

WORLD TRADE CENTER EVACUEES
SHARE LESSONS LEARNED AS NFPA
STARTS NEW BEHAVIOR STUDY

■ **STEPHEN MURPHY**

THE HUMAN factor

MANY VETERANS OF THE 1993 WORLD Trade Center truck bombing weren't going to make the same decision on September 11, 2001, that they'd made eight years before.

"Every fiber in my body said, 'I'm getting out of here,'" says Magdalena Brown, who worked for Washington Group International, an engineering firm on the 91st floor of the South Tower. In 1993, she'd stayed put for hours, then had to walk down 88 flights in the dark.

On the 74th floor of the North Tower, Dharam Pal, chief mechanical engineer for plumbing and fire protection for the Port Authority of New York and New Jersey, thought the noise he heard was only the explosion of the television antenna transformer on the roof, but he didn't hesitate to leave immediately. In 1993, he and his co-

workers had stayed because they didn't realize the severity of the situation.

"I might have stayed this time, too, if I hadn't gone through 1993," Pal says. "In 1993, evacuating later, I almost died in the stairway because of the smoke."

John Van Name, who'd worked in 1993 with Brown on the 88th floor of the South

Tower for EBASCO, a predecessor of Washington Group International, was having lunch a block away during the bombing. Most of his colleagues stayed at their desks because the smoke from the bomb affected mostly the lowest section of the North Tower. On September 11, however, he and 150 co-workers on the 91st floor of the South Tower were among the first—Van Name believes—to evacuate offices above the 78th floor.

Even so, Rita Fahy, Ph.D., manager of the NFPA Fire Databases and Systems, and Gylène Proulx, Ph.D., a research officer at

Pedestrians flee the area of the World Trade Center as the center's South Tower collapses.



FIVE SURVIVORS... FIVE WAYS OUT

As an example of the complexity of tracking how thousands of people evacuated the Twin Towers on September 11, the five survivors interviewed for this article took quite different paths to escape, using stairs, elevators, or trains. The illustration shows the jets' impact area in the South Tower between the 78th and 84th floors, and in the North Tower between the 94th and 99th floors. See page 45 for another illustration of the World Trade Center complex.

John Van Name

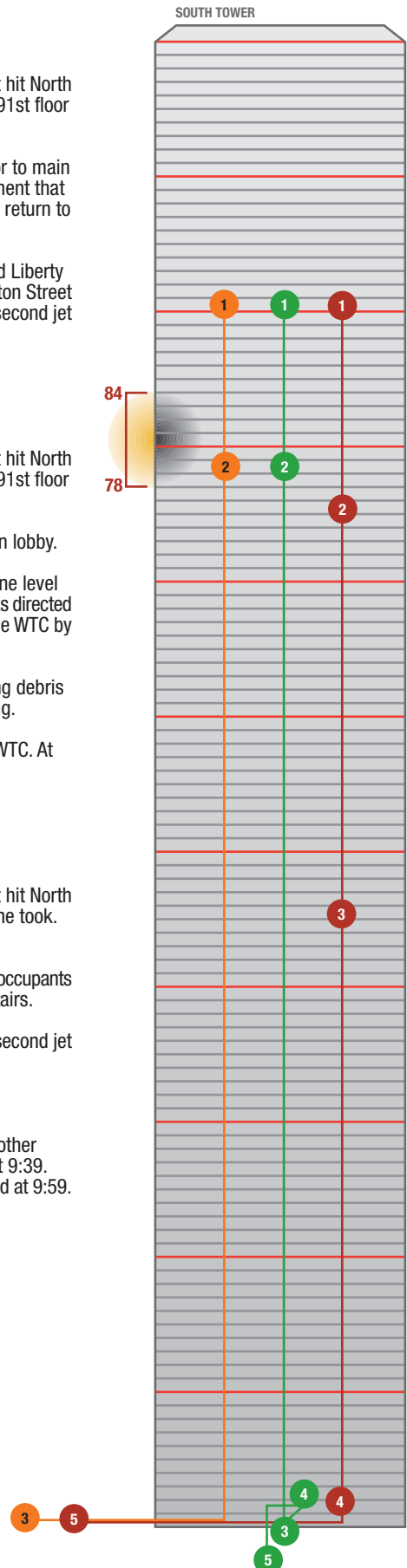
- 1 Left 91st floor, South Tower, minutes after jet hit North Tower at 8:46 a.m. Took local elevator from 91st floor to sky lobby at 78th floor.
- 2 At 8:50, took express elevator from 78th floor to main lobby. While in elevator, heard PA announcement that South Tower was safe and occupants should return to work.
- 3 Exited WTC through concourse at Church and Liberty Streets and reached subway entrance at Fulton Street and Broadway, two blocks north of WTC, as second jet hit South Tower at 9:03.

