

SYSTEMATIC ANALYSIS OF BAM EARTHQUAKE ON DEC 26th 2003

***Dr. M.J.Andalibi
Director of Geological Survey of
Shiraz center,
Professor of University,
P.O.Box:71365-1183***

The overall damage of Dec 26th 2003 Iran (Bam) earthquake was dramatic and disastrous with substantial losses on everything. The epicenter coordinates of the main shocks are reported to be in 58°, 21' - 29°, 07' (location of Bam city) with a moment magnitude of 6/3 and a focus of about 10km of depth. The quake originated close to the Bam city at 185km southeast of Kerman province. BAM had about one hundred thousand in habitant, and it is considered as a city rich in cultural and heritage structures and deserted states near the Loot and Jazmourian depression. The intensity of the damages reached the degree X on the Medvedev sponheuer–karnik (MSK) scale . The MSK macro seismic scale is somewhat similar to the Modified Mercalli or The Mercalli–Cancani–Sieberg intensity, but with less uncertainty concerning the classification of the constructions and the degrees of the damages. The city of Bam and Baravat town some 5km from Bam were fairly damaged. Buildings collapsed completely. From west to east part of the area, increasing of damage is considered. At this place, a peak ground acceleration of 1g^v has been estimated at the basement of buildings founded on soft soil. Unfortunately there was no strong motion accelerograph in the more damaged zone, close to the epicenter. In relation to the MSK macro seismic scale and to the extent of the heavy damages, the horizontal acceleration is thought to have been around 8g^h in the epicentral area. The duration has been more than one minute.

Buildings collapsed in Bam and in the surrounding, where about 99% were destroyed and to the East side of Bam destruction reached to %100. It looked like a field of rubble and stones. The remaining suffered significant damages, and the villages have been weakly affected due to limited Cruising – Range (the result of specialty of this quake which will be explained below). This devastating earthquake claimed more than 40 thousand lives.

The quake occurred on confluence point of three segments. The first one is North-East (Ark Fault), by a left lateral sense. The second is North-South (Bam Fault), by a left lateral sense, and the third is West-East (Tahrood fault), distal part of the Nayband segments by the complex thrust and right lateral mechanism (transpressive). The Naybad segments are in North - South direction.

On the base of neomorphotectonic data (seismites), rupture and movement in north westward of Bam fault are considered in recent period (upper Holocene). Offset correlative in south of BAM by 6.5 km (in pre-quatarnary) Net rotation and left lateral underthrusting (sickle like). Although The Bam earthquake caused extensive damage, in parts of the Bam and in some near populated areas much closer to the North-Eastern part (confluence area of segments), the nature and scope of the damage is particularly surprising to seismologists and geologists concerning to the

incomparability between rate of damages and magnitude of 6.3 . The other problem is surface faulting and fissure was not founded along the Bam and other segments above the rupture defined by the main shock and after shocks.

Small crack in Baravat (5 km to Bam) can not be accepted as a document. Answering to these questions and specialties of such earthquakes (final aftershock of summer induced earthquakes), which are documented by this author, has been presented in the following abstract:

