

Debris from the collapsing towers, some of it still on fire, rained down on surrounding buildings, causing structural damage and starting new fires (Figure 1-7). The sudden collapse of each tower sent out air pressure waves that spread dust clouds of building materials in all directions for many blocks. The density and pressure of the dust clouds were strong enough to carry light debris and lift or move small vehicles and break windows in adjacent buildings for several blocks around the WTC site. Most of the fires went unattended as efforts were devoted to rescuing those trapped in the collapsed towers. The 22-story Marriott World Trade Center Hotel (WTC 3) was hit by a substantial amount of debris during both tower collapses. Portions of WTC 3 were severely damaged by debris from each tower collapse, but progressive collapse of the building did not occur. However, little of WTC 3 remained standing after the collapse of WTC 1. WTC 4, 5, and 6 had floor contents and furnishings burn completely and suffered significant partial collapses from debris impacts and from fire damage to their structural frames. WTC 7, a 47-story building that was part of the WTC complex, burned unattended for 7 hours before collapsing at 5:20 p.m. The falling debris also damaged water mains around the WTC site at the following locations:

- 20-inch main on West Street, closed to the slurry wall, about midway between Vesey Street and Liberty Street
- 20-inch main along the Financial Center north of the South Link Bridge
- 20-inch main at the corner of Liberty Street and West Street
- main in front of the West Street entrance to 90 West
- 24-inch main on Vesey Street, near West Street
- main at the corner of Vesey Street and West Broadway, near the subway station
- main at the southwest edge of 30 West Broadway
- 16-inch main inside the slurry wall

Damaged mains were located after the collapses, but access was impeded by the collapse debris.

The timeline of the major events is summarized in Table 1.1. The times and seismic data were recorded at the Lamont-Doherty Earth Observatory (LDEO) of Columbia University. The signal duration and Richter Scale magnitudes were included to indicate the relative magnitudes of energy transmitted through the ground between the events. Figure 1-8 shows the accelograms recorded by the observatory during the events.

Other buildings surrounding the WTC plaza were also damaged by falling debris. A few buildings, such as the Bankers Trust building, suffered significant damage but remained standing. Many buildings had their façades and glazing damaged and their interiors blanketed with debris from the collapse of the WTC towers and WTC 7. Figures 1-9A and 1-9B are satellite images of the WTC site taken before and after the September 11 attacks, respectively.

1.4 Response of the Engineering Community

1.4.1 Local Authorities

Immediately after the attacks, it became apparent to the City of New York that there was an enormous need for structural engineering and construction expertise and support. Within hours, the DDC appealed to several construction companies (Bovis/Lend-Lease, AMEC, Turner-Plaza and Tully) and the engineering firm, LZA Technology/Thornton-Tomasetti (LZA) to assist in the search and rescue effort. Mobilization began immediately. A reconnaissance inspection by DDC and LZA took place in the afternoon of September 11. A first round of building inspections was performed on September 12 by engineers from DDC, the NYC Department of Buildings (DoB), and LZA.