

Lessons learned from the housing reconstruction following the Bam earthquake in Iran

Dr. Alireza Fallahi recounts some of the highlights and pitfalls of Iran's participatory model of providing permanent housing for survivors of the 2003 Bam earthquake

Abstract

The worst earthquake in the last decade, hit the ancient city of Bam, in southeastern Iran, on 26th December 2003, resulting in 30,000 dead, 20,000 injured and over 60,000 homeless. The devastating 6.6 magnitude quake struck at 5.28 am local time; an hour at which almost all of the city's 80,000 residents were in bed on the Muslim day of rest. The catastrophe razed more than 80 per cent of the city to the ground. In addition, Bam's historical landmark—a giant medieval fortress complex of towers, domes and walls, all made of mud-brick—was totally destroyed. This Citadel, (Arg-e Bam), was one of the wonders of Iran's cultural heritage.

According to the *Bam Sustainable Development Manifesto*, the aim of providing permanent shelter for survivors during the reconstruction phase was to make them as independent of government aid as possible. Householders were encouraged to take an active part in the relief process. During the reconstruction period the Housing Foundation and a number of private engineering and architectural firms announced that 'the responsibility for rebuilding was for the homeless'. Each firm established processes of consultation with householders and implemented specific approaches to reconstruction based on these consultations. This method of providing shelter increased survivors' abilities to actively participate in the process of reconstruction. However, the bureaucratic paperwork process was a major obstacle to the success of these operations.

This paper is a condensed and edited version of a larger study on the relief and reconstruction process after the Bam earthquake.

Introduction

Earthquakes have been part of the world since the dawn of time. Their occurrence is inevitable. However, in contrast to the natural environment, the man-made environment needs specific disaster management in response to earthquakes. The Iranian Government is responsible for disaster management at local, state and regional levels. Disaster management is divided into two sections—pre-disaster planning and post-disaster recovery. *The Continuum from Relief to Development* (Habitat, 1994) defines the phases of these two sections as: preparedness, mitigation, prevention, relief and rescue, rehabilitation and reconstruction.

Earthquake response includes activities that take place during or after an earthquake and is designed to provide emergency assistance for victims, providing shelter and repairing lifeline infrastructure and networks to stabilise the situation and reduce the probability of secondary damage (for instance, preventing secondary damage to the gas supply or shutting off a contaminated water supply, etc.) (Blaikie 1994). In the rehabilitation and reconstruction phases, shelter provision is the most important activity in helping the homeless population.

Iran is an earthquake-prone country and has experienced a number of devastating earthquakes over the past decades. The Iranian Government has developed a strategy to meet the needs of disaster victims by undertaking a participatory approach to rebuilding damaged areas. This community based approach is used to respond to community shelter needs in a more effective way.

Methodology

A review of the past four decades of implemented housing reconstruction projects in Iran reveals that the houses provided in new settlements have only been partially successful in meeting peoples' rebuilding needs (Razani 1984, Parsa 1985, Rafyie and Niroomand 1986, Zargari 1988, Fallahi 1996).

Analytically-based social studies of the housing of affected communities after earthquakes have generally been less studied than technical issues. This deficiency is consistent with the view of several scholars, who have stressed the importance of periodical assessments of the impact of post-disaster reconstructions and of monitoring the occupiers' attitudes towards their dynamic reconstructed environments (Aysan 1987).

A preliminary review of the literature raises a number of important questions about post-earthquake housing programs, including:

- How successful are the investigations into safe buildings?
- How suitable are the permanent houses that are provided by the government or other agencies for the accommodation of the homeless?
- To what extent are the resettlement projects acceptable to the people they house?
- Do the houses provided meet the needs of their occupiers?
- If they are built to be safe in future disasters do they remain safe?

(Aysan 1987: 4-5)

The importance of these issues continues to be discussed, with an emphasis on community involvement in post-earthquake housing as *a central element in recovery* (Habitat 1994: 2, Kronenburg 1995: 19).

This study analyses the process of providing shelter in a zone with 100 per cent damage around the City of Bam in Kerman Province. Access to all reconstructed settlements was somewhat limited due to restrictions of time, cost, and climatic conditions; however, outcomes deemed to be significant were attained.

