Photo credit: Denise Blankenberger

Cathedral of Christ the Light

Location:
Oakland, CA

Architects
Craig Hartman - Skidmore, Owings & Merrill LLP

General Contractor
Webcor Builders

Design Start // Finish
2002 - 2008

Area
2.5 sqm

Exterior Wall Systems
Glass, Precast Concrete

Interior Systems
Glulam Arches

Owner
Catholic Diocese of Oakland

Construction And Program Management
Conversion Management Associates, Inc. (CMA, Inc.)

Content: SOM

Photo credit: Cesar Rubio

Background:

The Cathedral was commissioned by the Oakland Diocese to replace the Francis de Sales Cathedral that was lost in an earthquake in 1989. As the primary church of Oakland, the structure serves over 60,000 Catholics.

The commission was originally won by Santiago Calatrava, but after various design negotiations, the union was dissolved, and Hartman's scheme was chosen instead (Stephens).

Abstract:

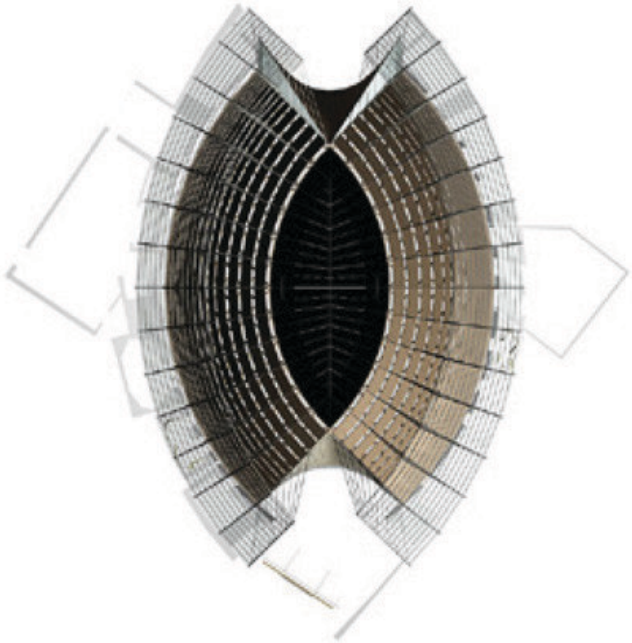
The Cathedral is a sanctuary among the somewhat grim and grungy atmosphere of Oakland. It shines in the daylight and glows from within during evening and night hours.

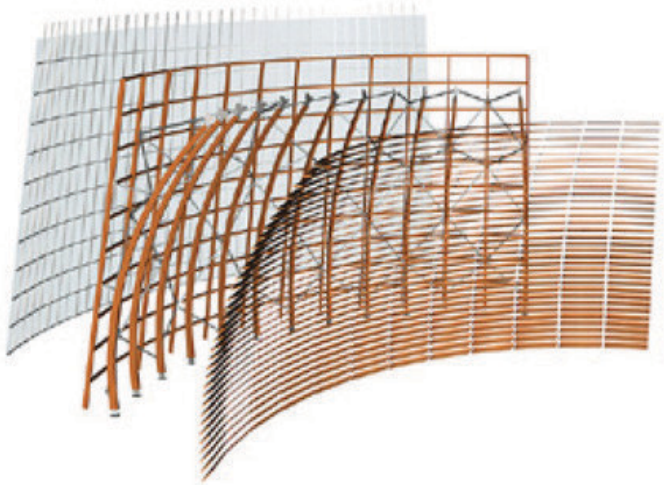
To Craig Hartman, the primary architect on the project, the design is a "once in a lifetime" experience. He said that the intricate design and substantial budget that he was fortunate to work with gave him creative liberties to explore otherwise unfeasible options. The Cathedral is designed to last at least 300 years into the future, so it faced some considerable constraints both in structural and site design.

