Nat Hazards (2008) 44:229–241
DOI 10.1007/s11069-007-9108-3

ORIGINAL PAPER

# Post-Bam earthquake: recovery and reconstruction

**Mohsen Ghafory-Ashtiany · Mahmood Hosseini**

Received: 25 August 2006 / Accepted: 10 January 2007 / Published online: 6 April 2007


**Abstract** This paper gives a brief explanation of the earthquake in Bam. It also reports on the rescue and relief operations, including the construction of emergency shelters and temporary housing, and on the country's plan for the reconstruction of the city, which includes debris removal, the rebuilding of rural and urban residential and commercial units, the reconstruction of state and public buildings and public facilities such as schools, rural and urban water aqueducts and grids, the construction of a sewage system, power network and telecommunication system, the provision of water to orchards and farmlands, the renovation of industries and the revival of the cultural heritage, particularly the historical Bam citadel, among others. We also report briefly on the effect of the Bam earthquake on the Iran Earthquake Risk Reduction Strategy and actions.

**Keywords** Bam, Iran · Construction Bazar · Emergency shelters · Local participation · Reconstruction strategy funding · Rescue and relief · Risk Reduction · Temporary housing

## 1 Introduction

The ancient city of Bam is located on a vast plain in the middle of the desert in the southeast corner of Kerman province, 190 km from Kerman toward the south. The city's plain slopes from the southwest towards the northeast with a gradient of about 1.2%. Bam covers an area of 19,374 $km^2$ and is situated at 1076 m a.s.l. With the exception of the citadel, which has a height of 60 m, there is no natural structure in Bam. Winds often blow from the northwest to the southeast. The average annual temperature is 23°C

M. Ghafory-Ashtiany (✉) · M. Hosseini
Risk Management Center of Excellence, International Institute of Earthquake Engineering and Seismology (IIEES), Tehran, Iran
e-mail: ashtiany@iiees.ac.ir

(maximum: 44°C, minimum: −2°C). The city experiences an average of 298 days of dry weather and eight days of rainy weather annually (minimum: 3 days); the average annual rainfall is 62.5 mm. The southern part of Bam has rich underground waterbeds of which 51.5% is used in the city's aqueducts. Bam had a sophisticated water irrigation system and a long history of successful agriculture (Eshghi and Zare 2004, Ministry of Husing and Rural Development 2004, Ghafory-Ashtiany 2004).

Farming and gardening formed the primary sources of income, and the city has large orchards of citrus fruits and palm groves. Bam's date is well known worldwide, with 100,000 tons of the finest quality dates being exported per year. A new major industrial complex was built during the last decadewhich houses various factories, including a major automobile assembly factory. According to the most recent statistics, in 1996 Bam had a population of 142,376, of which 52% lived in the urban area of Bam. The dominant culture of Bam is a tribal one, consisting of large ''family'' units, and there is a very strong attachment to the land, with 81.2% of families owning their homes and only 18.8% living in rental housing. There were 62,364 buildings in Bam prior to the December 2003 earthquake, of which 34,531 were residential. Few homes were steel-framed or constructed of reinforced concrete (20 steel-framed, 11 reinforced concrete); most were constructed of brick and steel (40.6%), brick and wood (1.9%), brick only (3.5%) or adobe (sun-dried brick and clay, 53.2%). About 84% of the buildings (including 93.1% of adobe buildings) were built prior to the implementation of seismic codes in Iran (1991). Many of the older buildings as well as some of the newer buildings built after the implementation of the code collapsed during the 2003 earthquake due to the lack of effective seismic code enforcement (Iran Statistics Center-ISC 2004).

Prior to the 2003 earthquake residential utility coverage in Bam was 93% for electricity, 86% for clean water and 32% for telephones. About 51% of homes had coolers. Liquefied natural gas is used by 88.7% of families for cooking and kerosene by 93.4% for heating. The source of drinking water for 14% of the families is from fountains and Qanats[1]. The transportation network of Bam consisted of 10 km of highway, 327 km of main road, 369 km of paved (asphalt) and 57 km unpaved rural road. There were six gas stations and 18 fuel tanks in Bam, with a total capacity of 720 $m^3$. In 2002, 398,000 passengers used the out-of-town bus services and 150,000 ton of goods have been transported.