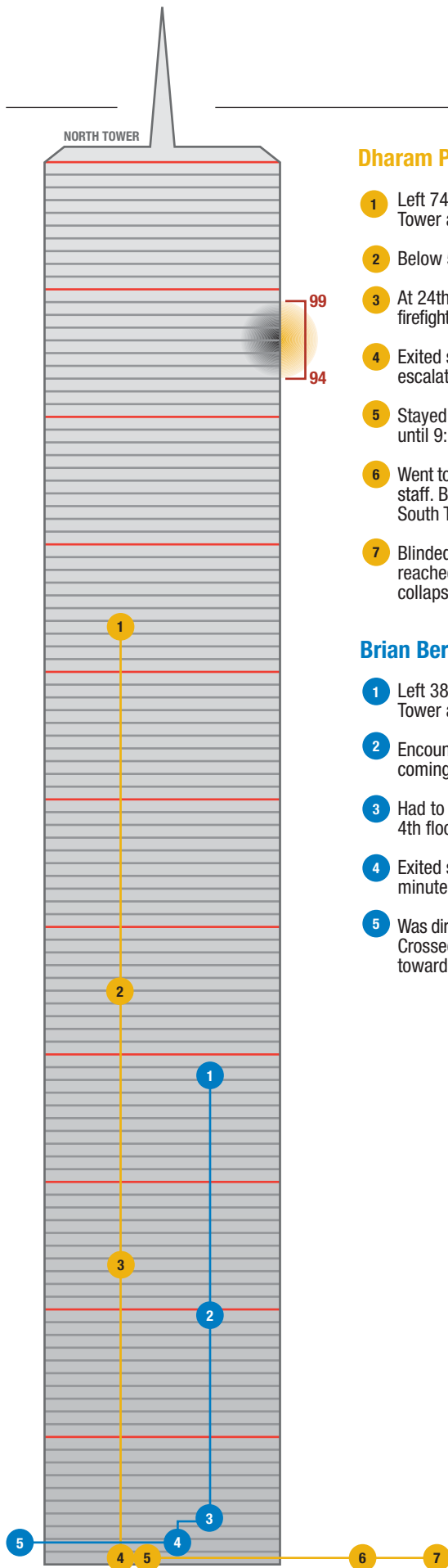
Pete Trombetta

- 1 Left 91st floor, South Tower, minutes after jet hit North Tower at 8:46 a.m. Took local elevator from 91st floor to sky lobby at 78th floor.
- 2 Took express elevator from 78th floor to main lobby.
- 3 Was directed up an escalator to the mezzanine level and to stay there. Five minutes later at 9:00, was directed to go back down to the concourse and exit the WTC by the Liberty Street exit of 4 WTC.
- 4 At 9:03, second jet hit South Tower and falling debris at two exits prevented his leaving the building.
- 5 Walked 300 to 400 feet to subway beneath WTC. At 9:10, got on train. Train left WTC at 9:20.

Magdalena Brown

- 1 Left 91st floor, South Tower, minutes after jet hit North Tower at 8:46 a.m. Unsure which stairwell she took.
- 2 Between the 80th and 70th floors, heard PA announcement that South Tower was safe and occupants could return to work. Kept going down the stairs.
- 3 Between the 50th and 40th floors when the second jet hit the South Tower at 9:03.
- 4 Reached mezzanine level around 9:20.
- 5 Walked down escalator to main lobby, up another escalator and exited WTC at Church Street at 9:39. Reached City Hall when South Tower collapsed at 9:59.





