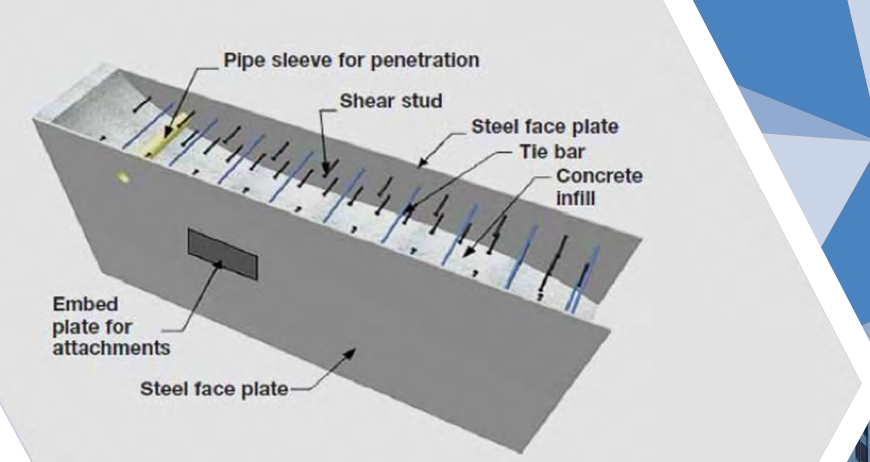


Innovation at Scale

2019
Annual Report

CHARLES PANKOW FOUNDATION

Images courtesy of (clockwise from left): Carbon Leadership Forum; AISC; Wright Runstad & Company

The Charles Pankow Foundation leads industry collaborations, funds research, and delivers solutions that help the design and construction industry be more efficient and cost competitive through innovation.

Charles Pankow Foundation Leadership Team

RICHARD M. KUNNATH,
P.E., PRESIDENT

TIMOTHY P. MURPHY,
ESQ., SEC. & CFO

RON KLEMENCIC,
P.E., S.E., HON. AIA, DIRECTOR

GREG GIDEZ,
A.I.A. FDBIA, DIRECTOR

GLENN BELL,
PE, SE, CEng, F.SEI, F.ASCE, FIStructE, DIRECTOR

ANNE M. ELLIS,
P.E., FACI, F.ASCE,
EXECUTIVE DIRECTOR

VISION

To provide the AEC industry with a better way to design and build

MISSION

To be a catalyst to advance innovation in the design and construction of buildings

Charles Pankow Foundation is incorporated as a nonprofit, public benefit, charitable foundation with 501(c)(3) status and operates independently of the Pankow Companies. The Foundation carries forward the spirit of Charlie Pankow's legacy, vision, innovation, and leadership.

President's Letter

In a short ten years, it's encouraging and rewarding to see the incredible impact the Charles Pankow Foundation has made on advancing innovation in the AEC industry. Yes, there are many individual research results that have proven to be game-changers, but more important is that wherever you go or whatever periodical you read, engineers, architects and builders have come to accept and are talking about the need for research-led innovation to meet the great challenges of the 21st Century.

We continue to be blessed with a great board of directors, superb executive directors, and a legion of volunteer advisors and principal investigators who continue to demonstrate the passion and vision that drives our progress. Oh yes, and let me not forget the support we've received from our industry association partners, including ACI, AISC, ASCE, CII, CRSI, DBIA, NCSEA and PCI. Last, but certainly not least, is the essential press coverage our work has enjoyed, especially from *Engineering News Record.*

While we continue to pursue best-in-class research that leads to meaningful innovation, our success is also measured by the number of firms, associations and others who are picking up the baton and developing their own research agenda. It's a trend we hope is just beginning and which we intend to foster in every way we can.

Which brings me to the theme of this year's annual report: "Innovation at Scale." Importantly, the research we've funded has accelerated learning and innovation across the industry and delivered real value. Let me highlight a few recent examples:

- An innovative structural system, Concrete-Filled Composite Plate Shear Walls, also known as SpeedCore, was informed by research funded by the Foundation and used in the Rainier Square Tower in Seattle, WA. The system eliminated the need for wall formwork and steel reinforcing which resulted in the 850-foot building topping out in only 10 months, an eight-month savings as compared to the traditional alternative.
- Design-build, once an innovative approach to contracting and procurement, continues to deliver value even as it has moved from innovative to mainstream. "Revisiting Project Delivery Performance," a study of 212 contemporary projects, validated that teams using design-build deliver projects faster and with greater reliability in cost and schedule performance.
- Collaboration and co-creation with individuals, companies and industry organizations accelerates scaling of innovation. In less than one year, our funded efforts launched several "industry firsts," including a prestandard that facilitates design of more efficient buildings; a digital tool that enables embodied carbon in procurement decision-making; and a construction industry project performance measure tied to productivity.

