ENTRY FORM



# DVASE 2017 Excellence in Structural Engineering Awards Program

## **PROJECT CATEGORY (check one):**

Buildings under \$2M		Buildings Over \$100M	
Buildings \$2M-\$10M		Other Structures Under \$5M	
Buildings \$10M - \$30M		Other Structures Over \$5M	
Buildings \$30M - \$100M	Х	Single Family Home	

Approximate construction cost of facility submitted:	Confidential (initial public numbers were around \$70 Million)
Entry Fee:	FREE
Name of Project:	The Church of Jesus Christ of Latter-day Saints Philadelphia Pennsylvania Temple
Location of Project:	Philadelphia, PA
Date construction was completed (M/Y):	September 2016
Structural Design Firm:	Keast & Hood Structural Engineers Philadelphia, PA
Affiliation:	All entries must be submitted by DVASE member firms or members.
Architect:	Executive Architect: Perkins + Will Associate Architect: FFKR Architects
General Contractor:	L.F. Driscoll Co. and Big-D Construction

Company Logo (insert .jpg in box below)



## **Important Notes:**

- Please .pdf your completed entry form and email to <u>bkoroncai@barrpino.com</u>.
- Please also email separately 2-3 of the best .jpg images of your project, for the slide presentation at the May dinner and for the DVASE website. Include a brief (approx. 4 sentences) summary of the project for the DVASE Awards Presentation with this separate email.
- Provide a concise project description in the following box (one page maximum).
- Include the significant aspects of the project and their relationship to the judging criteria.

#### **The Church of Jesus Christ of Latter-day Saints, Philadelphia Pennsylvania Temple** Philadelphia, PA

The Philadelphia, PA Temple is a 61,000-square-foot building that will serve over 40,000 members from the Philadelphia region. It is part of a 300,000-square-foot complex occupying a full city block consisting of an underground 210 parking garage, public plaza, and services building. The Temple building features one of the most thoughtfully proportioned and richly detailed natural stone facades constructed in Philadelphia in nearly 100 years.

The new Temple is an extremely sacred space for The Church of Jesus Christ of Latter-day Saints. Due to the importance of the building, the Church specified that it be constructed to sustain centuries, not decades. The request by the client created a complex challenge, how to resolve the competing goals of a highly ductile lateral resistance system and a solid stone façade, usually reserved for traditional, solid walled building types? The client essentially requested a 19<sup>th</sup> century façade on a 21<sup>st</sup> century building designed to California code requirements. Keast & Hood's response was an inventive, lateral system design that utilized a two stage equivalent lateral force procedure; *ordinary concentric braced frames* for the Temple Towers and *special reinforced concrete shear walls* for the main Temple structure. An R=3 seismic force resisting system was strictly prohibited by the Church. Additional seismic detailing, redundancy, and a capacity based connection design, similar to that of a Seismic Design Category of D, were also specified by the Church's design guidelines.

### Key structural design elements

Resolving through design the competing goals of a highly ductile lateral resistance system and a solid stone façade usually reserved for solid walled building types:

- The lateral system for the Temple was "special reinforced concrete shear walls" (R=5)
- The lateral system for the towers were "ordinary concentric braced frames" (R=3 1/4)
  - The braced frames connections were designed by K&H using a capacity based design approach. An elliptical hinge zone was utilized in the gusset plates to minimize the gusset plate dimensions.
- Designed to the Church's strict seismic performance criteria.
  - Met seismic design category D code requirements at a minimum at the church's request. Technically seismic design category B per code.

Building a 19<sup>th</sup> Century Façade in the 21<sup>st</sup> Century

Support with modern technology a classically designed facade that is highly ornate and richly detailed:

- Engineers were able to reinterpret the traditional façade edifice and design it as a modern wall system using steel brackets and framing to support the solid stone granite blocks.
- The façade's articulation and relief had structural implications. Specifically at the fourth floor where the façade steps out to the fifth floor, a steel truss was utilized to support the façade and the cornice.

The client's overall goal of "Everything [to be] designed to the highest standards" resulted in an exceptional building with recognition by the Philadelphia Inquirer's Pulitzer prize winning Architecture Critic, Inga Saffron. • The following 5 pages (maximum) can be used to portray your project to the awards committee through photos, renderings, sketches, plans, etc...



A view of the Philadelphia Pennsylvania Temple at night. The building immediately became an iconic part of the Logan Square area. (photo ©The Church of Jesus Christ of Latter-day Saints)



The Philadelphia Pennsylvania Temple is part of a larger, 300,000-square-foot complex consisting of an underground 210 parking garage, public plaza, and services building. (photo ©The Church of Jesus Christ of Latter-day Saints)



The stone façade of the Temple is one of the most ornately detailed natural stone facades built in Philadelphia in nearly 100 years. (photo ©The Church of Jesus Christ of Latter-day Saints)



The solid stone granite was quarried from an island off the coast of Maine, then carved and shipped down from Quebec. (photos ©Dan LePore & Sons)



High seismic design criteria necessitated the use of special reinforced concrete shear walls. The shear walls were reinforced with heavy steel reinforcement closely spaced to meet detailing requirements, fitting with the client's strict seismic specifications. (photos ©Keast & Hood)

Below: The heavily reinforced concrete shear walls were incorporated into a steel framed building. (photos  $\bigcirc$ Keast & Hood)



Pictured Below: Structural detail of the tower's braced frame connection and photograph of it in the final design. (structural photo & detail ©Keast & Hood)





Pictured Bottom Left: Support bracket for heavy stone façade connected to CMU backing. Pictured Bottom Right: The support steel for the cornice at the roof cantilevering off of the façade truss. (photos ©Keast & Hood)





By signing, signatory agrees to the following and represents that he or she is authorized to sign for the structural design firm of record:

All entries become the property of DVASE and will not be returned. By entering, the entrant grants a royalty-free license to DVASE to use any copyrighted material submitted.

Submitted by:			
Print name:	Signatu	ure: Date:	
Thomas J. Normile, PE		Apr 11, 2017	
Submitting Firm:	Keast & Hood		
Mailing address:	400 Market Street Suite 1250 Philadelphia, PA 19106		
Telephone:	Fax:	Email:	
(215) 625-0099	(215) 625-9408	tnormile@keasthood.com	