Researchers trying to explain why the World Trade Center's south tower fell first, though struck second, are focusing on new calculations showing that the passenger jet that hit the south tower had been flying as fast as 586 miles an hour, about 100 miles an hour faster than the other hijacked plane.

The speed of the two planes at impact has been painstakingly estimated using a mix of video, radar and even the recorded sounds of the planes passing overhead.

Two sets of estimates, by government and private scientists, have surfaced, but both show that the plane that hit the south tower at 9:02 a.m., United Airlines Flight 175, approached the trade center at extremely high speed, much faster than American Airlines Flight 11, which hit the north tower at 8:46 a.m.

In fact, the United plane was moving so fast that it was at risk of breaking up in midair as it made a final turn toward the south tower, traveling at a speed far exceeding the 767-200 design limit for that altitude, a Boeing official said.

"These guys exceeded even the emergency dive speed," said Liz Verdier, a Boeing spokeswoman. "It's off the chart."
The speed of the planes is far from the only factor that will be important in explaining why the south tower, which was struck between the 78th and 84th floors, fell within 56 minutes and the north tower, which was hit between the 94th and 99th floors, stood for 102 minutes.

Ultimately, it was the combination of structural damage and the fires, fueled by thousands of gallons of jet fuel, that brought the buildings down. The south tower was also hit at a lower point, meaning there was more weight bearing down on the damaged floors.

But the difference in the towers' survival times, which translated into a difference in the amount of time tenants and rescue personnel had to get out, could be related in part to the planes' speeds, researchers said.

"Clearly one plane came in faster and had more energy," Dr. Jerome Connor, a professor of civil engineering at the Massachusetts Institute of Technology who is studying the collapses, said of the new calculations, in which he was not directly involved.

"If one building had more damage, it would take less for the heat to build up enough for it to come down," Dr. Connor said. "That would help explain why the building that was hit second, fell first."

The high speed of United Flight 175 may also have complicated the hijackers' mission, because it would have been more difficult to make accurate adjustments in the plane's direction, several pilots said. Loud and repeated alarms would also have been sounding in the cockpit.

"The faster you go, the less time and room you have for error," said Tim O'Toole, a former 767 pilot and staff engineer in safety department of the Air Line Pilots Association.

The flight data recorders from the two planes have not been found; Boeing officials said these so-called black boxes are not designed to survive the forces they encountered in the collapse.
But a researcher at Massachusetts Institute of Technology, by closely studying videos of the attack, has estimated the planes' speeds. The Federal Aviation Administration, in consultation with the National Transportation Safety Board, has come up with its own estimates, based on radar and video.

The M.I.T. analysis, by Eduardo Kausel, a professor of civil and environmental engineering, found that the United plane was traveling an estimated 537 m.p.h., while the American plane, the first to hit, was traveling 429 m.p.h.

The Federal Bureau of Investigation said the government's analysis put the speeds at 586 m.p.h. for the United flight and 494 m.p.h. for the American one.

In both cases, the planes were flying much faster than they should have been at that altitude: the aviation agency's limit below 10,000 feet is 287 m.p.h.

Investigators could not say for sure why one plane was traveling faster than the other; it may have been accidental choices of novice pilots, or perhaps the second group of hijackers feared being shot down. But what is clear is that at impact, this difference was important.