341a. A reinforced concrete shaft tower at the Xinfeng shaft of the Tangshan Coal Mine, Coal Mine Bureau of Kailuan was 40.25 m in height. It broke at the bottom, subsided, and the tower tilted in a N60°E direction with an angle of 6°25'.
(Photos: Seismological Brigade, State Seismological Bureau and Chen Dasheng)
341b. A close-up view of the bottom portion of the shaft tower at the Xinfeng shaft.

342. A foundation of a diagonal rack cracked, one foundation bolt out of 50 was sheared and three others were pulled out at the steel head-frame of pit No. 3 at the Tangshan Coal Mine, Coal Mine Bureau of Kailuan. (Photo: Sun Ming)
343. A steel shaft tower at the Tangshan Coal Mine, Coal Mine Bureau of Kailuan was basically remained intact. (Photo: Chen Dasheng)

344. A steel shaft tower for ventilation No. 2 at the Tangshan Coal Mine, Coal Mine Bureau of Kailuan basically remained intact. (Photo: Chen Dasheng)
345. The assembly reinforced concrete head-frame at the Guogezhuang Alumina Mine 17.5 m in height was slightly damaged. (Photo: Coal Mine Bureau of Kailuan)

346. The steel structure parts were basically intact and the brick columns supported by steel frames cracked at the mixed head-frame of pit No. 3 at the Tangjiazhuang Coal Mine, Coal Mine Bureau of Kailuan. (Photo: Coal Mine Bureau of Kailuan)
347. At the Fanggezhuang Coal Mine, Coal Mine Bureau of Kailuan, the steel head-frame of the main pit was 44.64 m high and was slightly damaged. The elevator house collapsed and the base of the elevator partially cracked 4 cm wide. (Photo: Coal Mine Bureau of Kailuan)

348. The column cap and column footing on the bottom floor were damaged at the cooling tower of mechanical ventilation at the Tangshan Iron and Steel Company. (Photo: Liao Jishan)
349. Both edges of a pillar on the bottom floor were damaged at the newly built cooling tower of the Second Steel Works of the Tangshan Iron and Steel Company. The photo to the right is a close-up view of the pillar damage. (Photos: Du Zhaomin)
The end of a frame beam was damaged and concrete at a column footing peeled off and reinforcing bars were bent out at the cooling tower at the Qixin Cement Plant in the city of Tangshan. (Photos: Chen Dasheng)
351. The cooling tower of the power plant at the Qixin Cement Plant in the city of Tangshan was slightly damaged. (Photo: Seismo-geological Brigade, State Seismological Bureau)
352. At the cooling tower of the Linxi Power Plant, Coal Mine Bureau of Kailuan, the jalousie cooling plate surrounded by screen at the lower portion fell down and joints between the beam and column of the frame were cracked. (Photo: Coal Mine Bureau of Kailuan).

353. The columns of the frame were broken at the sand tower of the Cast Steel Workshop of the Tangshan Rolling Stock Plant. (Photo: Xu Changjiang)
354. A brick cylindrical tube collapsed and a reinforced concrete funnel turned over at the precipitating tower at the Coal Dressing Plant of the Tangshan Coal Mine, Coal Mine Bureau of Kailuan. (Photo: Chen Dasheng)
Steel columns buckled and collapsed at the dolomite steel storage at the Second Steel Mill of the Tangshan Iron and Steel Company. (Photo: Central Research Institute of Building and Construction, Ministry of Metallurgical Industry)
356. Column caps of reinforced concrete columns on the bottom floor were broken off and the bunker settled on wagons at the elevated bunker at the Second Steel Mill of the Tangshan Iron and Steel Company. The photos are a close-up view of the broken column caps. (Photos: Central Research Institute of Building and Construction, Ministry of Metallurgical Industry)
357. The cover of a cylindrical cement container displaced 2 m at the Qixin Cement Plant in the city of Tangshan. (Photo: Seismo-geological Brigade, State Seismological Bureau)

358a. Reinforced concrete columns 5 m high were broken off and the cylindrical containers settled at the Qixin Cement Plant in the city of Tangshan. (Photos: Earthquake Research Institute, State Seismological Bureau and Han Jiagu)
358b. The damage condition of the lower ring beam of a cylindrical container at the Qixin Cement Plant.