In 2019, our active research portfolio included $5.4M in grants for 23 projects involving 15 universities and industry partners. These projects also received technical and financial support from hundreds of industry leaders.

As we move into this new decade, we've also scaled the Foundation's expertise with the aim of expanding our impact. We've added two new members to our Board, Glenn Bell and Greg Gidez, whose experience, insights and vision will shape our future work.

Finally, to all of you reading this annual report, thanks for your support and for spreading the message of how, working together, we can and will find new solutions and keep the United States AEC industry at the forefront of innovation and excellence.

Richard M. Kunnath, P.E.
Board President, Charles Pankow Foundation

EXPANDING Our Expertise: Two Industry Leaders Join the Board

Glenn Bell,
PE, SE, CEng, F.SEI, F.ASCE, FIStructE

- CEO of Simpson Gumpertz & Heger (retired)
- Expert in structural design involving new and advanced materials and engineering approaches and diagnosing structural distress
- President of the Structural Engineering Institute (SEI) of the American Society of Civil Engineers (ASCE) and Co-Director of Confidential Reporting on Structural Safety-US
- Served on five academic advisory boards; is the Galletly-Dickson Visiting Scholar in Structural Engineering and Architecture at the University of Bath, United Kingdom; recipient of the 2019 Dennis L. Tewksbury Award of SEI, the 2018 President's Award of SEI, the 2014 Edmund Friedman Professional Recognition Award of ASCE, and 2015 Fazlur R. Khan Distinguished Lecturer at Lehigh University

Greg Gidez,
A.I.A. FDBIA

- Corporate director of design services for Hensel Phelps
- Nationally recognized subject matter expert on effective innovations in integrated design and construction methods
- Board director of the BIM Forum of the Associated General Contractors of America
- Past chairman of the board of the Design Build Institute of America (DBIA)
- Member of the DBIA College of Fellows

The knowledge and forward thinking that Greg and Glenn bring to the Foundation are unmatched assets for us. Their experience and ability to envision the future will help us advance our mission to be the catalyst to advance innovation in design and construction.

– Richard Kunnath, President
Charles Pankow Foundation

Research Grants Completed

STANFORD UNIVERSITY
Gregory G. Deierlein, Ph.D., P.E.
Low-Cycle Fatigue Criteria for the Seismic Design of Concrete Structures with High-Strength Reinforcing Steel

UNIVERSITY OF TEXAS AT SAN ANTONIO
Wassim M. Ghannoum, Ph.D., P.E.
Acceptable Elongations and Low-Cycle Fatigue Performance for High-Strength Reinforcing Bars

CATHOLIC UNIVERSITY OF AMERICA
Gunnar Lucko, Ph.D.
Construction Industry Validation of Schedule Performance

UNIVERSITY OF BUFFALO (SUNY)
Michel Bruneau. Ph.D., P.Eng.
Amit H. Varma, Ph.D. (Purdue University)
R-Factors for Coupled Composite Plate Shear Walls—Concrete Filled

UNIVERSITY OF CALIFORNIA, LOS ANGELES
John W. Wallace, Ph.D., P.E.
"Enhanced Ductility" RC Coupled Wall Systems

ASCE STRUCTURAL ENGINEERING INSTITUTE
Donald R. Scott, P.E., S.E.
Prestandard for Performance-Based Design for Wind

COLORDO UNIVERSITY, BOULDER
Keith R. Molenaar, Ph.D.
Revisiting Project Delivery Performance

Research Grants Awarded

$332K
PURDUE UNIVERSITY
Amit H. Varma, Ph.D.
Seismic and Wind Behavior and Design of Coupled CF-CPSW Core Walls for Steel Buildings

$234K
UNIVERSITY OF CINCINNATI
Bahram Shahrooz, Ph.D., P.E.
Normal- and High-Strength Continuously Wound Ties

$230K
UNIVERSITY OF CALIFORNIA, BERKELEY
Jack P. Moehle, Ph.D., P.E.
Foundation Mats with High-Strength Steel Reinforcement