The Bam Ms = 6.5 destructive earthquake at a depth of 10 km leveled the historical city of Bam and Barvat in the early hours of 26 December 2003 at 05:26:26 hours local time. 80% of all buildings were completely destroyed, 17% of all buildings were so badly damaged that they can no longer be used, about 2.8% of the buildings remained undamaged and 0.2% experienced minor damage. The earthquake caused 31,383 deaths and left about 20,000 persons injured and 65,000 homeless. Figure 1 provides a general view of the damage inflicted by the December 2003 earthquake on Bam and its distribution. A total of 27,734 buildings in Bam and 25,022 in the rural area were destroyed and 9,005 were damaged. In addition, most of the public and state buildings, urban facilities, including water, sewage, power, and telecommunication systems, as well as irrigation and agricultural systems, gardens, streets and roads were badly damaged. The Bam historical citadel was totally destroyed.

[1] Aqueducts.

**Fig. 1** A general view of Bam and a map of the distribution of damage to buildings

## 2 Rescue and relief operations

As the news broke, the responsible organizations, such as Iran Red Crescent Society, law enforcement forces, Basij (volunteer mobilization force) and volunteers from both inside and outside of the country rushed to the area and made every effort to rescue the people, transport and treat the injured and help the quake-stricken people. Injured people were transferred to the Kerman and Tehran hospitals by planes and helicopters. The people of Iran resolutely faced the challenge and were praiseworthy in terms of their massive relief effort. Relief workers removed the victims and wounded people from the debris with the help of machinery and people. The injured were transferred to field hospitals or the above-mentioned hospitals. The dead were buried through traditional religious ceremonies in the newly-established cemetery. Figure 2 show some scenes of the relief operation.

## 3 Emergency shelters and temporary housing

The Iran Red Crescent Society began distributing more than 50,000 tents as emergency shelters among those made homeless by the earthquakeas early as the first day of the earthquake. The tents were set up either near the victims' homes, in groups in an open area or in congregate camps throughout Bam. For intermediate shelter, the Interior Ministry and Kerman Governor Office were ordered to provide the homeless with temporary housing units in the form of prefabricated or in-situ built dwellings, about 16–20 $m^2$, equipped with a water heater, air conditioning and sink; sanitary facilities were erected in the area and in the camps housing the survivors. From the 35,905 units, 9,005 units were set up in camp form (which were not welcomed by most of the people and consequently were used for student housing) and 26,900 were built within the owner's property. About 18,000 showers

**Fig. 2** Various views of the Bam earthquake rescue and relief operation

**Fig. 3** Example of emergency shelters and prefabricated and in-situ-built temporary housing

and latrines were installed to support the sanitation need of the victims. Most of the survivors were moved from the tents to the temporary housing by the end of March, and the settlements were finished by June 12, 2004, 2 months behind schedule. A better planning and need assessment is recommended for future disaster scenarios. Figure 3 shows various views of emergency and temporary housing units.

Taking into consideration government policy for a rapid and seismically safe reconstruction of Bam in order to minimize long-term socio-economic losses, it is expected that the reconstruction will be finished by mid-2007; if this goal is achieved, those made homeless will have not had to live longer than 3 years in temporary housing. A prolonged reconstruction process and long delays would eventually result in the temporary housing becoming permanent settlements; this would not benefit the rebuilding of the city, either financially or esthetically, as has been the case in Manjil and other post-earthquake reconstructions. A prolonged post-earthquake reconstruction period has also been found to create many social problems in the past (Ministry of Housing and Rural Development 2004).