358c. The damage condition of cylindrical containers which hit against each other at the Qixin Cement Plant.
359. The native-style cylindrical container for grain storage in the city of Tangshan was constructed of reed framework, straw, mud and lime hemp-fiber plastering. The circular roof of the empty container was damaged and the containers full of grain were basically intact. (Photo: Hei Deyong)

360. A brick structure on the top of a cylindrical cement container at the Guye Refractory Material Plant was damaged. (Photo: Xu Hanbing)
361. A cylindrical brick barn at the Guye grain depot, which was constructed with cement mortar, was slightly damaged. (Photo: Hei Deyong)

362. Four units on the left side of an expansion joint collapsed at a coal bunker supported by reinforced concrete columns at the Zhaogezhuang Mine, Coal Mine Bureau of Kailuan. The brick and wood structure at the top of the right side collapsed. (Photo: Earthquake Resistant Group of the Design Administration Bureau, Ministry of Coal Industry)
363. At the Zhaogezhuang Mine, Coal Mine Bureau of Kailuan, the brick structures on the top of a cylindrical silo collapsed while the barn remained basically intact. (Photo: Earthquake Research Institute, State Seismological Bureau)

364. Site soil liquefied and columns of screening and loading coal bunker were damaged at the Xujialou new shaft of the Tangjiazhuang Mine, Coal Mine Bureau of Kailuan. (Photo: Coal Mine Bureau of Kailuan)
365. Five units on one side of an expansion joint collapsed and three units on another side were seriously damaged at a cylindrical barn at the Fangezhuang Mine, Coal Mine Bureau of Kailuan. (Photo: Chen Dasheng)

366. Reinforced concrete cone funnels fell down and broke at the Fangezhuang Mine, Coal Mine Bureau of Kailuan. (Photo: Coal Mine Bureau of Kailuan)
At the loading passageway at the Second Steel Works of the Tangshan Iron and Steel Company, the protective brick wall collapsed and roof covers fell down (above) and column caps were damaged (left). (Photos: Yu Chuncheng and Han Jiagu)
368. The chord and web members buckled at a steel support structure at the Second Steel Works of the Tangshan Iron and Steel Company. (Photo: Han Jiagu)

369. A reinforced concrete support cross beam was damaged at the raw material passageway at the Iron Works of the Tangshan Iron and Steel Company. (Photo: Han Jiagu)
370. Short columns cracked at the horizontal conveyor at the Tangshan Mine, Coal Mine Bureau of Kailuan. (Photo: Zhang Qihao)

371. The horizontal conveyor at the top of a cylindrical silo at the Kailuan Guogezhuang Alumina Mine collapsed. (Photo: Zhang Xiguang)
372a. A conveyor building at the Kailuan Guogezhuang Alumina Mine broke off. (Photos: Central Research Institute of Building and Construction, Ministry of Metallurgical Industry)

372b. A close-up view of the damage at the Kailuan Guogezhuang Alumina Mine.
373. A conveyor and transfer building collapsed at the Kailuan Guogezhuang Alumina Mine. (Photo: Gu Zhiqing)

374. The protective brick wall collapsed and a span fell down at a conveyor of the Majiagou Mine, Coal Mine Bureau of Kailuan. (Photo: Chen Dasheng)
375. The protective wall totally collapsed at a conveyor belt of the Linxi Mine, Coal Mine Bureau of Kailuan. (Photo: Coal Mine Bureau of Kailuan)

376. The brick wall and top of the transfer structure collapsed at the conveyor of the Xujialou new shaft of the Tangshan Mine, Coal Mine Bureau of Kailuan. (Photo: Coal Mine Bureau of Kailuan)
377. The brick wall collapsed at the conveyor of the newly built Coal-Dressing Plant of the Zhaogezhuang Mine, Coal Mine Bureau of Kailuan. (Photo: Chen Dasheng)

378. The upper portion of a brick wall at a belt conveyor, supported by a brick arch at the Zhaogezhuang Mine, Coal Mine Bureau of Kailuan, was damaged. Only one side of the brick arch was seriously damaged. (Photo: Earthquake Resistant Group of the Design Administration Bureau, Ministry of Coal Industry)
379. A coal yard conveyor at Fangezhuang Mine, Coal Mine Bureau of Kailuan, had its protective brick wall collapse. The top cover slabs fell down and the supports differentially settled and dislocated. (Photo: Chen Dasheng)
380. A steel structure conveyor at Lujiaotuo Mine, Coal Mine Bureau of Kailuan, collapsed due to damage of the brick supports. (Photo: Sun Ming)

381. The conveyor to deliver coal and the coal washing building at the Maoershan Chemical Fertilizer Plant in the city of Tangshan both collapsed. (Photo: Han Jiagu)
382. The conveyor at the Tianjin Caustic Soda Plant in Tanggu District in the city of Tianjin subsided 15 cm. The photo below is a view of the damaged joint support.

