

RECONSTRUCTION AFTER 1988 ARMENIA AND 1990 IRAN
EARTHQUAKES: A COMPARATIVE STUDY

by

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ABSTRACT

The 1988, Armenia earthquake ($M_s=6.8$) and the 1990, Iran earthquake ($M_s=7.7$) caused tens of thousands of fatalities and enormous destruction. Although the extent and type of damage from both events were similar, the reconstruction programs followed in the respective countries were quite different. The recovery of Armenia has been very slow and plagued with significant difficulties and problems whereas, the reconstruction program in Iran has been progressing successfully. In this paper various aspects of the two reconstruction programs are discussed. The reconstruction experiences in Armenia and Iran can be valuable to other countries that may suffer similar disasters in the future.

INTRODUCTION

The Armenia earthquake ($M_s=6.8$) of December 7, 1988 inflicted over 40,000 fatalities and caused almost total destruction of major cities and towns within 30 km from the fault. One and a half years after this disaster, on June 21, 1990 another earthquake ($M_s=7.7$) struck Northwestern Iran, 400 km to the southeast of the Armenia earthquake epicenter. The epicenter of this earthquake was inferred to be in or near the town of Manjil, Iran. The earthquake, similar to that of Armenia, caused over 35,000 fatalities and extensive destruction of single-story residential and

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commercial structures as far away as 80 km from the fault.

Following these earthquakes, after tending for the dead and injured, rebuilding of the physical infrastructure and the devastated communities became a vital priority for the respective governments. Since both earthquakes occurred in the same tectonic region, along the boundary of the Eurasian and Arabian Plates, many scientific similarities between the two events could be observed (Yegian & Ghahraman 1990, Yegian et al. 1992). Although, both events inflicted the same level of damage and destruction, the reconstruction plans, programs and the progress in these two countries were quite different. From the start, in Armenia, reconstruction was plagued with significant problems, difficulties and controversies which have caused it to progress at a very slow pace. To date, less than 30% of the needed reconstruction in Armenia has been completed. Whereas, in Iran, the reconstruction program was well planned and organized and to date, all indications are that it has been effective and progressing successfully.

This paper briefly describes the various aspects of the reconstruction in Armenia including associated problems and difficulties encountered. In addition, the paper compares the reconstruction experience from Armenia with that from Iran. Finally, the paper presents a brief summary of the lessons learned from the recovery programs in both countries.

RECONSTRUCTION IN ARMENIA

The 1988 Armenia earthquake left about 40,000 dead (although the official figure stands at 26,000), 20,000 injured and over 500,000 homeless. Over a thousand multi-story (4 to 9 stories) buildings in the towns and cities of the epicentral region collapsed or were damaged beyond repair; and about 360 villages were destroyed. Libaridian (1989, 1990) reports on the reconstruction needs that were estimated following the earthquake. These needs in the major cities and towns included: 4 million sq. meters of residential space; schools for 63,000 students; kindergartens for 15,400 children; hospitals for 4,800 patients; ambulatory polyclinics that could care for 800 patients per shift; food centers; and 93,000 sq. meters of space for businesses and other structures. In the villages, the reconstruction needs included: 1.6 million sq. meters of residential space; schools for 41,500 students and cultural centers; 40 agricultural production centers; a large number of shelters for animals; storage areas; and offices for technical services. Furthermore, many of the industrial facilities needed to be reconstructed and new buildings for production plants and for 160 enterprises related to reconstruction were required.

At the time of the earthquake, Armenia was still a part of the Soviet Union and did not have an independent economic base. Hence, the Soviet government in Moscow assumed the sole responsibility for the planning and executing the reconstruction activities in Armenia. An unrealistic two-year timetable for completion of reconstruction was announced. Various Soviet republics were assigned responsibility for reconstruction in different cities. Progress of reconstruction in Armenia has been very slow and at times stagnant. There are many factors that have contributed to this failure of the much needed recovery. A brief summary of these follows:

Planning and Organization

It is noted that there were no serious plans and organizational infrastructure developed in Armenia prior to commencement of reconstruction. Failed urban development plans of the past, which focused on creation of high population density societies, were reimplemented. Dependence of such an urban development on a large scale infrastructure was most detrimental, as evidenced in the city of Leninakan, during the Armenia earthquake (Krimgold 1992). In addition, due to lack of proper planning, there was no coordination among the activities of the construction teams from the different republics. Each team started its construction activities as soon as they arrived in their designated sites (shortly after the earthquake) without proper study of the region and with no provisions to ensure the quality and progress of construction.

