

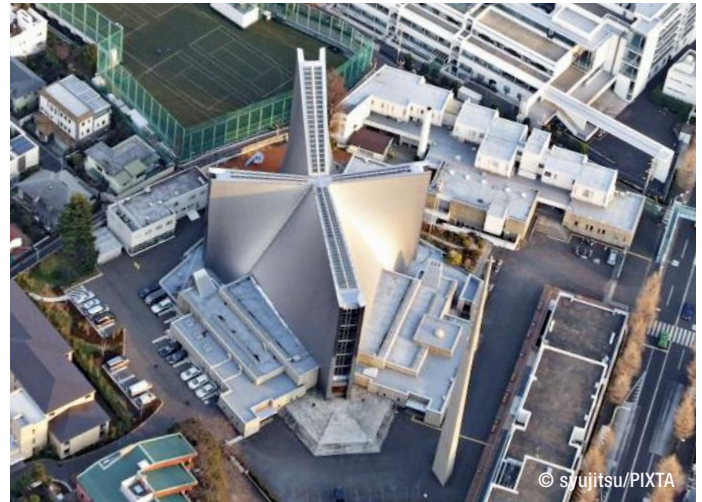


Resurrecting St. Mary's Cathedral

In a city where Shinto shrines and Buddhist temples abound, a Catholic cathedral is an unexpected sight. Nonetheless, Tokyo's St. Mary's Cathedral is one of the world's most famous churches. Designed in the early 1960s by master architect Kenzo Tange, its stainless steel-clad shape was ahead of its time – both in terms of its architecture and of the available technology of the day. To fix some of the resulting problems, the cathedral was re-clad after 40 years with a molybdenum-containing ferritic stainless steel certain to last a lifetime.

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In the Catholic religion, a church is the literal House of God. Charged with designing a home for the divine, one of the 20th century's greatest architects, Kenzo Tange, dreamed up a building unlike any before. However, his pioneering design, which included a skylight roof in the shape of a cross, was far ahead of the construction methods of the 1960s. Over time, the sealant and galvanic separation failed, and rain infiltrated the church's Type 302 stainless steel standing seam roof, which also formed the walls of the building. This caused galvanic corrosion of the iron support structure beneath. By the early 2000s, the corrosion-stained stainless steel panels sometimes ripped off in typhoon-force winds because the clips holding them to the building had rusted. To ensure safety, the church needed prompt restoration. Architects, engineers and religious leaders joined to save the timeless structure. In 2007, it was re-clad with type 445J1 ferritic stainless steel, incorporating the modern building methods needed to recapture Tange's design with a more corrosion resistant alloy capable of withstanding the service environment.



- St. Mary's Cathedral has the shape of a cross viewed from above. The bell tower at the bottom sits apart from the main building.

A church is resurrected

St. Mary's history begins officially in the 19th century. The original church at the site of the cathedral was a gothic style wooden structure built in 1899, which became the Tokyo Cathedral in 1920. That church held services for nearly 50 years before it burned down in 1945 during an air raid. It was not until 1960 that the planning for the new cathedral started, after Tange won a design competition. Construction began in 1963, and after 18 months, the iconic church reopened to parishioners.

By the start of the project, Tange was already a defining force in the reformation of post-war Japan. Now that World War II is largely beyond living memory, it is easy to understate the significance of his work and its influence not only on Japan but also on the rest of the world. The Pritzker Prize winning architect arguably pushed civilization towards peace and progress at a critical juncture. At just 33, he created proposals

for rebuilding the recently decimated city of Hiroshima. A few years later, his design for the Hiroshima Peace Center and Park won first prize. The museum's axis spans the park, intersecting both Peace Boulevard and the site of the atomic bomb. In this way, the museum becomes a literal touchpoint between the visible horrors of war and harmonious reconstruction. The Peace Center externally signaled a commitment to lasting peace. Internally, it signaled the beginning of the search for modern Japan. Tange continued that search throughout his career with designs that incorporated both traditional Japanese architecture and modernist styles. St. Mary's Cathedral remains as one of his most celebrated creations.

A seminal structure

St. Mary's Cathedral is an enormous yet graceful structure in Tokyo's Sekiguchi district. It spreads out in all directions, embodying the lightness of a bird in flight. The outer

Galvanic corrosion

Galvanic or dissimilar metals corrosion occurs when two different metals are in direct contact and an electrolyte medium, usually water, is present on a regular basis. This situation is called a galvanic couple. When two metals form this couple, corrosion of the "anode" (less noble metal) is accelerated, while corrosion of the "cathode" (more noble metal) slows or even stops. Galvanic corrosion was first identified by Italian scientist Luigi Galvani in the late 18th century. Stainless steels are among the most noble of the commonly used building materials, so separating them from less noble metals like iron with an inert barrier is important where moisture is or could be present. To learn more about galvanic corrosion visit <https://bit.ly/galvcorr> on our website.