(Photos: Liao Shutang)
WATER TOWERS

383. The brick cylinder wall collapsed and a water tank dropped at the Tangshan Oil Pump Plant. (Photo: Chen Dasheng)
384. The brick cylindrical wall of a water tank collapsed and the water tank dropped at the Tangshan Measuring and Cutting Tools Plant. (Photo: Chen Dasheng)

385. During the earthquake a water tank on a masonry tower at the Steel Mill of the Tangshan Iron and Steel Company was empty. After the earthquake horizontal ring cracks were found at the bottom portion of the brick cylindrical wall but the water tank remained intact. (Photo: Central Research Institute of Building and Construction, Ministry of Metallurgical Industry)
Diagonal cracks occurred on the cylindrical brick wall of a water tower at Kaipingzhen in the city of Tangshan. (Photo: Lei Tongshun)
387. The reinforced concrete wall of a cylindrical water tower, which had a 300 t capacity, was slightly damaged at the Tangshan Railway Station.
(Photo: Liao Shuqiao)

388. X-shaped cracks occurred on the cylindrical brick wall of a water tower in Zunhua county town.
(Photo: Chen Dasheng)
389. The lower portion of cylindrical support at a water tower at the Lutai Railway Station, Ninghe County in the city of Tianjin, was constructed of stone 8 m in height and the upper portion was brick masonry 9 m in height. After the earthquake the cylindrical brick wall collapsed and the steel water tank dropped down onto the stone cylindrical support. (Photo: Beijing Railway Bureau)

390. A water tower of the Tianjin Course Bureau was 35 m high with a 60 t capacity. The cylindrical brick wall fell apart and the water tank dropped vertically. (Photo: Tian Yuqing)
391. The cylindrical support of a 50 t water tower at the Tianjin Chemical Plant was 15 m high and the water tank was 5 m high. The cylindrical brick wall collapsed at the bottom. (Photo: Li Yihong)

392. The cylindrical brick wall cracked at a 200 t water tower at the Tianjin Engineering Mechanical Plant. The photos show the front and back views. (Photos: Earthquake Resistant Office, Ministry of Machinery Industry)
393. The base of a water tower at the Tianjin Xinhe Shipyard was horizontally dislocated while the upper portion basically remained intact. The photo below is a close-up view of the dislocation at the base. (Photos: Xinhe Shipyard)
394. A large piece of brick masonry collapsed at a water tank at the Xiji Supply and Marketing Cooperative, Tongxian County in the city of Beijing. X-shaped cracks occurred on the back of the water tank (below). (Photos: Earthquake Resistant Code Group of the Beijing Design Institute of City Planning and Tong Xingzhen)
The upper portion of a brick chimney at the Tangshan Rolling Stock Plant collapsed and the middle portion cracked at various levels. (Photo: Qian Peifeng)
396. A brick chimney at the Tangshan Power Industrial Bureau collapsed at the base and the upper portion dropped. (Photo: Chen Dasheng)

397. A brick chimney at the Tangshan Exhibition Hall was horizontally displaced at the bottom and the middle portion sheared. (Photo: Shanghai Design Institute of City Planning)
398. The upper portion of a brick chimney collapsed and the middle and lower portions were sheared at the Cast Steel Workshop of the Tangshan Iron and Steel Company. (Photo: Han Jiagu)

399. A brick chimney at the Tangshan Printing and Dyeing Mill, 35 m high, broke into five sections. The maximum displacement was 30 cm. (Photo: Seismogeological Brigade, State Seismological Bureau)
400. The upper portions of the brick chimneys at the Tangshan Architectural Ceramic Works were damaged. (Photo: Chen Guishen)

401. A brick chimney at the Tangshan Fifth Ceramic Works broke at the base and bricks were scattered around. (Photo: Han Jiagu)
402. A brick chimney at the Tangshan Railway Institute collapsed at the bottom.
   (Photo: Chen Dasheng)

403. A brick chimney at the Fengnan Chemical Fertilizer Plant toppled over.
   (Photo: Chen Dasheng)
404. The brick chimney at Gaozhuangzi Commune collapsed. (Photo: Institute of Geology, State Seismological Bureau)

405. A brick chimney collapsed to one side at the Phosphate Fertilizer Plant of Leting County. (Photo: Zhang Qihao)
406. The upper portion of a brick chimney, 37 m high, cracked and tilted at the Chemical Fertilizer Plant of Sanhe County. (Photo: Institute of Geology, State Seismological Bureau)
407. The upper two thirds of a brick chimney at the Hangu Salt Works in the city of Tianjin collapsed and also broke at the base. (Photo: Xie Yunxiang)

408. The upper portion of a brick chimney at the Tianjin Metallurgical Materials Plant collapsed. A small section sat on the top of the un-collapsed portion. (Photo: Dong Jincheng)
409. A chimney at Shigezhuang Commune, Baodi County in the city of Tianjin, which was 37 m high, dislocated at the upper 10 m portion.

