

# Fred N. Severud

## Cable Roof Pioneer and Monument Builder

By Richard G. Weingardt, P.E.

When the American Society of Civil Engineers (ASCE) designated the 50-year-old Dorton Arena in Raleigh, North Carolina, a National Civil Engineering Landmark, the spotlight centered on the structural engineer responsible for its successful execution—Fred N. Severud. The Dorton, which North Carolinians boasted was the first permanent cable-supported roof system anywhere, was but one example of the many structural innovations pioneered by the quiet Norwegian-born genius.

Three years after the Raleigh project, Severud completed another NC world record holder—the Cricket Arena in Charlotte, the largest free-span dome of its time, 4-inches thick and 332-feet in diameter. Two of his later and more-advanced hanging roof structures, the Yale University Hockey Rink, New Haven, Connecticut, and Madison Square Garden, New York City, were likewise history-making masterpieces.



*Fred Severud at the height of his career (late 1960s). Photo courtesy of Fred Severud, Jr.*

Not limited solely to engineering unique roof systems, Severud successfully designed an impressive list of different types of structures throughout the U.S. and Canada. Among them were (1) Mile High Center, one of downtown Denver, Colorado's first significant highrises in the mid-1950s, (2) Place Marie Centre, Montreal, Canada, (3) Ford Foundation Headquarters Building, New York City, (4) City Hall Complex, Toronto, Canada,

and (5) Richard J. Daley Center, Chicago, Illinois, a 32-story civic center highrise.

The highlight of and gemstone in Severud's career, however, was being the structural designer of one of America's greatest monuments—the elegant, towering stainless-steel-faced Gateway Arch in St. Louis Missouri. The cross-sectional shape of the majestic 630-foot-tall structure is an equilateral triangle with 54-foot-long sides at its two bases and only 17-foot-long sides at its peak. It weighs 43,000 tons and has a 60-foot-deep foundation system. The structure is designed to withstand high winds and earthquakes, and to sway about one inch in a 20-mph wind and up to 18 inches in sustained 150-mph wind.

Born on June 8, 1899, in the coast-town of Bergen, Norway, Fred had two brothers and nine sisters. His father Herman, a businessman, and his mother Cecilia, a homemaker, encouraged their children to attend college, but not what field to pursue. Fred's decision to become an engineer was his own.

When he first enrolled at the Institute of Technology in Trondheim, Norway, his original idea was to pursue a military career. Once at the Institute—and having exposure to the field of engineering—he quickly changed his mind, thinking how much more exciting it would be to become an engineer and build great structures. By the time he graduated as an engineer, young

Severud had some lofty goals. He said it was now “my ambition to become the greatest [structural] engineer in the world.” The 24-year-old engineer married his college sweetheart Signe Hansen in 1923. They would have four children—Fred, Jr., Inger, Laila and Sonjan. Although Fred and Signe were still a young couple when they immigrated to the U.S. in the early 1920s, they stayed in close touch with many of their university friends throughout their lifetime. Several became as famous as Severud—Helge Ingstad, for one, became a well-known Arctic explorer and author. And Fred's brother Harald was one of Europe's most important modern music composers.

Shortly after the Severuds arrived in America, he obtained a position with an engineering company practicing on the east coast, where he advanced rapidly. In 1928, he founded his own consulting engineering firm—Severud Associates, based in New York City. Its first major commissions focused on designing major housing project structures. Before long, though, Severud developed a reputation as troubleshooter for fixing all types of buildings that had developed problems, which greatly broadened his company's client base.

In 1947, Severud utilized the experience he gained in his early years of designing successful housing projects and, along with Joseph Abel, wrote one



*Dorton Arena, the focal point of the North Carolina State Fairgrounds in Raleigh since 1952. Its saddle-shaped, cable-supported roof is supported by wires connected to a pair of intersecting parabolic arches, which are supported on slender columns around the structure's perimeter. Photo courtesy of Fred Severud, Jr.*



*Madison Square Garden, New York City (1967). A photograph of Severud along with a model of the Garden's unique cable-supported roof was on the cover – and the feature story – of the June 9, 1966, issue of Engineering News-Record. Photo courtesy of Fred Severud, Jr.*

of the industry's first comprehensive books, *Apartment Houses*, on how to best design, build and operate apartment ventures.

A few years later, as one of the few structural engineers in the world to have analyzed the forces from – and the effects of – atomic bombs, he also wrote a textbook on protection from nuclear explosions called *The Bomb, Survival and You*. His concern about the destructive forces of bombs partly stemmed from the fact that his brother Bjarne was one of the leaders of the Norwegian underground resistance to the Nazis during WWII, and the two often exchanged communications concerning the impact of warfare.

By the time the two history-making arenas in North Carolina and the multi-story Mile High Center in Denver were finished, Severud's engineering practice was in high gear and expanding – and he was in a position to devote more energy to non-office related activities. Spending more time writing and being a speaker at industry as well as non-industry functions were two of them, and he was extremely good at both.



*David S. Ingalls Hockey Rink, Yale University, New Haven, Connecticut (1959-61). Its roof structure, 76 feet at its zenith, features two saddle surfaces spanning between three arches. The roof's cable nets are covered with wood decking. Photo courtesy of Fred Severud, Jr.*

The famous thin shell concrete expert Anton Tedesko (1903-1994), a fellow member of the National Academy of Engineering (NAE) with Severud and the author of the NAE memorial to him in 1990, said, "Fred was not only an innovator of leading-edge structural systems, he was an excellent speaker who inspired complete confidence."