To obtain information for analysis and examination, the following methods were used:

- a review of bibliographical sources and documents;
- the undertaking of unstructured interviews with policy makers and researchers involved in the process of providing shelter after the earthquake;
- conduct of a field survey; and
- direct personal observation and informal communication.

National disaster management system in Iran

Under the Ministry of Interior, there are three organisations that play important roles in disaster

management and reconstruction: the Bureau for Research and Coordination of Safety and Rehabilitation Activities (BRCSR), the National Disaster Task Force (NDTF) and the Housing Foundation (HF). The BRCSR conducts research on safety measures; formulates preparedness and mitigation plans; and collects, analyses and disseminates information on disaster management. The NDTF is an inter-organisational body chaired by the Ministry of Interior, whose activities vary during different phases following disasters. The Housing Foundation (HF) is a revolutionary council and semi-autonomous agency. Amongst its legal responsibilities, reconstruction after disasters and rural development are predominant.

The Housing Foundation is the government's implementing arm for the construction and reconstruction of damaged houses. With its headquarters in Tehran and more than 100 branches in the country, it maintains rural development activities consisting of planning and implementation, regional planning, research and development, post-disaster reconstructions and the improvement of buildings. Due to past earthquake reconstruction experiences, rebuilding of housing in Bam was to be carried out as a collaborative effort, with the participation of the owners, community assistance, support of banks and free technical and engineering services from the government through the Housing Foundation.

Bam earthquake

The ancient City of Bam, in Kerman Province, is said to be the doorway to Iran from its eastern border. The weather in the region is hot in summer and cold in winter. Most houses are of mud and dried brick construction and are vulnerable to earthquakes (Fig 1). However, in recent years, a number of so called 'urban buildings' have been constructed using metal, brick and reinforced concrete.

The main source of income of the population is administrative and small business. However, most of the people are engaged in agricultural activities. Dates and oranges are the most well-known agricultural products in Iran and date trees are scattered throughout the city (Fig 2). Bam residents believe that "Bam is nothing without its date orchards". The residents value land ownership as part of their family heritage. This means that land is not only a source of income but also a part of family identity and characteristic. As a result, many inhabitants consider land more important than housing.

'New Bam' has been developed over the recent years as an industrial zone, 10 kilometers away from the City of Bam. There are a number of automobile and packaging factories in this new area.

In terms of socio-cultural aspects, the people of Bam are mainly well educated. However, many of younger generations have already migrated to nearby cities or abroad.

The Bam earthquake with a magnitude of 6.6 on the Richter Scale occurred at 5.28 am on 26th December 2003 and caused considerable human and financial loss in the region. More than 30,000 people were killed, 20,000 were injured and over 60,000 left homeless. Almost 80 per cent of Bam was ruined. It also caused considerable loss to lifeline infrastructures, such as the water supply network, power lines and also health care centres, educational buildings, cultural centres, and other cultural heritage (Fig 3). The epicentre was approximately 10 km to south-west of Bam. Damage was concentrated in a 16 km radius around the city, which is famed for its 2,500 year old citadel *Arg-i-Bam*. In terms of human cost, the Bam earthquake ranks as the worst recorded disaster in Iranian history.



Fig 1: Bam before the Earthquake.



Fig 2: Residents believe that Bam is nothing without its date palms.