(Photo: Institute of Geology, State Seismological Bureau)
A brick chimney of the Beijing Institute of Foreign Trade, 34 m high, dislocated at the upper 8 m. The displacement was roughly 7 cm with clockwise torsion.

(Photo: Institute of Geology, State Seismological Bureau)
411. The upper portion of a brick chimney cracked and partially toppled down at Sanlihe in the city of Beijing. (Photo: Lei Tongshun)

412. The upper portion of this brick chimney, at the Grape Garden residential quarter on Zhanlan Road in the city of Beijing, shows crisscross fractures. (Photo: Lei Tongshun)
413. The upper portion of a brick chimney collapsed at the Xiaotangshan Sanatorium of Changping County in the city of Beijing. (Photo: Institute of Geology, State Seismological Bureau)
414. The upper strap-strengthened portion of a square chimney remained intact and the middle portion cracked at the Majiagou Fireproof Material Works in the city of Tangshan. (Photo: Han Jiagu)

415. Stovepipes on a roof were broken with clockwise torsion in Fengren county town. (Photo: Seismo-geological Brigade, State Seismological Bureau)
416. The lower half of a chimney constructed of low-grade mortar was seriously damaged while the upper half made with high-grade mortar (50 grade) remained intact at the Beijing Municipal Engineering Bureau. (Photo: Lei Tongshun)

417. A chimney with a water tower at the Baigezhuang Farm Chemical Works was basically left intact. (Photo: Yang Deyong)
418. A chimney with a water tower basically remained intact at the Baigezhuang Chemical Fertilizer Plant. (Photo: Yang Deyong)

419. A reinforced concrete chimney at the Tangshan Rolling Stock Plant remained intact. (Photo: Ma Fukang)
420. Reinforced concrete chimneys and cooling towers at the Tangshan Power Plant basically remained intact. (Institute of Geology, State Seismological Bureau)

421. A reinforced concrete chimney 180 m high at the Douhe Power Plant broke and toppled over at an elevation of 130.5 m. (Photo: Shi Guobin)
422. The upper portion of a brick chimney collapsed while steel chimneys with tension stays basically remained intact at the Casting Works of the Tangshan Iron and Steel Company. (Photo: Zhang Zhaoxiang)

423. At the Xinfeng Shaft of the Tangshan Mine, Coal Mine Bureau of Kailuan, one of the steel chimneys with tension stays broke off and the other remained intact. (Photo: Chen Dasheng)
FURNACES AND KILNS

424. A lime kiln at the Raw Material Works of the Tangshan Iron and Steel Company collapsed. (Photo: Zhang Zhaoxiang)
425. The pellet sintering vertical kiln at the Iron Works of the Tangshan Iron and Steel Company was a poured-in-place reinforced concrete structure. It had no filled walls on the bottom floor and during the earthquake the reinforced concrete columns broke and the vertical kiln collapsed. (Photo: Central Research Institute of Building Construction, Ministry of Metallurgical Industry)

426. The end of a platform of a coking furnace at the Tangshan Coking Plant collapsed. (Photo: Han Jiagu)
427. The furnace wall of a coke oven carbonization room at the Tangshan Coking Plant partially peeled off. (Photo: He Guangfu)

428. At a coke oven at the Tangshan Coking Plant, the upper and lower joints of a side column of a base frame burst apart. (Photo: Han Jiagu)
429. A lift pipe on the top of a coke oven tilted at the Tangshan Coking Plant. (Photo: Han Jiagu)

430. The upper portion of kiln No. 8 collapsed at the Qixin Cement Plant in the city of Tangshan. (Photo: Earthquake Research Institute, State Seismological Bureau)
431a. The columns of a frame broke at a rotary kiln at the Kailuan Guogezhuang Alumina Mine. (Photos: Han Jiagu and Zhang Xiguang)

431b. A furnace collapsed at the Kailuan Guogezhuang Alumina Mine.
431c. A roof cover fell down and hit a rotary kiln at the Kailuan Guogezhuang Alumina Mine.