## 4 Bam reconstruction strategy and planning

Keeping in mind the post-earthquake reconstruction experiences of Manjil, Ardebil, Ghaen-Birjand and Avaj (Ghafory-Ashtiany 1999) as well as the strategy for reconstructing Bam on the same location, but with modifications in land use planning, the President of Iran ordered the formation of the ''Bam Reconstruction Headquarters'', chaired by the Minister of Housing and Urban Development, which would be the focal point for all reconstruction activities and the responsible authority coordinating the reconstruction process. This committee appointed the Islamic Revolution Housing Foundation (IHF) as the main executive organization for the reconstruction based on its past performance. In addition to the many challenges facing the authorities in terms of the differences between designing a new city and reconstructing an existing one (Hosseini 2007) as well as the main issues and criteria from urban design point of view, a number of other issues needed special attention. These included:

- population of the city (present and future)
- proof of land ownership after the event;
- debris removal planning;
- identifying the components which should be repaired or rebuilt in their previous locations;

- identifying the components which should be relocated;
- identifying the components which should be added to the city;
- planning the transition from emergency sheltering to permanent housing.

Once these had been issues had been taken into consideration, the headquarters decided on planning, financing, policymaking, executive operations and supervision, which were presented in brief as the following topics (The Acts collection of ''Bam Reconstruction Headquarter'' 2004):

1. Removing the debris in the city and suburban villages by the IHF.
2. Reconstructing the city of Bam in its current location, keeping local architecture in view.
3. Reconstructing damaged residential and commercial units in the city and villages through:
    - promoting regional construction quality and taking maximum benefit of the local expertise with the aim of creating job opportunities and promoting the technical know-how of the local population;
    - establishing a construction market (Bazaar) with the objective of providing the required consulting, technical and engineering services through certified consulting companies as well as providing construction materials market and stores;
    - preparing the ground for mass-constructors to build residential complexes in the areas where residential units cannot be constructed due to technical reasons;
    - setting up the Bam Architecture Council to issue orders on architectural designs and urban development in conformity with Islamic cultural, social and regional values of Bam;
    - running laboratories to control the quality of construction materials;
    - adopting an effective construction quality control.
4. Inviting all state-run organizations to offer proposals on the reconstruction of destroyed units with the aim of regional development.
5. Feasibility study on plans and projects to be made in the Projects and Allocations Committee, with the final decision-making by the Bam Reconstruction Headquarters.
6. Using international help (foreign loans) for implementing development plans on water and sewage, power, irrigation, health, streets and roads, railroad and schools.
7. Managing reconstruction operations whose financial needs are met by foreign bank loans.
8. Authorizing the executive branch of public and state buildings and facilities to carry out their authorized tasks.
9. Authorizing the Ministry of Agricultural-Jihad for reconstruction of the agriculture sector's infrastructures.
10. Authorizing the Ministry of Energy to manage the reconstruction of the necessary infrastructure for water, sewage and power systems.
11. Authorizing the Ministry of Industries and Mines to manage the reconstruction of industries.
12. Authorizing ''Schools Construction Organization'' to manage reconstruction of schools.

13. Authorizing the technical and engineering departments of the military and law enforcement forces to manage the reconstruction of military centers and police stations.
14. Ratifying the ex gratia aid and banking facilities for residential and commercial units in the city and villages and for private units used by the public.
15. Attracting financial aid from benevolent institutions and private individuals to allocate for the building of schools and medical centers.
16. Introducing qualified people to banks by the IHF for administering the banking facilities.
17. Planning for running websites to provide necessary information.

The IHF was given the authority to supervise the reconstruction of buildings whose costs are paid by non-governmental organizations, endowment institutes and benevolent individuals. The executive organizations are obliged to submit their schedule(s) to the IHF as well as to report the actual progress being made on their projects; in addition, they must set up a secretariat to institutionalize the reconstruction process and to document all of the reconstruction process.