Dharam Pal

- 1 Left 74th floor, North Tower, minutes after jet hit North Tower at 8:46 a.m. Took Stairwell C.
- 2 Below 50th floor, stairwell became crowded.
- 3 At 24th floor encountered water in stairwell, and firefighters coming up slowed down the flow of evacuees.
- 4 Exited stairwell at mezzanine level and walked down escalator to main lobby at 9:40.
- 5 Stayed at bottom of escalator to help direct evacuees until 9:50.
- 6 Went to Marriott Hotel lobby at 3 WTC with Port Authority staff. Buried in debris in hotel lobby when at 9:59 the South Tower collapsed. Dug himself out.
- 7 Blinded by dust, crawled over collapsed beams and reached waterfront marina at 10:13. North Tower collapsed at 10:28, crushing hotel lobby.

Brian Bernstein

- 1 Left 38th floor, North Tower, minutes after jet hit North Tower at 8:46 a.m. Took Stairwell C.
- 2 Encountered smoke around 20th floor and firefighters coming up at about the 9th floor.
- 3 Had to cross over to northeast corner of core around 4th floor.
- 4 Exited stairwell at mezzanine level. Descent took 20 minutes.
- 5 Was directed to a mezzanine exit in the northwest corner. Crossed a bridge over the West Side Highway, heading toward the waterfront.

the National Research Council Canada (NRCC), are surprised so many people in the South Tower felt they were in danger and started evacuating before the second airliner hit.

"I would have stayed in place in the South Tower," says Proulx, who with Fahy conducted a survey of occupants' evacuation behavior during the 1993 bombing. After the bombing, the World Trade Center made a number of improvements in evacuation procedures and aids, including the installation of emergency lighting in the stairways and elevators.

Fahy and Proulx applied to the National Institute of Standards and Technology (NIST) to again fund a similar survey of occupants' behavior and their interaction with the towers' environment and the fire on September 11. The money NIST is seeking for its overall study of the collapse, of which Fahy and Proulx's study would be a part, is included in a supplemental homeland security appropriation President Bush signed in August (see "Inside the Beltway" on page 34).

After months of waiting for funding, NFPA and NRCC started the project on their own, mailing out more than 600 questionnaires last June and July. Fahy and Proulx were concerned that the longer they waited to survey survivors, the less valid the findings will be.

"Time is a factor," says Proulx. "These surveys need to be done as soon as possible after the incident. As time goes by, people rationalize their responses as to why they escaped." Proulx believes that to obtain information needed to improve life safety in high-rises, it's essential to conduct a scientific survey. Although the media have published many accounts of survivors' experiences, those specific cases can't be generalized.

Fahy hopes the NIST funding will be available to pay for the analysis, once the responses are back.

What they want to know

In the September 11 study, Fahy and Proulx want to gather statistics on the occupants' initial awareness of the attacks; their actions before evacuation; how they perceived, exchanged, and obtained information; conditions on the floors; how long they waited before starting to evacuate; their movement and the conditions in the stairwells; their

evacuation training; the impact of the 1993 evacuation on their September 11 behavior; and the outcome for people with disabilities.

Unlike their 1993 survey, which was sent out five to six months after the bombing to 1,598 fire wardens for the 1,200 World Trade Center tenants, Fahy and Proulx contacted

feel or hear anything until a secretary ran to her side of the floor, screaming that a plane had hit the North Tower, that it was on fire, and that people were jumping.

On the 38th floor of the North Tower, Brian Bernstein was working at his desk at Lehman Brothers when he heard a thunder-

TO OBTAIN INFORMATION NEEDED TO IMPROVE LIFE SAFETY IN HIGH-RISES, IT'S ESSENTIAL TO CONDUCT A SCIENTIFIC SURVEY. ALTHOUGH THE MEDIA HAVE PUBLISHED MANY ACCOUNTS OF SURVIVORS' EXPERIENCES, THOSE SPECIFIC CASES CAN'T BE GENERALIZED.

tenant companies to obtain their help in distributing this new survey to staff who were in the Twin Towers on September 11.

