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Dachverband Lehm e.V.
Bundesverband zur Förderung des Lehmbaus

Building with Earth in Iran

January 2004

For earthen builders around the world, two events in Iran dominated the news in December 2003: the terra 2003 and the earthquake catastrophe in Bam. Both events, just three weeks apart, are tragically connected with one another.

The terra 2003, the 9th International Conference on the Study and Conservation of Earthen Architecture, took place from the 29th November – 2nd December 2003 in Yazd, approximately 400km from Bam. The Iranian Cultural Heritage Organization (ICHO) hosted the congress supported by a series of national and international organisations such as UNESCO, ICOMOS, ICCROM as well as several Iranian universities. Further information about the location and conference programme is available online at www.terra2003.org. One of the three excursions organised by the ICHO included a round-trip to Bam, and a photo of the old town of Bam and the citadel can be seen on the cover of the conference proceedings.

In the conference buildings, a glass case contained an adobe block from the region near Tehran from approximately 8000 B.C. Remains of adobe constructions have therefore survived over 10,000 years, proof that when used appropriately, earthen building materials can last for hundreds or even thousands of years in an environment which has been traditionally prone to earthquakes.

The citadel in Bam before and after the earthquake in December 2003

And in Bam too? Were builders from previous centuries cleverer than those of today? Initial television commentaries from the disaster areas appear to suggest that the building material earth is to "blame" for the high number of deaths and casualties which resulted from the recent comparatively moderate earthquake.

It is inappropriate at this moment in time to point the finger of "blame" as this can no longer help those who have died. However, it is clear that it is absolutely necessary to ensure that well-known principles of building for earthquake resistance are implemented and guidelines heeded, not just for new buildings but also for existing buildings, particularly in light of the fact that Iran has pledged to rebuild Bam.

An examination of the kind of damages suffered by the destroyed buildings shows clearly that many central principles of building for earthquake resistance have been neglected. This had already been recognised before the earthquake in Bam and also applies elsewhere, not only in Bam. The cautionary warnings from Iranian engineers and earthquake experts have not been forceful enough to bring about signi-

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ficant improvements. A similar catastrophe could feasibly happen in another Iranian town at any time, and history shows that Iran has often suffered earthquakes with a similarly tragic loss of life.

Even without an on-site investigation, the photographs of destroyed buildings do give some indication of causes for the large-scale of destruction suffered in Bam: **the heavy self-weight of the flat roofs** resting on the earth block walls.

Heavy flat roofs with earth coverings are a common feature in traditional buildings in central Asia due to their thermal resistance. However they are less favourable in earthquake conditions due to their heavy mass. Lightweight palm or poplar trunks, both tree species which thrive in oasis towns such as Bam or Yzad, serve typically as supporting construction.

In the "modern-day" buildings in the "new town" of Bam (and elsewhere) the timber roof joists have been replaced by steel girders, as they supposedly allow larger spans. Steel joists are considerably heavier than timber. In most cases the flange of the joist is simply laid directly on top of the adobe wall, without additional anchoring of joist and wall or a load-distributing ring beam. As a result the compression stability of the adobe blocks directly beneath the steel joists is often exceeded even in moderate earthquake conditions.

A typical floor plan of the adobe load-bearing walls of the "modern" houses in Bam can be described as U-shaped with the base of the U towards the street. In most cases there is only one entrance, possibly with additional ventilation openings. The long sides of the plan stand side by side with the neighbouring buildings and serve as supporting walls for the roof joists. Large full-height gates or shutters can be used to close off the open ends. In earthquake situations the inadequately-braced free ends of the walls often collapse allowing the heavy roof to fall into the house. This is also the case with freestanding walls made of fired bricks.

Destroyed buildings in Bam after the earthquake

A traditional Arabic courtyard house forms a "closed" square or rectangular floor plan. In earthquake situations each side is braced by the other perpendicular walls at the corners and intersections.

A further reason for the high loss of life is that the earthquake struck when most people were asleep inside their houses.

The adobe earthen bricks are **not** the central problem. It is possible to build adobe structures that could have withstood an earthquake of the strength of that experienced in Bam. The knowledge and skills are readily available. By way

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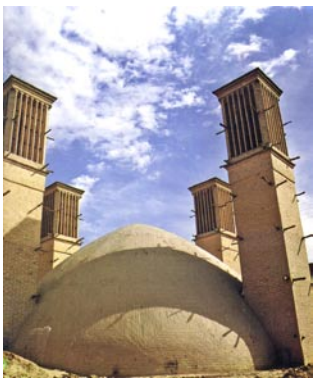
of example, the Bauhaus-Universität in Weimar, Germany, has been investigating building for earthquake resistance in central Asia using locally available materials (including earth) for more than 10 years. The research activities have been published in cooperation with professional colleagues in Uzbekistan and Kazakhstan. "Building for earthquake resistance" was also the subject of the author's paper at terra 2003. It was the only paper concerning this issue.

Conference location
terra 2003 in Yazd, Iran

It was also announced at the terra 2003 that a Centre for the Research and Documentation of Adobe Architecture will be established in Yazd supported by the Iranian government. Furthermore, it was suggested that the 10th International Conference on the Study and Conservation of Earthen Architecture, the terra 2006, should again take place in Yazd. Yazd was host to the 1st and 2nd conferences almost 30 years ago, though with fewer participants.

The decision whether and how to re-erect Bam, including the choice of materials and construction, will be made by the Iranian authorities. Building with earth bricks has been an integral part of Iranian architecture for thousands of years and this was also the main reason why Bam was a much-visited tourist destination. The opinion and expertise of the terra 2003 hosts, the Iranian Cultural Heritage Organisation, will certainly be sought; it is inconceivable that the citadel in Bam be rebuilt in concrete. The international opinion will also be important for the earthen builders and conservationists in Iran, as the old town of Bam is listed as a UNESCO World Heritage Site.

The Dachverband Lehm e.V. has arranged the LEHM 2004 conference to run parallel to the "denkmal 2004" international trade fair for reconstruction and building conservation in Leipzig from the 27th-30th October 2004. The "call for papers" is currently underway. In response to the situation in Bam and to reflect the participation of colleagues from Iran, we will be adding a fifth theme to the conference proceedings: **"Earthquake resistant construction with earthen building materials"**. To this end, the deadline for submissions for papers has been extended until the 15th February 2004. The Dachverband Lehm would like to give Iranian experts the opportunity for professional dialogue with international colleagues. The planned Centre for the Research and Documentation of Adobe Architecture in Yazd could play an important role in the dissemination and provision of guidelines for earthquake resistant construction using earthen building materials.



Earthen constructions
in Yazd, Iran:
Fort and water cistern
with wind cooling towers

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The international relevance of the catastrophe at Bam for building conservationists around the world is reflected in the decision by the president of the International Council on Monuments and Sites ICOMOS, Professor Dr. Michael Petzet, to act as official sponsor and co-host of the LEHM 2004 in October 2004.

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