



Saving Fallingwater

What was intended to be a weekend retreat for a wealthy Pittsburgh department store magnate and his family, “Fallingwater” now stands as one of the most iconic tributes to architect Frank Lloyd Wright. Molybdenum-alloyed Type 316L stainless steel plays a small but crucial role in preserving one of the greatest buildings of all time.



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As Frank Lloyd Wright's most famous creation, Fallingwater welcomes tens of thousands of visitors each year. In 2015 alone, over 167,000 people traveled to the Laurel Highlands of rural southwestern Pennsylvania to see the legendary home. Fallingwater is defined by its relationship with the waterfall that traverses the property and spills out from beneath the living room. Frank Lloyd Wright famously told the Kaufmann's, the family who lived at Fallingwater, that "I want you to live with the waterfall, not just to look at it, but for it to become an integral part of your lives". Yet, the idea to design a home physically integrated with its natural surroundings was not without structural challenges. By the 2000s, key elements of Fallingwater were at risk of being lost forever. As part of an intensive restoration effort, Type 316L stainless steel was used in the famous staircase that leads from the living room into the river.

The family and the falls

In 1934, global economies were in the throes of the most severe depression of the 20th century. Without jobs to provide economic stimulus, people around the world were struggling to make ends meet. Edgar J. Kaufmann, a department store magnate from Pittsburgh, Pennsylvania, was an exception. Founded in 1871, the Kaufman's Department store grew to become a giant among merchandising businesses in the eastern U.S.. It was a recession-proof staple of the local economy. Fifty miles southeast of Pittsburgh, the Kaufmanns purchased a rundown camp on a stream named Bear Run. Kaufmann loved the unspoiled surroundings, especially the waterfall that cascades from a rock outcropping. This idyllic setting was perfect for the Kaufmann family getaway.



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➤ Over the years corrosion weakened the structural steel of the famous staircase.

Enamored with Frank Lloyd Wright

Kaufmann's son, Edgar Jr. returned from studying art in Europe in 1934. A friend encouraged him to read the autobiography of Frank Lloyd Wright. Young Kaufmann was so impressed with his organic architecture philosophy that he joined a select group of apprentices at Wright's school, Taliesin, to study the master's principles. There is disagreement as to which of the Kaufmann men contacted the architect to design the country retreat. Whether it was Edgar Sr. or Edgar Jr. is moot. Wright would receive the commission to design the iconic home. At age 67, Frank Lloyd Wright was considered by some to be past his prime. His most notable work before designing Fallingwater was the summer home of an entrepreneur from Buffalo, New York. The Fallingwater commission revived the aging architect's career. He would go on to complete more than one-third of his total work, including the Guggenheim Museum in Manhattan.

The Bear Run retreat was always a playground for the nature-loving Kaufmanns. The falls are the focal point of the property, both aesthetically and recreationally. A staff member who worked at the retreat once observed the Kaufmanns and friends bathing beneath the falls au naturel! The Kaufmanns thought that their new country home would be built on the banks of Bear Run with a view of the falls. Wright, however, had a different perspective. After an initial site visit, he would apply his philosophy of organic architecture that promotes a harmonic relationship between the human habitations inherent in the house with the natural surroundings. The home would be constructed atop the falls. Three years after Wright and Kaufmann Sr. first walked the site, Fallingwater was completed.



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➤ Close-up image of severely corroded steel hangers and concrete deterioration.

On the precipice of disaster

Although Fallingwater is an architectural marvel, reinforced concrete design and placement issues coupled with gravity, caused serious structural problems from the outset. A month after the Kaufmanns took up residence, deflection and cracking of the cantilevered portions of the house occurred. The second-floor master terrace contained the largest fissures. Engineers began monitoring and documenting the downward deflection of the cantilevered terraces.

An extensive computer analysis by Robert Silman Associates in 1996 confirmed that Fallingwater's terraces had continued to deflect or sag – one of them nearly 18 centimeters from its original position. These findings lead to a massive restoration effort, headed by Silman's engineering firm, to save the masterpiece before it collapsed upon itself into Bear Run. After extensive evaluation, a system of steel cables or tendons was installed to relieve pressure on both the concrete and the existing steel reinforcement to check the sagging terraces.

Stairway to the waterfall

A unique feature of Fallingwater is a stairway leading from the living room to the head of the falls. It offers easy access to the stream and a plunge pool while providing ventilation for the home when the hatch cover is opened. The original design indicated that the stair treads and landing were to be suspended from the east terrace using steel hangers. However, early pictures document that, in addition to the tread hangers, larger vertical steel members connected the bottom of the east terrace with the riverbed at the landing of the stairs. Over time the steel members have gradually become more substantial, as more vertical structural support was needed for the sagging terrace.

The mild carbon steel used in the original tread hangers of the "hatch" stairs corroded over years of exposure to the moist environment. At times, the staircase would become partially submerged during flood conditions. It also acted as a trap for flotsam and jetsam, adding additional stress to the steel supports. At one point, during a violent storm in the 1960's, the staircase was torn from the structure and had to be replaced.

To prevent the future weakening of the structure from corrosion and the forces of debris-filled storm water, restoration architects replaced the stair hangers and the reinforcement within the concrete treads and landing with molybdenum-alloyed Type 316L stainless steel. The same stainless steel was also chosen for the replacement of the structural columns at the landing that support the east terrace, which can be submerged in the stream after



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➤ Fully-restored "hatch" staircase over Bear Run.

heavy rains. An additional benefit of this alloy is its' impact resistance to flooding debris. A specially formulated "Cherokee Red" paint that Wright claimed reflected both the color of iron ore and the fiery process used in steel-making was applied to blend the new stairs with the existing construction.

The legend lives on

With all its faults, Fallingwater stands as one of the most remarkable architectural achievements of the 20th century. The American Institute of Architects designated it "The Building of the Century." And in 2019, Fallingwater was added to the UNESCO World Heritage List, along with seven other Wright-designed sites. This prestigious recognition is the first designation of modern architecture in the United States. Molybdenum-alloyed stainless steel plays an important role in maintaining both the beauty and structural integrity of this priceless building. (Robert Bukk)