SUMMER INDUCED EARTHQUAKES FOLLOWS WITH LARGE QUAKES

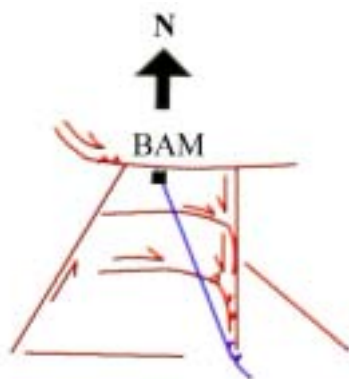
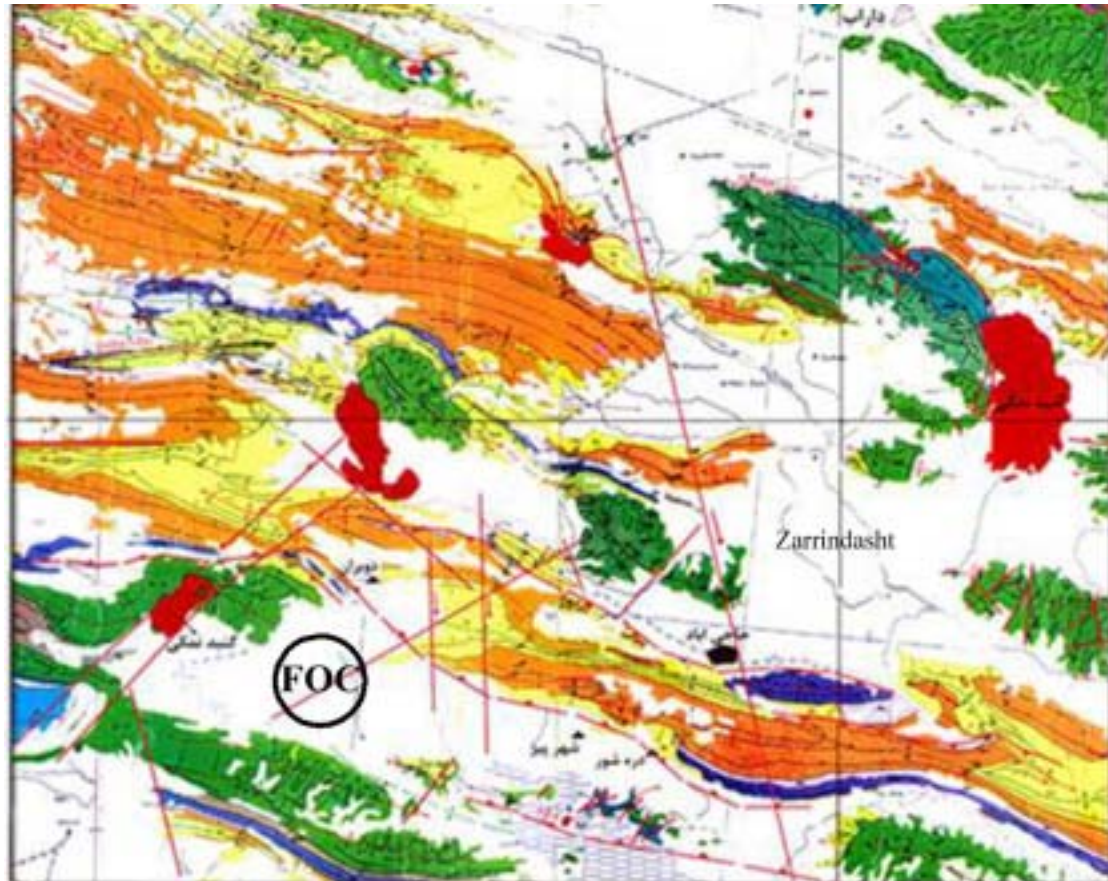
Dr.M.j.Andalibi Director of Geological Survey of Shiraz Center, P.O. Box:
71365/1183. Shiraz-Iran, E-mail: JSI.SHZ@MAIL.DCI.CO.IR

Studies around epicenter area of the Iranian earthquakes in last ten years (1993-2003), to distinguish ensuring seismic safety places (Microzoning) for reconstruction of cities and villages (by the author) indicates that most of the earthquakes, specially in Zagros belt (part of Alp-Himalayan belt) and similar areas are due to human activities. Among them, the summer quakes are very common and significant. The Zarrindasht (July 19th 2003, MS = 5.8), Khonj (June 30th 1996, MS = 5.7) and Bam (August 4th 2003, MS = 5.5) earthquakes are very good case studies. Abundance of these quakes is related to the rate of constancy in drought periods and human activities during the extremum of the hot climate (in warm season). In most important geological aspects, the first reason is the existence of thick sedimentary cover which overlay the shallow magnetic basement which is located abnormally near the surface.

Point 1: Usually, the location of summer quakes is restricted to the margin of young and smooth semi rhomboidal tectonic plain, but in their margin there is faulted zone with reverse mechanism which consists of thick and young saturated amount of water deposits which is comparable to seismic radiation zone and high seismic hazard zone. In general the plunge of structures around these plains is opposite of regional plunges and so on.