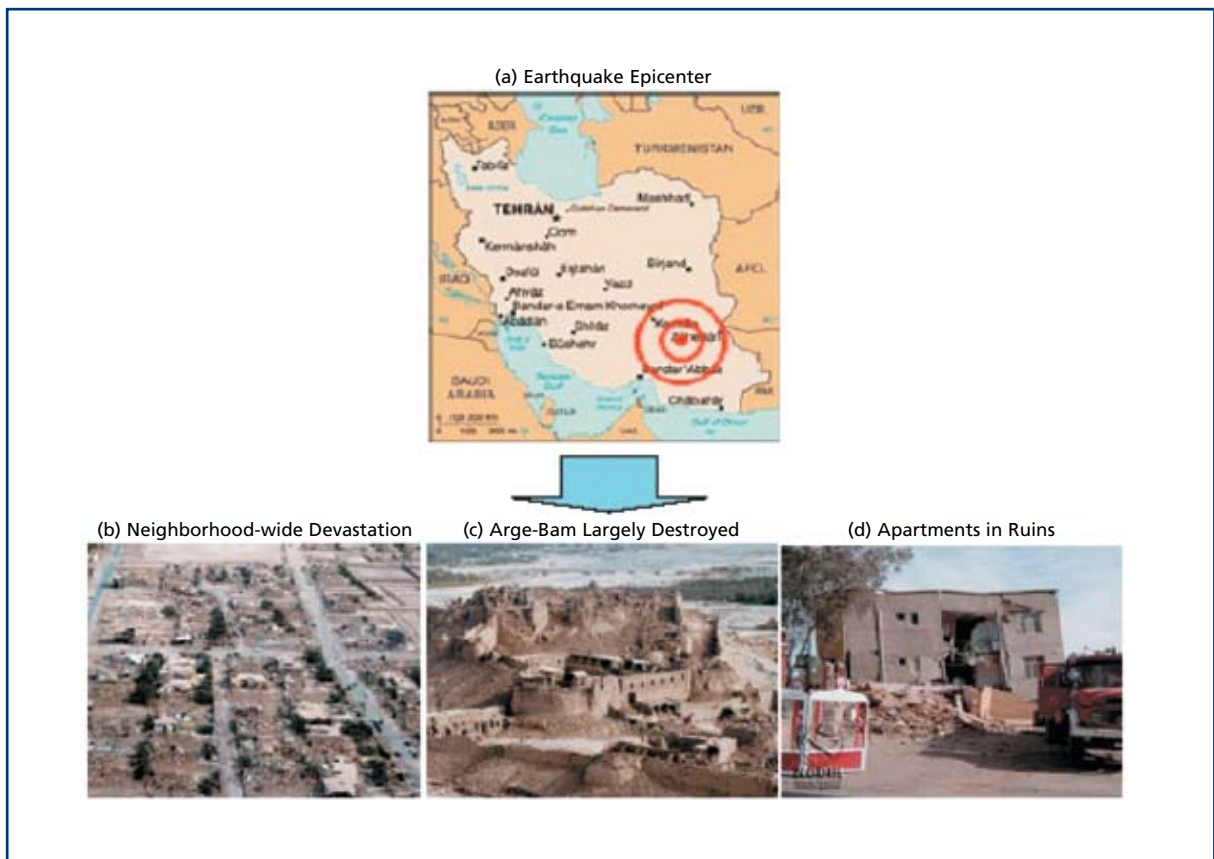


Fig 3: Epicentre of the Bam Earthquake and examples of the devastation.

Response to the earthquake

Despite the enormous devastation caused by the earthquake, the response of and cooperation between the Iranian authorities, Iranian Red Crescent Society (IRCS) and the international community was swift and exemplary (United Nations 2004). Various government agencies including the Ministry of Interior, Ministry of Health, the Army and the IRCS launched a massive rescue and relief operation. Nearly 12,000 people were airlifted and taken to hospitals in other provinces. The IRCS mobilised 8,500 relief volunteers. The provincial government set up a six-member committee chaired by the Governor-General of Kerman to coordinate the relief efforts. In addition, all sections of Iranian society came together to help the affected people. (National Report of the Islamic Republic of Iran 2005).

More than 1,600 search and rescue, health and relief personnel from 44 countries arrived in Iran to assist in the rescue and relief operations. Within hours of the earthquake, the UN dispatched its Disaster Assessment and Coordination Team (UNDAC) to support the Iranian Government in coordinating this enormous international response. The UN Country Team and UN agencies provided relief items as well as technical support. The International Federation of Red Cross and Red Crescent Societies (IFRC) and various Non-Governmental Organisations (NGOs) set up field hospitals and distributed food items and blankets (United Nations, 2004). Tents, as emergency shelters, were distributed among the homeless right from the early days (Fig 4).



Fig 4: The IFRC and various NGOs set up field hospitals, distributed food items, tents and blankets in the emergency phase.