Initial awareness

In the 1993 study, the wardens returned 406 useable surveys. Of these, 84 percent of the respondents in the North Tower and 73.9 percent in the South Tower said the explosion initially alerted them to the bombing.

On September 11, Pete Trombetta heard pipes clanging on the 91st floor of the South Tower and saw the lights flickering. His first thought was that it was caused by the construction that had been going on for months on the floor above him. Trombetta, a design supervisor for the Washington Group International, didn't have a window and his work area faced away from the North Tower. The first plane had hit at 8:46 a.m., and he didn't know it.

Van Name, a member of the NFPA Technical Committee on Heat Recovery Steam Generators, was in his 91st-floor office, facing the south and east sides of the North Tower, when he heard jet engines then a loud crash. Looking two or three floors up, he saw holes in the North Tower's east face and a tremendous amount of paper flying out of them, followed by a huge fireball. Then another fireball erupted on the south face.

On the same floor, but on the south side facing away from the North Tower, Brown noticed paper flying around outside and wondered if it was ticker-tape parade. She didn't

ous boom and felt the building sway, as though someone had grabbed his shoulders and was pushing him back and forth.

"I looked out the window just a few feet away to see glass, thousands of sheets of paper, and large metal pieces raining down," he says. "My first reaction was that the top of the building blew off in some gas explosion or that a plane or helicopter had clipped the top of the building."

Evacuation training

The Port Authority's Pal says everyone on the 74th floor in the North Tower took the fire drills seriously after the 1993 bombing when they'd struggled to find which dark, smoke-filled stairwells were less crowded. Bernstein, who'd just started working 36 floors below Pal the previous May, believes the building policy was to evacuate the floor where a fire occurred and two floors above and below it, but he can't remember that being said during a fire drill.

"I think I can speak for most in saying that people in the workplace don't really pay too much attention to a fire drill," Bernstein says.

Working in the South Tower, Brown recalls fire drills in which people congregated where the hallways intersected in the center of the floor and were told to wait for instructions and not to use the elevators. Colleague Van Name, a senior consulting engineer, says that during the drills, which they had at least twice a year, a public announcement told them they should go three floors below or above their floor if it were on fire. But they



People who had fled the World Trade Center in New York after it was struck by hijacked airplanes react to the sight of the burning towers.

never practiced evacuating the area by going into the stairwells.

"You've done this hundreds of times since you were a school child, and you know you'll be able to get out," says Bernstein. "However, now I can't help but pay serious attention."

Actions before evacuating

In the 1993 study, 65.9 percent of the respondents self-evacuated from the North Tower, and 45.5 percent self-evacuated from the South Tower. Of those who stayed, most did so because they were waiting for information or instructions, were told to wait, thought it was better to wait, or didn't know there was a problem.

After witnessing the fireball on September 11, Van Name started to call 911, which required getting an outside line first, but stopped when he thought someone else was probably doing it. He next tried unsuccessfully to reach a friend at LaGuardia Airport to tell him a plane had crashed into the North Tower.

"Then I decided, 'This isn't the place to be,'" Van Name says. "I've seen power plant fires, but I never saw that much fire in my life." He and another engineer started herding people out, telling them to leave everything there, call people later, and not to bother shutting down their computers.

"Within a minute, John came down the aisle saying, 'Everybody up and out,'" Trom-

betta recalls. "He didn't tell us why so as not to panic us. I kidded him that I had to get my plot plans I had just printed. He said, 'No, go.'" Trombetta left the 91st floor immediately, as Brown had on her own.

In the North Tower, Pal, who's a member of the NFPA Technical Committee on Motor Vehicle and Highway Safety, looked down from the 74th floor and saw large, dark pieces of the building falling into the plaza.

"I told my staff, 'Let's get out,'" Pal says. "Some were already on their way down. Practically everyone had been there in 1993." He was off the floor within three minutes of

the crash.

Thirty-six floors below, Bernstein paused a few seconds to see if the building was going to fall over. Then, he looked out the window for three to four seconds, grabbed his wallet, keys, and Palm Pilot™, which were all in front of him, and left for the stairs. His instincts got him out.

