Herausgeber*innenkollektiv, eds. 2021. *Pearls, Politics and Pistachios. Essays in Anthropology and Memories on the Occasion of Susan Pollock's 65th Birthday*: 103–16. DOI: 10.11588/propylaeum.837.c10737.

Patterns of Post-Earthquake Domestic Architecture in Bam County (Southeastern Iran), an Archaeological Study

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Preface

Domestic architectures, besides their spatial structure and elemental functions, are signs of economic class, amount of (surplus) wealth, and lifestyle. They are also contexts of cultural, material, and human behaviors (Vaughn 2005). Therefore, by identifying and studying them, it can be possible to categorize and define other material culture patterns, and to reconstruct the human behaviors and social statuses of the inhabitants. On the other hand, we are speaking of a private space directly related to everyday life and private human actions.

In the city of Bam, we faced a context that had lost its function due to the occurrence of a dramatic earthquake. For archaeological researchers, the evidence of the disaster, and the surviving materials were significant. From these it was possible to gain a better understanding of the conditions of the context, and the short-term, local, events and aspects following a disaster. So, thereby, the patterns deduced from the domestic architecture of Bam can help us to interpret and define cultural materials in static contexts and apply them to contemporary disaster-stricken contexts.

The studying and documentation of buildings in Bam county was urgent in the first stage of this research because once architectural debris had been removed it would make it impossible to observe the influences of earthquakes on the architecture. In fact, by removing the debris, the entirety of the old context would be eliminated and a new one would be formed in its place. Therefore, in the case of domestic architecture, quick documentation was simply done to provide an instant salvage excavation at an abandoned site. This approach was only possible during the first stage of the research (2003–2005) as debris was removed quickly by heavy machinery. Due to the rapid (re-)construction process in the second and third years after the earthquake, this allowed for the documentation of new construction methods as well as new patterns of human behaviors in Bam and its satellite villages and settlements. It is noteworthy that although the role of the government and humanitarian aid agencies was the most effective with regards to the construction of residential buildings, the Bam survivors own agency was also effective.

The "Ethnoarchaeology and Contemporary Archaeology of Bam After the Earthquake" project was conducted by the authors and supported by the "Bam Citadel Foundation" from 2003 to 2008. The domestic spaces of the disaster's survivors were mainly studied during the first three seasons of the project before all the debris were removed and the older contexts were completely demolished. As explained below, both the houses in Bam, and also those of its satellite settlements and villages were surveyed.

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In this article, factors related to human agency are more strenuously highlighted, while the government's role is reduced in terms of general patterns. The scattered and modern style of patterns after the disaster allow for behavioral modeling (Chamberlain 2006; Hutson et al. 2007) and observing dynamic patterns of diachronic change (Mcilvaine-Newsad et al. 2003).

Unlike many other archaeological studies into domestic architecture, this article is based on studying a disaster-stricken context (Cronin and Neall 2000), and attempts to elucidate the rapid and short-term changes after a disaster which may be ignored when excavating ancient layers.

Concepts and terms

Building Style:
Refers to a set of factors including material type(s), structure, and arrangement (e.g., walls and roof), the types of relationships between parts, and the decorations within a residential unit.

Traditional Style:
Before the earthquake Bam was famous as one of the unique mud brick cities of Iran. In its historical districts, clay and mud bricks are the main building materials, the roofs are arched, and 30–60 cm thick walls support the weight of the roofs. Decorative features in such buildings include partitions between, or among, roof arches (**Fig. 1**).

Fig. 1. Traditional houses, Bam city.
Photo: L. Papoli-Yazdi.

Transitional Style:
In modern districts of the city, the buildings are unlike the traditional ones, which were mostly surrounded by palm gardens. Most of the buildings in this style are constructed of bricks, clay, and lime mortar for the walls, and soil and chalk for the roofs. Wooden beams and girders are used to construct flat roofs, and the walls carry the load of the roofs without having any organic relation with the roof. These buildings are mostly decorated with chalk layers, and tiles are used in specific parts like the kitchen and toilet (**Fig. 2**).

Fig. 2. Transitional style of houses, Bam.
Photo: L. Papoli-Yazdi.

Modern Style:
Most of the buildings in this style are constructed of bricks, cement, girders, and block posts. Roofs are flat and the building has a framework that transmits the roof's load to the walls. The major parameter of this style is having a framework. Buildings are decorated on the exterior with ornamental 3 cm bricks and cement, and on the interior by arches and paintings on chalk layers (**Fig. 3**).

Fig. 3. Modern buildings, Bam.
Photo: M. Dezhamkhooy.

Temporary Habitations:
These are domestic architecture temporarily inhabited after the earthquake, until the construction of permanent buildings was finished. They include tents, booths, and some modest houses built by the residents.

Permanent Buildings:
They include constructions that were built before or after the earthquake, and designed for permanent habitation.

Study sample

The city of Bam was destroyed by an earthquake on the 26th December, 2003. Approximately 40,000 people were killed, a further 30,000 people were injured (Tahmasebi et al. 2005), with 100,000 people being made homeless. Mudbrick villages and concrete buildings alike were all destroyed resulting in a dramatic change in the landscape. Two months after the earthquake, the Bam residents returned to what used to be homes, cleaned up the debris, and were forced to adopt new ways of life to adapt to their altered environment. As the survivors searched for bodies of their dead relatives and neighbors buried beneath tons of rubble, they attempted to reconstruct some semblance of their former lives with the assistance of the Iranian government and international relief agencies (Garazhian and Papoli 2008).