The Reason of quake: As previously mentioned the observed principle stress horizontally are considered (ANDALIBI, 1996) but in the area of quake secondary vertical stress dominate artificially -Concerning to water escape, it mostly occurs through the fault plans and discharge of water by irrigation wells etc.- which causes vertical and sudden collapse of saturated part of sediments that create sudden summer quake without pre-indicators on the surface and without crack and new fault line on the surface. So the unsaturated surface part of plain sediments (without water) remains like a semi cap rock .Due to irregularity of seismic radiation, the destructions are different and limited without distinct epicenter and hypocenter. -Identification of pseudo epicenter or multi point of hazard will be possible to find out, by the rate of destruction.-

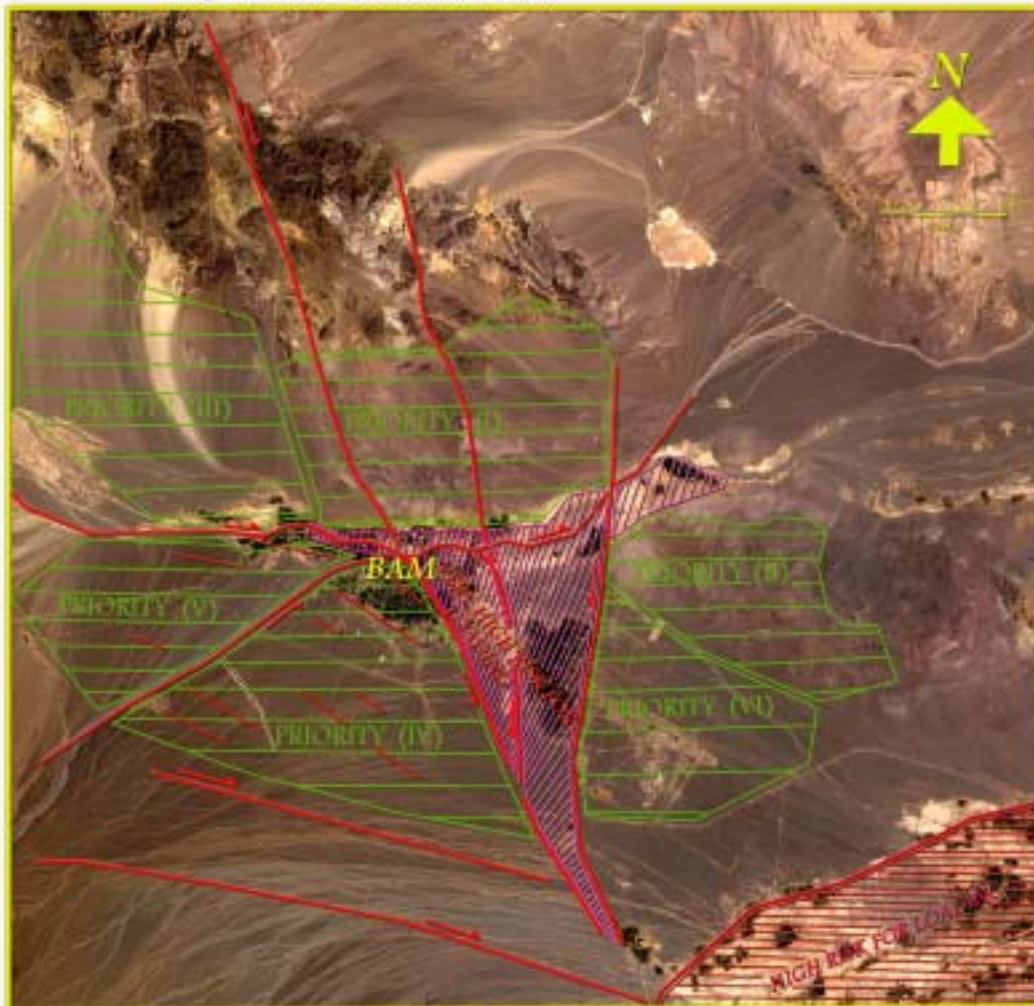
Point 2: The most important consequence is that the summer quakes usually follow by post-quakes (final stable equilibrium quakes) which occur several months or several years later and coincide with first season of raining and sever moisture. In fact every summer quakes follows with large magnitude quake in the first wet season, as it happened in Khonj area (Fars province) and Bam area (Kerman province) in Dec 26th 2003, and we must wait for another one in Zarrindasht area.



Active faults in Bam depression
(Schematic map)

PRELIMINARY MICRO ZONING OF BAM AREA

Preparation : M. J. ANDALIBI (2004) GEOLOGICAL SURVEY OF IRAN (SHIRAZ C.)



58° 21'