➤ The raw, unfinished texture of the church interior invokes *wabi-sabi*, a Japanese concept honoring the beauty of transient and incomplete things.

airiness of the church betrays its dense concrete and steel constitution. The church's eight faces serve as both wall and roof, curving like hyperbolic parabolas to form a cross from above. The cross-shaped skylight roof allows natural light to enter the dark concrete interior of the church, symbolizing the light of Jesus Christ.

Similarly, Tange chose a stainless steel cladding for the exterior of the church specifically for its ability to reflect light and constantly change its appearance. The light bouncing off the stainless steel façade also symbolizes the light of Christ reflecting across the world. Together, the luminous stainless steel juxtaposed with the dark-toned interior concrete embody the relationship between the earthly and the divine, and how Christians believe Jesus to have bridged that divide.

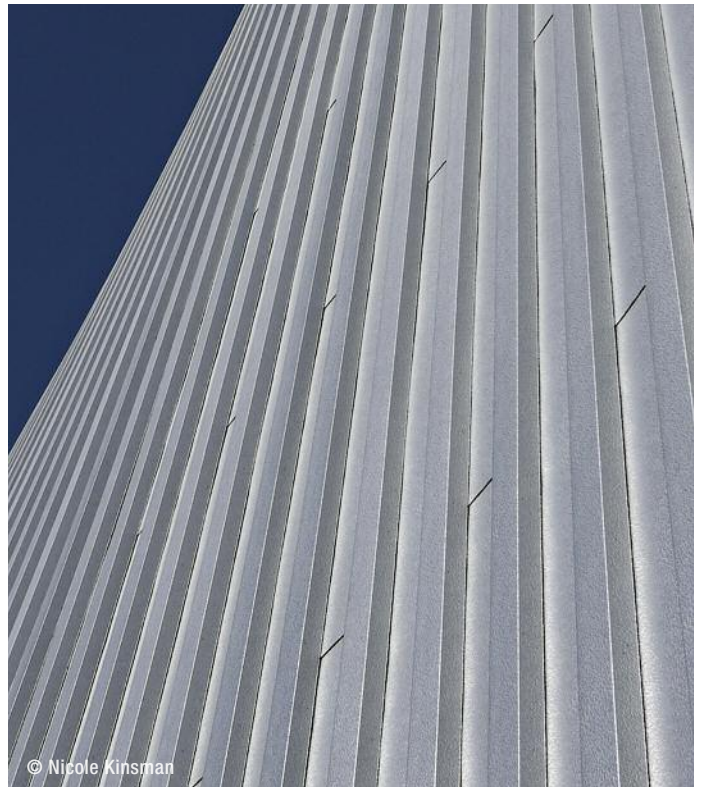
However, the cathedral showed signs of water damage just a few years into its lifespan. The original skylight, made

of steel and glass, was particularly susceptible to leakage and had to be covered with a second roof to prevent rain from entering the church. But this second roof also blocked the church's signature natural lighting. Fortunately, with the help of molybdenum-containing stainless steel and modern building methods, Tange's original design has been restored to withstand wind, rain and even typhoons.

The restoration

To maintain the safety and integrity of St. Mary's, both its exterior wall cladding and supporting iron structure were replaced. Ensnared in labyrinths of scaffolding, workers carefully stripped the cathedral down to its concrete skeleton, which was then cleaned and rainproofed. A special joining method allows for air to flow between the new stainless steel cladding and the inner concrete layer. This air flow dries out any moisture. The restoration and advances in glazing technology also made it possible to reopen the skylight, now constructed from glass and aluminum.

Ferritic stainless steel was chosen for the cladding, because of its lower coefficient of thermal expansion compared to austenitic stainless steel. That means ferritics don't expand and contract as much with temperature changes, making them particularly well suited for many roofing applications. Depending on the design, such thermal movement of the metal can cause high stresses in the connections and can lead to unsightly warping.



➤ The new façade uses a classic Japanese large batten roof design, developed specifically for ferritic stainless steels. The vertical battens follow the curvature of the structure and emphasize the skyward reaching of the building.



- The roof skylights extend to vertical glass walls on all four endpoints of the cross. Behind the central glass column above the main entrance sits a magnificent custom organ, the only one of its kind found in Japan outside a concert hall.



The Type 445J1 alloy used here contains around 1% molybdenum. Adding molybdenum to ferritic stainless steels improves their resistance to localized corrosion in challenging environments. Tokyo is coastal and often humid, so molybdenum is key to preserving the cladding's look and service life. Furthermore, the stainless steel cladding features a smooth, rolled-on patterned finish, also contributing to its corrosion resistance. This finish creates a more consistent appearance by diffusing light more effectively than the original flat finish. This provides a certain uniformity to the surface, hiding any oil canning or uneven spots. Importantly, modern stainless steel roof finishes like the one on St. Mary's reduce reflectivity, sparing drivers, pilots and pedestrians from glare.

Today, the symbolic light of the divine once again floods St. Mary's interior. The return of this light serves as a reminder that neither war, fierce storms, nor the ravages of time can destroy a structure entirely. So long as the spirit of the building lives in the hearts of its community, there's always a way to rebuild. (Karlee Williston)

- Molybdenum helps improve the corrosion resistance of the deeply-textured surface finish used on most of the church.