Bam county includes Bam city (the district center; **Fig. 4**) and five other cities: Baravāt, Rostam Ābād, Nezām Ābād (recently established), Fahraj, and Rigān. These cities are, sequentially, district centers of Markazi, Narmāshir, Rudāb, Fahraj, and Rigān. In addition to the district centers, there are also some large (more than 100 families), medium (20–100 families), and small (less than 20 families) villages in the mentioned districts. Some of these villages had been randomly documented, observed, and studied in different seasons of this research from 2003 to 2007. Overall, 247 new constructions were studied in Bam county's settlements during the first season. These constructions, which were comprised of two distinctive parts, were studied as two different samples. In the second season (2004), the post-earthquake building process and building classification were noted and some information was gathered to categorize the new and old styles. The information obtained about the domestic architecture of Bam county was gathered from 235 samples situated in Bam's five districts and its villages during the first two years after the earthquake.

In the third stage, due to the completion of (re-)construction processes in the satellite settlements, the field research moved to become more focused on the city of Bam itself. During the 2004 season, information was gathered from over 241 residential buildings from different districts of Bam. During this stage, the researchers mostly tried to cover the different villages which had previously been seldom studied. According to the studied districts of Bam, the city was divided into three general groups: dense residential houses, houses beside the roads, and houses situated in city-garden areas (a combination of agricultural lands and residential spaces). Sampling was performed using a random selection method to cover all types, different ethnic groups, and statues and situations in Bam county. Residential houses in each settlement were randomly selected for study as well; therefore, it is possible to make generalizations about the patterns of all settlements and domestic architecture within the confines of Bam county.

Styles of domestic architecture in the pre-earthquake settlements of Bam

The city of Bam

Overall, 94 buildings in different zones of the city were studied in the first season in Bam city. Of the analysed buildings, 20% were traditional in style, 70% were transitional, and 9% had modern styles. According to

