7 WORLD TRADE CENTER

rebuilding sets new standard

While Freedom Tower and the Memorial have been the most public symbols of the World Trade Center rebuilding, the iconic significance of Seven World Trade Center (7 WTC) should not be underestimated — not only because it is the first of the buildings felled on September 11 to be rebuilt but also because it is expected to set a new standard for high-rise construction in New York City and elsewhere.

Conceived to be the "safest high rise built in New York City to date," according to Carl Galioto, technical partner on the project for the architect, Skidmore Owings & Merrill LLP, the new 7 WTC has been designed to exceed the New York City Building Codes and the Port Authority of New York and New Jersey's safety requirements. The safety and environmental enhancements to 7 WTC are numerous — from double-capacity fire reserve water tanks and higher capacity automatic sprinklers, to exit stairs that at 66" inches are 20% wider than required, improved egress lighting and a separate, redundant fire command center. In November 2002, Larry Silverstein, the building's developer, said, 7 WTC "will probably be the forerunner of the new fire code and building code for the city of New York when it comes to high-rise buildings. (And it) will become the prototype for new high rise construction, including Freedom Tower and the four other buildings that Silverstein Properties will build on the Twin Towers site."

Construction technology, environmental standards and safety concerns have all evolved significantly over the more than two decades since the original 7 WTC was built, so it is not surprising that the new building will be different in many ways from its predecessor. But as different as the two buildings will be, they will have several important features in common: the developer, general contractors and structural engineer (Silverstein Properties, Tishman Construction, and Cantor Seinuk Group, respectively) responsible for the original 7 WTC are all involved in the building of the new project and steel, the structural material used in the first building, has also been selected to frame the new 7 WTC.

Although the first five levels of the structure housing a Con Edison electrical substation are reinforced concrete, a decision driven by the need to have the substation quickly

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operational and accommodated by existing foundations, Skidmore, Owings & Merrill selected steel for the remainder of the 52-story building to create the column-free office space the market requires. And their expectation is that 7 WTC, with its life-safety enhancements and innovative engineering solutions, will be a building that others will seek to imitate in quest of not only strength and safety but also of flexibility in operating the building for a changing array of tenants over the years.

Unsurprisingly, to construct a building to higher safety standards requires more advanced and innovative solutions than are generally used. According to Silvian Marcus, Chief Executive of Cantor Seinuk Group, the most significant engineering challenge was to utilize standard construction methods to achieve a higher-than-standard result. "The building had to be built to ensure that if one or more exterior columns were to be damaged, that it would still be able to withstand a disproportionate collapse. And that is what we have done," he said.

To achieve this level of lateral stability, the engineer elected to (1) convert the perimeter spandrel beams to rigid frame and moment connections that would be able to support the weight of the structure above a damaged column, and (2) utilize reinforced concrete for the building core. For Marcus, this was the "key combination to prevent disproportionate collapse."

"Every spandrel beam and perimeter girder throughout the building is designed to link together like a chain that would bend and deform but not break," Marcus explained, adding that the use of a concrete core in steel construction is a first in New York City. In addition, massive 30 feet-on-center 14W176-730 Grade 50 steel columns and similarly robust filler beams, spanning about 45 feet from the exterior of the building to the center core, contribute to the building's enhanced strength.

Combining innovative structural steel engineering with a concrete core envelope for added protection and stability, resulted in "ideal construction," Marcus said — one that answers many of today's concerns for safety as well as economy. He also pointed out that even with the significant redundancy in structural steel and the addition of all other important safety enhancements, the tonnage of the building was kept surprisingly low at 12,500 tons, he said, making it efficient from the standpoint of both function and cost.

According to Mike Goldberg, vice president and project manager for Tishman, the addition of a concrete core presented many new challenges in constructing the building. "The original 7 WTC was a traditional steel-framed structure with concrete placed only on the metal deck areas. The new 7WTC is designed as a steel framed structure followed by a reinforced concrete core structure, necessitating an entirely different erection plan," he said.

Under the plan, the steel frame was erected up to a tier height of four stories followed by concrete placement at the metal deck areas, core shear walls, and core slabs. Until the concrete core was completed there was a steel frame in place at the core with no decking. This presented a unique situation in which additional safety elements had to be provided by the ironworkers to allow erection of the steel frame to proceed while the work of the follow trades could continue below. The solution was to provide, in addition to fall protection netting below the erection floor, a fabricated metal-deck-on-joist-framing assembly that was placed over the core at the working deck level and jumped every two floors with the erection of the steel.

Massive columns 30 feet on center support similarly robust filler beams spanning 45 feet from the exterior wall to the center core…

The stairs at 7 WTC are enclosed in massive walls as thick as 2 ft. 3 in. and are constructed entirely from concrete, requiring another unique solution to the need for access through the building for the trades. Here again the ironworkers provided two scaffold stair towers through the metal deck areas, up to 12 floors, for safe access. Access was also provided with fabricated walkways over the open core areas to gain access to the other areas of metal deck. These were just some of the challenges in the construction of the new 7 WTC.

