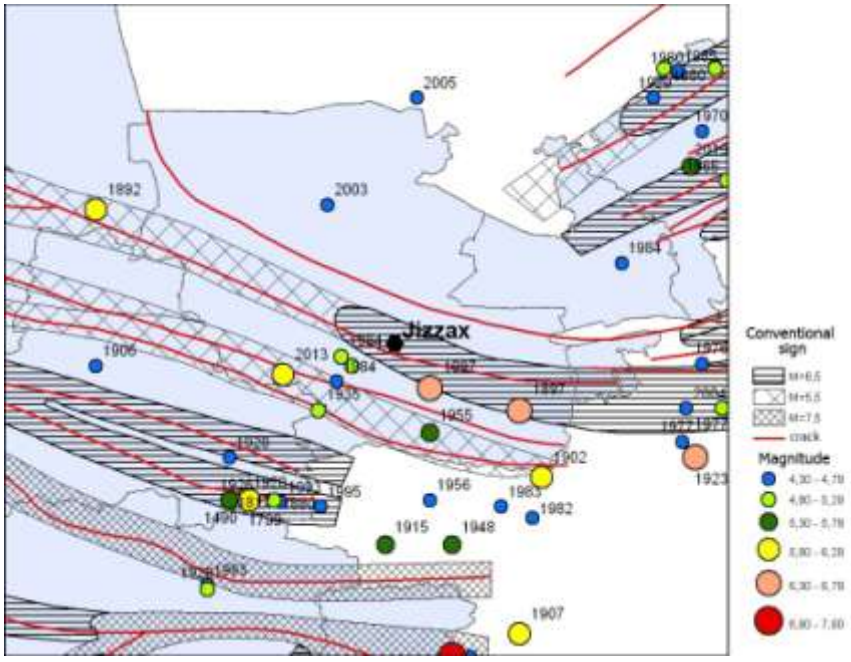


Figure 2: Isocoheistic map of the Marjanbulak earthquake on May 26, 2013. [5].Zone 7-8 is shown in red, zone 6-7 in green, zone 5-6 in brown and zone 4-5 in yellow.

Figure 3: Damage to houses affected by the Marjonbulak earthquake of May 26, 2013 (damage level -5).

Figure 4: Damage to raw brick houses affected by the Marjonbulak earthquake on 26 May 2013. (5th and 4th damage level)

Figure 5: New type of residential buildings affected by the Marjonbulak earthquake on May 26, 2013. (damage level - 2).

Determining the extent of damage to buildings caused by large earthquakes largely depends on the process of studying the consequences of a large earthquake. It is not necessary to expect a strong earthquake to assess the seismic resistance of buildings, as the applications were developed on the basis of all collected statistics. One of them is GESI_Program (GESI_program, Usmanova *et al.*, 2015; RADIUS, 2000).

The programme was developed between 1999 and 2001 under the United Nations Global Earthquake Safety Initiative (GESI) project. The programme is written in * .xls format and is based on five indicators: building type, project specificity, quality of construction and maximum acceleration of seismic impact. Based on these indicators, a functional diagram of the vulnerability of buildings to damage and seismic impacts is constructed. Damage to buildings is assessed on four levels: light, medium, heavy and very serious. Buildings are divided into 9 types: wood (shit), metal, reinforced concrete or steel, reinforced concrete brick, reinforced concrete brick, raw brick, stone and lightweight cladding. The quality of the project is divided into four: designed with seismic calculation, designed without seismic calculation, unplanned (without seismic calculation), but with symmetrical proportions of the building shape, unplanned (without seismic calculation) the shape of the building is not symmetrical. Construction is also divided into four quality areas: low, medium, good and very good. In terms of building materials are divided into good and bad. Local indicators suitable for each building type have been selected and a vulnerability function has been built (GESI_program, Usmanova *et al.*, 2015; RADIUS 2000).

Seismic risk has been calculated based on the methodology described above for the cadastral book value of all raw brick buildings in Jizzak oblast and the size of their useful area.

Using the GESI_Program program, building damage diagrams were constructed and their values were determined based on the maximum acceleration of building materials and the level of seismic impact (in points) (Table 1) (Ismailov, 2018 Ismailov *et al.*, 2018; and Ismailov and Aktamov 2018).

