

## The World Trade Center Collapse

September 11, 2001, New York, U.S.A.

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Two passenger planes taken over by terrorists crashed one after the other into two skyscrapers of the World Trade Center (WTC 1, WTC 2) located in the southernmost tip of Manhattan, New York City. Both towers were engulfed in flames and collapsed in less than 2 hours.

Victims of the incident totaled up to 2,752 people (last announcement of New York City Police Authorities on October 30, 2003). The damage total is said to be 83 billion to 95 billion dollars.



Picture 1. The flared WTC by the crash of a passenger plane [1]

### 1. Event

Two passenger planes taken over by terrorists crashed one after the other into two skyscrapers of the World Trade Center (WTC 1, WTC 2) located in the southernmost tip of Manhattan, New York City. Both towers were engulfed in flames, and collapsed in less than 2 hours afterwards. Thousands of people were killed.

### 2. Course

At 8:45am, Tuesday, September 11, 2001, American Airlines flight 11 (Boeing 767) from Boston to Los Angeles with 81 passengers and 11 crew plunged into the upper floors of the World Trade Center 1 (the north side) located in the financial district of the

southern part of Manhattan, New York. Dark smoke spewed into the sky from a large hole created in the upper floors, and the wreckage of the plane poured onto streets of the financial district.

At 9:03 am, United Airlines flight 175 (Boeing 767) from Boston to Los Angeles with 56 passengers and 9 crew plunged into the middle floors of WTC 2 (the south side).

In WTC 1, the people who could not bear terrible high temperature and smoke began to jump off the building. People who jumped off numbered about 200.

WTC 2 collapsed at about 10:05am.

At about 10:28am, WTC 1 collapsed.

WTC 3, 4 and 5 then collapsed one after another.

At about 17:20, WTC 7 collapsed. While only WTC 6 did not collapse, it was greatly damaged.

Victims of the incident summed to 2,752 people (last announcement of New York City Police Authorities on October 30, 2003).

The damage total is said to be 83 billion to 95 billion dollars.

### 3. Cause

The direct cause was hijacks by international terrorists (said to be Al Qaeda) who flew the planes into the buildings. Source say that President Bush was aware, before September 11, that Osama Bin Laden and his group (Al Qaeda) might hijack American planes, however, the threat had been more of a general one pointing to a more conventional airline hijacking, and that the Administration had no prior knowledge that terrorists would use commercial jetliners as weapons to attack the World Trade Center. Acting on the information received, the Administration notified the appropriate agencies that hijackings in the traditional sense were possible. The warning was never made public (according to the White House press secretary Ari Fleischer at the press conference on May 15, 2002). The airport security at the time failed to detect the knives that the hijackers used to threaten crews and passengers.

First, we will examine the cause of how these high-rise buildings collapsed; the mechanism that enlarged the size of disaster.

In 1945 before the World Trade Center was built, a B25 bomber, which was going to land at the Newark Airport, crashed into the Empire State Building in New York. Dense fog was blamed for this accident. So the WTC design was intended not to collapse even if an airplane collided with the buildings.

Figure 1 was a typical floor plan of the WTC. The vertical plane is constructed with a perimeter of 990mm spaced steel columns, with an internal lift, and the horizontal plane consists of trussed steel and concrete slabs of about 100mm thickness.

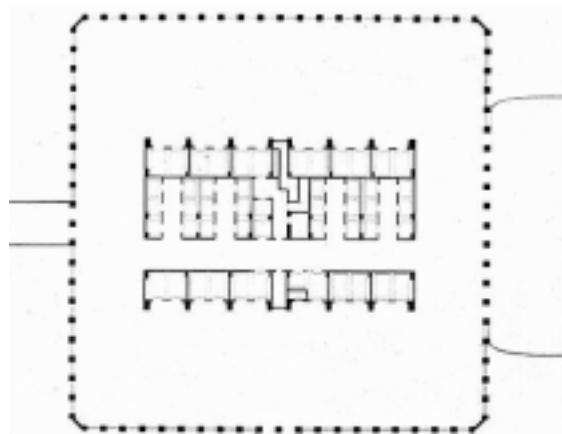


Figure 1. WTC floor plan [1]

Despite the design intention, the building actually collapsed. The following are estimated factors.

- (i) Damage/collapse of many columns from the impact of passenger planes (about 200t) crashing in the structure.
- (ii) Falling of fireproof coatings on the structural material due to the impact.
- (iii) Material (especially horizontal truss steel) strength dropped due to the fire fed with a large volume of jet fuel of 60,000 pounds (27t).
- (iv) Structural fragility of the pin joints of beams/columns.

For these factors, it was estimated that the floors that could not bear the weight of the upper floors first dropped, and the lower floors, which could not resist this impact collapsed in a chain reaction. Picture 2 is the collapsing building, and Picture 3 is the state after the building collapsed.