## 5 Execution of the Bam reconstruction policy

Based on the government reconstruction policy, the new Bam master plan, which was completed some months before the earthquake, was modified based on the new microzonation map of Bam (Askari et al. 2004). For preparing the land for the reconstruction of the residential and commercial units, 17 provincial affiliates of the IHF and other executive organizations in the region were assigned the tasks of removing the debris of 27,734 damaged and destroyed buildings following the confirmation of the unit's ownership. To separate usable materials or goods from the debris, the owner was encouraged to salvage undamaged brick, iron profiles, etc.

To help the victims, the government has provided low interest (4% for rural area and 5% for urban housing and commercial units) and 15-year loans as well as a grant through the banking system for the reconstruction and repair of residential and commercial buildings in Bam and Baravat and in the rural areas, as shown in the Table 1. The difference in the interest rate is covered by the government. The fund, which is accessible to each household whose house was destroyed or damaged, is almost enough to cover the expenses for the 60-$m^2$ and 85-$m^2$ residential units in villages and Bam, respectively. Banks are also encouraged to provide long-term loans at a regular interest rate to those interested in building larger homes. There were also loans of $2000 allocated for the construction of property fences or walls. As the permits are issued, the owners are advised on how to receive the loan from the banks, with the amount being decided on by the IHF based on the progress being made in construction. There have been many complaints, primarily due to a lack of clear understanding of the procedures and the demand for a more flexible usage of the loan.

The role of the construction Bazaar is to provide a supervised aseismic design to new construction based on the ''Iran's National Building Standards'' and household demand and to ensure that the reconstruction of the buildings follows the quality-control guidelines. This process enables the Bam resident to choose the pre-approved design and construction models, as shown in Fig. 4. To assure the use of good-quality, controlled construction material, the market also provides the needed materials, which have been approved of by a group of seven material testing laboratories and 17 workshops, at a low and affordable price.

**Table 1** Direct financial aid and grants for the reconstruction and repair of the buildings in Bam, Baravat and surrounding villages

| Type of aid and distribution of reconstruction and repairs | Residential building | | Commercial (3704 units) |
|---|---|---|---|
| | Rural area[a] (136 villages) | Bam, Baravat | |
| Amount of low interest loan | C: $5,500 | $16,000 | $150/m$^2$ |
| | R: $1,800 | | Maximum = $7,000 |
| Amount of grant (aid) | C: $2,000 | $4,700 | $1,200 |
| | R: $400 | | |
| Number of buildings to be reconstructed | 25,022 | 26,900 | 834 |
| Number of buildings to be repaired | 7,378 | 1,317 | 310 |

[a] C, New construction; R, repair of damaged building

The total cost of design (free up to 250 m$^2$), licensing (free up to 100 m$^2$), supervision and certifications as well as the quality-control process, which are conducted and financially supported by the IHF (overhead cost) are covered by a World Bank loan and government resources. Despite all of the best efforts for ensuring the proper control of reconstruction in terms of structural control and materials, people sometimes use damaged materials that have been salvaged from their damaged home to save costs.

The housing foundation of Kerman and 17 other provinces as well as the Kerman branch of the Construction Engineering Organization cooperated and provided the required manpower (with priority given to the local employee) for carrying out the reconstruction operation; this force consisted of 104 engineers, 194 technicians and 1000 workers.

## 5.1 Urban reconstruction

The reconstruction plans for residential and commercial units in Bam were implemented in June 2005 and still ongoing. Of the 27,734 units that need to be reconstructed, as of May 2006 a start has been made on the construction of 20,119 buildings, and the (re)construction of 7,206 houses and 72 commercial units has been completed. For those who did not own property, seven housing complexes with 1084 apartment units are being constructed using newer construction techniques; these will be completed by end of 2006. Figure 5 shows the various stages of construction, types of units under construction and completed housing units. The management of this housing reconstruction program takes the form of one resident team with one supervisor for each 100 units, and one head supervisor for each ten teams; the responsible body is the Evaluation and Supervision

**Fig. 4** Construction Bazaar (market) for the reconstruction of Bam, consisting of consulting offices, sample frame and model home from which the people can choose

**Fig. 5** Reconstruction of Bam in terms of individual dwellings and apartment buildings

Office in the Bam. Even though the overall assessment of the constructed housing units is good, more serious and rigorous supervision was needed to avoid some of the problems observed in the nonstructural sector of the reconstruction program.