431d. A rotary kiln remained intact at the Kailuan Guogezhuang Alumina Mine.
432. A cast iron support of a gear wheel of a cooling drum tilted outward and broke at the Kailuan Guoge Zhuang Alumina Mine (above). The kiln body dislocated and the gear wheel was displaced (below). (Photos: Han Jiagu)
Columns of the frame of a vertical kiln were slightly damaged (above) and the concrete of the column top of a base frame cracked horizontally (below) at the Kailuan Guogezhuang Alumina Mine. (Photos: Han Jiagu)
434. An end platform of a coking furnace collapsed at the Maoershan Chemical Fertilizer Plant in the city of Tangshan. (Photo: Han Jiagu)

435. A lime kiln at the Tianjin Dongsheng Resin Works collapsed. (Photo: Liao Shutang)
436. The brick protective wall collapsed at a steel oil tank of 500 cubic meters but the oil tank remained intact which was in the city of Tangshan. (Photo: Earthquake Resistance Office, Ministry of Commerce)
437. Three vertical oil tanks of 100 cubic meters remained intact in the city of Tangshan. (Photo: Earthquake Resistance Office, Ministry of Commerce)

438. An oil tank of 1000 cubic meters had the joint between the wall and the bottom of the tank crack, in the city of Tangshan. (Photo: Earthquake Resistance Office, Ministry of Commerce)
439. A vertical oil tank at the Tangshan Fat Depot remained intact.
   (Photo: Yang Wenzhong)

440. A group of elevated tanks collapsed at the Tangshan Oil Depot.
   (Photo: Earthquake Resistance Office, Ministry of Commerce)
441. Slight horizontal cracks were found on the support of the elevated tanks at the Tangshan Oil Depot. (Photo: Earthquake Resistance Office, Ministry of Commerce)

442. An outside oil depot remained intact at the Douhe Power Plant. (Photo: Shi Guobin)
443. Brick walled oil tanks, partially underground, remained intact at the northern oil depot of the Tangshan Iron and Steel Company. (Photo: Central Research Institute of Building and Construction, Ministry of Metallurgical Industry)

444. Oil tanks, partially underground, remained intact at the Tangshan Rolling Stock Plant. (Photo: Yang Wenzhong)
445. An underground horizontal oil tank covered by soil remained intact in the city of Tangshan. (Photo: Earthquake Resistance Office, Ministry of Commerce)

446. The bottom of a 1000 cubic meter oil tank buckled at the Tianjin Chemical Plant. (Photo: Yu Zufan)
447. The bottom wall of a 1500 cubic meter oil tank buckled in the city of Tianjin. (Photo: Earthquake Resistance Office, Ministry of Commerce)

448. A 1000 cubic meter steel oil tank remained intact in the city of Tianjin. (Photo: Earthquake Resistance Office, Ministry of Commerce)
The floating deck at the Tangshan Chemical Fertilizer Plant tilted (above) and the pilot wheel broke (left). (Photos: Chen Dasheng).
450a. The brick base of a dust remover was damaged and the cylindrical body of reinforced concrete settled and tilted at the Douhe Power Plant. (Photos: Shi Guobin)

450b. A close-up view of the broken base of the dust remover at the Douhe Power Plant.
A dust remover at the Douhe Power Plant tilted and the joint of a flue pipe and expansion section were pulled off. (Photo: Wang Gongkang)
452. An ion converter at the Douhe Power Plant was totally displaced and toppled over. The photo below is a close-up view of the damaged bottom. (Photos: Wang Gongkang)
453. The west side of the vault peeled off and a beam used to set up lines was bent at garage No. 4, the ninth horizontal tunnel of the Tangshan Mine, Coal Mine Bureau of Kailuan.
454. At the north lane of the eleventh horizontal tunnel of the Tangshan Mine, Coal Mine Bureau of Kailuan, the vault peeled and cracked 25 cm in width.

455. Temporarily supported by an arch support a lane collapsed and fell down at a parking lot at the eleventh horizontal tunnel of the Tangshan Mine, Coal Mine Bureau of Kailuan.
456. The top and both sides of the arch support collapsed at the south wing train lane at the eleventh horizontal tunnel of the Tangshan Mine, Coal Mine Bureau of Kailuan.

457. The top of each arch peeled off and bulged at the parking lot for empty cars at the pit head of shaft No. 7 at the twelfth horizontal tunnel of the Tangshan Mine, Coal Mine Bureau of Kailuan.
458a. The stone arch of the engine garage peeled off at a parking lot at the bottom of the shaft at the twelfth horizontal tunnel of the Tangshan Mine, Coal Mine Bureau of Kailuan.

