

= 2002 Bou 'in @-@ Zahra earthquake =

The 2002 Bou 'in @-@ Zahra earthquake ( also known as the 2002 Avaj earthquake or the 2002 Changureh earthquake [ a ] ) occurred on June 22 , 2002 . The epicenter was near the city [ b ] of Bou 'in @-@ Zahra [ c ] in Qazvin Province , a region of northwestern Iran which is crossed by several major faults that is known for destructive earthquakes . The shock measured 6 @. @ 3 on the moment magnitude scale , had a maximum Mercalli intensity of VIII ( Severe ) , and was followed by more than 20 aftershocks . At least 261 people were killed and 1 @, @ 500 more were injured .

According to the International Institute of Earthquake Engineering and Seismology ( IIEES ) , the earthquake was felt as far away as the capital city of Tehran , approximately 290 kilometres ( 180 mi ) east of the epicenter , although no damage was reported there . Most houses in the region were single @-@ story masonry buildings , and virtually all of these collapsed . The public became angry due to the slow official response to victims who needed supplies . Residents of the town of Avaj resorted to throwing stones at the car of a government minister .

= = Background and tectonics = =

The northeastern part of Iran lies across part of the belt of active continental collision between the Arabian Plate and the Eurasian Plate . Iran is crossed by several major faults , with 90 % of them being seismically active and subject to many earthquakes each year ; the area around the rupture experiences minor quakes almost daily . The most seismically active parts of this area are the Zagros fold and thrust belt and the Alborz mountain range . Qazvin Province , which is located between these two zones , suffers less earthquakes , but these may be more powerful because stresses have longer to build .

The Bou 'in @-@ Zahra earthquake was located in an area of active thrust faulting and folding , parallel and south of the southern edge of the Alborz mountain range , and was the 11th rupture in the previous two months in central Iran . A seismic inversion of long @-@ period P and SH body @-@ wave seismograms indicated a rupture on a thrust fault that dips 49 degrees to the southwest and had a centroid depth of roughly 10 kilometres ( 6 mi ) . The rupture 's mechanism of faulting was reverse .

Multiple @-@ event relocation of the main shock and aftershock epicenters and discontinuous surface ruptures recorded after the earthquake are compatible with northeastward movement on a southwest @-@ dipping thrust , although maximum recorded displacements were less than would have been expected from the observed magnitude . This suggests that most of the slip did not actually reach the Earth 's surface but caused folding at the surface . A previously unmapped thrust with little surface expression , the Abdareh fault , has been identified from the disruption of earlier drainage systems by the growth of the fold in its hanging wall , and is thought to be responsible for the earthquake . Such structures are known as blind thrusts , and have been responsible for many destructive earthquakes in Iran and elsewhere . The geomorphological effects of this particular fold have been partly obscured by the presence of an earlier Neogene topography . The Qazvin region was hit by an even greater earthquake in 1962 , which killed 12 @, @ 200 . In 1990 a rupture killed over 40 @, @ 000 people , injured 60 @, @ 000 , and left more than 500 @, @ 000 homeless .

= = Damage and casualties = =

The earthquake occurred at 02 : 58 UTC ( 7 : 28 a.m. Iran Standard Time ) , while many of the estimated 60 million Iranians affected were in their homes . Its duration was seven seconds , and the epicenter was near the settlement of Bou 'in @-@ Zahra in the Khar river valley , a mountainous farming region about 60 kilometres ( 37 mi ) from the provincial capital of Qazvin . The greatest damage was across an area best known for its seedless grape harvesting , a getaway for wealthy residents of Tehran . At least 261 people were killed , 1 @, @ 500 injured , and 25 @, @ 000 left homeless . An earlier death toll was reported as 500 , but this number was believed to be inflated

once it became known that some of the severely injured had been mistaken for dead . Most of the dead were women , children and the elderly , as many of the men were working in local vineyards . Over 20 aftershocks were recorded , with magnitudes up to 5 @. @ 1 on the moment magnitude scale . At least three of these caused further casualties and damage , most of which were within a 25 kilometres ( 16 mi ) radius of the main shock .

An estimated 5 @, @ 000 buildings were damaged beyond repair . In the Qazvin province , 120 buildings were demolished and 50 villages suffered massive damage . In the neighboring Hamadan province , 45 villages were destroyed . A large majority of houses in the region were single @- @ story masonry buildings , and virtually all of these collapsed . As non @- @ engineered structures , these could not withstand seismic forces , with structural failure and collapse resulting from wall @- @ to @- @ wall separation and the lack of structural integrity and of a proper lateral system of resisting . Newer structures built in accordance with the Iranian code of practice for seismic @- @ resistant design fared much better . Damage to the historic Kharaqan tomb towers , which were in a good state of preservation before the event , suggests that the earthquake was possibly one of the most powerful in the region for approximately 900 years .

At a station 28 kilometres ( 17 mi ) from the epicenter , the maximum horizontal and vertical accelerations were recorded to be roughly 0 @. @ 5 g and 0 @. @ 26 g . A bridge collapsed as a result of the disaster . Water and irrigation systems were severely damaged near the epicenter , and water facilities were demolished in nine villages . Many of the main water pipelines in the affected areas were damaged or destroyed , causing inadequacies in water availability and quality . Surface cracks were observed in Ab Darreh and Changureh , the villages that suffered the heaviest damage , being roughly 25 kilometres ( 16 mi ) from the epicenter .