Temporary steel working deck assemblies in place over center core area until concrete core completed.

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In addition to its unique mechanical properties, steel's general benefits were also a factor in its choice as a framing material. "For safety, constructability, flexibility and economy, structural steel framing was the system of choice," Galioto said, pointing out that in New York especially, steel is a preferred material "because it is very accessible and we have access to highly skilled ironworkers so the building can go up quickly."

To address concerns arising after September 11, fireproofing the structure was also an important focus of the design. The architects decided that medium density fireproofing was the best solution. According to SOM's Galioto, the medium density, spray-on fireproofing is "five times stronger than standard fireproofing."

The use of steel, while contributing to the constructability and safety of 7 WTC, also played a part in achieving other design objectives for the building that, according to Galioto. Since structural steel shapes are produced almost entirely from recycled material and utilize less imbedded energy that other framing materials, they contributed to the project's ability to create a sustainable "Green Building" impact. It also allowed the designers to achieve success from urban design and architectural perspectives, with a stainless steel façade of the building used to create an exciting, ever-changing appearance at the streetscape.

From an urban design perspective, one of the goals was to establish the building as an entry point to World Trade Center site from the north.

Safety and Environmental Enhancements

- A building structure designed to increase robustness and structural redundancy by providing **enhanced structural connections** at the core and columns, alternate load paths, and hardened columns in the lobby and loading dock.
- **Reinforced concrete walls** to protect the building core, exit stairs and elevators and containing internal corridors to facilitate occupant egress.
- **Fireproofing on structural steel** will exceed existing code requirements for increased bond strength, adherence ability and impact resistance.
- **Fire protection reserve water storage tanks** to provide twice the required storage capacity and connect to two fire standpipes serving alternating floors to create secondary protection by automatic sprinklers if any standpipes are compromised.
- **Automatic sprinkler system** at each floor designed to higher capacity than required by code.
- **Exit stairs to be 20% wider** than currently required with oversize landings to facilitate both the exiting of building occupants and enhanced access for emergency responders.
- **Exit stairs pressurized to mitigate smoke infiltration** and interconnected at a common transfer floor allowing occupants to exit the building at any one of four locations and directly to the street.
- **Exit stairs and fire standpipes are physically separated** and encased entirely within concrete enclosures to provide a high level of protection for exiting occupants and fire suppression systems.
- To improve emergency responder communications, an **internal antenna and repeater system** will be provided within stairways to enhance communication capabilities of emergency personnel.
- A **physically separated redundant fire command center** will be provided on the ground floor containing a fire alarm system with a physically separated redundant communication backbone.
- The smoke exhaust system has been **designed to purge three floors simultaneously,** exceeding the code requirements.
- **Fresh air intakes for the building's HVAC systems** will be located at the top of the building and provided with filters to mitigate biological and chemical contamination.

"In a broad sense, we set out to change the overall massing of the site by setting the building back from (its original eastern property line) and opening up the space at the entrance so this taller, sleeker building would become, in effect, an entrance pylon to the site," he explained. As a result, a new Greenwich Street corridor is established as a connection between Tribeca and the Financial District.

Meanwhile, the building's crystal-like facade itself contributes significantly to achieving this pylon effect. The facade, designed by David M. Childs, of Skidmore, Owings & Merrill, with glass artist and designer James Carpenter, "appears as a very tight skin with a highly reflective quality," Galioto said, adding that the combination of a super-clear, low iron glass along with stainless steel spandrels produces this reflective skin that continuously changes with the natural changing patterns of light and weather conditions. The building's base, which "was conceived as a block of stainless steel that is carved or sculpted from within, creates the 45-foot high lobby and front door to the tower."

With an enormous red, white and blue banner displayed during its construction , 7 WTC heralds the spirit of redevelopment and renewal in Lower Manhattan. Taller and more transparent than its predecessor, the 52-story, 1.7 million square-foot building is comprised of 41 tenant floors with clear spans of 45 feet from the exterior window wall to central core at three locations and virtually no interior columns for maximum design flexibility. All stories below the eleventh floor are dedicated for use as a Consolidated Edison substation. Fittingly and symbolically, the substation will supply the electrical service for all of Lower Manhattan and replaces equipment destroyed by the attacks on the World Trade Center.

7 WTC will be completed by the end of 2005 and One World Trade Center —known as the Freedom Tower—is now in its first stages of design. Steel framing for Freedom Tower is expected to be completed by September 11th, 2006, marking another milestone as "The Rebuilding Continues."

Perhaps Governor George Pataki summed it up best when he spoke at the groundbreaking for 7 WTC: "This building absolutely reinforces the idea that we will not just recreate, but move beyond what was achieved before in a way that will make us all proud. This is a symbol of New York's strength — a new high-rise building rising to change the skyline of the city…a symbol of our cooperation, consensus and unity." ■

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Construction Manager	**Credit here Credit here Credit here Credit here**
Fabricator	**Credit here Credit here**
Erector	**Credit here Credit here Credit here Credit here**
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