### 5.2 Rural reconstruction

A total of 25,022 houses in 136 villages were destroyed during the earthquake. A number of factors had to be taken into consideration in making the reconstruction plans for the rural areas, such as the simplerlife style relative to urban housing, economy, need for rapid reconstruction, management of migration and availability of the technical manpower. Consequently, rural reconstructions involved were less flexible in terms of design, with fewer variations of the building types based on the 60 $m^2$ and 85 $m^2$ residential units with steel frames that were the approved construction. In the first phase, 66 villages that had almost been totally destroyed were reconstructed with minor modifications to village layout. Of these, 35 were reconstructed under the management of the Kerman IHF and the remaining were reconstructed under the management of the IHF of the remaining seven provinces IHF, with maximum input from the owners and local workmen. In the second phase, reconstruction began on those villages that had either suffered only minor damage or those for which the land use had to be changed. To date, about 93% (23,215) of these houses have been completed, and life in these villages has almost returned to normal. The construction of rural housing units was supervised and managed by one resident supervisor for each 100 units and one head supervisor for each 1,500 units. Although there were deficiencies in the quality of the construction in the initial stages, contact with the authorities eliminated most of these deficiencies, and the overall assessment is that the reconstruction process has been carried out at an acceptable level of safety and was better than past reconstruction projects carried out following the 2001 Ardebil and Ghaen-Birjand earthquakes (The Collection of Work Progress Report of the Islamic Revolution Housing Foundation 2004–2006).

### 5.3 Reconstruction of schools

The Bam earthquake caused the physical destruction of many schools; in addition, approximately 10,000 students and 1000 teachers died or were injured in their homes, as shown in Table 2. Within the context of the school safety program in Iran, the recon-

**Table 2** List of the schools that need to be reconstructed or repaired

| City | New | | Repaired | |
|---|---|---|---|---|
| | Schools (number) | Classrooms (number) | Schools (number) | Classrooms (number) |
| Bam | 71 | 556 | 33 | 268 |
| Baravat | 16 | 112 | 3 | 18 |
| Bam area | 25 | 79 | 1 | 3 |
| Dahabkery, Poshtrood, Kerk | 19 | 73 | – | – |
| Total | 131 | 820 | 37 | 289 |
| Completed | 48 | – | 37 | 289 |

struction of 131 new schools and repair of 33 schools were given high priority, with construction beginning in the summer of 2004 under the supervision of the ''School Reconstruction Organization''. Of these 131 schools, 71 were funded by the various governments, 23 by private donations, 28 by funds from foreign countries and ten with the help/cooperation of international organizations. To date, half of the schools have been finished, and the remained will be functional in September 2006. Four educational cultural centers, eight sport halls and six dormitories have been built as well. Figure 6 shows some of the schools that have been built and those under construction. The preliminary assessment indicates that the quality of the school reconstruction has been very good. Relative to the old schools in Bam that were destroyed, the newly constructed schools are safer and better equipped.

The impact of the Bam earthquake on school safety, the development of ''National Strategy for Earthquake Risk Reduction'' in 2005, the hard efforts of the Ministry of Education, the International Institute of Earthquake Engineering and Seismology's (IIEES) promotion of school safety and the support of the government resulted in Iran's parliament passing the ''School Safety Bill'' in May 2006 for the reconstruction of 131,935 new classrooms and the improving of 126,010 vulnerable classrooms (39% of the total) by the end of 2010, with the budget of $4 billion.