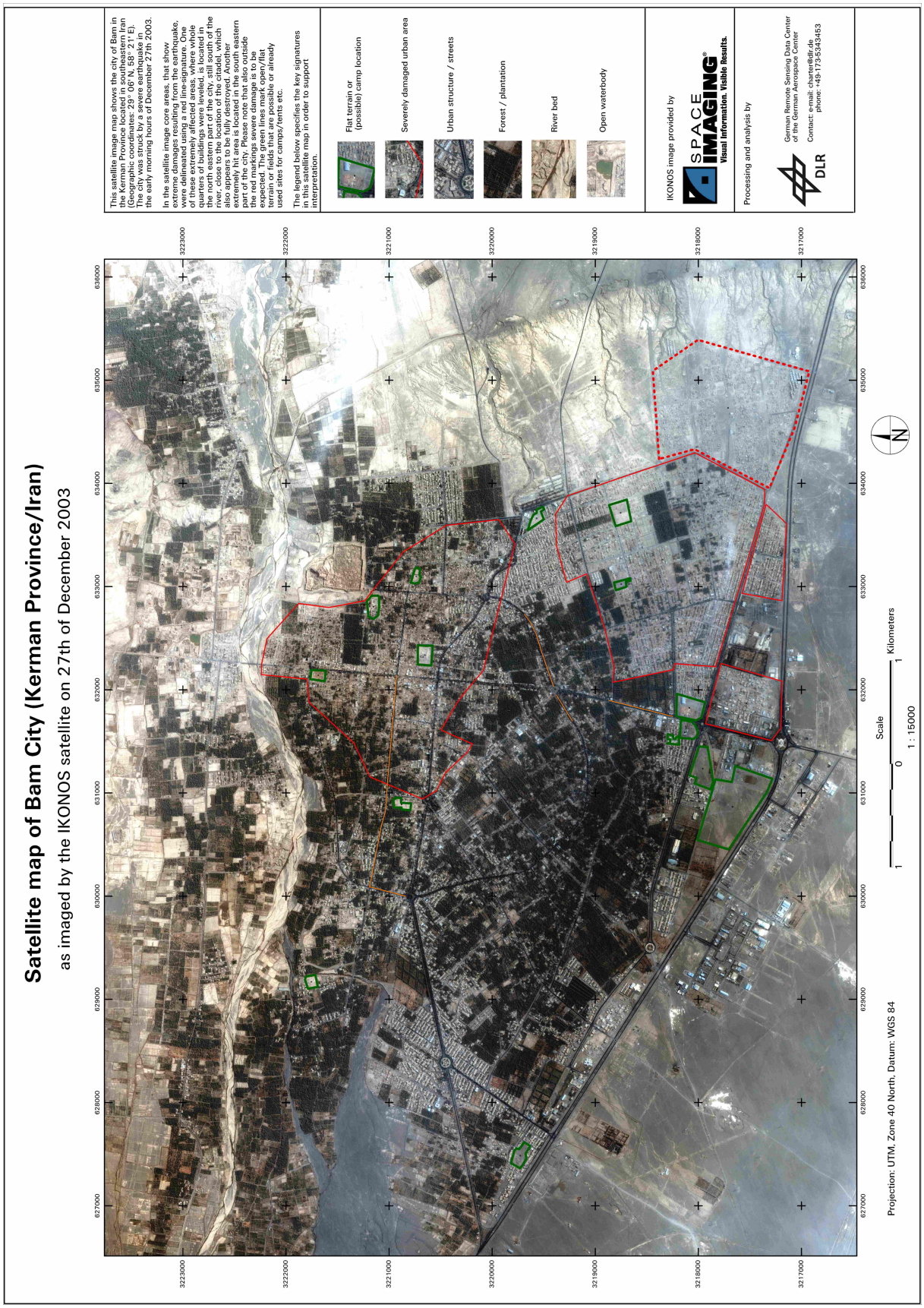

Fig. 4. Bam city after the earthquake.

the studied sample, the traditional buildings have been inhabited since about 70 years ago, transitional ones since 50 years ago, and modern style ones since 25 years before the earthquake.

Realistically, the appearance of one style does not deconstruct previous styles; yet, it is common in Bam to combine several styles together. Older buildings are mostly traditional in style; while more recent buildings have a modern style, and a wide spectrum of transitionally styled buildings are somewhere between these two other styles.

District centers

In the district centers, 39% of the residential buildings were of the traditional style, 52% were transitional, and 9% were modern style buildings. This means that more than half of them are of the transitional style.

Buildings in district centers can be aged as follows: traditional style buildings were built and first inhabited 80 years ago, the transitional ones date to 25 years ago, while the modern style buildings have been inhabited from 10 years before the earthquake.

Large villages

Generally, from the studied buildings, 67% of them had a traditional style, 32% were transitional, and 1.5% were modern in style. Therefore, in the large villages there was an abundance of traditional style buildings, compared to the other styles.

Traditional style buildings have been constructed and inhabited for 70 years, transitional ones for 25 years, and modern ones only became a common style of habitable building in the 15 years before the earthquake.

Medium villages

53% of the studied buildings were traditional in style, and 46% of them were transitional in style; producing an almost 50:50 split in these two building styles. No modern style buildings were observed in the medium villages.

The traditional style buildings have been inhabited for 40 years, and the transitional style buildings for 20 years before the earthquake.

The popularity of styles in the medium villages is almost similar to that of small villages, with the main difference being related to the number of transitional building styles, which had considerably increased during the recent years before the earthquake at the expense of the traditional style. However, the traditional style was still the most common in both medium and small villages.

Small villages

Traditionally styled buildings accounted for 75% of the studied buildings, whilst it was found that transitional style buildings accounted for 25% of the study sample in small villages. As with the medium villages, no modern style residential buildings were observed in these settlements.

In small villages, the age of the traditional style buildings dates back to 50 years ago, and the transitional ones were constructed 20 years before the earthquake.

Pre-earthquake construction style and residents' economic status

Domestic architecture can be defined in two ways in Iranian culture: firstly, a place for living in and, secondly, as a way of demonstrating the socio-economic status of the residents. This second aspect is more evident in local regions, in particular, where

investments in buildings are less common and renting out the buildings is not profitable.

Based on the studied cases in Bam, about 45% of the traditional buildings belong to low-income people/families, 47% to those of middle-income status, and 7% to high-income residents. This means that most of the residents in traditional-style buildings are from those with middle- and low-income status. For the transitional style buildings, 14% of the residents are of low-income status, 65% belong to those of middle-income status, and 21% to high-income status residents. This demonstrates, that for transitionally styled houses the majority belong to those of middle-income status. Following the positive correlation pattern between income status and the modernity of building style, 64% of the residents in modern-style buildings were of high-income status, and 35% were of the middle-income group. In our study it was observed that modern-style buildings were never inhabited/owned by low-income status people (**Fig. 5**).

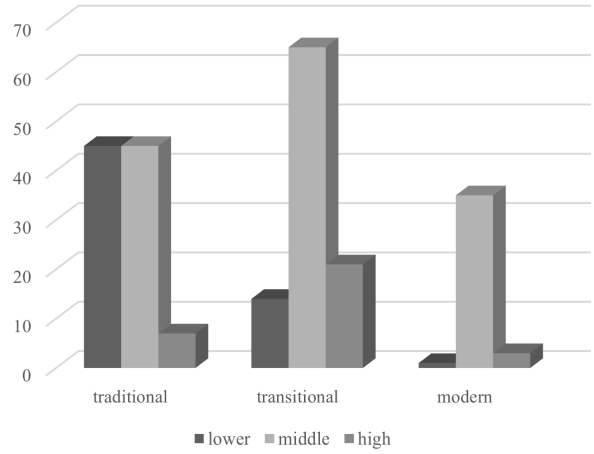

Fig. 5. Number of each construction style according to different economic statuses.

The amount of destruction was divided into four degrees when studying damaged and destroyed buildings. The first degree signifies the minimum rate of destruction (affecting 2.5%–5% of the total structure) and consists of decoration collapse and small cracks. In the second degree of destruction (30%–50% of the total structure) the walls and roof are generally still standing, but some parts may be collapsed. In the third degree (55%–75% of the total structure) the walls still stand, but the roof has completely collapsed. The fourth degree (80%–100% of the total structure) consists of complete disarray of the building structure; all parts have collapsed.