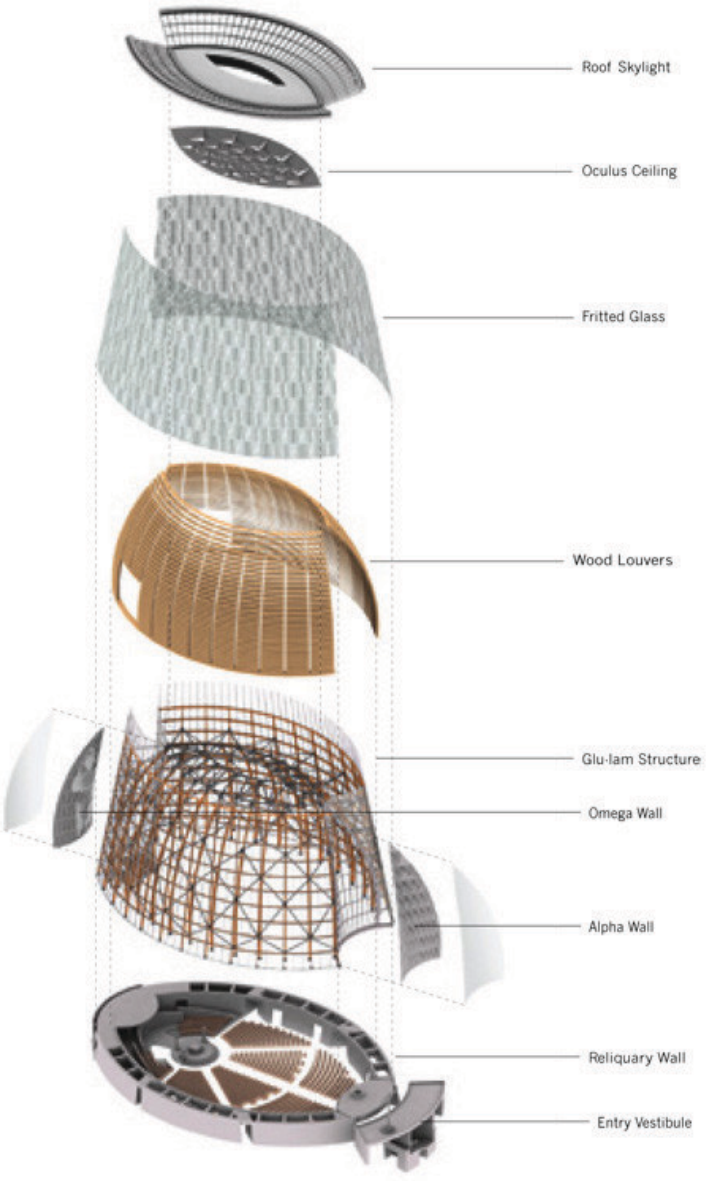
Taking the name of the Cathedral to heart, quality of light is the driver of the design and materials used in the sanctuary. Only natural daylighting is used to light the sanctuary space during the daytime hours.

Content: SOM

Photo credit: John Blaustein







CATHEDRAL OF CHRIST THE LIGHT

SKIDMORE, OWINGS & MERRILL LLP

Design:

Though not expressly evident at first, in plan, the Cathedral is designed in the shape of the vesica pisces - the iconic symbol of Christian believers. The majority of the site is actually found below ground. A concrete base enshrouds the rest of the program underneath the sanctuary. This was designed intentionally to draw emphasis to the sanctuary itself and to save costs in other pieces of the program, again, to give greater attention to the main public space. The sanctuary itself is 118 feet high and seats 1,350. Contained within the reinforced concrete walls are chapels, a vesting room, and the sacristy.

The remainder of the program includes a mausoleum, parish hall, offices, a conference center, library, cafe, and parking for 200 cars.

The major components of the cathedral (from bottom to top) are: reinfoced concrete underground structure, reinforced concrete reliquary wall, glulam structure [curved ribs, compression rods, straight timbers, louvers], glass wall, oculus ceiling, roof skylight. All the components have a radial symmetry around the vesica pisces shape.

Content: SOM

Photo credit: Timothy Hursley

Structure:

The structure of the Cathedral sanctuary is a hybrid structure of reinforced concrete, glulam timber arches, steel rods, glulam compression struts, and a steel friction-pendulum seismic base isolation sustem - all on top of the reinforced concrete base structure that makes up the remainder of the Cathedral.

Douglas fir timber glulam columns make up the ribbed structure of the sanctuary. The curved ribs are 10.75" wide and vary from 30" deep at the base to 19.625" at the oculus roof framing. In total, 52 rib members comprise the interior superstructure.

