発生日時／Date and Time [Local Time]	19.47, 3 March 1985	被害／Damage	
震央／Epicentre [Lat., Lon., Depth]	33.13°S, 71.87°W, 15 km	死者／Deaths	179
規模／Magnitude [Richter Scale]	7.8	被災建物／Damaged buildings	221,000

地震と被害概要

本震は、中南米の太平洋沿岸諸都市であるサンアントニオ、バルパライソ、ビニアデルマール等に大被害を与え、震源から160km離れた首都サンチャゴにも被害が生した。この地震は、太平洋のナスカプレートが南アメリカプレートにもぐりこむ形で生した逆断層型の地震であり、津波は、生じていない。

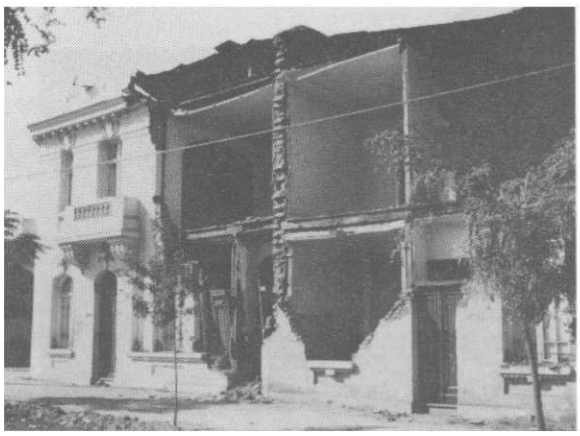
なお、今回とほぼ同じ震源域で、1906年にMs 8.4の大地震が、また1971年にもその近くにMs 7.9の地震が起こっている。

この地震により、アドベ（日干しレンガ）造住家の倒壊は7万3千戸、損傷は14万8千戸に及んだ。アドベ造の耐震性は、チリ国の大きな課題である。古いレンガ造や石造、中空ブロック造も被害を受けたが、木造には殆ど被害はなかった。

RC造建物の大破は10数例を数えた。いずれの被害も、構造の不整形生、ピロティ、施工不良、構造計画の不適切、山地形による地震動の増幅など、耐震構造上重要な問題を含んでいる。一方、激震地においても多くの中低層、及び高層RC建物は無被害であり、耐震設計の重要性を示した。また、斜面に沿って建てられた階段状RC造アパートが斜面全体の滑動により大被害を生じ、地滑りの危険性を痛感させた（ビニアデルマール）。

ライフライン関係では、上下水道の被害が広範囲にわたって生じ、最も震源に近いサンアントニオでは、給水能力は1ヶ月後で50%であり、ビニアデルマール、バルパライソ等でも復旧に10～20日を要している。橋梁、道路の被害が多く、また港湾施設も被害が大きかった。電力の被害は、軽微であった。

なお、この地震により、各地で多数の強震記録が得られている（水平最大655ガル）。



Damaged Adobe House (By courtesy of Prof. Shibata)

The Earthquake and Resulting Damage

The Chile earthquake caused serious coastal damages to cities, such as San Antonio, Vina del Mar, Valparaiso, and Santiago, the capital city located about 160 km away from the epicentre. It occurred in the subduction zone of the Nazca plate underneath the South America plate. No tsunami occurred. It is to be noted, that a big earthquake of Ms 8.4 occurred in almost the same fault area in 1906, and also an earthquake of Ms 7.9 in 1971 in a close fault area.

The earthquake completely destroyed 73,000 adobe houses and damaged 148,000. Old buildings made of bricks, stones or hollow bricks were damaged. Wooden houses, however, suffered little.

More than ten cases of heavy damage to reinforced concrete buildings were observed. This was due to various architectural reasons such as structural irregularity, vulnerable piloti, poor construction, inadequate framing, or topological effects on earthquake motions. Reinforced concrete apartments on the hillside were largely damaged from landslides. Water supplies suffered severe damage in a wide area. In San Antonio where the damage was the severest, the capacity of water supply was still reduced to 50 per cent even after one month. In Vina del Mar and Valparaiso, it took about 10-20 days before the supply system was restored. Damage to bridges, roads and facilities at the harbour was significant. The electricity supply was scarcely damaged, however.