$200K
UNIVERSITY OF CINCINNATI
Bahram Shahrooz, Ph.D., P.E. in memory of Patrick J. Fortney, Ph.D., P.E., S.E., P.Eng.
Steel Coupling Beams in Low-Seismic and Wind Applications

$200K
WASHINGTON STATE UNIVERSITY
Christopher J. Motter, Ph.D., P.E.
Nonlinear Wind Design of Steel Reinforced Concrete Coupling Beams

$75K
UNIVERSITY OF NOTRE DAME
Yahya C. (Gino) Kurama, Ph.D., P.E.
Seismic Precast Concrete Wall and Frame Structures with Short-Grouted Ductile Rebar Connections

$20K
ASCE STRUCTURAL ENGINEERING INSTITUTE
Donald R. Scott, P.E., S.E.
Determination of Pressure Coefficients for High-Rise Buildings of Different Aspect Ratios

Delivering **SCALABLE** Innovation

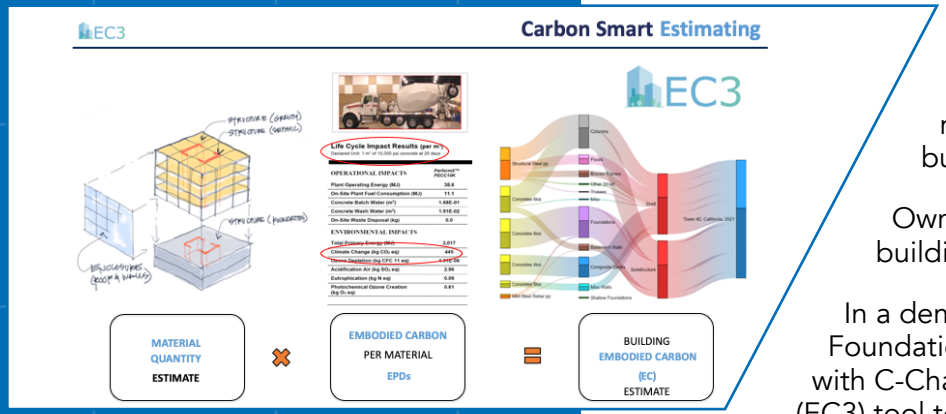


Image courtesy of the Carbon Leadership Forum

Embodied Carbon: Materials Matter

Carbon emissions generated during a building's operation are only part of a structure's carbon footprint. Embodied carbons — the emissions generated during the manufacturing and transporting of construction materials and the construction process — can represent as much as half of a building's total carbon footprint over its lifetime.

Owners, intent on constructing environmentally sensitive and sustainable buildings, are becoming aware that materials used do matter.

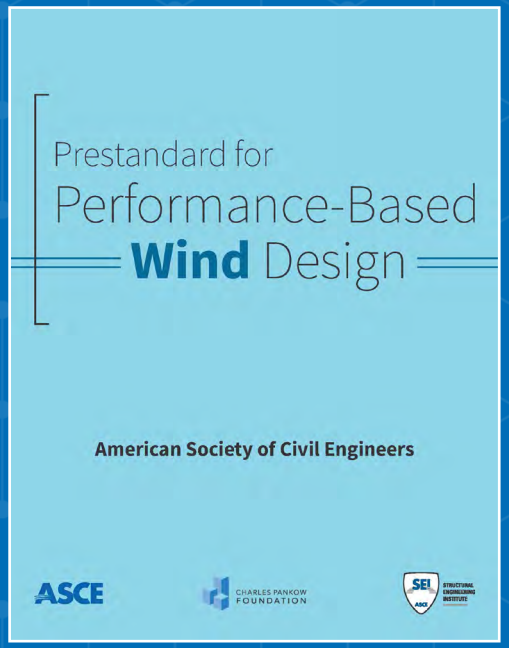
In a demonstration of global industry collaboration and funded by a grant from the Foundation, the University of Washington's Carbon Leadership Forum in partnership with C-Change Labs developed the Embodied Carbon in Construction Calculator (EC3) tool to help owners, designers, and builders make more informed design and procurement decisions on embodied carbon.

This open-access, cloud-based tool relies on building material quantities from construction estimates and/or BIM models and a robust database of digital, third-party verified Environmental Product Declarations (EPDs).

Co-funding for this tool was provided by over 30 industry leaders including Skanska USA, Microsoft, Autodesk, Interface, and the Magnusson Klemencic Associates Foundation.

For more information on the EC3 tool click here.

