

LDS Conference Center

LOCATION

Salt Lake City, Utah

ARCHITECT

Zimmer Gunsul Frasca
Portland, OR

OWNER

The Church of Jesus
Christ of Latter-Day Saints

STRUCTURAL ENGINEERS

KPFF, Portland, OR

GENERAL CONTRACTOR

Okland, Jacobsen &
Layton Construction
Companies
(A Joint Venture)

READY MIX SUPPLIER

Metro-Ready Mix

LIGHTWEIGHT PRODUCER

Utelite Corporation

TOTAL LW CONCRETE

15,000 Cu. Yds.

PROJECT SPECIFICATIONS

Facility: 1,500,000 sq. ft. highlighted by a 21,000-seat, 600,000 sq. ft. assembly hall, and including a 900-seat theater, and 1,300-car underground parking structure, and a richly landscaped 5-acre rooftop garden

LDS Conference Center Uses ESCS To Solve Unique Design and Construction Challenges



LDS Conference Center Complex in Salt Lake City

UNIQUE BUILDING MARKS 150th ANNIVERSARY

The July 24, 1997 groundbreaking marked the 150th anniversary of the arrival of the first pioneers to the Salt Lake Valley, a truly significant date in Utah's history, and heralded the beginning of a remarkable and demanding experience for the Church of Jesus Christ of Latter-Day Saints. The new 1,500,000 square foot Conference Center is a unique building in countless ways – both in its design and construction. The LDS Church wanted a facility that would last 150 years! That meant designing a structure that would not only meet but vastly exceed the 1994 Uniform Building Code in which Salt Lake City is designated in a seismic Zone 3.



LDS Conference Center - Main Entrance

DESIGN AND CONSTRUCTION CHALLENGES

The Conference Center has won numerous national and international architectural and structural design awards. The main assembly hall, with a seating capacity of 21,000 people, is the largest known indoor non-column theater in the world. The desire of the church leaders to have an assembly hall of this magnitude with unobstructed views meant a complex and intricate long-span truss design with trusses up to 290 feet in length, up to 30 feet deep, and with the ability to handle rooftop loads between 250 and 525 psf. The roof is supported by a 682-ton King Truss (largest on the planet).

Another primary structural challenge was to design a building that would have to be partially embedded up to 90 feet below grade, and which could resist the external horizontal soil pressures. This is required because of city zoning laws that restrict the building's height to 75 feet.

Perimeter and interior concrete walls of the building's foundation were placed up to 30 inches thick, while excavation shoring surrounds the site perimeter and uses a conventional tied-back pile shoring system for support. The exterior walls of the parking garage foundation, which extend 45 feet below grade, are 10 to 14 inches thick, and span horizontally between pilings.

UTELITE SHARES IN THE 150TH ANNIVERSARY CELEBRATION

Structural lightweight concrete was used extensively to lighten the dead load and help solve the design and seismic demands placed on the structure. In the roof system 15,000 cubic yards of 4,000 and 6,000

psi lightweight concrete weighing 110 lb/ft³ were used.

Much of the lightweight concrete roof is exposed to the freezing and thawing conditions of the Utah climate. In this regard, the excellent durability performance of structural lightweight concrete proved beneficial.

In the wall systems, 120,000 lightweight concrete masonry units, with a maximum weight of 28 lbs. per 8 x 8 x 16-inch unit, were used. The CMU's were manufactured by Amcor Masonry Products and installed by B&T Masonry.

MAIN ASSEMBLY HALL

The main assembly hall consists of three concrete walls – east and north walls, and a 660-foot quarter-circle radius wall, each of which is 106 feet tall, 16 inches thick, and supports the lightweight concrete roof structure. The final exterior wall design incorporates heavily reinforced concrete buttress walls that are 24 to 36 inches thick, and are supported by 6-foot-thick mat footings.