458b. The stone arch of the heavy truck lane cracked at the twelfth horizontal tunnel of the Tangshan Mine, Coal Mine Bureau of Kailuan.
459. Under the twelfth horizontal tunnel of inclined shaft of 2100 belt at the Tangshan Mine, Coal Mine Bureau of Kailuan, an arch 100 m from the feed coal engine was compressed, cracked and peeled off (above). The roof, 150 m from the feed coal engine, fell (left).
460. The machine of the inclined shaft of 2100 belt at the Tangshan Mine, Coal Mine Bureau of Kailuan was blocked and covered by coal and water. There were two holes for cleaning silt and water, one was silted up and the other had only 50 cm of height left.

461. The belt, frame, wire rope and bracket roll of conveyor broke at the lift and carry section of the twelfth and thirteenth horizontal tunnels of inclined shaft of 2100 belt at the Tangshan Mine, Coal Mine Bureau of Kailuan.
462. At the belt conveyor path from the stone gate to half way to the thirteenth horizontal tunnel at the Tangshan Mine, Coal Mine Bureau of Kailuan, the rock at the entrance of the cross pipe broke (above). The top of the cross pipe collapsed and waste rock piled up (below).
463. The mouth of the tunnel collapsed at the thirteenth tunnel of the Tangshan Coal Mine, Coal Mine Bureau of Kailuan.

464. Temporarily supported by an arch support, the vault cracked and peeled off at the entrance of the pump house at the thirteenth horizontal tunnel of the Tangshan Mine, Coal Mine Bureau of Kailuan.
465a. The underground tunnel at Lutaizhen, Ninghe County in the city of Tangshan had a reinforced concrete bottom plate, brick wall and brick arch with cement mortar. Ring cracks occurred at the tunnel crossing (left). (Photos: Liu Guanghan and Zhang Zongyan)

465b. Both sides of the wall corners also suffered cracks at the underground tunnel at Lutaizhen.
466a. Underground tunnels of reinforced concrete bottom plates, brick walls and brick arches were not covered with backfill in Hangu District in the city of Tianjin. There were cracks 9 cm wide at the t-shaped joints and vertical displacement of 14 cm. (Photos: Zhang Zongyan)

466b. There were cracks in a tunnel in Hangu District.
467. There were oblique cracks of 45° at t-shaped joints at the tunnels in Hangu District. (Photo: Zhang Zongyan)

468. An underground tunnel in the center of the city of Tianjin had longitudinal cracks at the top edge of the arches, 3 cm in width with 1.5 cm of vertical displacement, where they were not covered by backfill (Photo: Zhang Zongyan)
469. There were annular cracks, sand boils and waterspouts at the underground tunnel of the Fireproof Material Works of Tianjin. (Photo: Zhang Zongyan)

470. The Tianjin subway, a reinforced concrete structure, was intact after the earthquake. (Photo: Zhang Zongyan)
UNDERGROUND PIPES

471. The welding seam broke at the elbow of the steel pipe joint at the water treatment pool and pump house at the waterworks of the northwest suburbs of Tangshan city.
300

472. The steel circulatory water pipes at the Douhe Electrical Power Plant remained intact.
(Photos: Wang Gongkang)
473. The Ф900 steel pipes for delivering water to a pump house near a riverbank of the Tianjin Caustic Soda Works, Tanggu District in the city of Tianjin, had a crushed elbow which was seriously damaged due to sliding of the riverbank.

474. The elbow of the Ф300 drainage pipelines was crushed at the Tianjin Caustic Soda Works.
475. At the Tangshan East Waterworks, there was 15 cm of vertical displacement at the joint of the Φ300 cast iron pipeline and the bottom of the joint broke.

476. At the Tangshan East Waterworks, the joint of the Φ200 cast iron pipeline was pulled apart 3 cm with 22 cm of vertical displacement.
477. At the Tangshan East Waterworks, the joint of the Φ300 cast iron pipeline at well No. 14 was pulled apart 25 cm (left).

478. At the Tangshan East Waterworks the Φ300 cast iron pipeline broke at the sleeve and the joint pulled apart 15 cm.
479. The Φ200 joint pulled apart 10 cm, Φ75 middle-mouth dislocated 1 cm at the joint of a cast iron tee pipe at Liulin in the city of Tianjin.

480. The Φ200 cast iron valve of natural gas line broke at Liulin in the city of Tianjin.
481. The $\Phi 200$ cast iron pipeline valve of natural gas broke, pulled apart 54 cm, had 4 cm of vertical displacement and 10 cm of horizontal displacement at Liulin in the city of Tianjin.