**Fig. 6** Reconstruction of various types of schools in Bam, Baravat and the surrounding villages

### 5.4 Reconstruction of hospital and health centers

The two operational hospitals in Bam, with a total of 216 beds, private clinics, health centers, pharmacies and orthopedic centers became un-operational due to the collapse of roofs and walls and damage to equipment. To cover this loss and to be able to respond the post-earthquake increasing demand for medical services, several temporary hospitals were established by the Iranian Red Crescent Society, International Red Cross and non-governmental organizations (NGOs) to provide services with 150 beds. By the spring of 2005 the new Bam hospital with 96 beds became operational, and 18 of the health centers had been repaired. To date, two new General hospitals and 64 new clinics and health centers are under construction, financed with national and international funds. When construction is complete, the residents of Bam and its surrounding will have better and safer medical facilities than they did prior to the earthquake. Figure 7 shows some of the health facilities already constructed and some of those still under construction. Given the increase in the number of orphans (150–5,649) and disabled and needy people (3,750–9,494) as well as the psychological traumas inflicted by the earthquake on people, a large-scale project has been established to provide psycho-social support to residents of the affected area, funded by the Ministry of Health and UNICEF. To date, three rehabilitation centers have been built and five are under construction.

### 5.5 Reconstruction of cultural and sport centers

To avoid excessive emigration from the area and to provide residents in Bam and its surroundings with hope for the future, reconstruction was begun on cultural centers, such as two cinemas with 1800 seats, eight libraries, Centers for Intellectual Development of Children and Youth, a large sport stadium, 160 mosques, the old Bazar of Bam, the renovation of Bam Radio and TV stations and Arg-e-Bam, together with the housing reconstruction. Figure 8 shows some of the projects ongoing or completed. The reconstruction and/or restoration of Arg-e-Bam (Bam Citadel) and other damaged

**Fig. 7** Reconstruction of hospitals, clinics, health and rehabilitation centers

**Fig. 8** Construction of cultural centers in Bam, including sport stadiums, libraries, mosques, among others

buildings with a cultural heritage have been started with the cooperation of UNESCO, Italy, Japan, and other countries. The process is slow and there is no expected time for their completion.

### 5.6 Reconstruction of government buildings

In line with the 'new' Bam city being service-oriented, all government and local offices will be housed in several building complexes rather than being spread throughout the city as before. Thirty-one projects, including the (re)construction of police stations, court-houses, post offices, banks andcolleges, 170,000 $m^2$ in total, are under construction. Progress has been estimated to be 68% (see Fig. 9), and the main government complex will be completed by mid-2007.

### 5.7 Reconstruction of the water supply and network

Bam has considerable importance as an agricultural center. Consequently, the repair and restoration of the Bam agricultural irrigation system and 164 Qanats were started

**Fig. 9** Reconstruction of Bam government building complexes

immediately after the earthquake and completed by the spring of 2004 in a major effort to save the palm tree and farming industry in Bam. The repair and erection of 20 new wells that supply water at a rate of 700 l/s, the repair and construction of a new water reservoir with a capacity of more than 10,000 $m^3$ and the repair and installation of 704 km of main and secondary water pipelines were completed by mid-2006. It has been reported that 75% of Bam and the surrounding area now have a normal water supply.

### 5.8 Reconstruction of the electricity network

The repair, installation and expansion of the Bam electricity network and power lines consisted of constructing main sub-stations and power distribution networks that included5 km of high-voltage grids, 75 km of average-voltage grids and 30 km of low-voltage grids, 40 elevated electric posts, street lights, among others. To date, these projects have been completed with a total budget of $ 90 million.

## 6 Iran national strategy for earthquake risk reduction

The Bam earthquake disaster provided a unique window of opportunity to raise national and international awareness of the importance of the effective implementation of a comprehensive earthquake risk reduction program in Iran as well as in hazard-prone developing countries. The government of Iran was faced with a daunting challenge to implement and integrate state-of-the-art earthquake mitigation know-how into its development programs. Based on past experiences and the success in reducing earthquake risk in the reconstruction following the 1990 Manjil earthquake, the government adopted the new long-term ''Iran's Strategy of Earthquake Risk Reduction'', which comprises several components, including policy change, increasing know-how, improving management quality, using advanced technology, code enforcement, increasing the safety of public buildings and infrastructures (especially schools), public awareness and increasing public preparedness for the correct response during and after an earthquake. It is well recognized that achieving the final objective of reducing earthquake risk to an acceptable and affordable level with a good response team will require long-term educational goals and the nurturing of a collective culture of safety in Iranian society (Ghafory-Ashtiany 2006).

