

A STUDY ON ONE WORLD TRADE CENTER

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ABSTRACT

The tallest building in the Western Hemisphere rises a symbolic 1,776 feet above New York City. The largely steel structure also includes a concrete core that provides additional security and strength. It's almost as if there's a second skyscraper within the first. The seventh-highest structure in the world is One World Trade Center, which is also the tallest structure in the Western Hemisphere and the United States. The incredibly tall building shares its name with the old-World Trade Center's North Tower, which was demolished after the terrorist attacks of September 11, 2001. On the location of the previous 6 World Trade Center, the new skyscraper is situated on the northwest corner of the 16-acre (6.5 ha) World Trade Center complex. West Street to the west, Vesey to the north, Fulton to the south, and Washington to the east are its boundaries.

Keywords: World trade center, Tallest building, western hemisphere and skyscraper.

I. INTRODUCTION

The site is being rebuilt with six new skyscrapers, a memorial to those killed in the attacks, and a transportation hub. One world trade Centre will be the lead building for the new complex, reaching more than 100 stories at its completion. It is the tallest building in the United States. At the time of completion, the "twin towers", the original 1 WTC (417m), and 25 WTC were the tallest building in the world. The other buildings in the complex included the 3 WTC, 4 WTC, 5 WTC, 6WTC and 7 WTC. All these buildings were built between 1975 and 1985, with a construction cost of \$400 million (\$2300000000 in 2014 dollars). The complex was in New York city's Financial district and contained 13400000 square feet (124000 Sq. meters) of office space.

On April 27, 2006, work on the new building's footings, foundations, and relocation of underground utilities started. On March 26, 2009, the Port Authority of New York and New Jersey (PANYNJ) announced that the structure would no longer go by the slang term "Freedom Tower" and instead adopt the formal name "One World Trade Center." The structure comprises 94 levels, with floor 104 at the top. On April 30, 2012, One World Trade Center surpassed the Empire State Building in height to take the title of tallest building in New York City. The steel framework of the tower was completed on August 30, 2012. The last part of the skyscraper's spire was put in place on May 10, 2013, giving the structure a total height of 1,776 feet (541 m). Intentionally referencing the year that the United States Declaration of Independence was signed, it is measured in feet. One World Observatory debuted on May 29, 2015; the structure opened on November 3, 2014.



Fig-1: One world trade center in 2022

II. CONSTRUCTION

The building occupies a 200 foot (61m), with an area of 40000 square feet (3700 m²), nearly identical to the footprints of the original Twin Towers. The tower is built upon a 185 foot (56 m) tall windowless concrete base, designed to protect it from truck bombs and other good level attacks. Originally the base was to be covered in decorative prismatic glass, but a simpler glass and steel façade was adopted when the prisms proved unworkable.

The current base cladding consists of angled glass fins protruding from stainless steel panels, like those on 7 World trade centers. LED lights behind the panels illuminate the base at night. Cable net glass facades on all four sides of the building for the higher floors, designed by Schlaich Berger Mann, will be consistent with the other buildings in the complex. The facades are 60 feet (18m) high, and range in width from 30 feet (9.1m) on the east and west sides, 50 feet(15m) on the north side, and 70 feet (21m) on the south side.

The curtain wall was manufactured and assembled by Benson industries in Portland, Oregon, using glass made in Minnesota by Viracon. From the floor upwards, the square edges of the tower's cubic base are chamfered back, shaping the building into eight tall isosceles triangles, or an elongated square antiprism.

The tower creates a perfect octagon towards its center, and it culminates in a glass parapet with a square shape that is 45 degrees from the base. A 408 foot (124m) sculpted mast containing the broadcasting antenna—designed in a collaboration between Skidmore, ownings, and Merrill(SOM), artist Kenneth Snelson (who invented the tensegrity structure), lighting designers, and engineers is secured by a system of cables, and rises from a circular support ring, which contains additional broadcasting and maintenance equipment. At night, an intense beam of light is projected horizontally from the spire and shines over 1000feet(300m) above the tower.