482. At the Tianjin General Paper Mill the flange of the $\Phi 500$ cast iron pipeline broke.
483. At the Tianjin General Paper Mill the straight pipeline flange linking the Φ500 cast iron pipeline and elbow broke.

484. At the North Suburb Waterworks in the city of Tangshan, a rubber ring broke away from the joint of the Φ400 pressure cement pipeline but the cement filling was still in the joint.
485. At the North Suburb Waterworks in the city of Tangshan, water spouted from the joint of the Φ500 pressure water pipeline (rubber ring joint).

486. The joint of a reinforced concrete circulatory water pipeline dislocated and was vertically displaced at the Douhe Power Plant.
487. The joint of a reinforced concrete circulatory water pipeline dislocated at the Douhe Power Plant.

488. A joint of the dust removing pipeline pulled apart at the Douhe Power Plant. (Photo: Shi Guobin)
489. At the Douhe Power Plant, the $\Phi 600$ pre-stressed concrete dust removing pipeline was snakelike in shape. (Photo: Shi Guobin)

490. A joint of reinforced concrete water pipeline from the Douhe Reservoir to the power plant pulled apart. (Photo: Chen Dasheng)
491. The circulatory water supply pipeline pulled apart at the Tianjin Chemical Works, Hangu District in the city of Tianjin. (Photo: The Sixth Design Institute, Ministry of Chemical Industry)

492. At the Tianjin Chemical Works, the Φ1500 water supply pipeline broke near the joint. (Photo: The Sixth Design Institute, Ministry of Chemical Industry)
493. The joint of a concrete sewage pipe pulled apart at the Yueya riverbank, Zhangdazhuang, in the city of Tianjin.

494. The joint of a drain pipe pulled apart and the plaster broke near the No. 1 bridge of Jingtang Highway in the city of Tianjin. (Photo: Tong Xingzhen, et al)

(Photos without credits in this section have all been supplied by the Group of Earthquake Resistance Code, Beijing Design Institute of Municipal Administration)
OVERHEAD PIPES

495. A pipe on top of its support was displaced at the Tangshan Iron and Steel Company.
(Photo: Du Zhaomin)
496. A pipe slipped off of its support at the Second Steel Works of the Tangshan Iron and Steel Company. (Photo: Han Jiagu)

497. A pipe slid and its bracket was displaced at the Tangshan Coking Plant. (Photo: He Guangfu and Qu Zhaojia)
498. The brick support of a recovery pipe collapsed and the pipe fell to the ground at the Tangshan Coking Plant. (Photo: Han Jiagu)

499. At the Douhe Power Plant an I-shaped steel support on the top of an elevator shaft pulled apart and bent. (Photo: Wang Gongkang)
500. At the Douhe Power Plant the end of a steel truss footpath between an elevator shaft and oxygen remover at a coal bunker bent and pulled apart. (Photo: Wang Gongkang)

501. The roof of a vaporization room at the Douhe Power Plant collapsed and smashed the pipes and facilities. (Photo: Wang Gongkang)
502. A pumping station at a village in Luanxian County collapsed but the pipeline was basically intact. (Photo: Qi Yongquan)

503. At the Tianjin Chemical Works a reinforced concrete support for a pipe was damaged. (Photo: Mao Shihong)
504. At the Tianjin Caustic Soda Works a support for an overhead pipe was damaged. (Photo: Earthquake Resistance Office, Ministry of Machinery Industry)
At the Dagu Chemical Works in the city of Tianjin, the pipeline at the section of polyvinyl chloride polymerization was basically intact. (Photo: Han Guangzhu)
506. Two phases of 110 KV circuit breakers with less oil were pulled out from the base at the Tangshan Power Plant.

507. One phase of 110 KV circuit breakers with less oil was pulled out from the base at the Tangshan Power Plant.
508. At the Tangshan Power Plant the support frame for leading wire from the 110 KV iron core sector filled with oil and was pulled out of the anti-shock wall.

509. All three phases of the 110 KV bus bar lighting arrester were broken at the base at the set-up station of the Tangshan Power Plant.
510. Insulator string and lead wire broke and the sleeve broke at the base at the set-up transformer substation at the Tangshan Power Plant.

511. The transformer substation of the Tangshan Power Plant was basically intact.
512. The 115 KV switch with less oil, current mutual inductance, voltage mutual inductance and circuit breaker were intact at the Tangshan Power Plant.

513. Two phases of 115 KV switch with less oil were intact at the Tangshan Power Plant.
514. A transformer at the Douhe Power Plant displaced and tilted.