Classification of building damage was done using aerial photography. By using a pre-earthquake image, the location of individual buildings was registered on a GIS and city blocks surrounded by major roads were marked. This was then compared with a post-earthquake image. Then visual inspection of building damage was conducted. By this method, buildings were classified from Grade 1–5.

A total 12 063 buildings were classified:

- 1,597 Grade 1 and 2;
- 3,815 Grade 3 – buildings surrounded by debris;
- 1,700 Grade 4 – partially collapsed buildings, and
- 4,951 Grade 5 – totally collapsed buildings (Fig 5).



Fig 5: Damaged houses such as this one were classified on a grading system from 1-5.

Rehabilitation and reconstruction phases

In an immediate response to the needs of the earthquake stricken people of Bam, the Housing Foundation (HF) took action to provide temporary shelters for the homeless. Some 16 Assisting Headquarters from provinces around the country were established in Bam. Ten of these Headquarters were situated in the City of Bam and six were located in rural areas. The HF started a program for removing debris of about 19,000 houses in the city and 4,000 in rural areas. Until the end of April 2004, most of the survivors received temporary accommodation consisting of prefabricated units with an area of 18–20 square meters, equipped with water heater and air conditioning. (Fig. 6) (Havaii and Hosseini 2004: 229).

The reconstruction strategy

The Iranian Government set up a Guiding Office for the Recovery of Bam (GO), consisting of 11 members and with the Minister of Housing and Urban Development as its head. One of the most important decisions made by the GO was to appoint consulting architects to review and analyse a comprehensive urban design and planning of the City of Bam.



Fig 6: Temporary shelters on individually-owned plots of land (top) and pre-fabricated camp cities (bottom).

The priorities that they identified for the Bam reconstruction program are as follows:

1. Removing the debris in the city and suburban villages
2. Reconstructing the city in its original location, observing local architecture
3. Reconstructing damaged residential and commercial units through:
 - Householders participation in rebuilding
 - Providing people with the necessary facilities and information about construction technology
 - Promoting regional construction quality
 - Inviting academics, consulting engineers and contractors to render technical services, including design and implementation
 - Inviting construction material suppliers to set up plants to meet the material needs and supervision
 - Establishing a workshop and exhibition area for offering technical and engineering advice and services to householders
 - Preparing the sites for mass residential construction complexes in areas where individual units cannot be built due to technical reasons
 - Employing local people for reconstruction with the aim of creating job opportunities
 - Setting up a Bam Council of Architecture and Urban Development to lead architectural and urban development process
4. Inviting appropriate organisations to offer proposals on reconstruction with the aim of regional development
5. Utilising international aid (foreign loans) for implementing development plans on infrastructure and public services
6. Authorising the Ministries of Agriculture, Energy and Industries and Mines, to reconstruct their own sectors
7. Introducing qualified people to banks through the Housing Foundation to receive financial facilities

Government responsibilities	Affected people responsibilities
Free of charge and long-term bank loan	Construction management
Technical assistance	Design, consultation, implementation
Preparing plans and designs	Participation in the process of decision making and planning
Construction materials and other resources	Choice to accept or reject the proposed plans
Supporting of vulnerable families	Training programs

The table above summarises the responsibilities of the affected people and the government.

Council of architecture and urban development

The Council of Architecture and Urban Development (CAUD) consisted of eight distinguished members, including businessmen, academics, architects, engineers and members of the Housing Foundation. This Council outlined the measures and guidelines for rebuilding houses as well as the urban design of the City of Bam.

The CAUD approved the amount of credits and bank loans for each individual household and business unit. They also made decisions regarding the allocation of loans for the fencing of gardens, surrounding walls, and the reconstruction of schools that had already been approved. In terms of temporary housing, some 30,000 units were built in Bam. These houses initially were supposed to be built in camps. However, by consulting with survivors, most units were erected on the sites of damaged houses or within the same plots of land where houses were located prior to the earthquake. Most of newly reconstructed units were reinforced steel structures.

