The Core Structures

The Structural System of the Twin Towers

Each tower was supported by a structural core extending from its bedrock foundation to its roof. The cores were rectangular pillars with numerous large columns and girders, measuring 87 feet by 133 feet. The core structures housed the elevators, stairs, and other services. The cores had their own flooring systems, which were structurally independent of the floor diaphragms that spanned the space between the cores and the perimeter walls. The core structures, like the perimeter wall structures, were 100 percent steel-framed.

The exact dimensions, arrangement, and number of the core columns remained somewhat mysterious until the publication of a leaked collection of detailed architectural drawings of the North Tower in 2007. Although the drawings show the dimensions and arrangement of core columns, they do not show other engineering details such as the core floor framing. It is clear from photographs, such as the one on the right, that the core columns were abundantly cross-braced.

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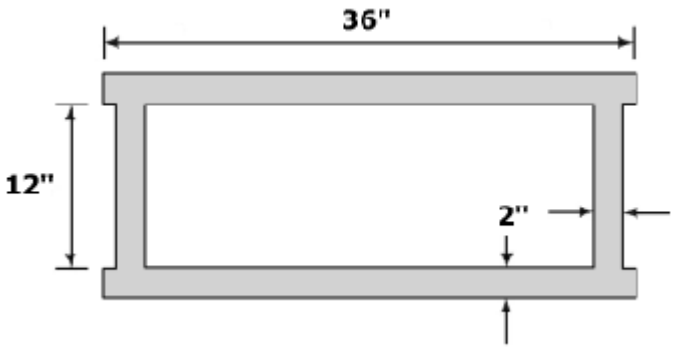
Core Denial

Establishing the true nature of the core structures is of great importance given that the most widely read document on the World Trade Center attack -- the *9/11 Commission Report* -- denies their very existence, claiming the towers' cores were "hollow steel shaft[s]:"

> For the dimensions, see FEMA report, "World Trade Center Building Performance Study," undated. In addition, the outside of each tower was covered by a frame of 14-inch-wide steel columns; the centers of the steel columns were 40 inches apart. These exterior walls bore most of the weight of the building. The interior core of the buildings was a hollow steel shaft, in which elevators and stairwells were grouped. Ibid. For stairwells and elevators, see Port Authority response to Commission interrogatory, May 2004. [1]



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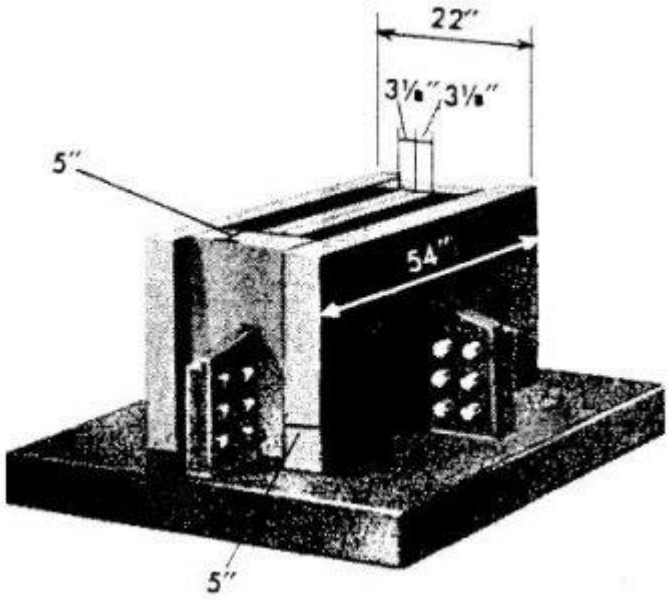
Columns



The top illustration indicates what may have been typical dimensions and thickness of the smaller core columns, about half-way up the tower. The outermost rows of core columns were apparently considerably larger, measuring 54 inches wide.

The core columns were steel box-columns that were continuous for their entire height, going from their bedrock anchors in the sub-basements to near the towers' tops, where they transitioned to H-beams. Apparently the box columns, more than 1000 feet long, were built as the towers rose by welding together sections several stories tall. The sections were fabricated by mills in Japan that were uniquely equipped to produce the large pieces. [2]

Some of the core columns apparently had outside dimensions of 36 inches by 16 inches. Others had larger dimensions, measuring 52 inches by 22 inches. [3] The core columns were oriented so that their longer dimensions were perpendicular to the core structures' longer, 133-foot-wide sides. Construction photographsfound at the Skyscraper Museum in New York City indicate that the outermost rows of core columns on the cores' longer sides were of the larger dimensions. Both the FEMA's *World Trade Center Building Performance Study* and the NIST's Draft Report on the Twin Towers fail to disclose the dimensions of the core columns, and the NIST Report implies that only the four core columns on each core's corners had larger dimensions.

Like the perimeter columns -- and like steel columns in all tall buildings -- the thickness of the steel in the core columns tapered from bottom to top. Near the bottoms of the towers the steel was four inches thick, whereas near the tops it may have been as little as 1/4th inch thick. The top figure in the illustration to the right is a cross-section of one of the smaller core columns from about half-way up a tower, where the steel was about two inches thick. The bottom figure shows the base of one of the larger core columns, where the steel was five inches thick. The bases of the columns also had slabs of steel running through their centers, making them almost solid.

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Column Arrangement

The exact arrangement of the columns and how they were cross-braced is not apparent from public documents such as FEMA's *World Trade Center Building Performance Study*. The arrangement of box columns depicted in Figure 2-10 of Chapter 2 (pictured to the right) seems plausible, even though it contradicts other illustrations in the report showing a more random arrangement. It depicts the top floors of a tower and does not indicate the widths of the columns on a typical floor.

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Cross-Bracing

Construction photographs show that the core columns were connected to each other at each floor by large square girders and I-beams about two feet deep. The debris photograph below shows what appears to be one of the smaller core columns surrounded by perpendicular I-beams approximately three feet deep. In addition, the tops of core structures were further connected by the sloping beams of the hat truss structures.

This photograph from Ground Zero is apparently of one of the smaller core columns connected to a set of I-beams.

This image from the documentary *Up From Zero* shows the base of a core column, whose dimensions, minus the four flanges, are apparently 52 by 22 inches, with walls at least 5 inches thick.

References

1. 9-11 Commission Report; NOTES; Chapter 9 Heroism and Horror; Note 1, *9-11Commission.gov*,

2. APPENDIX B: Structural Steel and Steel Connections, *FEMA.gov*, 2002
3. World's Tallest Towers Begin to Show Themselves on New York City Skyline, *Engineering News Record*, 1/1/1970