Relocation of a Major City

Two weeks after the earthquake, to expedite reconstruction, the Soviet central planners decided to relocate the major city of Leninakan (population of 300,000). The issue of relocation became a major controversy in Armenia right from the start of reconstruction. Such a move required overtaking substantial agricultural land. Since only 11% of Armenia is suitable for agricultural purposes, the relocation decision was strongly objected to by the Armenian people and still remains a point of contention.

Seismic Design Practice

From the assessment of the earthquake damage it was evident that the Soviet building design practice and the quality of construction was seriously deficient compared with current state-of-practice and technology in developed countries.

New construction also did not take advantage of current seismic design technologies and hence, were wasteful in terms of building materials and labor. Also, in many instances, the architectural design, building material used and the urban planning philosophy adopted were alien to the social and cultural lifestyle of the local people. Colorfully painted concrete buildings and untreated wooden houses that require constant maintenance, especially in the harsh climate of the region, are some typical examples.

Construction

Because of lack of proper planning, reconstruction progressed at a different pace in each region. The pace of construction was much faster in certain regions of low priority than that of high priority. This caused major difficulties in distribution of completed dwellings. Shelterless people could not receive new dwellings while people who were housed in buildings that had experienced only minor damage did receive. Also, independent construction supervision and quality control was lacking, thereby, instilling doubt in the minds of the local people about the safety of the newly constructed structures.

The Soviet republics brought in most of their own labor and construction material. Such infusion of tens of thousands of foreign laborers into a region devastated by the earthquake caused significant tensions and problems. The social and cultural habits of the laborers were in conflict with those of the distressed victims of the earthquake, leading to communal problems.

Inter-republic transportation of construction materials was another cause for construction delays. Whenever political conflicts within and between the republics were heightened, border blockades were imposed and the supply of construction material to Armenia was interrupted.

Retrofitting

The policy of the Soviet reconstruction planners was to replace buildings that had suffered some damage rather than to retrofit them. Subsequent damage assessment and building survey showed that many of these buildings did not experience structural damage and could be retrofitted. This would have aided in reducing the overall scope of the needed new construction and accelerating the recovery of the region.

Temporary Houses / Shelters

The earthquake left over 500,000 people homeless. Despite the announcement of the unrealistic two-year timetable, it was evident that reconstruction in Armenia would take many years, and hence, temporary shelters would be desperately needed. Unfortunately, the Soviet government's announcement of its two-year plan for reconstruction discouraged many relief agencies and other Soviet republics from providing adequate temporary shelters that could protect people from the harsh winter climate. The majority of the affected people have remained in tents or in shacks made from the debris of the demolished buildings, and many others have sought refuge with their friends and relatives in other parts of the country.

Participation of the Affected People

Regrettably, in all aspects of reconstruction in Armenia including policy decisions, planning, labor, and construction quality assurance, the local affected people were excluded. Furthermore, because of lack of right to ownership, the local people, especially in the villages, were neither permitted nor were motivated to participate in rebuilding their own dwellings. Such policies left the people affected by the earthquake with high expectations of receiving permanent shelters from the Soviet government within two years. This exclusion of the local people was most detrimental to the recovery process in Armenia.

RECONSTRUCTION IN IRAN

Almost one and a half years after the Armenia earthquake, on June 21, 1990, another earthquake with magnitude $M_s=7.7$ struck Northwestern Iran, south of the Caspian Sea and on the Alborz Mountain Range. The epicenter of the earthquake is inferred to be in the town of Manjil. Official estimates indicated that about 35,000 people lost their lives during the earthquake. Because of the rural nature of the populated region within the earthquake zone, damage was primarily to one and two-story single family residences and commercial structures. These structures traditionally constructed of unreinforced brick or masonry had little resistance to the earthquake-induced forces. The building damage statistics compiled by the Housing Foundations (1990) in Iran indicated that a total of 75,000 rural and about 16,000 urban housing units suffered more than 30% structural damage and would require replacement. Furthermore, a total of 30,000 housing units suffered less than 30% damage requiring retrofitting. In addition, in the city of Rasht, 70 km North of the

epicenter, 9 buildings, 5 to 8 stories high , collapsed or were heavily damaged.

