

発生日時/Date and Time [Local Time]	3:42, 29 July 1976	被害/Damage	
震央/Epicentre [Lat, Lon, Depth]	39°56'N, 117.87°E, 23 km	死者/Deaths	242,000
規模/Magnitude [Richter Scale]	7.8	倒壊建物/Collapsed buildings	94%

1 地震と被害概要

震央は、北京：Beijing市の東南東約200kmの人口100万人の炭坑・工業都市唐山：Tangshan市の直下。被害は半径100kmに及んだが、唐山の中心市街地では、長径10km、短径6kmの楕円状に震度11（中国震度階、JMAの6～7に相当）を記録。死者数は、今世紀最大である。

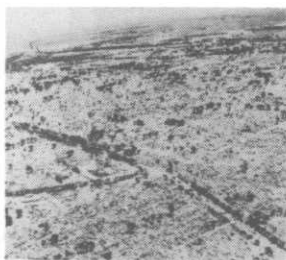
中国では、1966年の邢台地震以降、地震予知を緊急国家事業とし、地震予報に「長期予報：数年以上前」、「中期予報：1～2年前」、「短期予報：数カ月前」、「臨震予報：数日前」の段階を設け、海城地震（1975）、竜陵地震（1976）の予知に成功していた。唐山地震においても、発震の1ヵ月前に「短期予報」を出していたが、「臨震予報」は発令できなかった。

唐山市では、建築物の設計震度が6（中国震度階）であったため、住居の94%、産業施設の80%が全壊し、鉄道・道路・電力・電話・上水等も壊滅した。しかし、幸い火災は発生せず、死者の大半は、崩壊した建物の下敷となったものである。

2 復旧と復興

応急対策は、中心部の道路が瓦礫に埋まったため、困難を極めたが、まず、人命の救出と被災者の生活安定に重点が置かれ、次いで、衣食住の確保がなされ、約40万戸の応急仮設住宅が建設された。

復興は、都市計画の段階から設計・施工に至るまで地震の教訓を生かした耐震防災指導指針に基づいて、1979年7月に着手された。復興計画の骨子は、従前の市街地をシティーセンターとし（計画人口40万人）、比較的震動の弱かった地区に新区（ニュータウン：25万人）を建設するとともに、郊外の鉱山町に30万人を収容するというものである。この3地区は、互いに25km離れ、それぞれ、鉄道・道路で結ばれている。市内には幅員50mの幹線道路、一人当たり6㎡の公園が造られ、上水・電力の供給は多重化が図られている。



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△ Ruins of Tangshan after the Earthquake ("The Mammoth Tangshan Earthquake of 1976 Building Damage Photo Album", China Academic Publishers, 1986, pp 5)

1. The Earthquake and Resulting Damage

The epicentre was just under Tangshan city, an industrial and coal mining city with a population of 1 million. The city is located about 200 km east-south-east of Beijing. The radius of the damaged area was 100 km. In the central business district, seismic intensity was recorded at 11 (according to Chinese Seismic Intensity) in the ellipseshaped area with the major axis of 10 km and the minor of 6 km. The death toll was the largest ever recorded in the 20th century.

After the Kaidai Earthquake in 1966, earthquake prediction had become an urgent national project in China, and the government established an earthquake warning system: long-term prediction several years before the earthquake; mid-term prediction 1-2 years before; short-term prediction several months before; the final prediction several days before. The system successfully contributed to predicting the Keizing Earthquake in 1975 and the Ryungnung Earthquake in 1976. In case of the Tangshan Earthquake, although the short-term prediction was issued 1 month before, no prediction was issued immediately before the earthquake.

In Tangshan city, where the building code allowed for a design magnitude of 6, 94 per cent of the houses and 80 per cent of the industrial facilities were destroyed. Infrastructures such as railways, roads, electricity, telecommunications, water and sewerage systems were badly damaged. The earthquake, however, did not trigger fires. Most of the people who died were crushed under the collapsed buildings.

2. Recovery and Reconstruction

Because the streets in the central part of the city were buried, it was difficult to carry out emergency response activities. Response measures firstly concentrated on the rescue, and later, on measures to rehabilitate the livelihood of the inhabitants. Approximately 0.4 million temporary shelters were constructed.

Reconstruction started in July 1979, in accordance with the guidelines on disaster prevention measures against earthquake. The reconstruction aimed at rehabilitating the previous built-up areas as a new city centre, with a target population of 400,000, and at constructing a new town in the least damaged area, with a target population of 250,000. It was also planned to resettle 300,000 people in coal mining towns in the suburbs. These areas are 25 km away from one another and connected by roads and railways. Within the inner city, 50 m wide highways were constructed, 6 m² of park per capita were allotted and multiple systems for water and electricity supply were established.