Movement in the stairwells

"I never really knew where the stairwells were," Bernstein says. "I just assumed they were in the core somewhere." He took Stairway C in the southeast quarter of the North Tower's core.

Several times on the way down, the flow stopped. Around the 20th floor, he encountered a lot of smoke. At about the 9th floor, he met firefighters running up. A few floors below, he noticed water rushing down the stairs.

Bernstein believes he had to cross over to the northeast quarter of the core at the 4th floor, exiting the stairway on the mezzanine at the plaza level. The descent had taken him 20 minutes.

On the 74th floor, Pal automatically took the closest stairwell, also C. Within seven or eight minutes, he smelled burning fuel. Still thinking it was a transformer fire, he felt safer in the stairwell. Below the 50th floor, the stairs got crowded, and people made

room for burn victims to pass. There was still no panic, and he still didn't know what had actually happened.

At the 24th floor, Pal encountered a lot of water, and firefighters coming up the stairs slowed the downward flow. He finally exited the stairwell on the mezzanine after a 40-minute descent.

Brown is unsure which of the three South Tower stairways she took, but she was in the 70s series of floors when a public address system announcement told the occupants that the South Tower was okay and they could return to their offices. Although she didn't smell any burning jet fuel or encounter any smoke, she kept going down.

Stopping a couple of times, once as people came back up after the announcement, she was in the 40s when the second jet hit. Her body swayed with the building and her knees buckled, but people stayed calm because the stairway remained intact. Walking down at a good clip, she reached the mezzanine half an hour after she left her office.

Many people in the South Tower took elevators down, and Brown thought for a second about taking one, too. She knew that in the stairway she'd be in harm's way longer, but she also remembered that the power loss in 1993 had trapped people in the elevators for hours.

Still, Van Name and Trombetta got on the local elevators at the 91st floor. Trombetta had said to Van Name that maybe they should take the stairs instead, but Van Name said it was okay to take an elevator as they still had power.

By now, 60 to 100 people had gathered at the 78th-floor sky lobby, where passengers changed to the express elevators to the 44th-floor sky lobby or to the main lobby on the ground floor. Four or five of the 10 express elevators were running; the others were out of service for repairs or weren't scheduled to run until more businesses were open.

Trombetta, who could now smell something like burning rubber, hadn't heard the announcement that the South Tower was safe.

The 25 to 30 people in his elevator to the main lobby asked each other what had happened. One man said a 727 had hit the North Tower.

"I knew that 20- to 30-second ride enclosed in that elevator would be the longest of my life," Trombetta says.

Van Name says most of his co-workers rode rather than walked down. Concerned about using an elevator, he discussed with another engineer the possibility that the North Tower might lean into the South Tower.

"But I felt getting out faster was better than getting out slower," he says.

At the 78th floor, Van Name met two women from his office who'd been outside smoking and who were going back up to the 91st floor to get their coats before evacuating. Two men from his office went back up with them. The two women evacuated safely by taking an elevator. The two men were among the 13 people from the Washington Group International who died that day. Several of his co-workers who returned to the South Tower's 91st floor were on the phones to their families when the second 767 jet crashed into the 78th to the 84th floors at 9:03 a.m.

At 8:50 a.m., Van Name took an express elevator to the main lobby with about 30 other people. While in the express elevator, he heard the announcement that the North Tower was in a state of emergency, the South Tower was safe, and that they should return to work. However, he felt it was better to have a 360-degree path of escape outside.

His two elevator rides took 72 seconds.

"The elevators were waiting for us," he says. "A number of businesses start at 9:00 and 9:30, so the building wasn't full."

Getting outside the towers

Once they reached the mezzanine or the main lobby below it, the evacuees faced more choices and greater dangers.

Brown left the stairwell on the mezzanine and walked down an escalator to the main lobby, where security guards urged people to move faster. By that time, however, she couldn't run. She went up another escalator and left the World Trade Center by the Church Street doors because all the other exits were blocked by debris.