Bam sustainable reconstruction manifesto

One of the policies proposed by the CAUD was the Bam Sustainable Reconstruction Manifesto. A Committee on Sustainable Development consisting of academics and experts in reconstruction was set up to develop the manifesto. Three of the principles in this master plan for sustainable reconstruction and development in Bam were:

- a) preserving the city identity in urban design,
- b) strengthening the new houses against the national building code, and

- c) householder participation in the process of rebuilding.

Community participation was suggested in various aspects of physical, environmental, social and economic issues, as well as, improving living quality in Bam without affecting later generations (The Committee on Sustainable Development 2004).

It was decreed that survivors and householders should not be looked upon as “desperate condemned people” but “cooperative active actors” in the process of designing, planning and implementing their own houses. In other words, local people should be involved in the process of reconstruction planning and its execution. Such integration would pave the way for training people to acquire new skills and reviving their spirits.

Community, designers and contractors interaction

In the City of Bam, community active participation in the process of designing, planning and constructing units was strongly encouraged. This approach provided a great relief to peoples’ pain and suffering and helped to mitigate their psychological pressures (Fig 7). In addition, research has shown that the lower the level of participation rates of recipient individuals in the reconstruction process, the lower the level of satisfaction rates of the resultant relocation and shelter (Fallahi 1996). In the case of Bam, householders were given the ability to choose their own plans and layouts and act as the supervisors of their own projects, thus paving the way to establish a line of cooperation between designers and contractors. This approach also ensured that government loans resulted in the desired houses being built for the people.

The HF invited designers, practitioners, and contractors to Bam and provided them with construction materials and an allocated site. These private enterprises erected



Fig 7: Community, designers and contractors in consultation inside the mosque of Bam.

and displayed their designs as life-size exhibition units and shared their technical knowledge of safe building with the people. Their building designs were approved and certified by the HF against a number of criteria, including that the design:

- should be resistant against future earthquakes,
- must be economically viable,
- must be suitable for the climatic and environmental situation,
- should be culturally familiar to the local people, and



Fig 8: Exhibition of proposed new houses.

- should be easy to repair and construct with available local expertise and materials (Fig 8).

This established an interaction between the community, designers and contractors. People expressed their needs and designers attempted to sketch plans for these requirements. This process continued until the householders were satisfied with the plans. Although householders were free to select their designers and contractors, a framework agreement form was developed between the contractors and the reconstruction committee within the Housing Foundation branches. The reconstruction committee supervised the process of technical and legal agreements between communities, designers and contractors.

In this process, people were encouraged to fully participate in all stages of rebuilding their houses. In addition, the Civil Engineering Society Organisation of the Province was tasked to supervise the process by sending architects and engineers to the areas of reconstruction. At the same time, the Building Materials Quality Control Committee had the responsibility of making available soil mechanics laboratory and building material testing equipment (Fig 9).

Survey results

Most disaster research is conducted by outside scholars from industrial communities, while most disasters occur in developing countries (Cuny 1992). It is accepted that direct objective observations will often be required; however, 'intimate local knowledge is essential' (Casley and Lury 1987: 2). Aysan and Davis (1993:9) acknowledge this limitation of an 'academic view', and suggest that to 'balance this bias' work needs to be carried out with local counterparts, for 'virtually all fieldwork and consultancy'.

In the case of Bam, both qualitative and quantitative analysis techniques were employed with benefits flowing from the advantages of each method. Opposite is a summary of findings and survey results:





Fig 9: Exhibition site for construction materials and architects offices in Bam.

