

Economic and social impacts of Armenia earthquake

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The first shock (magnitude 6.8) of the December 7, 1988 Spitak earthquake struck at 11:41 a.m. local time in Armenia. The epicenter was situated north of the city of Spitak, 32 km to the northeast of the city of Leninakan, 25 km to the northwest of the city of Kirovakan and 15 km southwest of the city of Stepanavan. The earthquake affected 40% of the territory of Armenia including a population of 960,000. Four cities and 17 districts of the republic suffered heavy damage.

EARTHQUAKE LOSSES

According to the official reports of the Soviet Civil Defense, 25,000 people died under the debris of collapsed structures. 514,000 people were rendered homeless. In the rural areas 58 villages were totally destroyed. 61,000 dwellings were lost. 200 school buildings and 180 kindergartens were destroyed. 160 hospitals and clinics were lost. In the earthquake affected region there were more than 200 industrial plants. As a consequence of the earthquake 157 plants were rendered inoperable. The total damage to industry is estimated at 1,900,000,000 Rbbls. * The estimated annual loss of production from these plants exceeds 1,250,000,000 Rbbls (1988) per year. The city of Spitak (pop. 18,500) which was closest to the epicenter zone was 100% destroyed. The city of Lenniakan (pop. 232,000) was 75% destroyed. The city of Stepanavan (pop. 21,800) was 67% destroyed and the city of Kirovakan (pop. 171,000) was 25% destroyed. One hundred sixty-nine settlements in affected rural areas with a population of 146,500 were 34% destroyed. (See fig. 1)

The greatest number of casualties (9974 fatalities) and greatest number of collapsed and seriously damaged buildings were experienced in the city of Leninakan. According to post-earthquake surveys 70% of public housing was destroyed or required demolition. This represented 1,200,000 m² of residential floor area. Most private residential

buildings suffered damage. 18.7% of private houses were destroyed or required demolition. Of a total of 80 schools in the city 26 were destroyed completely, 9 need repair, 28 require strengthening and 27 must be demolished. Of a total of 75 pre-schools and kindergartens, 27 were destroyed, 48 were severely damaged, 7 need repair, 30 need strengthening and 11 must be demolished. Eleven hospitals were destroyed. 32 health services buildings suffered damage. Of these 19 must be demolished, 4 will be repaired and 9 need strengthening. Of 38 industrial plants, 13 were destroyed completely. Among the 250 buildings on the grounds of industrial plants in the city of Leninakan 48 buildings may be repaired, 104 need strengthening and 98 must be demolished. The total cost of lost production capacity is estimated at 400,000,000 Rbbls. The smaller city of Spitak experienced the most severe damage from the earthquake. More than half the population was killed (9,732). 70% of the structures in the city were completely destroyed the remaining 30% suffered severe damage. The structures and network of public utilities including water, power and sewer systems were totally destroyed. According to civil defense reports, "The city as a complex of infrastructure ceased its existence."

In the rural areas 54,000 dwellings, 191 schools and kindergartens and 84 clinics were damaged. Agricultural facilities suffered damages estimated at 2,000,000 Rbbls.

Estimated direct losses due to the earthquake were estimated to be 13,500,000,000 Rbbls. The loss of housing represented roughly 20% of the housing stock of the republic. The loss of industrial and agricultural production represented approximately 40% of the economic activity of the republic.

EMERGENCY RESPONSE

The initial period after the earthquake was characterized by the absence of a unified coordination center. Operations were carried out by local inhabitants, local military units, fire-fighting forces and military men. Initial area reconnaissance efforts were frustrated by dense dust clouds and smoke.

* All damage estimates are given in 1988 Roubles, 1988 official exchange rate was 1 Rouble = \$1.10.

During the initial period more than 531 ignition points were identified and contained by fire-fighting units in the cities of Leninakan, Kirovakan and Spitak without the benefit of functioning water supply. The gas supply in the city of Leninakan was disconnected 15 minutes after the earthquake. This lapse allowed gas to collect in pockets under building debris.

