

Twin Quakes

09 Jan 2004



On 26 December 2003, the town of Bam in Iran experienced an earthquake measuring 6.6 on the Richter Scale. More than 40,000 people were killed.

In one street, Edalat Alley, only ten were left alive out of several hundred residents (*The Guardian*, 03 January 2004). The total death toll may yet rise to 50,000, the highest earthquake toll for 25 years. However, less well reported was the identical earthquake that hit central California on 22 December. Measuring 6.5 on the Richter Scale, it resulted in the deaths of only 3 people when a clock tower toppled over in the town of Paso Robles (population: 25,000).

The depths of the earthquakes were also very similar, 10km for Iran and 7.6 km for California (making both shallow-focus earthquakes). How, then, can two near-identical hazards have such different impacts? The answer is that they are not really 'identical' hazards at all. A hazard is a function of both the magnitude of a physical event such as an earthquake and the state of preparedness of the society that is affected by it. Hazard risks (especially direct mortality) tend to be much lower for societies that possess the knowledge and financial capital to insulate themselves from the worst effects of the natural environment, such as the US.

The impacts of hazards are measured in ways other than direct mortality, of course. There are economic impacts to be considered as well as the irreversible loss of ancient monuments or historical landmarks. Long-term impacts cannot yet be known, as hazards can make their presence felt long into the future via insurance claims or losses in tourist revenues that impact negatively upon local economies.

Long-term impacts sometimes include a second wave of mortality that follows the hazard event when diseases spread through refugee camps. This was the cause of the extraordinary death toll of 650,000 that followed the Tangshan earthquake in China in 1975.

What caused the earthquakes?

The causes of the Bam earthquake are very complicated. The complex geology of the Asian highlands results from the movement of three plates: the Arabian plate, the Asian plate and 'the central Iranian block'.

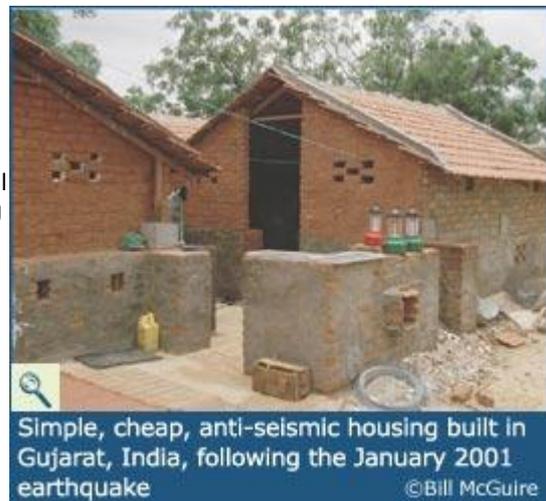
A sudden strike-slip movement along the flank of the Iranian block (similar to the processes that occur along the San Andreas Fault) is probably to blame (*The Guardian*, 27 December 2003).

The Paso Robles earthquake was centred on a series of **transverse faults** that run parallel to the San Andreas Fault, a **conservative plate margin**. Earthquakes are frequent in this region but it only become newsworthy when they strike a populated area, which magnifies the hazard severity. For instance, Monday's earthquake was the State's most powerful since 1999, when a non-fatal magnitude-7.1 event struck the desert near Joshua Tree. In contrast, the 1994 Northridge earthquake hit a densely populated area near Los Angeles and killed 72 people, injured 9,000 and caused an estimated \$15.3 billion in insured losses.

In LEDCs such as Iran, the risks associated with geophysical hazards are growing all the time as natural population increase and migration into cities outstrips any improvements that are made to building designs and safety regulations. There are now over 200 cities of more than 2 million people in the world and forty of them are within 120 miles of a tectonic plate boundary (*The Guardian*, 27 December 2003).

Notable impacts of the Bam, Iran earthquake include:

