The Cathedral of Christ the Light

Sacred Geometry, Luminosity, and Longevity

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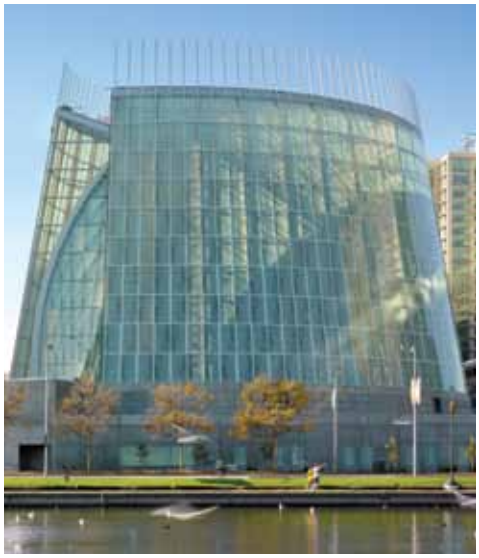

When the Roman Catholic diocese of Oakland began planning a replacement for the St. Francis Cathedral, damaged in the 1989 earthquake, they required a facility that would last at least 300 years, just as the great Cathedrals of Europe have endured for centuries. Through an invited design competition, the San Francisco office of Skidmore, Owings & Merrill LLP, was selected to design the new building, The Cathedral of Christ the Light. The design of this sacred space is deeply rooted in ancient Christian symbolism, unites light and structure, and overcomes difficult site conditions in this seismically active region.

The 1,350-seat cathedral is the centerpiece of a 224,000-square-foot complex that includes a mausoleum, a conference center, administrative offices, clergy residences, a bookstore, a café, and community-serving ministries. Drawing on the tradition of light as a sacred phenomenon, Design Partner Craig Hartman envisioned the Cathedral to transform throughout the day as changing patterns of light interacted with the structure. In order to accommodate both the design concept and the potential seismic motion caused by nearby faults, a delicate structure was required to enable the play of light within the sanctuary and manage ground motions to reduce the demand on the superstructure during an earthquake. The main cathedral superstructure consists of a highly redundant hybrid structural system composed of reinforced-concrete, prefabricated glue-laminated (glulam) wood timber members, high-strength structural steel rods paired with glulam wooden compression struts, and a steel friction pendulum seismic base-isolation system.

As the basis of the Cathedral's geometric vocabulary, the *Vesica Piscis* ("vessel of the fish") shape, formed of two interpenetrating circles of the same diameter, is an early Christian symbol that represents the fusion and reconciliation of opposites. These interpenetrating circles are related to one another through the square roots of 2, 3, and 5 – the first three digits of the Fibonacci Sequence. The geometric and mathematical applications of the resulting shape commonly occur in nature and in the order of the universe itself. The *Vesica Piscis* conceived in plan is translated three dimensionally into the Cathedral's superstructure. Two intersecting spheres define the interior volume, while creating truncated vesici at the Alpha and Omega Windows, which represent the beginning and the end in traditional Christian liturgy. The Omega Window features a 58-foot-tall image of Christ rendered by light passing through the pixel-like perforations in the aluminum panels of the window. The architecturally exposed reinforced concrete reliquary walls used to create both the inside and outside of the structure are formed by overlapping circles with the same radii offset in plan.

To achieve the effect of luminosity within the Cathedral, curved, tapered, and glued-laminated Douglas Fir timber rib members form the framework of the sanctuary superstructure. A total of 724 closely-spaced louver members interconnect and provide lateral bracing for inner rib members. Their sizes and orientations respond to structural demand and allow natural daylight to filter into the space. Light reflects off the upper louver surfaces and illuminates lower, neighboring louvers. The inner curved rib members form a spherical shape in plan and section. Exterior sloping, straight, glued-laminated outer rib members form a conical shape in plan and are aligned in a radial geometry with inner ribs. Thirteen sets of inner and outer vertical glued-laminated ribs form each half of the superstructure. Gravity loads are resisted by 52 vertical, glued-laminated, and wood timber elements.

High-strength steel rods and tapered, turned glued-laminated wood struts interconnect the inner and outer ribs, forming a hybrid steel-timber, three-dimensionally braced frame structure, providing stability under both vertical and horizontal loading. Steel rods are designed to resist both wind and seismic forces. A total of 224 steel rods and 104 glued-laminated wood timber compression struts provide redundancy and reserve ductile capacity in the lateral load resisting system. The high-strength steel rods and wood struts are connected to the ribs with hidden steel knife plates and dowels from the backside of the rib.

While wood provides an important unifying architectural, structural, and spiritual design element, its use as a primary material in the glue-laminated superstructure also contributes to the desired long-term performance objectives. This material has proven to be aesthetically pleasing, highly durable and structurally forgiving. The wood's surfaces add warmth while its elasticity allows for flexibility during seismic activity in this extremely sensitive area. Located approximately 2.9 miles from the Hayward Fault and 15.8 miles from the San Andreas Fault, the site is listed as Seismic Zone 4 under the 2001 California Building Code (CBC) seismic design parameters. Through a rigorous analysis and design process, the entire cathedral complex was engineered to resist a 475-year return period earthquake as defined under the CBC. The main sanctuary was designed to meet an even higher standard – to resist without damage the CBC's "maximum capable" 1,000-year return period earthquake, which could measure 7.0 or more on the Richter Scale. The reliquary walls and sanctuary floor diaphragm are supported by a steel, friction-pendulum seismic base isolation system.

Through the innovative use of renewable materials and advanced seismic engineering, the Cathedral has been designed to withstand a 1,000-year earthquake while using minimal energy and natural resources, and achieves a luminous and evocative architectural presence that exemplifies the devotion and craftsmanship of the world's great religious landmarks. As a result, the Cathedral of Christ the Light will endure for centuries and represents a true integration of structure and light.▪

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