515. At the Douhe Power Plant, fixed bolts connecting a wheel at the bottom of a transformer were sheared, the transformer tilted, the wheel stand separated and the wheel positioner bent.
516. At the Douhe Power Plant a porcelain insulator for a lightning arrester at the middle portion of a transformer broke.

517. The bus bar of a side phase was shaken down at a transformer substation at the Douhe Power Plant.
518. One phase broke, one phase parted from the casing pipe of a pillar and damage occurred at the insulator of the 220 KV lightning arrester at a transformer substation at the Douhe Power Plant.

(Photos 506-518 were supplied by Qi Yongquan)
519. Electric porcelains were seriously damaged but the structure basically remained intact at the 220 KV step-up station of the Douhe Power Plant. (Photo: Shi Guobin)

520. Electric porcelain insulators broke at the 220 KV step-up station at the Douhe Power Plant. (Photo: Wang Gongkang)
521. At the 220 KV step-up station at the Douhe Power Plant, the structure was basically intact and the SF6 switch was intact. (Photo: Wang Gongkang)

522. The bus bar of a side phase pulled apart and the lightning arrester broke at a 110 KV transformer substation at the Douhe Power Plant. (Photo: Qi Yongquan)
523. The main transformer derailed at the Jiaanzi transformer substation in the city of Tangshan. (Photo: Wang Gongkang)

524. A 35 KV lightning arrester broke and fell down at the Jiaanzi transformer substation in the city of Tangshan. (Photo: Wang Gongkang)
525. A structural beam collapsed at the Lujiatuo transformer substation in the city of Tangshan. (Photo: Qi Yongquan)

526. Soil liquefaction occurred, a transformer collapsed and a support frame tilted at the main transformer substation of Fangezhuang Mine, Coal Mine Bureau of Kailuan. (Photo: Coal Mine Bureau of Kailuan)
527. An oil switch and an electric porcelain broke and fell down at the Hangu transformer substation in the city of Tianjin. (Photo: Shi Guobin)

528. A support tilted, a cross beam broke and a voltage mutual inductance fell down at the Hangu transformer substation in the city of Tianjin. (Photo: Shi Guobin)
529. Voltage mutual inductances which had been strengthened remained intact at the Junliangcheng Power Plant in the city of Tianjin. (Photo: Wang Gongkang)

530. Porcelains of electric facilities linked with flexible cord remained intact at the Junliangcheng Power Plant in the city of Tianjin. (Photo: Wang Gongkang)
531a. Main transformers, which were fixed or had a spacing device before the earthquake, showed no signs of derailment or displacement after the earthquake (above and below).
(Photos: Wang Gongkang)
531b. Photos of main transformers continued (above and below).
Column caps were sheared and the pool dropped down at a sewage treatment pool at the Guye Chemical Fertilizer Plant. (Photo: The Sixth Design Institute, Ministry of Chemical Industry)
533. At the precipitating tank of the Tanggu Waterworks in the city of Tianjin, the body of the tank cracked, the multi-hole wall at the water entrance collapsed, cracks 50 cm of visible depth were found on the foundation, expansion joints at the base plate pulled apart 15 cm, and there was 5 cm of vertical displacement (left). (Photo: The Group of Earthquake Resistance Code, Beijing Design Institute of Municipal Administration)

534. The enclosing wall of the Cement Design Institute of Tangshan toppled over from the bottom to a side with no buttress. (Photo: Zhou Bingzhang)
535. An enclosing wall of an oxygen preparation station toppled over to the outer side at the Douhe Power Plant. (Photo: Shi Guobin)

536. An enclosing wall toppled over in both directions in Tanggu District in the city of Tianjin. (Photo: Earthquake Resistance Office, Ministry of Machine-Building Industry)
537. Reinforced concrete round electric poles partially broke (above) and toppled over (below) in the city of Tangshan. (Photos: Wang Gongkang)
538. A reinforced concrete electric pole broke at the Xinfeng shaft of the Tangshan Mine, Coal Mine Bureau of Kailuan. (Photo: Chen Dasheng)

539. Electric poles along the dam of the Douhe Reservoir were broken. (Photo: Chen Dasheng)
540. Reinforced concrete electric poles broke at Dagu Chemical Works in the city of Tianjin. (Photo: Han Guangzhu)

541. A breakwater wall cracked and a cast iron electric pole broke at the main dam of the Yanghe Reservoir. (Photo: Zhang Bochong)
542. The lightning arrester on top of a triangular reinforced frame structure was bent, at a transformer substation at the Xinfeng shaft of the Tangshan Mine, Coal Mine Bureau of Kailuan. (Photo: Earthquake Resistance Group of Design Administrative Bureau, Ministry of Coal Industry)