Strong earthquakes were recorded at more than thirty stations (maximum horizontal acceleration was recorded 655 Gal).

Collapsed Piloti of Reinforced Concrete building in Santiago City (By courtesy of Prof. Shibata)

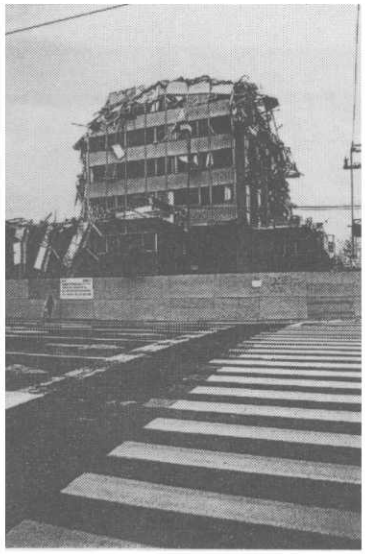
発生日時／Date and Time [Local Time]	7 18, 19 September 1985	被害／Damage	
震央／Epicentre [Lat., Lon., Depth]	18 266°N,102.748°W, 33km	死者／Deaths	4,334
規模／Magnitude [Richter Scale]	8.1	倒壊建物／Collapsed buildings	5,728

1．地震および被害概要

震源は、メキシコ市から西方約300km、北アメリカプレートの下にココスプレートがもぐり込んでいるメキシコ西海岸沿い地点。翌20日の午後7時37分にマグニチュード7.5の余震発生。震央はほぼ同位置。この連続地震のメキシコ市の被害は、メキシコ政府発表によれば、死者4,287人、負傷者14,268人とされている。メキシコ市以外では、47人の死者、424人の負傷者が報告されている。建物の被害は、完全に崩壊または全壊状態のもの、3,250棟、半壊2,478棟、合計5,728棟で、その内、スペイン統治時代からの日干しレンガ造りの老朽住宅の被害が65.4%を占めた。又、高層集合住宅、官公庁舎、事務所など近代耐震建築の被害も80棟以上に及び、長周期地震問題がクローズアップされた。電気はほぼ市内全域にわたり3日間停電し、水道も13日－20日間断水した。発震と同時に火災が発生し3日間の間に351ヵ所から出火、内1件は隣接棟に延焼した。総被害額は、CEPALの推計によると、間接被害も含めて、約40億ドルと見積られている。

2　復旧と復興

高層耐震建築に多くの被害が出たことから、地震後直ちに市内の全高層建物の診断を行い、崩壊の危険のあるものについて、使用禁止措置をとり、二次災害の発生を防いだこと、多量の被害のあった低所得者住宅について、強制接収を行い、勝手な再建を禁止して、その後2年間で220haに及ぶ再開発を敢行したことなど、近代都市でかつ、一国の首都を直撃した地震としてその復興が注目された。



A Collapse of a Topmost Floor of Building (Earthquake Mexico '85". The Munich Reinsurance Company, 1986)

1 The Earthquake and Resulting Damage

The earthquake was an interplate earthquake, occurring on the boundary of the Cocos plate which creeps beneath the North American plate. The epicentre was 300 km west of Mexico City. On 20 September, the following day, a big aftershock with a magnitude of Ms 7.5 occurred at 7.32 pm. The damage in Mexico City, reported by the Mexican National Emergency Commission, included 4,287 people killed and 14,268 injured. Forty seven persons killed and 424 injured were also reported in other places around the country. Completely destroyed buildings reached 3,250 and the damaged ones 2,478. Of these, 65.4 per cent were old houses made of bricks for low income people, which had been constructed in the Spanish colonial era. More than 80 modern earthquake-resistant buildings including high-rise apartment houses, government offices as well as private offices were severely damaged by a long-range periodical wave. The electricity supply failed throughout the city for three days and the water supply was cut off for 13-20 days. Fires broke out at 351 places in the three days following the earthquake, and one of them spread to neighbouring buildings. CEPAL reported that the total amount of damage reached about US$4 billion, including indirect damage.