A summary of survey results	
General characteristics of householders	Most of the householders were over 35 years old, and more than half of them were farmers or shepherds holding areas of land on their own. Nuclear families were the highest percentage of households. The average number of people in a dwelling was 5. More than half of the respondents were literate.
Pre-earthquake housing condition	Housing was often planned by family members and built by a local builder. Materials were mud brick, metal beam, and some concrete and cement. Most houses were connected to electricity and piped water.
Process of providing emergency and temporary shelter	<p>1 – Emergency shelter: A high percentage of the respondents received tents and lived in them for more than three months. These shelters created a number of problems. More than half of the respondents erected their emergency shelters on a plot of land.</p> <p>2 – Temporary shelter: A high percentage of householders built temporary shelters with financial and material assistance on their land. The average area of these units was 18 sq. m. However, a number of families who owned no house were located in pre-fabricated units in camp cities.</p>
Process of providing permanent shelter	<p>1 – Design: A high percentage of householders designed and planned their permanent shelters with free advice from architectural firms.</p> <p>2 – Technical advice: More than half of the householders participated in providing their permanent shelters, however all plans were checked to the building code</p> <p>3 – Construction materials: Most householders used concrete ceilings and metal structures.</p> <p>4 – Community participation: The task of reconstruction was carried out mainly by cooperation between householders, contractors and designers. The Housing Foundation supervised this interaction</p> <p>5 – Administrative process: Administrative paper-work was a major obstacle to rapid construction and active householder participation. For instance, householders needed to fill out nine sets of documentation to approve the quality of the building foundation.</p> <p>6 – Priorities in reconstruction: The urgent priorities for reconstruction were seen differently by survivors and interveners. For example, to the intervener, the priorities were, respectively: 1) house, 2) school, 3) water for land and drink. However, it soon emerged that watering date orchards was the most urgent task in the recovery phase. In addition, while providing permanent houses took a great amount of the reconstruction budget, a number of people lived in their temporary shelters for more than two years. In fact, a number of families found the temporary units much better than their damaged units and thus were not very interested in building a 'permanent' house. It seems that the amount of investment on temporary units was too high. Lessons learned from this are that the authorities should consider the pre-earthquake housing situation and spend less for intermediate units, as they are only temporary shelters.</p>
Degree of householders satisfaction	In general, householders who rebuilt their houses on their own land were more satisfied than those who were relocated.
Physical aspects of the new houses	<p>1 – Strength of house: More than 90 per cent of the householders were happy with the solidity of their new houses.</p> <p>2 – Quality of materials: Most of the survivors were satisfied with the materials used in their new buildings.</p>

Conclusion

The reconstruction of Bam was seen by the Housing Foundation as a social task rather than merely a physical operation. This official view was a major advance in disaster reconstruction policy in Iran. In addition, the Committee on Sustainable Development which was appointed to develop the reconstruction program proposed three principles in the master plan for sustainable reconstruction and development in Bam, including: a) preserving the city identity in urban design, b) strengthening the new houses against the national building code, and, c) active householders participation in various aspects of physical, environmental, social and economic issues (Fig 10). This approach differed from previous programs in that it incorporated a number of lessons from the past.

More time and research will be needed to fully evaluate the Bam housing reconstruction program (Maskrey 1994: 120). While there are many reasons why the current investigation of the householders' attitudes towards the reconstruction has validity, it should be perceived as a first evaluation and the initial step toward future research, particularly in the same area and about the same concerns.

The data analysis shows that the financial and construction material aid from the Housing Foundation on the one hand, and the survivors' participation in the process of rebuilding on the other, were two important factors contributing to the success of the Bam reconstruction program. However, although the local people were the main resource for any reconstruction operation, their importance was often overlooked by interveners. For example, while the householders were free to design their houses, training in the acquisition of new building and design skills was not generally available.

The critical importance of offering training in building safety techniques has been emphasised for both mitigation and reconstruction programs. However, an important factor is the improvement of overall local

construction techniques. In this sense, the objectives of disaster operations and innovation should be linked through community participation. Active survivor participation in housing leads to operational cost and time reduction, and can reduce the negative psychological impact of earthquakes. However, analysis of the field survey and on-site observations at Bam have also shown that, although the survivors were involved in the process of reconstruction, the program was deficient in providing householders with training in new forms of building safety. In other words, while evidence indicates a positive relationship between the degree of householders' participation and the general success of the program, the actual improvement of local building knowledge was limited.

