

## The Height of Ambition: Part Seven

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By JAMES GLANZ and ERIC LIPTON

One day the Lower Manhattan skyline appeared with such perfect clarity, the contours of the buildings so stark, that the view from the Hudson suggested abstract sculpture carved from the blues of the water and the sky rather than from a pounding, shouting, honking metropolis. Almost as if looking at one of Yamasaki's models, the eye rose from the Battery at the southern tip of the island, passed through the stone canyons of Wall Street, stepped up to Rockefeller's slablike steel-and-glass Chase Manhattan Bank building, swung around the white terra-cotta parapets of the Woolworth Building and skipped across the droll skullcaps of the World Financial Center, before settling at the obvious trail head in the sky: the twin towers.

On this morning of soft breezes and flawless skies in New York, David Rockefeller was in his 56th-floor office at Rockefeller Center. Les Robertson was having dinner with colleagues in a Hong Kong restaurant. Yamasaki's project manager, Henry Guthard, was on his way to his architect's office in the Detroit suburbs. (Yamasaki died in 1986.) Guy Tozzoli was zigzagging his black Mercedes through Jersey City along his Holland Tunnel shortcut. Frank Lombardi was in his office on the 72nd floor of the north tower, getting ready for a 9 o'clock meeting. And traveling at nearly 500 miles an hour down the Hudson River Valley, a hijacked plane with 92 people on board was heading toward the cultural, financial and symbolic focal point these men had created. Tozzoli and the Port Authority had conceived an immensity based on the Program, producing the biggest and most visible object in Manhattan. Yamasaki, after his walk around the Empire State Building, decided to create something completely different, a soaring sculpture set apart on a huge plaza. Austin Tobin and David Rockefeller in the end succeeded beyond their dreams in producing a cathedral of commerce and capitalism, a symbol that now attracted both grudging respect and deep envy around the world. They had molded a place of work, entertainment and shopping -- a "city within a city" that even at this early hour had drawn some 60,000 people into its borders. Tragically, these accomplishments were exactly what enticed the terrorists and made the buildings both easier and more attractive targets.

At a quarter to 9, American Airlines Flight 11 passed over Upper Manhattan and headed southward. The plane banked and flashed in the sun, and in the instant before it rammed the upper reaches of the north tower, it bore an eerie, horrifyingly precise resemblance to the image in Lawrence Wien's newspaper ad, down to the direction the plane flew and the location of the impact. But the reality was far more terrifying than Wien ever imagined. And worse: a second hijacked jet was soaring across New Jersey, about 20 miles to the northwest.

The second jet, United Airlines Flight 175, was flying south with 65 people on board. It made an enormous U-turn over New Jersey and accelerated northward in the direction of Manhattan. As the plane shot past the Statue of Liberty and the Battery and Wall Street, traveling at close to 600 miles an hour, it appeared at first that it might fly right past the southeast corner of the south tower. But at the last instant its

eastward wingtip canted up, and the plane banked to the west. Its nose struck the south face of the 81st floor, 70 feet from the southeast corner, the plane's 156-foot wingspan raking all the way from the 78th to the 84th floors.

That pattern was like the cut of a knife in a most literal sense.

Robertson had made the steel in the perimeter columns extraordinarily thin in the upper reaches of the towers, where they had less load to carry. As thick as four inches near the bottom of the buildings, the exterior steel tapered to only a quarter-inch in the upper stories. So, in an effect that stunned other structural engineers when they later analyzed what happened, the light aluminum of the plane's fuselage and wings simply entered the building, along with heavier parts like engines, slicing as many as 32 of the 59 columns on the south face like a machete hacking palm fronds. The soft exoskeleton and the vast interior volume of the tower allowed it effectively to ingest the Boeing jet whole, as if an elephant had disappeared through a wall.

