

AEI 2019

Integrated Building Solutions— The National Agenda

Proceedings of the AEI 2019 Conference

April 3-6, 2019

Tysons, Virginia





Edited by Moses D. F. Ling, P.E. Ryan Solnosky, Ph.D., P.E.

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ARCHITECTURAL ENGINEERING INSTITUTE

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PROCEEDINGS OF THE ARCHITECTURAL ENGINEERING NATIONAL CONFERENCE 2019

April 3–6, 2019 Tysons, Virginia

SPONSORED BY The Architectural Engineering Institute (AEI) of the American Society of Civil Engineers

> EDITED BY Moses D. F. Ling, P.E. Ryan L. Solnosky, Ph.D., P.E. Robert M. Leicht, Ph.D.





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Preface

We are excited to present the Proceedings of the AEI Conference 2019 and invite you to explore this collection of technical papers and case studies. These papers and case studies represent the collaborative effort of a community of scholars and practitioners working under the umbrella of "Integrated Building Solutions" who offer writings about their current research and leading-edge practices.

Studies indicate that people spend more than 85% of their lives inside buildings. As such, integrated building solutions are surely a high-priority national agenda. The outcome of the work of architectural engineers will long impact individuals and society as a whole for years to come. Given that only a very small portion of the current building stock are replaced each year, it is imperative that moving forward buildings are built with the best efforts of our community of planners, designers, constructors, developers, owners, and operators. Architectural Engineering Institute invites all stakeholders to engage in dialog on this national agenda through the conference and its proceedings and publications.

The Institute engenders to give rise to communities embracing each "AEI Build": Deliver, Enclose, Learn, Modular, Perform, Resilient, Secure, and Sustain. As such, the conference schedule and proceedings are organized under the AEI Build categories. All AEI members are encouraged to participate in conversation in these communities and seek out AEI leaders championing the respective AEI Builds.

The organizers of AEI Conference 2019 wish to extend our sincere appreciation to the authors, coauthors, and reviewers for their significant contributions by creating value for each manuscript and the conference collectively.

We invite everyone to explore this collection and to engage in the dialog.

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111 Main—A Case Study Illustrating Vision, Integration, and Collaboration

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ABSTRACT

Located at the heart of Salt Lake City's financial district, at the corner of South Main and East 100 South Street, 111 Main is a 25-story, 501,455 square foot Class A office tower that anchors a larger urban redevelopment project in the area. The construction of the building followed a parallel timeline with an adjacent project designed by another architect, the George S. and Dolores Doré Eccles Theater. The integration of the office building and theater design, a critical element in the city's downtown revitalization, contributes to the development of a walkable urban core and help to create a vibrant community. The office tower is LEED Gold and also supports Salt Lake City's commitment to increased urban density and long-term sustainability. The structural engineering of 111 Main reflects an innovative solution to a complex site challenge. To ensure the project would not compromise any of the theater's functionality, the entire structure is suspended from a steel hat truss on top of the building that allows the Eccles Theater to slide under the tower's south side. The 111 Main design vision was achieved by the project team—consisting of the owner, architect, engineer, general contractor, and subcontractors, by embracing common design goals and challenges through collaborative processes from initial design concept through final construction design assist phases. To permit the office tower and theater to proceed with construction independently, an innovative "saddle cable" temporary shoring support for the seven interrupted columns over the theater to the south side above Level 5 was developed integrated with the tower design. At the completion of the penthouse roof steel hat truss construction, loads from all 18 perimeter building columns were successfully transferred to the permanent structural system during a one-day 12-hour period. The lobby is enclosed by 35-foot-tall, ultra-clear, low-iron structural glass. The collaborative design team developed a sophisticated glass hinge system to meet this height requirement and mitigate seismic movement. The feature provides the office building with a high level of transparency, visually connecting its lobby interiors with the city outside. 111 Main's translucent glass fin facade reflects changing light conditions as the sun traverses the sky. The structural hat truss, situated behind a graduated translucent glass veil, is also visible in the sunlight and, when

backlit, appears like a glowing lantern in the night. The result is a building that adds lightness and luminosity to Salt Lake City.

INTRODUCTION

Project Overview

111 Main is a 24-story speculative office tower located at the corner of South Main and E 100 South Street in the heart of downtown Salt Lake City, Utah, and only blocks away from Temple Square, the historic headquarters of the Church of Jesus Christ of Latter-day Saints. The building is connected on the ground floor to the Eccles Theatre, a new 2,500 seat auditorium built concurrently to the 111 Main tower, and is directly across the street from City Creek Center, a 20-acre mixed use development with retail, commercial and residential program completed in 2012.

Design of 111 Main was nearly complete when the project was acquired by City Creek Reserve, Inc. (CCRI). CCRI is the real estate investment portfolio of the Church of Jesus Christ of Latter-day Saints and a major developer of commercial real estate in Salt Lake City, Utah. CCRI's recent developments include the City Creek Center.

In the years leading up to their acquisition of the project, CCRI had made significant investments in the revitalization of downtown Salt Lake City. CCRI viewed the 111 Main project as an opportunity to create a landmark building within this newly re-energized downtown corridor.



Figure 1: View of the 111 Main tower; Photo © Cesar Rubio

Complex Site Conditions.

The 111 Main tower is the cornerstone of a city block identified by the Salt Lake City Redevelopment Agency (RDA) as the ideal location for a new theater. Contained within this city 2