References

- Aysan, Y. (1987), Homeless in 42m². *Open House International*, 12(3), pp. 21-26.
- Aysan, Y. and Davis, I. (1993), *Rehabilitation and Reconstruction*, 1st Edition, Disaster Management Training Programme, UNDP-DHA.
- Blaikie, P. et al (1994), *At Risk*, Routledge, London and New York.
- Casley, D.J. and Lury, D.A. (1987), *Data Collection in Developing Countries*. Clarendon Press, Oxford.
- Cuny, F.C. (1992), "Review of Twelve Years' Experience of Disasters and Small Dwellings". In *Disasters and the Small Dwelling: Perspective for the UN IDNDR* (eds. Aysan and Davis), (pp. 23-29). James and James Science, London.
- Fallahi, A. (1996), *Post-Earthquake Reconstruction in Iran*, Unpublished Ph. D. Thesis, Department of Architecture, University of Sydney.
- Fallahi, A. (2004), *Assessment of the Bam Earthquake in Iran on 26 December 2003*, 14th World Conference on Disaster Management, June 20-23, 2004, Toronto, Ontario, Canada.
- Fallahi, A. (2005), *GIS applications in the process of recovery after the Bam Earthquake in Iran*, NARGIS 2005 Conference, Applications in Tropical Spatial Science, 4th – 7th July 2005, Australia.
- Habitat (1994), *International Workshop on: Human Settlement and Environment, Strategies For Action in the Continuum From Relief To Development*, 25-27 April 1994, Nairobi, Kenya, United Nations Centre for Human Settlement, United Nations Environment Programme (Workshop Document).
- Hawaii, M.H. and Hosseini, M. (2004), Bam Earthquake: From Emergency Response to Reconstruction, In *Journal of Seismology and Earthquake Engineering, Special Issue on*



Fig 10: Reconstructed houses in Bam after less than two years.

Bam Earthquake, International Institute of Earthquake Engineering and Seismology, IIEES, 5 (4), PP.229-237

Kronenburg, R. (1995), *Houses In Motion, The genesis, history and development of the portable building*, Academy Editions, London.

Maskrey, A. (1994), Disaster Mitigation as a Crisis of Paradigms: Reconstructing after Alto Mayo Earthquake, Peru, *Disasters, Development and Environment* (eds Varley, I.), (pp. 109-123). University College Wiley and Sons, London.

National Report of the Islamic Republic of Iran on Disaster Reduction, 2005, prepared for the World Conference on Disaster Reduction, 18th – 22nd January 2005, Kobe, Hyogo, Japan

Parsa, A.G. (1985). *An appraisal of Earthquake Resistant Housing Programmes in Iran*. Mphil Dissertation, School of Architecture, University of Newcastle Upon Tyne.

Rafyie, B. and Niroomand, M. (1986), *Bazsazy-yi manateq-e zelzel-eh zadeh, Junoob-e Khurasan, Gonabad, Jeld-e 2*, 68 (Reconstruction of the earthquake destroyed areas in South of Khorasan, Gonabad, Vol. 2, No. 68). Tehran - Iran: Building and Housing Research Centre, 1365 (1986). (In Persian)

Razani, R. (1984). Earthquake disaster area reconstruction experience in Iran. In *Earthquake Relief in Less Industrialised Areas, International Symposium on Earthquake Relief In Less Industrialised Areas/ Zurich/28-30 March 1984* (eds. Schuppisser, S. and Studer, J.), (pp. 79-86).

The Committee on Sustainable Development (2004), *Bam Sustainable Development Manifesto*, The Centre for Architectural and Urban Studies and Research, Ministry of Housing and Urban Development, Tehran.

United Nations (2004), Flash Appeal Bam Earthquake of 26 December 2003 of Iran, Relief, Recovery and Immediate Rehabilitation.

Zargar, A. (1989), Reconstruction of War-Damaged Rural Areas of Khuzestan, Iran. A dissertation for D Phil, June 1989, Institute of Advanced Architecture Studies, University of York, U. K. (Unpublished).

About the Author

Dr Alireza Fallahi gained a PhD degree from Sydney University in 1996 and for five years, worked in the disaster area in Australia. He now heads the Research Department in the Faculty of Architecture and Urban Planning at the University of Shahid Beheshti, Tehran-Iran. The university has recently established two post-graduate courses within the Faculty entitled Post-Disaster Reconstruction and Disaster Management. Dr Fallahi is currently directing the joint *Earthquake Risk Preparedness in Historical Districts of Bam* project with UNESCO in Tehran.

For a full copy of the report, Dr Fallahi may be contacted by e-mailing a_fallahi@yahoo.com