According to Tedesko, it was a characteristic that—along with the fact that Severud intuitively understood how structures worked on their deepest level and was able to clearly see the reasons for structural problems and how to prevent them—made Severud a tremendously stimulating role model and mentor.

Many of the talented engineers who worked with the pioneering genius from Norway became engineering superstars themselves. Two of the more prominent of them were (1) Horst Berger (b.1928), the well-known lightweight, tensile-structure mastermind whose expertise played a big part in the success of the fabric roofs for the San Diego Convention Center and the airport terminals at Denver International and Jeddah International, and (2) Hannskarl Bandel (1925-1993) of Kennedy Center for Performing Arts (Washington, DC) and Crystal Cathedral (Garden Grove, CA) fame.

One of Severud's main professional honors in the latter part of his career was his election into NAE – for his pioneering efforts in the structural field. Never one to let pass an opportunity to make a point on something important to him, Severud wrote in his acceptance letter to NAE, "Real engineering is like a melody that's softly played in tune. Engineers are often prone to juggle figures rather than ideas. To formulate a closer personal relationship with our architectural clients, an artistic temperament would be a great asset. I suggest that some efforts along this line be included in engineering training." Severud believed that, at the core,

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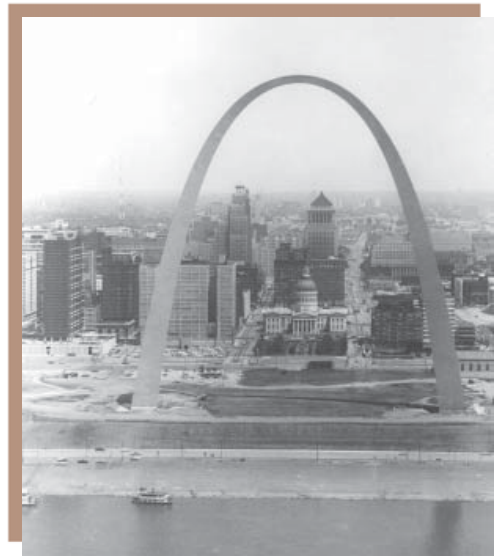
“engineers are artists.” He often would ask young engineers interviewing for a position with his firm, “What musical instrument do you play?”

Even though the daring Severud was exceptionally intelligent and talented, “he never made others feel stupid,” said his son Fred, Jr., who also became a consulting structural engineer. “Above all else, my father was a kind man. He accepted all as equals and as a result had everyone’s highest respect. He had the ability to get the best out of others, not by bullying, but by example and leadership. He was 38 years old when I was born and he died at age 91. In all the time I knew him, I don’t recall once seeing him lose his temper. When others let him down or pulled a nasty trick on him, he always could find some excuse for them.”

A confirmed atheist in his youth, Severud completely reversed his religious belief system after he arrived in the U.S. “His avocation (much more than a hobby) was the Christian ministry,” recalled his son. “He spent most of his time outside of working hours preaching and teaching the Bible. He applied his deep religious conviction in every aspect of his life; he didn’t just preach it to



*Mile High Center, Denver, Colorado (1954). The 23-story office tower was one of downtown Denver’s first noteworthy highrises. Photo courtesy of Richard Weingardt Consultants, Inc.*



*The Jefferson National Expansion Memorial Arch (often called the “Gateway Arch”) on the banks of the Mississippi River, St. Louis, Missouri. Construction, which cost \$13 million, began on February 12, 1963 and was finished on October 28, 1965. The project was opened to the public on July 24, 1967. Visitors enter the arch from an underground visitors center and can travel to the observation deck at the top in a 40-passenger tram that runs inside the structure. The Arch’s form is an inverted catenary, the shape a chain (or necklace) takes when held by its two ends. The curve, named by the Dutch mathematician Christian Huygens, came from the Latin word *catenarius*, meaning “related to a chain.” Photo courtesy of Fred Severud, Jr.*

others, he lived his faith. His love for honesty and justice—and doing the right thing even when it wasn’t to his advantage—was passed on to all he encountered.”

A fellow in the ASCE, Severud received numerous personal engineering awards for being an industry pacesetter, among them the Ernest Howard Award and the Franklin P. Brown Medal. The American Institute of Architects (AIA) presented him with its prestigious Honorary Associate Member award for his lifetime of contributions to structural design.

Severud retired from his firm in 1973 just before his 74th birthday. He spent the remaining 17 years of his life almost entirely dedicated to religious activities. He passed away in Miami, Florida, on June 11, 1990. ■

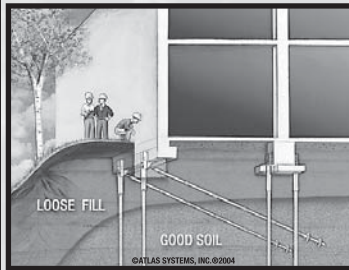
*Richard G. Weingardt, P.E. is CEO of Richard Weingardt Consultants, Inc., Denver, CO. He is the author of eight books. His latest Engineering Legends, which is being published by ASCE Press and is due out in early 2005, features many great structural engineers. Weingardt was the 1995-96 national president of ACEC.*

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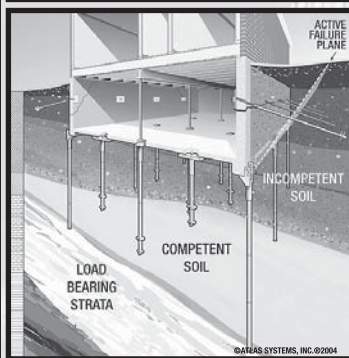
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