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DAMAGE TO BRIDGES DURING THE NORTH CAUCASUS EARTHQUAKES

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In the USSR damages of bridges were observed during the earthquakes of 1970 and 1975 in the North Caucasus region (Daghestan).

The earthquake of 1970 with magnitude $M = 6.6$ and focal depth $H = 13$ Km spreaded over an area of about 600 Km^2 with intensity 8 (MSK scale). It was accompanied by rockfalls and landslides along river banks and steep mountain slopes. The volume of landslides in some places exceeded 1 million m^3 , the extent of the breaches reached several hundred meters [1, 2]. Some of the stone buildings in the settlements, located on the epicentral area, were collapsed (fig. 1). The quake of 1975 had intensity 7. It caused heavy damages to rubble buildings (fig. 2).

In 1970 most of girder and arch railway bridges, constructed in 1914 (fig. 3), suffered moderate damages such as deep cracks in wing walls of abutments (fig. 4), ice-breakers (fig. 5), bridge seats and concrete arches. Among massive structures the least damages were received by simple-span bridges with reinforced concrete slab superstructures, anchored in the abutment masonry.

As a rule the damages of stone and concrete bridges in 1970 didn't create dangerous conditions for service of the structures. The quake of 1975 caused the development of the initial cracks and considerable decrease of the bearing capacity of these structures. In some cases stone and concrete bridges needed reinforcing.

In 1975 reinforced concrete frame highway overcrossings were subjected to ground shaking with intensity 7 and received unimportant cracks in the joints and end columns. These damages didn't effect the bearing capacity of the frame bridges.

The analysis of the seismic and soil conditions as well as bridge structures and their damages during the quakes of 1970 and 1975 confirms the provision of the USSR design specifications [3], that requires the girder bridge piers and the arch bridges should be prevalently designed of reinforced concrete and their foundations, as a rule, should be based on the hard ground.

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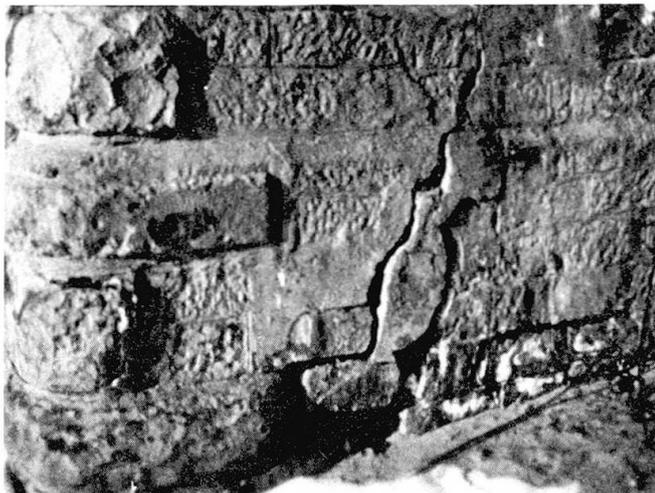
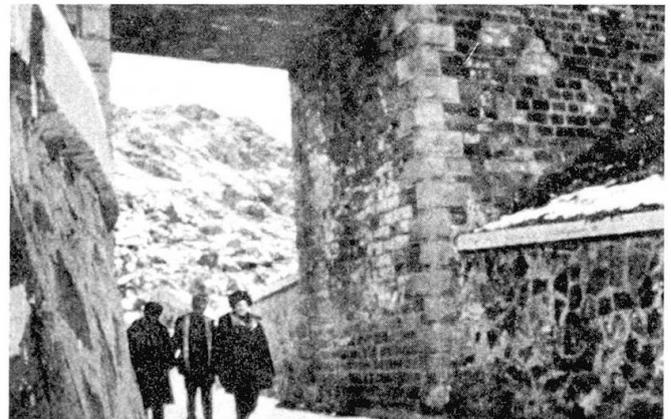
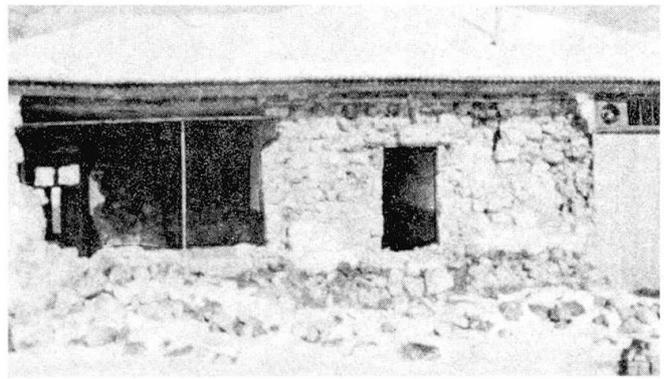
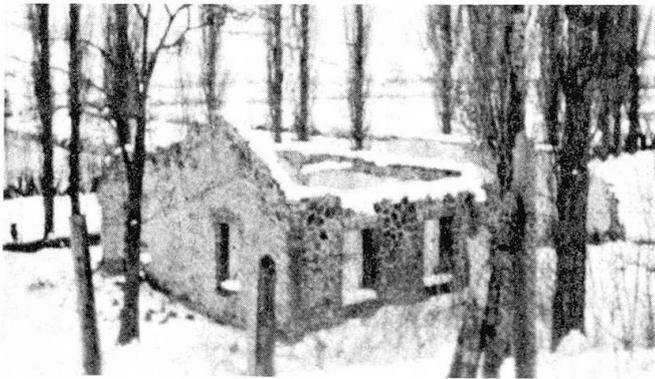


Fig. 1	Fig. 2
Fig. 3	Fig. 4
Fig. 5	