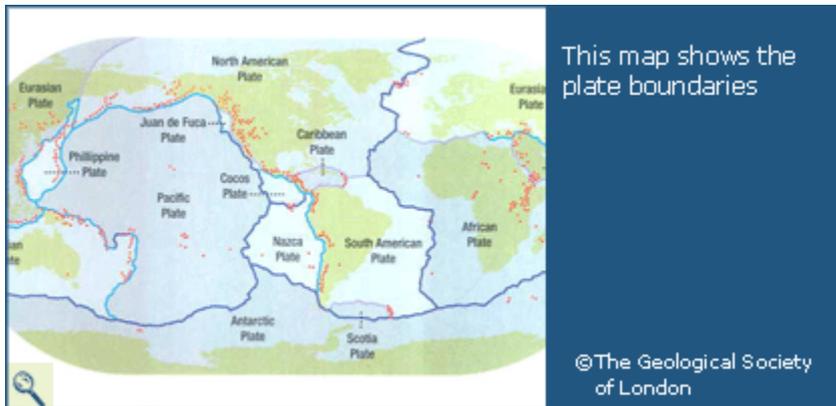
- Around 28,000 already confirmed dead due to the immediate collapse of poorly-constructed multi-storey homes with heavy roofs. Many of the city's buildings were made from mud-brick, which tends to disintegrate on collapse, meaning less chance of air pockets forming, in which people might survive.
- The irreplaceable loss of the historic monument of Arg-e Bam, an ancient citadel from the Parthian period which was over 2,000 years old.
- The likely *long-term* negative impact upon the local economy through loss of tourist revenues following the destruction of Arg-e Bam (it has always attracted around 100,000 visitors annually). This will compound the misery of Bam's population in coming years.
- Relatively low property and life insurance costs compared with the US, although modern industry and an airport are sited in the special economic zone at Bam (Daewoo car seats are made here).
- Rapid pledging of aid from other countries so that re-building should be quicker than otherwise.



In contrast, the impacts upon California include:

- Three lives lost (and 40 badly injured) in a region where great attention is paid to architectural design along the San Andreas Fault. Within 12 hours, search and rescue crews in Paso Robles had combed all seriously damaged buildings and had found all the quake's victims.
- 82 downtown buildings were identified as having at least some damage. Flexible structures, light roofs, diagonal bracing (to prevent rhombohedral collapse of buildings) and careful land zoning regulations all contribute to minimal damage to the housing stock for all but the highest intensity earthquakes.

- Paso Robles' irreplaceable historic clock tower structure, sometimes called the Acorn Building, was destroyed. It was made of wood and un-reinforced masonry, a type of construction no longer allowed under modern building codes.
- Closure of local airport due to cracks opening in the runway.
- About 75,000 homes and businesses in San Luis Obispo and Santa Barbara counties lost power after the quake, but service restored to all rapidly.
- Relatively high insurance recovery costs are anticipated for minor structural damage to the housing stock and airport.



In addition to the poor quality of the housing in Bam, another factor that contributed to the higher death toll than in California was the time of day when the earthquake struck. It was 5.10am on Friday, the Muslim day of rest, when most people were still in bed and were trapped by falling masonry. Had it been mid-day, greater numbers might have been relatively safe going about their business in the streets of Bam.

However, not all the news from Bam is bad. Early reports suggest that the relief efforts of the Iranian Red Crescent were excellent. Thousands of volunteers were on the scene within 24 hours and more than 90,000 tents were distributed in the first four days after the earthquake. University language students rushed to Bam from all over Iran to help foreign rescue teams in their efforts. A particularly cheering piece of news came on the ninth day, when a 97-year old woman was found alive and well beneath the debris. Experts have said it is rare for people to survive beyond three days without food or water in earthquake rubble.

Meanwhile, California Governor Arnold Schwarzenegger visited the battered downtown area of Paso Robles the day after the earthquake and vowed to raise aid for rebuilding. Schwarzenegger signed an emergency declaration that will allow San Luis Obispo County to get help from Sacramento as it recovers from the quake. "At 11 a.m. yesterday this was an American main street, alive with energy," he said. "Today this is a site of devastation. But we will come together once again as Californians and as neighbours. We will rebuild this town square."

Teachers' Notes for *Geography in the News* article "Twin Quakes: why do 'similar' earthquake events have very different impacts?"

<p>Themes / Geographical relevance</p>	<ul style="list-style-type: none"> • Earthquakes / hazard impacts
<p>11-16 curriculum</p>	<p>The contrasts between the impacts of the two earthquakes serve as a salutary introduction to the idea that hazards are an interaction between people and the environment. The impact has as much to do with the characteristics of the people that are affected as with the actual magnitude of the event itself. Working in groups, students could consider the different impacts that other events like floods or storms could have on different countries of the world.</p>
<p>AS/A2 exam tips</p>	<p>In addition to a strong appreciation of the relational nature of hazards (recognising the state of preparedness of a society is just as important as studying the physical processes that result in the hazard event), A2 students need to think carefully about what kind of 'impacts' they are addressing. These may be economic and cultural, in addition to the direct mortality that can result from hazards. There is plenty of scope for distinguishing between short-term and long-term impacts, as the article stresses.</p>