Brown then made the final decision that saved her life. Although a lot of people were outside gawking at the fires in the towers, she kept walking because she just wanted to get away from it all. She was at City Hall 10 minutes later when the South Tower collapsed at 9:59. A co-worker who'd been in the stairway ahead of her is believed to have tried to catch a train home; his body was found in the sub-

way under the collapsed World Trade Center.

In the South Tower lobby, Port Authority staff directed Trombetta and others through the concourse and up an escalator to the mezzanine.

"Facing the North Tower through 20- to 30-foot-high (6- to 9-meter-high) glass walls, we pasted our faces against the glass," he says. "We were drawn to the display of carnage. The plaza looked like Armageddon and Hiroshima. We didn't realize the danger to us."

Five minutes later at 9:00, Port Authority staff returned and told the group to go back down to the concourse and out of the building by the Liberty Street exit of 4 World Trade Center. Without panicking, they started walking.

Then the second jet hit, raining debris on the exit doors, jamming them shut. Trombetta, who thought the debris was from the North Tower, unsuccessfully tried two exits, then headed toward the subway entrance 300 to 400 feet (91 to 121 meters) away. Transit personnel opened the gates so the turnstiles didn't slow people down. One of the two trains in the station was just leaving, so he got on the second at 9:10 a.m. It pulled out at 9:20.

"I owe a debt of gratitude to John (Van Name) for acting instinctively," says Trombetta.

"John 'bullied' people into elevators and saved their lives," Brown says. "One colleague had a bad hip and probably wouldn't have made it out without taking an elevator."

After stopping in the concourse several times to try unsuccessfully to call his wife on his cell phone, Van Name himself left the building through the concourse exit at Church and Liberty Streets and was entering the subway two blocks north of the World Trade Center at Fulton Street and Broadway when the second jet hit.

In the North Tower, firefighters and security personnel on the mezzanine directed Bernstein to an exit in the northwest corner. To reach a bridge over the West Side Highway, he had to cross a 20- to 30-foot (6- to 9-meter) uncovered area as debris fell. But he followed the crowd that way because they were heading where he wanted to go—the waterfront.

Also in the North Tower, Pal walked down

the stopped mezzanine escalator to the lobby, where he was surprised by the amount of damage inside. There'd been no damage on the 74th floor when he left it. The time was now 9:40 a.m.

In the lobby, senior Port Authority staff asked Pal if he'd help direct people out since they were confused about which way to go, so he, several firefighters and police officers, and four or five Port Authority staff began directing people east toward the Borders bookstore, where they could take another escalator back up to street level at Church and Vesey Streets. As he did, he overheard people saying that they'd heard on the radio that planes had hit both towers and the Pentagon.

About 10 minutes later, with fewer and fewer people coming down, the Port Authority staff moved to the Marriott Hotel lobby at 3 World Trade Center to discuss what to do next. Pal and other Port Authority staff, along with 20 to 30 firefighters, had been in the lobby of the 22-story Marriott for no more than 5 minutes when they heard a loud rumble and saw the lights flicker. A rush of wind threw Pal up against a wall 15 feet (4.5 meters) away, where he ended up under a beam, buried in rubble. The South Tower had collapsed.

Cut and bruised, Pal dug himself out, but with the dust in his eyes, he couldn't see more than 2 feet (0.6 meters) away. He yelled, "Is there anyone here?" No answer. As he tried to find a way out, he saw what he thought was a light on a firefighter's helmet and went in that direction. At one point, as he crawled by himself over collapsed beams, his dust-filled eyes couldn't see how deep the pit below him was.

About six minutes later, he emerged from the ruins at a marina. Fifteen minutes later, the North Tower collapsed at 10:28. The bodies of seven firefighters and three civilians were recovered later from the hotel lobby that had been crushed by the collapse of the North Tower. All of the Port Authority staff who had been with Pal in the Marriott lobby escaped.

In addition to crediting the safety changes the Port Authority had made after the 1993 bombing, Pal sums up what had saved the survivors of the collapse of the Twin Towers: "Getting out immediately was the best decision." ♦

1. Survivors were interviewed for this article from November 2001 to March 2002.