On the whole, during the initial period there was severe shortage of appropriate equipment for rescue operations and absence of information about the scale of the disaster, the extent of building damage and the number of victims. After the initial period which lasted from 2 to 3 days in various localities the period of organized response began. Paramilitary units, Civil Defense military units, Soviet Army units, internal security units of the Ministry of Internal Affairs, volunteer teams, teams from ministries, agencies from other parts of the USSR and foreign rescue teams were included in search, rescue and debris clearance activities. During this period officials from Soviet and party bodies and from the military defined the tasks for commanders of arriving units. As a rule, tasks were not determined for small teams of volunteer or foreign rescuers.

First attention was paid to clearance of roadways to provide access to critical damage sites. Highest priority was given to schools, pre-schools, hospitals, educational institutions and factories.

Rescue operations were complicated by lack of street signs, maps, building plans and information on building design and materials. There was a serious shortage of equipment for heavy rescue operations. There were few experienced professional rescue specialists and no specialized equipment for search or extrication of victims in collapsed structures. Many of the collapsed reinforced concrete structures were beyond the capacity of local rescuers. Night rescue operations were impeded by lack of appropriate lighting equipment.

During this period of organized response 13,489 people were rescued alive from collapsed buildings, 13,566 bodies were recovered. 49,000 m³ of debris was removed and 4,400 m² of road surface were cleared. This work involved 357 cranes, 80 bulldozers, 109 excavating machines and about 37,100 personnel. (See fig. 2)

During the final phase of emergency response which began eight to ten days after the earthquake, adequate information was available on the scale and distribution of disaster damage. Reconnaissance and rescue operations were extended to rural populated areas. During this phase a comprehensive management systems was imposed. The city of Leninakan was divided into five sectors. The sectors were divided into bays and the management of the rescue operation was carried out at the level of the bay. The total number of operations bays was 14. Each bay included several operational rescue sites. Each operational rescue site consisted of several buildings or structures. All together in the city

there were about 400 such operational rescue sites. The city of Spitak was divided into five such sectors and the city of Kirovakan was divided into 10 such sectors.

By December 19th, twelve days after the earthquake 19,500 people from 500 different organizations of the USSR took part in rescue operations in the city of Leninakan alone.

During the final phase of emergency response demolition of hazardous structures was begun. During this phase in the city of Leninakan 362 damaged buildings were demolished. Some parts of water and power supply systems were returned to service. An entry permit system was enforced for the disaster area and organized registration of casualties and evacuees was instituted.

The final phase of the emergency response drew to a close about December 25, eighteen days after the earthquake. The last live victim was recovered in Spitak on December 21, 14 days after the earthquake. The total number of personnel dedicated to the emergency response was 61,400.

With the beginning of the transitional period search and rescue operations were completed. Extrication of dead and debris removal continued. Demolition and removal of collapsed and heavily damaged structures was carried out during this time. A total of 400 residential buildings were demolished in Leninakan alone. Safe construction materials were salvaged and stored. New construction sites were prepared. Approximately 47,000 workers were dedicated to this activity.

SEARCH AND RESCUE

In the four cities of Leninakan, Spitak, Kirovakan and Stepanovan 90 to 100% of all live recoveries and 65-95% of all dead recoveries from collapsed structures were accomplished within the first seven days after the earthquake. In Leninakan 60% of live recoveries were accomplished by the third day after the earthquake and 78% were accomplished by day four. (See fig. 3) The efficiency of rescue operations could be considerably improved if maximum resources could be applied during the first four days after the earthquake. Success of the rescue operation depends on quality of specialized and appropriate equipment and availability of trained rescue personnel. The high number of fatalities in this earthquake was the result of a lack of adequate preparedness and training for disaster response.