Picture 2. The collapsing WTC [1]



Picture 3. The state after the WTC collapsed [1]

#### 4. Immediate Action

The following actions were taken after the incident.

At 9:18am of September 11, the Newark Airport of New York was closed.

At 9:21am, tunnels and bridges in New York City (Manhattan Island) were closed.

At 9:25am, President Bush held a press interview.

At 9:40am, the Federal Aviation Administration (FAA) decided to shutdown all the domestic airlines.

At 10:15am, all international flights arriving in the U.S.A. were diverted to Canada.

## 5. Countermeasure

The direct cause of the incident was terrorism. Instead of discussing countermeasures against terrorist attacks, this report describes some of the responses and actions taken after the incident.

The Emergency Operation Center (EOC) of the Office of Emergency Management (OEM) was located on the 23rd floor of WTC 7. A total of 13 million dollars had built this OEM in 1999 after the lessons of the WTC bombing in 1993. This office, however, could not be used after the collapse of WTC 1 and WTC 2.

Mayor Giuliani of New York City entered the temporary Emergency Command Center (ECC) set at a block north of the WTC, but escaped for his safety on foot after the first collapse of the WTC 2.

At about 11:00am, the ECC was re-located in the fire station at Houston Street, which was about 2km north from the incident site.

At 11:02am, Mayor Giuliani gave an evacuation order to the district south of Canal Street and closed the district south of 14th street to the public except residents and the ECC transferred to the police academy on 20th street.

The EOC was transferred to a building owned by the city at pier 94 facing the Hudson River on September 17, operated until November 23 when it closed.

Subsequently, OEM carried on the functions of EOC.

## 6. Summary

In the incident of September 11, 2001, four passenger planes in total were hijacked in the United States. Besides those which went into the WTC, one plane plunged into the Pentagon (the Department of Defense) in Arlington, Virginia adjacent to Washington DC, and another crashed in the Stoney Creek area in Pennsylvania. Therefore it is called "9.11 (nine eleven) series of terrorist attacks".

The scene of the burning WTC from the first airplane crash went out live on national TV, then the scene of the second plane plunging into the building took place live on air. It was like a war movie for those watching the news.

The building collapse after the plane crash was totally unexpected and since there were firefighters on the rescue and others that were in the middle of evacuation, the collapse added more to the count victims.

## 7. Knowledge

Unexpected events occur sometimes. However, there are often signs. Proactive actions and measures are important when such signs appear.

The Office of Emergency Management (OEM) should not be built in an important institution (such as a possible target of an attack).

A disaster countermeasure office should not be built in the area where damage has occurred or the damage is severe.

Military OEMs are commonly built on the bedrock about 40m underground. However, it is still a possible target of terrorism. The best strategy is not to specify its location on a map or by a physical address.

## 8. Background

The attacks led to the so-called the War on Terror, or the war against terrorism, and the first military action on Afghanistan was initiated by the U.S.

Afghanistan is a country at the crossroads of Asia, geographically located between Central Asia and the Indian subcontinent. Through the ages, the region known as Afghanistan today has been invaded by a host of peoples who sought expansion of territory. The ones still fresh in our minds would be the British intervention during the period of the Great Game (between British India and the outlying regions of Tsarist Russia) in the 19th century, and the Soviet occupation during the Cold War era that led to the Soviet war in Afghanistan in late 20th century.

Following the removal of the Soviet forces in 1989 and the downfall of the Soviet-backed Democratic Republic of Afghanistan in 1992, Afghanistan was thrown into civil war between competing warlords. The Taliban, with its radical ideology and the 1994 legend (called the Taliban legend) and backed by Pakistan, Saudi Arabia and other strategic allies, developed as a politico-religious force, and eventually seized the capital city Kabul. It captured the seat of government and established the Islamic Emirate of Afghanistan in 1996. The Taliban were able to capture 90% of the country including Bamiyan seized in 1998, aside from the Afghan Northern Alliance strongholds primarily found in the northeast in the Panjsher valley.

In response to the 1998 U.S. embassy bombings in the East African capital cities, UN Security Council sanctions, Security Council Resolution 1267 (October 1999) and 1333 (December 2000), were imposed against Taliban to pressure it to cease the provision of sanctuary and training for international terrorists and their organizations as well as to turn over Osama bin Laden, the leader of Al Qaeda, who allegedly directed 1998 U.S. embassy bombings.

A London-based Arab newspaper, Al-Arab, reported that international terrorist Osama bin Laden had warned three weeks before the 9/11 attacks that he was planning an attack “against American interests” and threatened that it would be a big one. The World Trade Center situated near the south end of Manhattan in the

downtown financial district provided almost four percent of Manhattan's entire office inventory, and its Towers were undeniable icons of New York City.

There had been another incident at the World Trade Center prior to the 9/11 attacks. In February 1993, terrorists drove a truck packed with explosives into the basement parking garage, killing 6 and injuring 1,000 people.

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