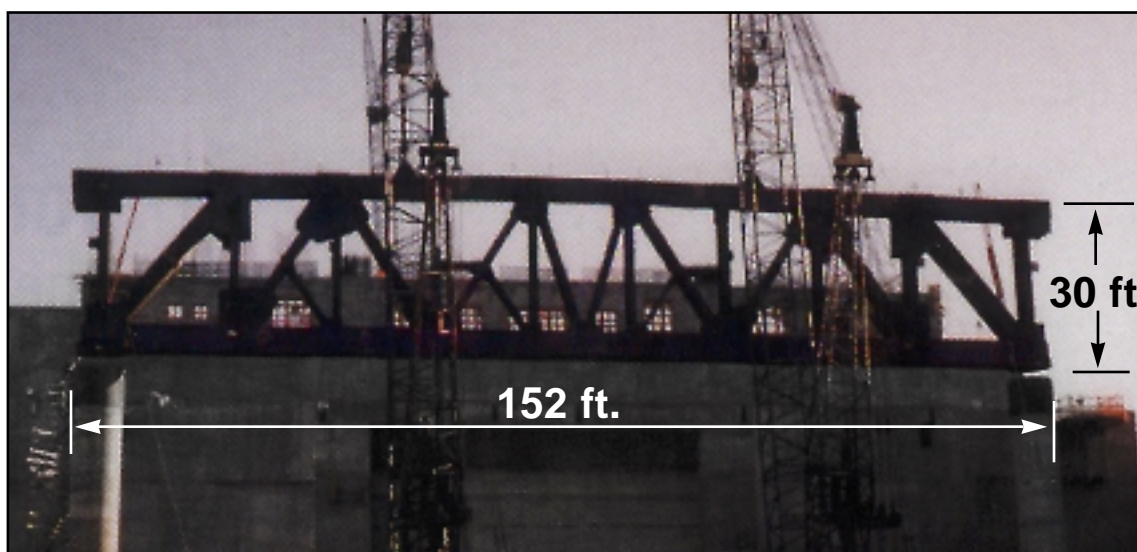
Another supremely challenging design aspect was the 34-cantilevered balcony-seating trusses. According to Nathan Charlton,



LDS Conference Center – Largest in-door non-column theater in the world.

associate manager structural engineering for KPFF, Portland, and project manager of the Conference Center added, “The magnitude of the project, as a single project, is something we haven’t come across in the past. This was a very fast-track project, designed and built very quickly, and the close relationships that developed were absolutely necessary to succeed.”

Perhaps the most monumental of all construction aspects of the Conference Center was the erection of structural steel performed by Schuff Steel of Phoenix, Arizona, specifically the proscenium king truss and 10 radial trusses. The 620-ton monster king truss (actual weight 1,232,156 lbs.) was 152 feet long, 30 feet deep, and rested on two giant reinforced concrete columns at each side of the stage. Two American 11320 cranes were brought in from California specifically to lift the trusses. The truss is constructed of square hollow-box steel members.



620 tons, 152-foot long, 30 feet deep – The proscenium king truss spans stage

SPECIAL HIGH-STRENGTH, HIGH-PERFORMANCE MIXTURE FOR KING TRUSS

A special high-strength normal weight concrete mixture was pumped into the actual hollow areas of the king truss to give it extra rigidity and limit deflections on the roof span. This high-strength mixture achieved 7.5 million psi of MOE, one of the highest modulus ever obtained in the intermountain region. In layman’s terms, the high-strength mixture has a compressive strength of 18,000 psi, four-to-five times more than a standard mix design.

CONCRETE TEAM

Metro West, recently purchased by Old Castle (Jack B. Parson Co.), supplied over 120,000 cu. yds. of concrete for the project. Total structural lightweight concrete (4,000 psi and 6,000 psi) equated to 15,000 cu. yds. There were over 20 different mix designs used throughout the project. According to Peter Snow, Vice President of Metro West, much of the normal density concrete (40,000 - 50,000 cu. yds.) were high-performance mixtures. Under the direction of Peter Snow, the Metro West Quality Control Team headed by Lou Nicoletti, Lonnie Grey, Cordell Peterson, Kelly Chatterton, and Bob Parker insured the success of all the concrete mixtures on the project.

MIX DESIGN CONSIDERATIONS

- a) Fc of 4,000 psi and 6,000 psi
- b) Required air dry density @ 56 days required 110 lbs/cf
(28 Day waived by structural engineer – KPFF of Portland, Oregon)
- c) Mix Design approximation for Fc 6,000 psi:

Cement: Type II/V	590 lbs.
Fly Ash: Class F	140 lbs.
Water:	250 lbs.
Coarse Aggregate (Utelite)	1,020 lbs.
Fine Aggregate (C-33)	1,170 lbs.
Air: 7 +/- 1%	
3 oz./cmt C 494 T. A	
18 oz./cmt C 494 T. F	

JOB SITE TEST RESULTS

- a) Standard Deviation of approximately 420 psi
- b) Mean Average Strength of 7,100 psi (cv of 6%)

TOTAL YARDAGE OF 6,000 PSI LIGHTWEIGHT

- a) 8,300 cubic yards



For Additional Information About Structural Lightweight Concrete Contact
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 or

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