MANAGEMENT

In general the response capability of the affected area was greatly reduced because many local leaders were killed or seriously injured in the earthquake. Furthermore all communications were lost including telephone and radio broadcast facilities.

Under the circumstances it was necessary to

create a new emergency management system. A Commission of the Political Bureau of the Central Committee of the Communist Party of the USSR was established under the leadership of N.I. Ryzhkov, Chairman of the Council of Ministers of the USSR, to provide guidance for the Government Commission of the Armenian SSR.

The Armenian Republican Civil Defense established three disaster zones: the city of Leninakan, the city of Kirovakan, and the city of Spitak. Search and rescue operations were carried out in these three zones under the guidance of the Government Commission of the Armenian SSR. In addition, in the city of Leninakan and the city of Spitak operative management units of the Chief of the USSR Civil Defense were organized. In order to strengthen the centralized management of search and rescue operations the Political Bureau of the Central Committee of the Communist Party of the USSR placed the Vice-chairman of the Council of Ministers of the USSR in charge of the city of Leninakan.

According to the decision of the Bureau of the Central Committee of the Communist Party of Armenia and Council of Ministries of Armenia, the Vice Chairman of the Council of Ministers became the representative of the Governmental Commission in the cities of Leninakan and Kirovakan and the secretary of the Central Committee of the Communist Party of Armenia became the representative of the Government Commission in the city of Spitak.

EVACUATION AND TEMPORARY SHELTER

It was determined within the first week following the earthquake that all those not needed in the demolition and reconstruction effort should be evacuated from the disaster area. During the month following the earthquake 119,318 people, primarily women and children and elderly were evacuated. Of those 79,750 were evacuated to temporary accommodation in the Soviet republics. Temporary shelter in the form of tents, construction trailers and "containers" were provided for workers engaged in demolition and preparation of reconstruction sites.

Return of evacuees was more rapid than permanent reconstruction. By the fall of 1989 it was estimated that the population of Leninakan had rebounded to approximately 200,000. Much of this returning population was housed in temporary structures without adequate infrastructure.

RECONSTRUCTION

Planning for reconstruction was initiated immediately after the initial emergency response phase. Within the first week following the earthquake Vice Chairman A. Krivov of the Goscomarchitecture of the USSR initiated the reconstruction plans for the cities of Leninakan, Spitak, and Kirovakan. Official

sanction for the general plans for reconstruction was received from the Chairman of the Emergency Commission of the Political Bureau of the Central Committee of the Communist Party of the USSR. The planning activity involved architects, engineers, and planners from the principal design and planning offices of the Republic under the direction of representatives of the All Union Goscomarchitecture and Gostroy. Detailed designs were completed by May of 1989 and major reconstruction was to begin during the summer building season. In accordance with the commitment of President Gorbachev, reconstruction plans were developed with intended completion in two years. Plans called for a division of reconstruction work between the construction organizations of the other Soviet republics and cities of the USSR. It was intended that 40,000 construction workers would arrive with equipment and building materials for the summer of 1989.

Unfortunately, because of ethnic and territorial disputes in the bordering republic of Azerbaijan imposed a blockade on Armenia depriving the reconstruction effort of building materials and fuel. This blockade proved effective between June and October of 1989 and effectively frustrated reconstruction efforts during that period.

Continued obstruction from Azerbaijan and the eventual collapse of the Soviet Union have left the earthquake effected region in desperate circumstances. Approximately 15% of the planned reconstruction has been completed. Even in newly constructed areas infrastructure hook-up are still incomplete more than three and a half years after the earthquake. Most the surviving population remain in precarious temporary shelter with a shattered economy and dim prospects of recovery.

While the plight of the survivors of the earthquake is in part a consequence of the collapse of the surrounding political and economic system, the experience of the earthquake significantly contributed to that collapse.