For the traditional-style buildings, 5% had the first degree of destruction, 27% the second, 22% the third, and 44% had the fourth degree of destruction. This means that nearly half of observed traditional-style buildings had >80% of their structure destroyed by the earthquake. In transitional-style buildings, 6% could be categorized as being destroyed to the first degree, 44% the second, 18% the third, and 30% had the fourth degree of destruction. Accordingly, the second and fourth levels had the highest degrees of destruction in transitional-style buildings. In modern-style buildings, 55% were destroyed in the first degree, 33% the second, and 11% the third. No modern style construction was observed having the fourth degree of destruction. This issue should be technically studied further.

Generally, in modern constructions, the first degree of destruction had the highest frequency; in transitional ones the second degree, and in traditional ones, the third and fourth degrees were the highest frequencies of destruction.

Post-earthquake construction processes and stylistic changes in Bam County

The (re-)construction process was studied in the second and third stages of this research in Bam County. It was also performed in all districts of Bam County, but on a smaller scale.

1. Fahraj District

Changes in the sizes of buildings:
The data for Fahraj district was gathered from the city of Fahraj and the villages of

Borj-Ma'āz, Jahān Ābāde Bālā, Borje Akram, and Dasht Ābād, and consists of 47 samples. The houses built by the government in Fahraj district occupy an area of about 60–80 m². In some cases, the area of building size occupied before the earthquake was different in size from the ones constructed after the earthquake. In 65% of the samples, the residential space decreased after the earthquake. In 17% of cases, the extension of the building increased, and in 17% there was no change in the residential area size.

The relationship between the size of post-earthquake constructions and socioeconomic status:
Post-earthquake buildings constructed by the government were of different sizes and each family – according to their financial means – chose the extent of the building. In Fahraj district, 13% of the buildings were constructed for high-income people, 82% for those of middle-income, and 7% for those of low-income status. In all high- and middle-income status groups, sampled in this study, the area of the newly constructed buildings is at least 60 m², however, 96% of the middle-income sample group include residences with 60 m², and only 4% have an area of 80 m².

Stylistic changes in post-earthquake constructions:
As was noted in the first stage of our study, the highest frequency of buildings, by style, were the transitional buildings in cities, and traditional buildings in villages. In the second stage of our study, it was noticed that there were stylistic changes, enforced by the government, with regards to the reconstruction of buildings. In Fahraj district, the traditional style used to be common before the earthquake, but, following the earthquake, 68% of traditional, 29% of transitional, and 3% of compound styles were converted into/or replaced by modern style buildings.

Configuration of the new building constructions:
New buildings constructed in the districts are in different configurations compared to those constructed before the earthquake. Almost all, 94%, of the new buildings constructed after the earthquake were built in an additional space to the previous ones, and 6% were completely relocated.

Assessment of building completion:
The construction process differs in various districts. In Fahraj, only 17% of the constructions were completed in 2005 with residents living in them. Currently, at the time of writing, 59% of buildings are still under construction, and 23% have not yet commenced construction.

2. Narmāshir District

Changes in the sizes of buildings:
The evidence for Narmāshir district was gathered from 44 samples from the city of Rostam Ābād, and the villages of Hossein Ābād-e Derakhti, Za'im Ābād, Tork Ābād, and Aziz Ābāde Pāin. The size of the buildings reduced (from pre- to post-earthquake context) in 86% of the samples; while in 13% of the samples the size of the buildings did not change, and none of the samples witnessed an increase in size.

The relationship between the size of post-earthquake constructions and socioeconomic status:
In the study sample, 20% belonged to high-income people, and 80% to those of middle-income status, and no low-income cases were observed. In those of the high-income group, 75% of the new buildings were constructed with an area of 60 m², and 5% had an area of 80 m². In middle-income group, 81% of new constructions were built with an area of 60 m², 6% with 200 m², and 12% with an area of 80 m².

Stylistic changes in post-earthquake constructions:
In Narmāshir district, 41% of the studied constructions were originally of the transitional style, 53% traditional, and 5.88% had compound styles (both transitional and

traditional). After the earthquake, all observed buildings in the study sample were re-constructed in the modern style.

Configuration of the new building constructions:
52% of the newly constructed buildings are in additional spaces to the previous ones. Of the new building constructions, 12% had distant, and 28% had nearby relocations. 8% of the buildings analysed as part of the sample study had been constructed exactly in the previous location.

Assessment of building completion:
For Narmāshir district: 16% of buildings are completed and inhabited by the residents, 41% have not been completed yet, and no construction action has begun in 42% of cases.

3. Rigān District

Changes in the sizes of buildings:
30 samples in Rigān district were gathered from the city of Mohammad Ābāde Rigān and the village of Seh Kahur. The building size has been reduced in 74% of the constructions, increased in 21%, and has not changed in 5% of the study sample.

The relationship between the size of post-earthquake constructions and socioeconomic status:
23% of the samples were considered as high, 54% as middle and 23% as low economic statuses. All of the Rigān district buildings are built with 60 m² areas.

Stylistic changes in post-earthquake constructions:
Three styles had been used in Rigān before the earthquake: traditional (84%), transitional (4%), and compound style (11%). All these styles were converted into the modern style after the earthquake.