Fig-2: Top view of WTC

III. DESIGN

- A 65 feet(20m) high public lobby, topped by a series of mechanical floors, form a 200feet (61m) per side visual cubic base to the tower.
- The next 69 floors, providing tenant office space, rise above the base to an elevation of 1150 feet(350m).
- Mechanical and observation floors culminate in a rooftop observation check at 1362 feet(415m) with a glass parapet extending to 1368 feet(417m). the heights of the original twin towers.
- A shrouded antenna structure supported by cables, rises to a total height of 1776feet(541m), which is a tribute to the year the united states declaration of independence was signed.

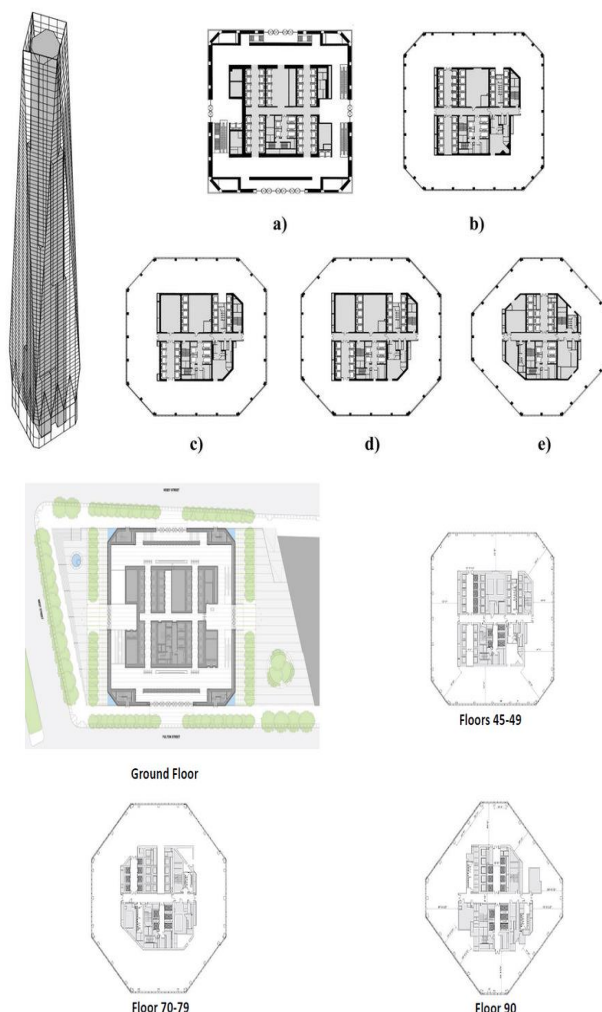


Fig-3: Reinforced concrete base and floor plans by floor wise

IV. STRUCTURAL DESIGN

- The tower's structure is designed around a massive, redundant steel moment frame consisting of beams and columns connected by a combination of welding and bolting.
- Paired with a massive concrete core shear wall, the moment frame lends substantial rigidity and redundancy to the overall building structure while providing column free interior spans.
- The foundation and below grade structure are founded on Manhattan bedrock using spread and strip footings with bearing capacities of 60 tons per square foot or better. Space constraints due to the proximity of existing train lines—which remained operational throughout construction required excavating deeper into the rock at select locations in order to achieve a higher bearing capacity of up to 114 tons per square foot. Rock anchors/tie downs extending 80 feet into the rock were installed to resist the overturning effect from extreme wind events.

V. CONCLUSION

The designers of One WTC were compelled to build a heavily reinforced tower with structural and life safety redundancies that exceed existing codes in order to withstand a potential similar attack while preserving life and the building itself because of the building's symbolic significance in rising to a record-breaking height from the ashes of the worst attack on American soil. One WTC is safer when the perimeter and core systems are combined than any system could be by itself. In many aspects, the WTC buildings were innovative, and the amount of open-plan commercial office space in midtown Manhattan was greatly increased as a result of their construction.

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