◎ Streets of Tangshan before the Earthquake ("The Mammoth Tangshan Earthquake of 1976 Building Damage Photo Album", China Academic Publishers, 1986, pp 1)

発生日時 / Date and Time [Local Time]	19:35, 23 November 1980	被害 / Damage	
震央 / Epicentre [Lat., Lon., Depth]	40.914°N, 15.366°E, 10 km	死者 / Deaths	3,114
規模 / Magnitude [Richter Scale]	6.9	被災建物 / Damaged buildings	100,000

1. 地震と被害概要

本震は、イタリアのナポリ市の東方約100kmのLaviano近傍で発生した。マグニチュードは、 M_L で6.5、米国USGSによる M_s は6.9と発表されている。余震は本震震央の北西側25kmの付近に集中して発生し、大きな被害はこの地域を中心に生じ、典型的な直下型地震とされている。

この地震による被害は、死者3,114名、負傷者7,671名、および行方不明1,575名とされた(12月10日時点でのイタリア内務省による)。住宅・学校等、約10万に及ぶ建築物が完全に崩壊する等の被害を受け、総被害額はイタリアリラ20兆にも及ぶと言われている。被害を受けた建物の構造は、木造床組の組積造および石造の建物と鉄筋コンクリート構造にレンカ壁を積み上げたものである。これらの構造は、重さに対して抵抗力が小さいうえに、粘りに欠けるため、瞬時の倒壊に至ったと考えられる。また、重量が大きいため、救援、復旧に当たっても困難が伴い、被害をさらに拡大することになった。

2. 北イタリア地方への地震警報の発令

1985年1月23日、公共防災省は、北イタリア地方(ボローニア及びフィレンツェを含む)に対し、地震警報を発令した。これは国立地球物理研究所のボスキー等の専門家による進言を受けて発令され、48時間以内にMM階で10(気象庁階で6相当)規模の大地震の発生が警告され、避難等の注意事項も勧告された。結局、この地震は発生しなかったが、地震警報の在り方に関する教訓となった。

1. The Earthquake and Resulting Damage

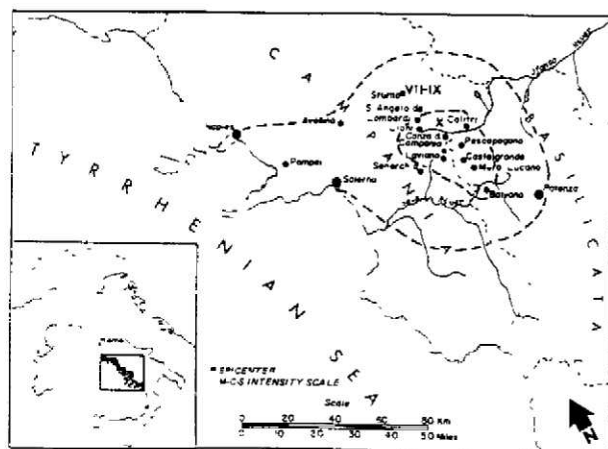
The earthquake occurred near Laviano, about 100 km east of Naples, Italy. The local magnitude M_L was reported 6.5 by Italian agencies, while the preliminary surface magnitude M_s was reported 6.9 by USGS. A number of aftershocks were observed within the region, 25 km northwest of the epicentre. The damage was most serious in this region. The earthquake was reported to be a typical earthquake with a vertical shock.

The damage was concentrated in the regions of Campania and Basilicate. The casualty figures were 3,114 dead, 1,575 missing, and 7,671 injured (by the Italian Ministry of Interior, 10 December 1980). About 100,000 buildings, including schools and public facilities completely collapsed during the shock. The estimated loss of properties reached US \$15-20 billion. The typical construction of buildings destroyed used rigid unreinforced brick or stone masonry walls with weak mortar and roofs of wooden beams and heavy clay tiles, or reinforced concrete frames with masonry bricks. Because the lateral resistance capacity of the buildings was insufficient and the ductility capacity inferior, structures must have collapsed suddenly, leading to serious disasters during the shaking.

2. Seismic Warning against Earthquakes in North Italy

On 23 January 1985, the Ministry of Civil Protection of Italian Government issued a warning against a large-scale earthquake, which would yield intense shock of 10 MM scale level within 48 hours, in the northern provinces of Italy, including Bologna and Florence. A shock with magnitude of 4.2 occurred at 11:10 pm on 23 January 1985. While the magnitude of the shock was small, historical data indicates that large-scale earthquakes occurred following foreshocks.

Receiving advice from consulting members, the Ministry issued the warning at 8:12 pm. Although the earthquake did not occur, the experience helped to identify the concrete importance in giving an adequate seismic warning.



Isoseismal Map of Epicentral Area From EERI Report by H. Lagorio et al.



A Damaged House in Laviano (By courtesy of Dr. Murakami)