Configuration of the new building constructions:
Recently built buildings consist of two configuration modes: buildings in additional spaces (86%), and relocated buildings (14%). There were no buildings constructed in the same place regarding pre-earthquake location in the Rigān district.

Assessment of building completion:
Residents are settled in 23% of the buildings; while 73% of the constructions have not been completed for habitation, and in 3% of cases, no building activity had started.

4. Rudāb District

Changes in the sizes of buildings:
Information from Rudāb district was gathered from the city of Nezām Ābād and the villages of Karuk, Ghāder Ābād, Lotf Ābād, Hojjat Ābād, and Mo'men Ābād. Moreover, the size (by area) of buildings has been reduced in 56% of cases, increased in 37%, and has not changed in 6% of recently built post-earthquake constructions.

The relationship between the size of post-earthquake constructions and socioeconomic status:
The buildings constructed by the governmental reconstruction headquarters in Rudāb district have an average area of 60–65 m². 20% of high-income, 72% of middle-income, and 8% of low-income have used the foregoing measures; so, there is no difference in building measures with regards to the different income statuses in Rudāb District.

Stylistic changes in post-earthquake constructions:
Before the earthquake there were traditional style buildings (52%), transitional (37%), a combination of transitional and modern (5%), and also modern (5%) style buildings in Rudāb district. All styles were converted into the modern style after the earthquake. This means that 5.26% of pre-earthquake buildings are similar to the post-earthquake buildings.

Configuration of the new building constructions:
53% of the recently constructed buildings are in additional spaces, 25% have been relocated, and 21% were constructed in the same place.

Assessment of building completion:
32% of the new buildings are not yet completely constructed, although 30% of the cases are completed, and in 37% of the cases the process of reconstruction had not begun yet.

5. Markazi District

Changes in the sizes of buildings:
The data from Markazi district was gathered from the city of Dehbekri and the villages of Khaje Asgar, Amir Ābād, Nārtij, Ahmad Ābād, Abārogh, Degfan, Aghche, and Khāne Khātun. The building size in 66% of cases decreased, while in 30% of the newly constructed buildings the size increased. No changes appeared in the sizes of 3% of the buildings.

The relationship between the size of post-earthquake constructions and socioeconomic status:
Among the studied samples of Markazi district, 36% of the samples were from high-income groups and 63.26% were from middle-income status peoples. No sample were of the low-income status. The average size of new buildings in all middle-income samples are considered to be about 60 m^2. 78% of high-income samples have an area of 46–85 m^2, 5% have a building size of 240 m^2, while 17% have an area of 120–180 m^2 area.

Stylistic changes in post-earthquake constructions:
Residential buildings in Markazi district were classified into three styles before the earthquake: transitional (39%), traditional (58%), and a combination of traditional and transitional styles (3%). All of these styles were converted into the modern style after the earthquake.

Configuration of the new building constructions:
Recently built structures of Markazi district are located in additional spaces (50%), 7% were relocated to areas not distant from their origin, 18% were distant relocations, and 28% of the newly constructed structures were built in the same place.

Aspects of post-earthquake domestic architecture and their differences compared to the pre-earthquake ones

Material types used after the earthquake

The government headquarters encouraged the residents to use materials that are more substantial and resistant to earthquakes after the earthquake. These materials generally have common qualities such as ductility, overweight resistance, homogeneity, resistance in at least two vertical directions, and the possibility of coupling generation with absolute resistance.

There is an increase in diversity of materials in the satellite settlements and villages. Ductility failure is the most important reason for material breakage as a result of earthquake shakes. Ductile metals, such as steel, used in constructions would not suddenly collapse; and thereby (complete) destruction rates would be less. Buildings with steel frameworks in Bam county were cracked, but had not completely collapsed.

Steel frameworks and reinforced concrete are now more commonly used in Bam instead of bricks. Rubble bricks are used for building corrals beside the new materials. But in the facings, 3 cm bricks and white cement are uniformly being used. Also pressurized bricks are being used instead of clay bricks. Block posts have become common for constructing the roofs. It should be noted that the light roof – which was only observed in one case – has a defect: it is not insulated against temperature changes, and an interior roof should be constructed in order to insulate the building, which raises the costs.

Also, Styrofoam, instead of bricks, was observed in two cases for the building of

walls; its major defect, however, is that it is flammable, but it is a very light building material.

Generally, fundamental changes can be observed in the material types utilised in post-earthquake constructions, including the replacement of traditional and local ones (such as mud bricks) with modern, exotic, and authorized materials.

Types of residential buildings and their durability

Overall, regarding the durability of the houses, three major building types were studied in this research: permanent, temporary, and compound (both permanent and temporary) buildings. A permanent building is constructed on a foundation, temporary ones include booths, prefabricated houses, and tents, and compound buildings are those used beside the permanent ones which do not have enough space but are utilised to help alleviate the mental condition of survivors (such as stress), or simply used to store everyday items.

From 241 studied samples (i.e., families/household groups), 53% have, so far, settled in permanent, 46% in temporary, and 6.2% in compound buildings.