Because the resistance was so slight, the plane did not even explode when it passed through the facade. Instead, traveling on an angling path toward the northeast corner of the building, large pieces of the plane probably soared freely across the open, column-free floors; others probably ripped through some of the lightweight trusses holding the floors up. In a kind of snowplow effect, the plane scooped up computers, carpeting, furniture and other combustible office contents and shoveled it all toward the northeast corner. Hundreds of people were killed within seconds. Parts of the plane, including an engine, pieces of landing gear and a hunk of the fuselage, blew straight through the building and out the other side, raining down and landing as far as six blocks north.

At some point, perhaps when the plane collided with the dense rectangular core filled with the building's interior structural columns, elevators and escape stairwells, perhaps a third of the plane's 10,000 gallons of jet fuel ignited, creating fireballs that blew out of the north, south and east faces of the tower. The rest of the fuel splashed across multiple floors, setting uncontrollable fires, spewed down elevator shafts and dribbled across the facades. The impact of the plane almost certainly knocked loose acres of the flimsy spray-on fireproofing, which meant that the fires were licking naked steel.

To preserve the wide-open, uninterrupted floors integral to the Program, the stairwells had been clustered together in the core, and thus could be knocked out almost entirely with a single blow. In the north tower, all three stairwells were instantly severed or made completely impassable. Some 800 people were trapped above or just below the impact zone.

In the south tower, two stairwells were wiped out. The third survived, but its lightweight gypsum walls were breached and shattered. An estimated 300 people at or above the impact zone survived the crash, but only 18 of them were able to find the open stairway, make their way past the gypsum debris and escape.

The concrete-and-masonry-encased stairwells used in traditional skyscrapers might well have fended off those impacts, particularly the ricocheting lightweight aluminum parts, allowing people to descend through floors that were engulfed in fire. But the trade-center stairwells were protected by the more delicate gypsum. Running within the same stairwells were pipes carrying water for sprinklers and firefighters' hoses. Those pipes were cut. The tops of the towers went dry.

The initial impacts, which each applied roughly 25 million pounds of force, might have toppled different buildings. As in the experiments at the phony optometrist's office in Eugene, Ore., the towers wobbled back and forth after the impacts like boats in a tempest. But just as

Robertson's calculations reassured him years earlier, the towers were built to withstand much greater lateral forces from wind than the planes could ever deliver. The towers rocked back and forth half a dozen times, perhaps a few feet each way at the top. And then Robertson's strange little shock absorbers, 11,000 in each tower, helped them come to a stop, intact and still standing.

Thousands of people in the towers and surrounding buildings lived because Robertson's structures did not topple. But even those few swaying trips back and forth damaged the unusually flexible buildings, jamming doors to elevators and escape stairways and conference rooms, and probably further ripping up the gypsum around the stairwells, helping to trap hundreds of people in and even below the impact zones.

Above each of the holes punched by the planes, Robertson's network of intersecting spandrel plates and columns acted like arches, spreading the loads to intact columns all through the buildings and preventing an immediate catastrophic collapse. Almost as if the towers were living beings trying to survive, they shifted loads from severed and damaged columns to intact ones. The process was so efficient, a federal study later showed, that columns only 20 feet from each gash were still carrying less than half the critical weight that would have ordinarily caused them to buckle. The towers stood long enough that thousands of office workers were able to escape.

In his 72nd-floor office in the north tower, Lombardi felt the room jerk to and fro. At first he thought there had been a big earthquake; then he saw the bottom edge of a fireball out of his window. He heard people screaming in an elevator, and the terror he felt in 1993 came back to him.

With the nozzle from a fire hose and a staple gun, Lombardi worked to pry open the elevator doors. Then he hustled down a stairway himself. And as he did, the fires began to spread. In the north tower, Lombardi's effort to thicken the spray-on fireproofing, begun in the mid-1990's, had been carried out on all the floors struck by the jetliner; by contrast, in the south tower, all but one of the impact floors had not been upgraded. Most of the fireproofing was probably knocked off by the impacts, according to Port Authority officials, but other experts say that the additional fireproofing in the north tower may have been able to at least retard the fire there: the conflagration in the south tower was, it appeared, the more furious of the two.