2. Recovery and Reconstruction

Because many high-rise buildings suffered severe damage, the Government of Mexico immediately started to evaluate the strength of buildings throughout the city and prohibited the use of buildings which were likely to collapse and cause secondary damage. About 4,000 low-income residential buildings were expropriated and banned from any reconstruction activities forestalled by the residents. A huge scale urban redevelopment project, which covered 220 ha of land was implemented, lasting two years after the earthquake, and the Government constructed four hundred new public houses.

A Collapsed Building like a Sandwich ("Earthquake Mexico '85". The Munich Reinsurance Company, 1986)

発生日時／Date and Time [Local Time]	11:41, 7 December 1988	被害／Damage	
震央／Epicentre [Lat., Lon., Depth]	41.2°N, 44.1°E, 33 km	死者／Deaths	55,000
規模／Magnitude [Richter Scale]	6.9	負傷者／Injured	15,000

1．地震と被害概要

震源は、スピタク市の北15km地点。アルプス、ヒマラヤ地震帯の「アナドリア断層（トルコ）」の北東にある活断層と見られる。同地帯は、アラビヤプレートとユーラシヤプレートの衝突地点であり、M＝5～7の地震がしばしば発生している。

震源に最も近いスピタク市（人口3万2千人）では、70～75%の建物が崩壊し、その隣のレニナカン市（人口29万人）でも、個人住宅1,100棟、高層ビル200棟以上が全壊し、80%の建物が何らかの損傷を受けた。

アルメニアの一般的な住宅は、トゥーフと呼ばれる特産の凝灰岩で建てられており、死者の大半は、崩壊した建物の下敷きになって圧死したものである。また、倒壊したビルの多くは、9階建てプレキャストコンクリートフレーム構造の集合住宅、及び4～5階建ての補強または無補強石造の集合住宅であった。ソ連では、地域によって最大予想震度を決め、これに耐えるような耐震設計がなされている。スピタクの耐震予想震度は、メルカリ震度7とされている。多くの建物が倒壊したのは、実際の地震動が、これを上回るものであったことと、梁スラブを工場生産し、現場で梁を柱に溶接し、梁の間にスラブを載せる簡単なプレハブ工法で建てられていたため、梁と柱の結合部が弱い上、梁の間に入れるスラブの鉄筋が梁に溶接されておらず、容易にスラブが梁から外れる構造になっていたからであろうと見られている。

2．復興

ソ連政府は、全滅状態となったスピタク市での復興を断念し、別の場所に新しい市を建設する方針を明らかにしている。カレキの山となったスピタクの町は、まだ回収し得ない遺体を残したまま埋め立て、聖地として保存することになると言われている。

(REUTER-SUN)

1. The Earthquake and Resulting Damage

The epicentre was 15 km north of Spitak, or north-east of the Anadolu Fault (in Turkey) in the Alps Himalayas Seismic Zone. Earthquakes with the magnitude of 5-7 have frequently occurred in the zone, where the Arabic Plate meets the Eurasian Plate

In Spitak, which was the closest to the epicentre, 70-75 per cent of the buildings were destroyed. In Leninakan, the neighboring city to Spitak, over 1,100 houses and 200 high-rise buildings were completely destroyed. Eighty per cent of all the building were damaged

Houses in Armenia are generally made of tuff. The major cause of death was the collapse of these buildings Most of the collapsed buildings were 9 story apartments, which used pre-cast reinforced concrete frames, or 4-5 story apartments, which were made of stone In the U.S.S.R., maximum seismic intensity is estimated in each region, and the building code is accordingly established for quake-resistant building In Spitak, magnitude 7 (Melkar Scale) had been estimated for quake-resistant buildings However, a number of buildings were destroyed in the earthquake because of the following reasons The seismic intensity was over the estimated intensity; the combination of pillars and beams was poor because a simple prefabrication technique was employed to put slabs on the beams melded to pillars; and, slabs easily came away from the beams because bars reinforcing the slabs were not melded to the beams.

2. Reconstruction

The Government of U.S.S.R. has announced plans to relocate Spitak which had been completely devastated. Because a number of persons are still missing, buried under the rubble in the city, Spitak is planned to be preserved as a sacred place

(REUTER-SUN)