Changes in the sizes of post-earthquake buildings in comparison to pre-earthquake ones

The sizes of the residential buildings

Residential buildings can be metrically categorized into four groups: under 85 m², 85 m², 85–100 m², and over 100 m². 197 samples were studied to analyse area extent; 23 had a size of under 85 m², 51 were 85 m², 24 were from 85 to 100 m², and 63 were 100 m².

It was observed that, for people/households of low-income status, 50% of the buildings had a size of less than 85 m², 33% were in houses with a size of 85 m², and 16% were in houses with a size of 85–100 m². No buildings for low-income status households had a building size of over 100 m². For middle-income families, 10% were residents of houses with sizes of less than 85 m², 25% lived in 85 m² houses, 11% in 85–100 m² sized buildings, and 32% live in houses with a size of more than 100 m². In the high-income samples, 23.5% of the constructions had a size of less than 85 m², 16% were 85 m², 11% lived in houses with a size of 85–100 m², and 52.9% were in buildings with a size of more than 100 m² (**Fig. 6**).

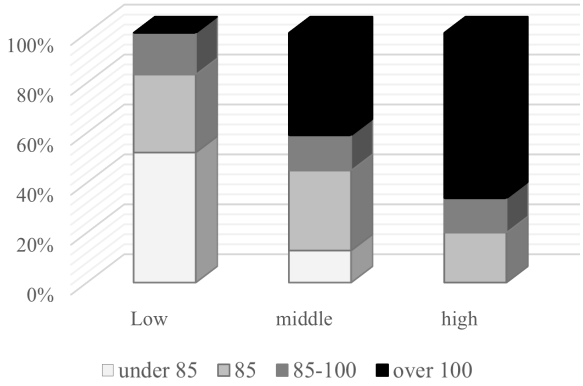

Fig. 6. The relationship between building extent and socio-economic status.

The relationship between socioeconomic status and changes in building size

In total, 204 samples were metrically studied, of which 177 had a reduced size compared with pre-earthquake ones, 13 had an increase in size, and in 14 cases no changes in size were observed.

The size in 72% of low-income status buildings decreased, while in 27% of cases there was no change in building size. There was no increase in size with regards to the buildings of this socioeconomic group. For the middle-income group, in 87.5% of cases there was a reduction in building size, in 5% of cases there was an increase in size, and in 7% of cases there was no change in size. For the high-income group, in 69% of cases there was a reduction in size, 23% demonstrated

an increase in size, and in 7.6% of cases there was no change in size. Generally, we can say that a decrease in building size was the most frequently observed size change. Size increases, when they occurred, were mostly in high-income households, as they have more capital to finance an increase in building size. Furthermore, high-income households experienced fewer changes in the size of their domestic spaces (**Fig. 7**).

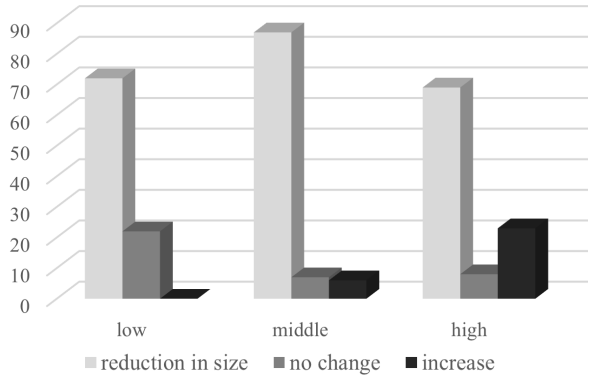

Fig. 7. Changes in building extents of different economic status compared with pre-earthquake ones.

Assessment of building completion

Five steps were considered to assess the rate and degree of completion of residential buildings: 1) only the foundation is laid, 2) the foundation and walls are built, 3) brickwork is completed, 4) the construction is completed, and 5) the construction is inhabited.

A total of 216 cases were assessed, of which 28 were in the first, 14 in the second, 57 in the third, 19 in the fourth, and 98 were in the fifth stages.

No low-income case was observed as being in the foundation and wall erecting stages. The brickwork was completed in 36% of samples, but no reconstructed buildings of the low-income group had been fully completed yet. However, 64% of low-income families were inhabited in permanent constructions.

In the middle-income sample group; 13% of new buildings were in the foundation stage, 7% were in the wall erecting stage, 29% had already finished the brickwork, 9% were completely finished, and 43% were inhabited by the residents.

In the high-income sample group; 18% were still in the foundation stage, none were observed as being in the wall erecting stage, 4.5% had finished the brickwork, 14% were completely finished, and 64% were inhabited by the residents.

The extent of completion and size of building foundations in the low-income group are shaped by the availability of government loans and, in general, are more limited in comparison with other income status groups. In some of the middle-income cases, the decision to construct larger foundations (thereby, a larger building size by area) resulted in the exhaustion of their government loans and unfinished construction due to a lack of further finances.

Building stages of the middle-income sample group generally lagged behind those of the high- and low-income sample groups. Studying the patterns of population replacement can help to further explain this pattern. It seems that the middle-income group included a lot of survivors who emigrated from the region, and the delay in returning has postponed the building activities of this income group (Papoli-Yazdi et al. 2016).