The relatively low levels of damage in the towns of Avaj or Ab @- @ e @- @ Garm in comparison to Changureh and Ab Darreh suggest a focus of damage to the northwest of the epicenter due to northwest propagation . In Changureh , only two buildings were left standing and over 120 casualties occurred . Ab Darreh also fared poorly ; the disaster destroyed the town 's only mosque , toppled 40 homes and killed at least 20 people . North of Avaj , in the village of Esmailabad , survivors recovered 38 corpses , a ninth of the total population , while searching for the missing , feared trapped in the ruins . In another village in the vicinity , Aliabad , two shepherds were the only known survivors . In the small village of Kisse @- @ Jin , roughly 80 corpses were recovered following the rupture . Survivors crying and beating their heads and faces over loved ones were a common sight on Iranian state television .

The cost of the damage was estimated at US \$ 91 million . [ d ] The quake was felt across a wide area , including the provinces of Qazvin , Gilan , Kurdistan , Zanjan , and Hamedan . Of all these , Qazvin was the most heavily damaged , with an unnamed Qazvin official reporting that 177 had died in the province . It was also felt in the capital of Tehran , roughly 290 kilometres ( 180 mi ) east of the epicenter , although no serious damage was reported . However , Iranian journalist Borzou Daragahi reported that in Tehran he saw buildings sway and glass objects shatter .

= = Landslides = =

The Bou 'in @- @ Zahra earthquake triggered 59 landslides over an area of about 3 @, @ 600 square kilometres ( 1 @, @ 390 sq mi ) . Landslides formed due to the quake included 47 falls and topples , nine slides , and three lateral spreads . The largest of these slides was a rockslide , 150 × 100 m ( 490 × 330 ft ) , which occurred southeast of Changureh . Landslides triggered by the quake occurred more often in the geologic areas most susceptible to damage , where there were many landslides before .

= = Relief efforts and aftermath = =

The Red Crescent Society sent relief workers , detection dogs , 100 tons of food , 1 @, @ 000 tents , 2 @, @ 500 blankets , and mobile kitchens to the earthquake @- @ stricken area . In addition , the Iranian army supplied soldiers , machinery and water trucks . To prevent the spread of disease ,

villages were sprayed with disinfectants and their inhabitants were given tetanus shots , among other measures . After Iranian officials launched an appeal for assistance , the United Nations Development Programme supplied \$ 50 @,@ 000 . The United Nations ' Office for the Coordination of Humanitarian Affairs ( OCHA ) mobilised a United Nations Disaster Assessment and Coordination ( UNDAC ) team , deploying five members . Pope John Paul II prayed for the earthquake victims and asked for a " generous " response .

United States President George W. Bush offered aid to Iran , which he had previously called part of an " axis of evil " . According to him , " human suffering knows no political boundaries " and he stood " ready to assist the people of Iran as needed and as desired " . However , the Iranian government refused his help , though it called for the help of non @-@ governmental agencies .

According to Hossein Rahnema , head of the Red Crescent in Changureh , the society " levelled an area to put up tents but most people wanted to stay next to their houses to look after their property " . Survivors instead lit small fires amongst the rubble to protect against freezing temperatures . The Iranian President at the time , Mohammad Khatami , declared three days of mourning and visited earthquake @-@ stricken areas on June 25 . Hospitals struggled to cope with the surplus of patients , discharging non @-@ critical ones from their wards . The Associated Press stated that 20 funerals were held on June 23 , 2002 at a cemetery overlooking the village of Abdareh . A bank account was started to handle public donations for the families of the dead .

Often armed with no more than shovels and spades , soldiers and civilians dug for bodies in the rubble . Other than this , rescue workers were faced with a number of obstacles , including the temperatures of the villages damaged . They were warm during the day , although the villages grew colder at night , making rescue work harder and threatening the health of the homeless and anyone alive and trapped under the debris . Many civilians were discouraged from helping due to fear of aftershocks . According to Gary O Shea of International Rescue , the volunteers did not have enough technical equipment , and the religious leaders seemed unwilling to contribute much . Official rescue work ended on June 24 , 2002 , when rescue workers said there were no more survivors .

= = = Public reaction = = =

Of the roughly 80 villages that suffered heavy damage , the Iranian government claimed that relief work was mostly complete . Residents of Changureh , however , complained that tents , food , and medicine had not reached them , after waiting in near @-@ freezing temperatures . A man from Avaj stated that only locals helped uncover the body of his child . In protest at Iran 's slow response to the tragedy , some 300 people blocked the main road through Avaj . On June 23 , " dozens " of Avaj residents threw stones at Interior Minister Abdolvahed Mousavi @-@ Lari 's car in anger at the government 's delay in providing relief . They also claimed that the death toll was higher than official reports said it was .

= = = Reconstruction = = =

Electricity was restored to affected areas by June 25 . On November 9 , 2002 , the World Bank granted \$ 225 million towards the reconstruction and economic rehabilitation of the area devastated by the quake . Reconstruction of housing and infrastructure by provincial authorities was interrupted for almost four months ( November 2002 ? February 2003 ) due to harsh weather conditions . In August 2003 , the reconstruction was completed in all villages affected by the earthquake .