As a consequence of "glasnost", the government policy of openness, the Armenian earthquake received much broader coverage than any previous natural disaster in Soviet history. Also as a consequence of "glasnost" many foreigners, particularly, westerners were allowed to operate with considerable autonomy and to meet Armenians and other Soviets freely. The result was that many Soviets were shocked at the ineffectiveness of the government response to the earthquake and the apparent corruption in building practices. At the same time impressed with the generosity of foreign disaster assistance. The combination of these experiences contributed significantly to the change in attitudes which supported republican independence and the collapse of the Soviet Union.

CONCLUSIONS

1. Inadequately designed and constructed modern

structures of reinforced concrete pose a major threat to building occupants in earthquake zones.

2. Search and Rescue operations must focus on the first four days after an earthquake in order to optimize effectiveness.

3. The public must be informed of earthquake danger and appropriately prepared for response. Earthquake risk in Leninakan had been arbitrarily downgraded and no effort had been made to maintain public awareness of the hazard.

4. Disaster response organizations must be established and exercised in earthquake prone areas. Local response capability was overwhelmed by the earthquake. Provision for immediate managerial and logistical support was inadequate.

5. Adequate provision must be made for temporary shelter which can serve for three to five years. Realistic reconstruction planning takes time. If adequate local participation is to be included in the planning process the need for adequate temporary shelter on site must be met.

6. Master plans for longterm urban development of cities in earthquake zones must anticipate earthquake occurrence and incorporate pre-earthquake planning for post earthquake reconstruction.

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Cities & Regions	Pop. Areas		Industr'l Facilities		Inst'al Bldgs		Res. Bldgs		Agriclt'l Facilities		Dom. Animals	
	I	D	I	D	I	D	I	D	I	D	I	D
Leninakan	1	.75	4	4	66	32	1,245	1,125	--	--	--	
Kirovakan	1	.25	34	6	456	?	7,162	2,333	--	--	--	
Spitak	1	1.00	9	6	28	24	433	433	--	--	--	
Stepanavan	1	.67	9	1	134	12	21,343	1,430	--	--	--	
Rural Areas	169	.43	3	3	58	18	2,953	2,009	136	125	76,500	34,300
TOTAL	173	.60	131	87	1,868	545	51,712	35,540	1365	1259	76,500	34,300

Figure 1. Selected effects of earthquake upon cities and regions in Armenia. (I = Initial; D = Destroyed)

Cities & Regions	Total	PERSONNEL			EQUIPMENT		
		Civilians	C.D. Units	Crains	Bulldozers	Evacuators	Motor Vehicles
Leninakan	39,300	30,500	8,800	974	301	167	2,389
Kirovakan	3,500	3,500	--	178	124	65	474
Spitak	7,300	6,000	1,300	415	187	103	897
Stepanavan	1,700	1,700	--	91	77	29	170
Rural Areas	9,600	9,600	--	333	299	275	1,391
TOTAL	61,400	51,300	10,100	1991	988	639	5,321

Figure 2. Resources utilized for rescue and treatment.

Classification	Days Following Quake							Total
	1	2	3	4	5	6-12	13-19	
Total Extricated	4,328	9,634	8,234	6,437	4,419	8,187	418	39,795
Extricated Alive	1,382	1,660	4,825	5,682	1,757	150	1	15,254
Total Evacuated	--	2,470	130	1,700	4,081	59,638	36,418	119,318
Evacuated to other Republics	--	--	--	--	1,300	34,980	29,235	79,750

Figure 3. Rescue and evacuation of injured populations by days following quake.

Cities & Regions	Initial Population	Persons Extricated	Persons Dead	Persons Evacuated	Persons Evacuated to other Republics
Leninakan	232,000	16,959	9,974	58,642	39,486
Kirovakan	171,000	4,317	420	34,720	32,188
Spitak	18,500	13,990	9,733	8,091	5,377
Stepanavan	21,000	108	63	--	--
Rural Areas	146,500	4,532	4,532	17,865	11,699
TOTAL	589,000	39,795	24,542	119,318	79,318

Figure 4. Response to earthquake consequences. Population.