Residential building fences

A fence marks the limit of every residential construction. In Bam, every available cultural material was used to mark out the private limits after the earthquake. These fences were constructed using a wide spectrum of materials, from old refrigerator doors to blankets and pieces of tents. In the third stage of this research, 176 residential buildings with fences were studied. In 12 of the cases, they used the pre-earthquake fences, 141 of cases constructed new fences, and six cases used the remains of pre-earthquake

fences. In 17 cases, no fences marking the limits were observed.

In the low-income sample group, it was observed that in 67% of the cases they were fenced after the earthquake, and that 33.3% had not been fenced yet. From the middle-income sample group, 78% of samples were fenced after the earthquake; with 9% using pre-earthquake fences, 7% had no fences, and 5% were in the process of being fenced. For the high-income group, 100% of the observed cases had fences erected after the earthquake.

The fence situation with regards to building types

89.5% of permanent, and 71% of temporary buildings were fenced soon after the earthquake. Fences around 3% of permanent buildings, and 10% of temporary buildings existed before the earthquake. Buildings without fences accounted for 3% of the permanent buildings and 13% of the temporary buildings. Finally, 3% of permanent, and 6% of temporary buildings have been partly fenced.

Residential area and fences

84% of the buildings located in dense residential areas were fenced after the earthquake, 7% still use the pre-earthquake fences, and 5% are not fenced yet, with 4% of the fences in these residential areas being incomplete.

76% of buildings located in rural areas, and one unique roadside building, were fenced after the earthquake. 6% used the pre-earthquake fences, 14% had no fence yet, and in 4% of cases the fences were semi-complete.

Exterior decoration on residential buildings

The exteriors of 44 buildings were studied in this research. There are five post-earthquake decoration types used in Bam: 1) using exterior bricks (37 samples), 2) using marble stones (1 sample – from a high-income group structure), 3) using tiles and ceramics (1 sample – from a high-income group structure), 4) using white cement (1 sample – from one low-income group structure), 5) Roman exteriors (4 samples). This final type of exterior decoration is the most expensive type, and is becoming common in Bam on the buildings of the high-income status group.

Tiled Quranic verses and Imams' icons can be observed on buildings with a brick exterior. These icons were placed on the interior of the houses before the earthquake but were moved to the exteriors after the disaster.

Discussion and conclusion

In most archaeological researches that consider residential constructions, the standing structure is given more importance than the human agency and its individuality (Wallace 2002). Residential constructions are places in which the individuality of human agency becomes preserved, and where cultural and social behaviors are expressed (Guijarro 2004; Steadman 1996; Hutson 2002). One of the most important post-earthquake aspects is the destruction of the environment in which human behaviors can be meaningfully formed and where primary human requirements can be provided.

More than 90% of the domestic spaces of Bam were destroyed (Khatam 2006). More than half of the buildings with a 100% degree of destruction were traditionally styled (Ramazi and Soltani Jigheh 2006; Ahmadizadeh and Shakib 2004). The most important action, after providing food and water, restrooms, and burying the corpses in order to avoid infectious diseases, was to provide temporary accommodation for the survivors. The building of permanent constructions commenced two years later and were finished three years after the earthquake.

Since reconstruction efforts and activities were initiated by the government, the traditional style was completely abolished and was replaced by modern metal frameworks and concrete buildings. This change in building materials and the issuing of loans by the government was enacted in city centers and villages alike. The transitional and modern styles faced two diffusion processes in Bam before and after the earthquake. Firstly, the transitional style occurred in Bam city about 25 years ago, and this stylistic concept diffused to the villages. Later, the government encouraged Bam city residents to build assimilated constructions after the earthquake, with this concept then diffusing to district centers and villages.

Changes also occurred in the number of residences classified in each socioeconomic group and residential constructions after the earthquake. Generally, before the earthquake, traditional-style buildings were inhabited by low-income residents, and modern-style buildings were mostly inhabited by high-income families. Furthermore, there was a direct relationship between living space size and socioeconomic group. After the earthquake, distinguishing socioeconomic status according to building styles became impossible. In the process of post-earthquake reconstruction, the size of buildings belonging to the high-income group were reduced, whilst no tangible changes were noted for the other socioeconomic groups.

It was expected that it would be possible to observe changes between the socioeconomic groups by studying the residential constructions and cultural materials, the accumulation of movable wealth, and the decorations on the exterior of the buildings in a normal condition after the earthquake. On the other hand, the popularity of the modern-style constructions can be regarded as an indication of rapid changes in the socioeconomic groups due to their scarceness in cities and district centers. Traditional buildings have the highest degree of destruction and, generally, the number of deaths and injuries in traditional domestic spaces was more than double in comparison with those in the modern ones (Tahmasebi et al. 2005; Kuwata et al. 2005). It can, therefore, be reasoned that most of the injured people were from low-income families within the society. With this perspective, the assumptions about population changes according to the study of changes in socioeconomic status are confirmed.

So far, archaeology has mostly been engaged in the analysis of residential constructions without paying attention to their general dynamic context (Alison 1999). Static patterns of change in residential constructions are usually used as being suggestive of a permanent pattern in archaeological analyses. Furthermore, crisis headquarters only focus on reconstructing and reproducing similar construction patterns in the disaster-stricken context, and are less concerned with results of destruction of a specific style (Bouchon et al. 2006). Patterns derived from the dynamic contexts of residential constructions – as a combination of human behaviors, everyday material culture, and social statuses – can be utilized in archaeology. These patterns provide a useful function for understanding crises, and anticipating posterior processes because they are combinations of both contextual and residential situations, and can also be generalized. These are the patterns which enable researchers to identify residence models of pre- and post-disaster domestic architecture, and provide a realistic outlook on residence and settlement situations.