## 7 Conclusion

The Manjil-Rudbar earthquake in 1990 was the catalyst for moving towards a policy of ''earthquake risk reduction'' in Iran, and the reconstruction of the area was the first major post-earthquake reconstruction experience at the national level, as very little experience had been gained in the reconstruction of Tabas after the destructive earthquake of 1978. Since the Manjil-Rudbar earthquake, many earthquakes have occurred and much experience has been acquired by the IHF, especially in the area of rural reconstruction. The reconstruction of Bam, which has essentially been the construction of an entire city in the shortest time possible, was planned and implemented using all of this newly acquired knowledge. The idea of establishing the ''Construction Bazaar'' was an innovative approach that ensured the maximum use of (local) expertises, maximizedthe contribution (benefit) of local people (the present and future residents of the city) and resulted in an

enforcement of the quality control system in the reconstruction process. The overall assessment shows the concept of ''Construction Bazaar'' was good; however, modifications need to be made for future cases, especially in the area of sustainability of the commitment of the various companies to provide a quality service to the people. In addition, the supervision, quality control and evaluation body of the reconstruction should be organizationally separated from the IHF and the Bam Reconstruction Headquarter in order to ensure a higher level of quality control in the reconstruction and to eliminate some of the problems that occurred due to conflicts of interest.

It should be pointed out that despite the full attention of the government to the reconstruction of Bam and the implementation of a number of innovative ideas, such as the ''Construction Bazaar'' (The Collection of Work Progress Reports of the Iran Housing Foundation (IHF) 2004–2006), there has been the inevitable delays in the reconstruction process, mainly due to the lack of an ''in-advance reconstruction plan''. Therefore, it is highly recommended that reconstruction plans for cities, particularly the older cities located in highly seismic zones, should be prepared long in advance; this would represent a very important step in the sustainable development of the country. Finally, more attention should be given to social reconstruction and rehabilitation instead of focusing most (or all) of the attention on physical reconstruction. People's expectations and demands need to be responded to, including rapid reconstruction, larger loans, simplifying the process of construction permits, rapid economic recovery, jobs for the youth, to name a few. The meeting of these demands is very difficult, and complete recovery is almost impossible, especially from the social and psychological aspects. However, eventually, Bam will be a safer place to live than before.

## References

Askari F et al (2004) Preliminary seismic microzonation of Bam. J Seismol Earthq Eng 5:69–80

Eshghi S, Zare M (2004) IIEES reconnaissance report on 26 December 2003, Bam Earthquake. IIEES Publ, Tehran

Ghafory-Ashtiany M (1999) Rescue operation and reconstruction of recent earthquakes in Iran. Disaster Prevent Manage J 8:5–20

Ghafory-Ashtiany M (2004) Bam earthquake of 05:26:26 of 26 December 2003, Ms6.5. J Seismol Earthq Eng 5:1–3

Ghafory-Ashtiany M (2006) Earthquake risk management strategies: the Iranian experience. UNESCO, Tehran Cluster Office, Tehran, Iran

Hosseini M (2007) Reconstruction of towns and cities after destructive earthquakes: challenges and possibilities form the urban design point of view. In: Proc 9th Can Conf Earthq Eng (in press)

Iran Statistics Center-ISC (2004) The results of the places and families listing of Bam earthquake regions. ISC, Tehran

Ministry of Housing and Urban Development. (2004) The preliminary report of Bam city. Deputy of the Engineering Statute and Building Executing, Tehran, Iran

The Acts collection of ''Bam Reconstruction Headquarter'' (2004). Tehran, Iran

The Collection of Work Progress Reports of the Islamic Revolution Housing Foundation (IHF) (2004–2006). Islamic Revolution Housing Foundation, Tehran, Iran