Straight glulam timbers frame the outer structure and are likewise 10.75" wide, but 15" deep. These timbers are connected to the interior curved timbers by 224 steel tension rods and 104 timber compression struts. This serves redundancy to resist lateral loads, even the highly demanding seismic forces. The steel rods are 1" in diameter typically, but vary at critical load paths up to 2" in diameter. The compression struts connect the the curved ribs to the straight ribs with pinned connections.

724 glulam timber louvers interconnect and provide the lateral bracing for the curved ribs. These are angled to optimize the fittering of light into the space throughout the course of the day - ranging from 60 degrees at the base to 16 degrees at the top. They are found at 36" intervals, and are 5" wide.

Being only 2.9 from the Hayward Fault line and 15.8 from the San Andreas Fault, the building is in seismic zone 4. For this purpose, the cathedral is designed to withstand even the most substantial earthquake with only minimal damage. The superstructure of the Cathedral rests on 36 base isolators that allow it to move up to 30" of displacement, independently of the reinforced concrete base.

Content: Sarkisian

Photo credit: Timothy Hursley

Construction + Challenges:

The curved ribs join at the oculus sreel roof framingin a compression ring, which gives tribute to the structure of historic Cathedrals with magnificent domed roofs that too employ compression rings to support the massive weight of the structure.

The ribs were prefabricated and outfitted with the joinery materials: aluminum plates for the connection of the louvers and pins for the compression struts that connect the curved ribs to the straight ribs. Connectors for the outer skin glass wall were also outfitted on the straight ribs. The superstructure was connected to the 14" thick reliquary walls of reinforced concrete with pinned connections. Significant scaffolding was necessart to place the curved ribs around the compression ring.

Due to its tension bracing system and seismic zoning, the cathedral faced a height limit of 65 feet. The designers had to prove that the structure could withstand up to a 7.0-magnitude earthquake. Advanced computer modeling was required to provide this documentation. Adequate analysis was met, and the sanctuary was allowed to be built to its designed height of 120 feet.

Content: Sarkisian

Photo credit: Timothy Hursley

Skin, details:

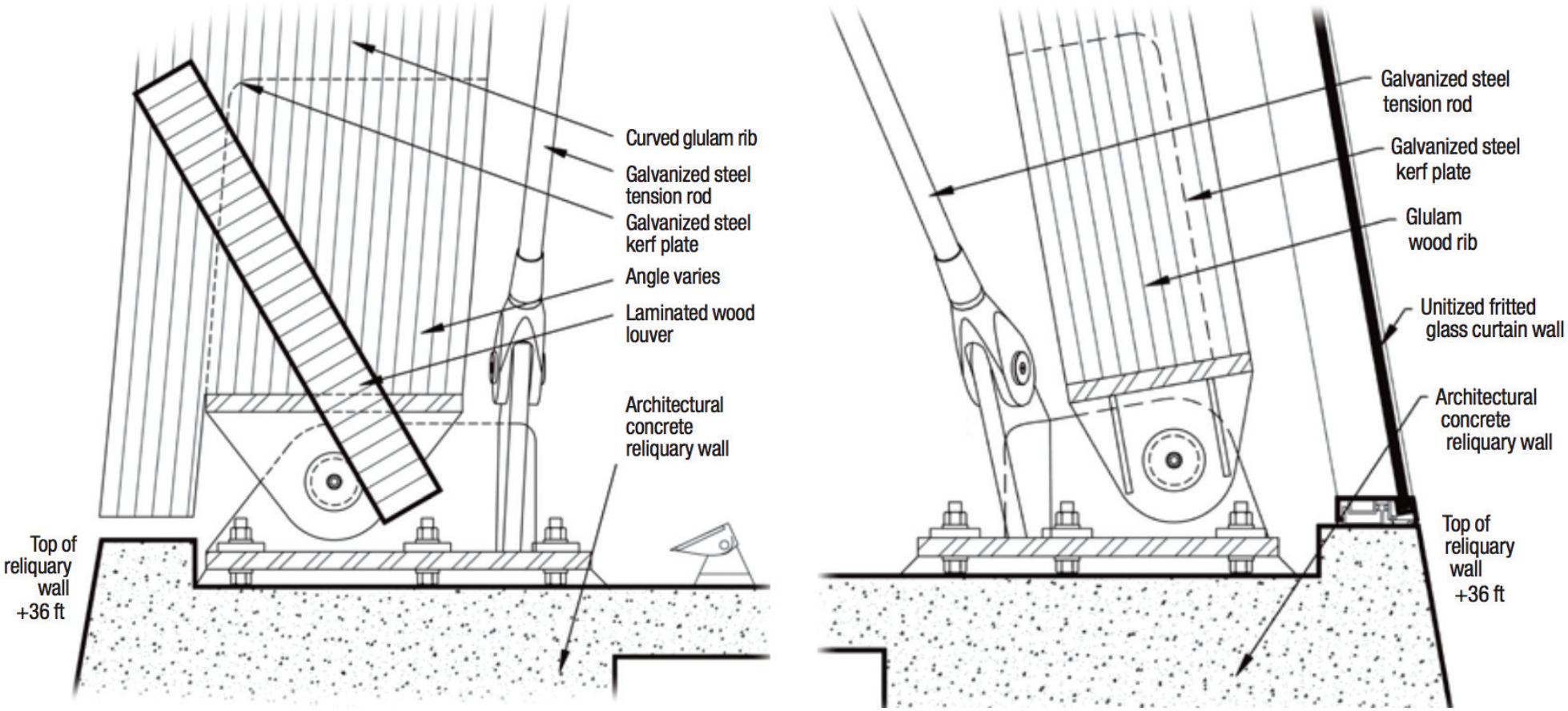
The glass that makes up the exterior of the sanctuary is a diaphanous outer skin that combines fritted glass with low-E glass to maintain the desired light quality without the heat gain and glare effect. The fritted glass also is laminated with a translucent film designed to look organic "like the bark on a tree" (Hartman quoted in Stephens).