Acknowledgments

This article is a result of the "Bam Ethnoarchaeology and Contemporary Archaeology Project" supported by the Iranian Cultural

Heritage and Tourism Organization (ICHTO), the Rescue Project of Arg-e Bam after the earthquake, and the Iranian Center for Archaeological Research (ICAR). We would like to express our gratitude to Dr. S. Mokhtari for his support.

References

Ahmadizadeh, Mehdi, and Hamzeh S. Shakib. 2004. "On the December 26, 2003, southeastern Iran earthquake, in Bam region." *Engineering Structures* 26 (8): 1055–70. DOI: 10.1016/j.engstruct.2004.03.006.

Alison, Penelope M. 1999. *The Archaeology of Household Activities*. New York: Routledge.

Bouchon, Michel, Denis Hatzfeld, James A. Jackson, and Ebrahim Haghshenas. 2006. "Some insight on why Bam (Iran) was destroyed by an earthquake of relatively moderate size." *Geophysical Research Letters* 33 (9): L09309. DOI: 10.1029/2006GL025906.

Chamberlain, Andrew. 2006. *Demography in Archaeology*. Cambridge: Cambridge University Press.

Cronin, Shane J., and Vincent E. Neall. 2000. "Impacts of volcanism on pre-European inhabitants of Taveuni, Fiji." *Bulletin of Volcanology* 62: 199–213. DOI: 10.1007/s004450000079.

Garazhian, Omran, and Leila Papoli-Yazdi. 2008. "Mortuary practices in Bam after the earthquake: An ethno-archaeological study." *Journal of Social Archaeology* 8 (1): 94–112. DOI: 10.1177/1469605307086079.

Guijarro, Santiago. 2004. "Domestic Space, Family Relationships and the Social Location of the Q People." *Journal for the Study of the New Testament* 27 (1): 69–81. DOI: 10.1177/0142064X0402700105.

Hutson, Scott R. 2002. "Built space and bad subjects: Domination and resistance at Monte Albán, Oaxaca, Mexico." *Journal of Social Archaeology* 2: 53–80. DOI: 10.1177/1469605302002001597.

Hutson, Scott R., Travis W. Stanton, Aline Magnoni, Richard Terry, and Jason Craner. 2007. "Beyond the buildings: Formation processes of ancient Maya houselots and methods for the study of non-architectural space." *Journal of Anthropological Archaeology* 26 (3): 442–73. DOI: 10.1016/j.jaa.2006.12.001.

Khatam, Azam. 2006. "The destruction of Bam and its reconstruction following the earthquake of December 2003." *Cities* 23 (6): 462–64. DOI: 10.1016/j.cities.2006.08.008.

Kuwata, Yasuko, Shiro Takada, and Morteza Bastami. 2005. "Building damage and human casualties during the Bam-Iran earthquake." *Asian journal of civil engineering (building and housing)* 6 (1–2): 1–19.

Mcilvaine-Newsad, Heather, Amy Sullivan, and Michael Dougherty. 2003. "Household Composition Timeline." *Field Methods* 15: 305–17. DOI: 10.1177/1525822X03252383.

Papoli-Yazdi, Leila, Omran Garazhian, and Elaheh Alikhani. 2016. "Patterns of displacement and migration of Bam after earthquake." *Iranian Journal of Anthropological Research* 6 (2): 69–91. (In Persian)

Ramazi, Hamidreza, and Hossein Soltani Jigheh. 2006. "The Bam (Iran) Earthquake of December 26, 2003: From an engineering and seismological point of view." *Journal of Asian earth sciences* 27 (15): 576–84. DOI: 10.1016/j.jseaes.2005.05.009.

Steadman, Sharon R. 1996. "Recent research in the archaeology of architecture: Beyond the foundations." *Journal of Archaeological Research* 4: 51–93. DOI: 10.1007/BF02228838.

Tahmasebi, Mohammad Naghi, Kambiz Kiani, Shahriar Jalali Mazlouman, Afshin Taheri, Reza Shahriar Kamrani, Behnam Panjavi, and Bahador Alami-Harandi. 2005. "Musculoskeletal injuries associated with earthquake: A report of injuries of Iran's December 26, 2003, Bam earthquake casualties managed in tertiary referral centers." *Injury* 36 (1): 27–32. DOI: 10.1016/j.injury.2004.06.021.

Vaughn, Kevin J. 2005. "Household Approaches to Ethnicity on the South Coast of Peru: The Domestic Architecture of Early Nasca Society." In *Us and Them: Archaeology and Ethnicity in the Andes*, edited by Richard M. Reycraft, 86-103. Los Angeles, CA: Cotsen Institute of Archaeology, UCLA.

Wallace, Claire. 2002. "Household Strategies: Their Conceptual Relevance and Analytical Scope in Social Research." *Sociology* 36 (2): 275-92. DOI: 10.1177/0038038502036002003.