Since both Northwestern Iran and Armenia are in the same tectonic region, many similarities were observed between these two earthquakes from the seismological and earthquake engineering perspectives. In addition, the recovery and reconstruction issues, needs and problems for both countries were also very similar. However, in the subject of reconstruction there exist significant differences between the Armenian and the Iranian programs. Based on the authors' evaluations, the following comments are made regarding the reconstruction plans and program in Iran:

Reconstruction Plans and Organization

Within two months after the earthquake, an extensive and detailed reconstruction program was prepared by the Housing Foundations of the Ministry of Housing and Urban Development of Iran. A comprehensive document was prepared that described the policy issues relating to relocation, as well as the required construction in every region; the organizational infrastructure; and the estimate of the needed construction material and equipment (Housing Foundation 1990).

Damage Assessment

The importance, for reconstruction, of the information gathered through evaluation of earthquake damage was recognized. Hence, reconstruction would start only after the completion of the damage assessments and the necessary field investigations especially in regions where widespread liquefaction occurred.

Role of the Government

The roll of the Iranian government in reconstruction was limited. The government assumed responsibility for providing new building design specifications that would address future seismic vulnerability of the region. In addition, the government would reconstruct the physical infrastructure (roads and bridges); provide construction loans; and supervise construction to ensure quality and adherence to design specifications.

Role of the People

Through past similar experiences the government has recognized that

participation of the people in rebuilding their own communities was essential. Hence, people were given the responsibility to rebuild their own dwellings, especially in the rural regions. Private ownership was an essential part of the plan.

Relocation

It was the government's position that existence of villages and communities in their present locations for decades, and sometimes centuries, must have had a reason. Thus, communities would not be relocated unless dictated by technical considerations regarding the adequacy of their present locations with respect to future earthquake hazard mitigation. Furthermore, to discourage migration of people from the rural regions to the major cities, the government loans were given to home owners in installments. After completing a specific stage of construction (e.g. foundation, building frame, exterior and interior finish) and upon successful inspection a home owner would receive the apportioned construction loan provided by the government.

Temporary Shelters

The initial policy regarding temporary shelters was that people would first build temporary shelters adjacent to their planned present dwellings. Subsequently, these temporary structures would be utilized for storage and other needs. However, as the first winter approached the dire need of temporary shelters was evident. Thus, prefabricated housing units were provided by the government in different affected regions to alleviate this problem.

As a result of a well planned and organized approach adopted, the reconstruction program in Iran is considered effective and successful.

CONCLUSIONS

Although there are many scientific similarities between the Armenia and Iran earthquakes, the reconstruction experience in the two countries have been quite different.

To date, four years after the earthquake, only about 30% of the much needed housing is completed in Armenia. Over 300,000 people still live in inadequate shelters under intolerable conditions. The following factors have contributed to the unsuccessful reconstruction efforts in Armenia:

1. There was a lack of organization, and reconstruction plans were inadequate.
2. Reconstruction policies and decisions were made prior to damage assessment and gathering of scientific data.
3. The Soviet republics that were assigned to rebuild the devastated regions, had little prior experience in such a large scale construction.
4. Instead of employing local people, tens of thousands of foreign laborers were brought into the region causing social, cultural, and economic chaos, and thereby hindering the reconstruction progress.
5. Building design and construction practice that were adopted in reconstruction were unnecessarily wasteful of valuable construction resources.
6. Dissolution of the Soviet government, conflicts between neighboring republics in the region, and border blockade of Armenia have had a significant impact on the reconstruction progress, and most importantly,
7. The exclusion of the local people from the planning, design and construction stages was the most detrimental to the recovery process in Armenia.

The reconstruction program in Iran is proceeding efficiently and communities are recovering from the devastation. In contrast to Armenia, the success of this program can be attributed to the following factors:

1. The reconstruction program is well planned and organized.
2. The role of the government is limited to providing design specifications, infrastructure, construction materials and supervision, and loans.
3. The government recognizes the importance of the participation of the affected people in rebuilding their own dwellings. Private ownership is a vital factor for ensuring successful implementation of this policy.
4. Devastated communities would be built in their existing locations, and unless dictated by technological constraints, they would not be relocated.
5. Reconstruction started only after earthquake evaluations and field investigations were completed.

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