Rather than the traditional stained glass sanctuary wall typical of cathedrals, modern or not, the design created a nearly 60 foot high image of Christ using laser-cut panels of white acoustic board. In this way, the image seems to glow as if being produced by a projector. The image is muted during the day, but at night, lights from behind make the image stand out in stark contrast to the rest of the space, which is dimly lit from the interior of the sanctuary. The laser-cut perforations that make up the image vary in size but are located strategically within a grid system for ease of fabrication.

To further negate the environmental impact of the Cathedral, fly ash and slag are used in the concrete. The sustainably harvested Douglas fir that comprises the glulam arches was also selected for its structurally forgiving qualities and ability to be replaced in isolated pieces when necessary to preserve the design to last for centuries (ArchDaily).

Content: SOM, ArcDaily

Photo credit: Timothy Hursley


Curved glulam rib
Galvanized steel tension rod
Galvanized steel kerf plate
Angle varies
Laminated wood louver
Architectural concrete reliquary wall
Top of reliquary wall +36 ft
Galvanized steel tension rod
Galvanized steel kerf plate
Glulam wood rib
Unitized fritted glass curtain wall
Architectural concrete reliquary wall
Top of reliquary wall +36 ft

Sources

Barrie, Thomas. "Sacred Space and the Mediating Roles of Architecture." European Review 20.01 (2012): 79-94.

Britton, Karla. The Cathedral of Christ the Light : The Making of a 21st Century Cathedral : Skidmore, Owings & Merrill LLP. Ostfildern, Germany: Hatje Cantz Verlag, 2011. Print.

"Cathedral of Christ the Light / SOM." ArchDaily. N.p., 12 Feb. 2009. Web. 4 Feb. 2017.

"Cathedral of Christ the Light." SOM.com. SKIDMORE, OWINGS & MERRILL LLP., n.d. Web. 4 Feb. 2017.

Sarkisian, Mark, et al. "The materials of the cathedral of christ the light." AEI 2011: Building Integration Solutions. 2011. 327-334.

Stephens, Suzanne. "Skidmore, Owings & Merrill's Craig Hartman Explores Immateriality And Luminosity In Oakland's CATHEDRAL OF CHRIST THE LIGHT." Architectural Record 197.1 (2009): 86. Vocational and Career Collection. Web. 4 Feb. 2017.