Air temperatures rose to 2,000 degrees in the hottest parts of the fires. Each tower's fire was producing heat equivalent to the power output of a nuclear plant. Jack Daly, the construction manager who heard the helicopter pilot ditch the lightweight floor truss when it was caught in the wind that day in 1970, started to worry that part of the south tower might collapse. Daly says he thought to himself, God, they're going to lose the top. But, he says, "I never in my world, never, thought the whole thing was going to go down."

The floor trusses, made of some of the thinnest steel in the World Trade Center, almost certainly began deforming before anything else of consequence. At first, the trusses probably expanded, bowing the exterior columns -- themselves thin and weakening in the heat -- outward in places and causing dangerous stresses. All along the eastern face of the south tower around the 80th floor, tremendous fires raged. Eventually the thin steel of the trusses became so hot in that area that they began to soften and sag, hanging like clotheslines between the exterior and core of the building. The sagging trusses tugged inward on their bolted and welded connections to the exterior columns, and those connections began to snap. Video records of the disaster show a line of dust beginning to blow out of

the east face around the 80th floor as floors began to slip away from their moorings and fall one upon the other.

Once Robertson's trusses tore away, the softening exterior columns no longer had anything to keep them from buckling. It was as if two gymnasts standing toe to toe, leaning backward and clasping hands, had suddenly let go. A single column on the east face of the south tower, about 30 feet north of the southeast corner, seems to have been the first to go, according to the videos. As other columns snapped, one by one, the entire top of the building tipped in that direction and, like a tree leaning toward the notch sawed by a lumberjack, began to fall. The force of the upper stories coming down then crushed the entire tower, ripping it apart as it fell. When debris from the top hit the ground, it was moving at an estimated 120 miles an hour. The north tower followed soon after. The death toll would soar to 2,800 people -- many of them,' a devastated Robertson would write, 'snuffed out by the collapse of structures designed by me.'

Before Sept. 11, Robertson always had an answer for every problem he faced. In conversations after the disaster, he often stammered into silence when trying to explain his feelings about the collapses. Later, he struggled to express himself. 'The responsibility for the design ultimately rested with me,' Robertson said. 'And I have to ask myself, Should I have made the project more stalwart? And in retrospect, the only answer you can come up with is, Yes, you should have.'

But in other conversations, he became resolute, even defensive. If not for the faraway look in his eyes and the bags underneath them, he could have been the young engineering gunslinger he once was. 'I don't feel blame for not having made it more stalwart than it was,' he said. 'I don't want to sound egotistical, but maybe it was as good as anyone would have made it, or maybe better than others would have made it. And a lot of that was associated with energy and youth and all that kind of thing. Had it not been me, I think it would have been an older, slower, more accepting kind of person than I was.'

'But even so,' Robertson said, the doubts beginning again, 'had it been more stalwart, surely 1, 2, 50, 100, 1,000 people might have gotten out. It's a big burden. I feel terrible remorse for those who died.'

As the structures weakened and collapsed that morning, David Rockefeller stood at the window of his office in Rockefeller Center, looking south at the smoke billowing over the business district he had done so much to create. He could see the Empire State Building, the old rival to the towers, in the foreground, a little to the east. When Rockefeller was a child, his family lived just a few streets north of where his office is now, and his mother commissioned a painting of the view from his bedroom window. The painting, which still hangs a few feet from where Rockefeller watched as the weakened steel lost its grip, depicts the 1930's New York skyline to the south, a jumble of lower buildings dominated by the Empire State Building to the east. On the West Side of the city, there is only a great swath of sky running the length of the island.

'There was so much smoke that we didn't really, fully understand -- the buildings literally collapsed,' Rockefeller says. 'You could see something drastic was happening, but it was so horrible in a way that it was almost like a dream, a bad dream.' When the smoke thinned, he saw again the swath of empty sky in the west, much as it once appeared from his bedroom window. But now even the sky had been invested with a horrible meaning. History had been undone.

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