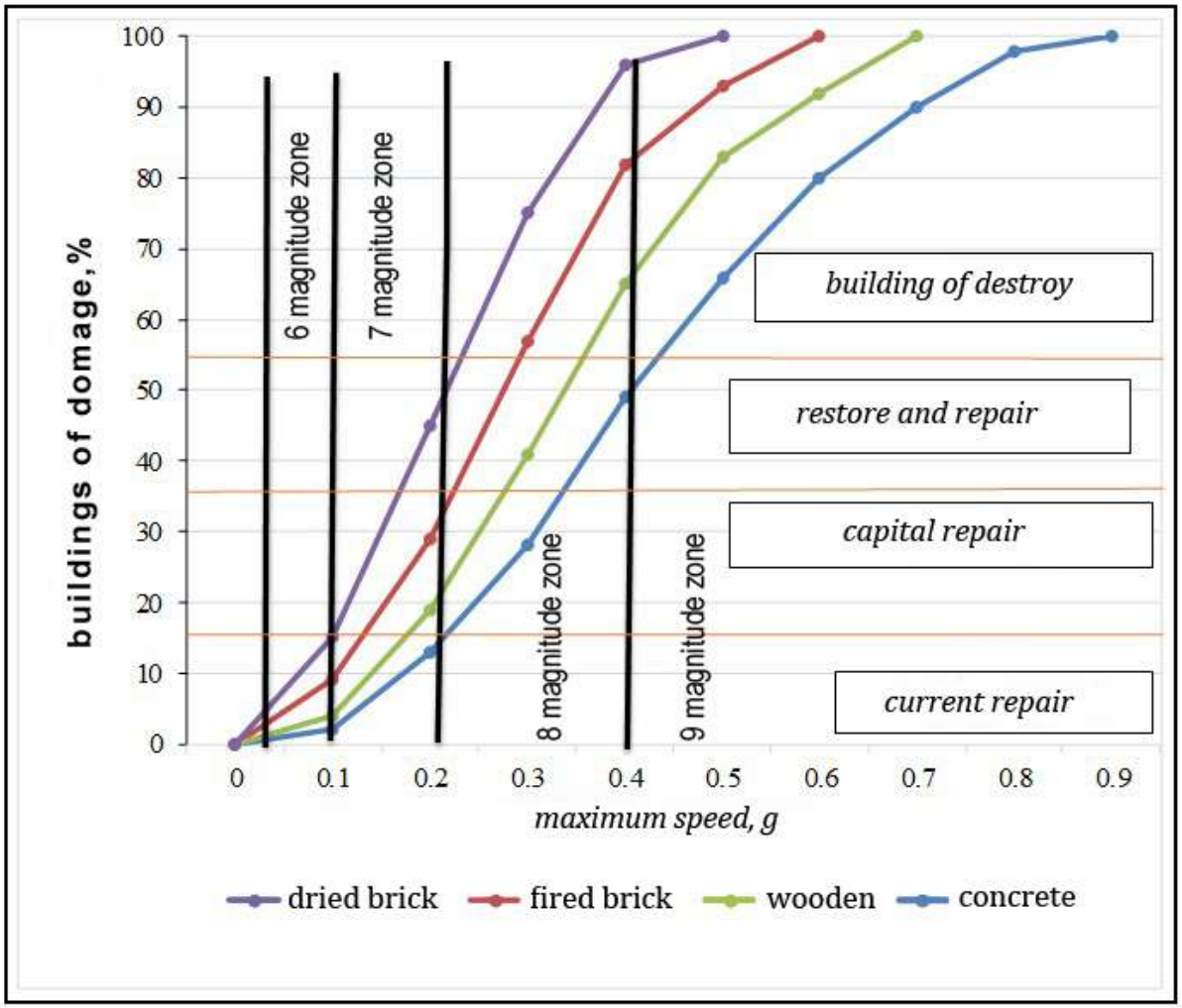
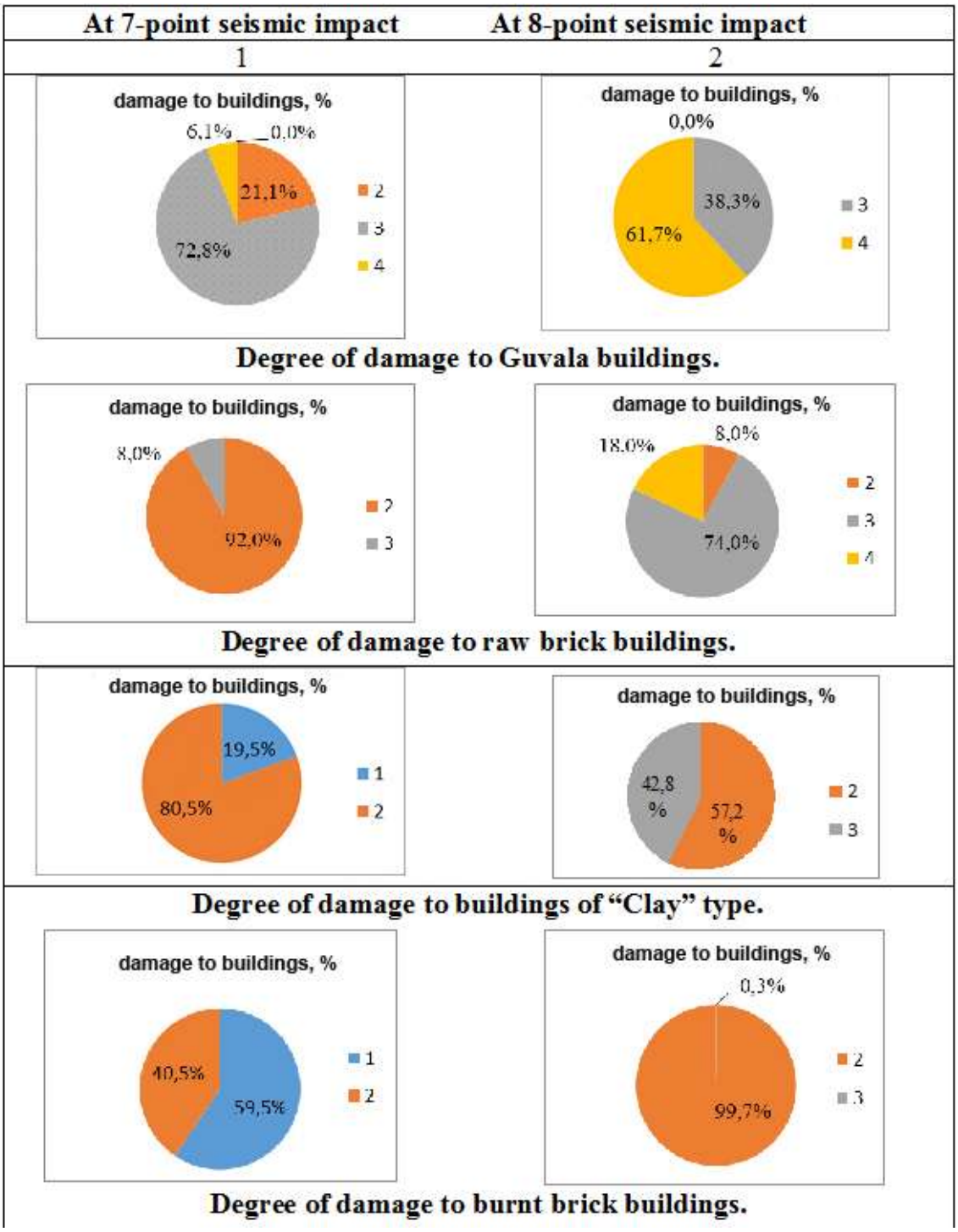


Figure 5: Function of damage to buildings made of guvala, clay, raw bricks and burnt bricks



Degrees of damage to raw brick buildings in Jizzak region

CONCLUSION

The following conclusion was drawn from the analysis. 15% of the total useful area of all guval-type buildings was damaged by a 6-point seismic impact, 47% - by a 7-point seismic impact; 8% of seismic

impacts cause 96% of damage, and clay buildings - 5.5% of 6-point seismic impact; 19% under 7-point seismic effects; 65% under 8-point seismic effects, 9% in raw brick buildings under 6-point seismic effects; 31% under 7-point seismic effects; 8-point seismic effects account for 83% of the damages.

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