> *This industry collaboration combined with its no-barrier-to-entry approach and third-party verified data is what makes the EC3 tool the most impactful innovation for the built environment to drastically reduce its impact on global warming.*
>
> – Lisa Conway
> VP Sustainability – Americas
> Interface



New Prestandard Supports Innovation in Buildings

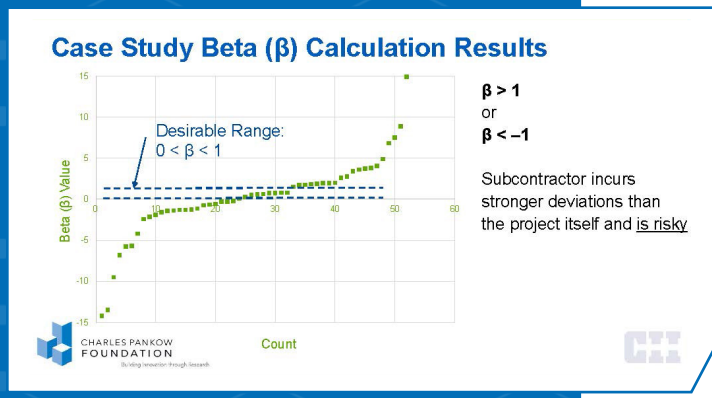
To help owners, designers and builders implement performance-based design in building structures subjected to potential wind hazards, the Foundation funded the development of the first "Prestandard for Performance-Based Wind Design."

Developed by the Structural Engineering Institute of the American Society of Civil Engineers, this Prestandard provides a recommended alternative to the prescriptive procedures for wind design of buildings. It introduces major innovations, including nonlinear dynamic analysis for wind design; limited inelasticity in the Main Wind Force Resisting System elements; system-based performance criteria; and enhanced design criteria for the building envelope.

The Prestandard reflects the collaboration and contributions of global leaders from professional practice and academia. Co-funding was provided by the ACI Foundation, American Institute of Steel Construction, American Society of Civil Engineers Industry Leaders Council, and the Magnusson Klemencic Associates Foundation.

Download this Prestandard.

Delivering **SCALABLE** Innovation



Project Performance Matters

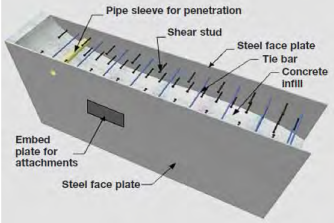
Schedule over-runs are all too common on construction projects. To help those seeking schedule certainty, an industry-wide standard to measure the schedule performance of subcontractors on an ongoing basis and applicable across all project types, complexities and company sizes was needed. The measure would be built upon past performance and intended to predict future performance.

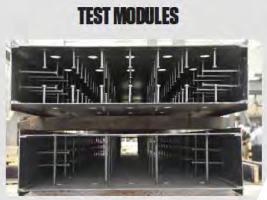
Introducing Schedule Beta! Inspired by an approach used by the financial industry to assess the historical performance of public company stocks, Schedule Beta went from theoretical to actual once tested with data from actual construction projects. This research validated the applicability and scalability of the Schedule Beta approach for construction.

The Schedule Beta validation, conducted by the Catholic University of America, was sponsored with a grant award from the Foundation in collaboration with the Construction Industry Institute. Industry partners provided data from their construction projects for the study.

Download the Schedule Beta Summary and Report.

Succeeding at **SCALE**





Innovation Making an Impact

Rainier Square Tower — Seattle's 850-foot tall tower that topped out in only 10 months, eight months sooner than the original construction schedule — is a successful proof of concept of a new construction approach supported with research co-funded by the Foundation.

The key to reducing the construction time was the use of Concrete-Filled Composite Plate Shear Walls, a modular sandwich system of cross-tied steel-plate walls that are field-filled with concrete. The steel plates serve as permanent formwork and eliminate the need for concrete-reinforcing steel. The non-proprietary system is engineered to be simpler, faster and safer to construct. Extensive research and development and intense collaboration among the project's entire design and construction team played pivotal roles in making this concept a reality in the Rainier Square Tower.

The design was informed by the Design Procedure for Dual-Plate Composite Shear Walls and several additional research projects funded by the Foundation. This innovative system has been advanced with the help of many, including the American Institute of Steel Construction, Bakewell Foundation, the Magnusson Klemenic Associates Foundation, Purdue University, Steel Institute of New York, and the University of Buffalo.

Images courtesy of (clockwise from bottom): AISC; Wright Runstad & Company; Magnusson Klemencic Associates

Succeeding at **SCALE**

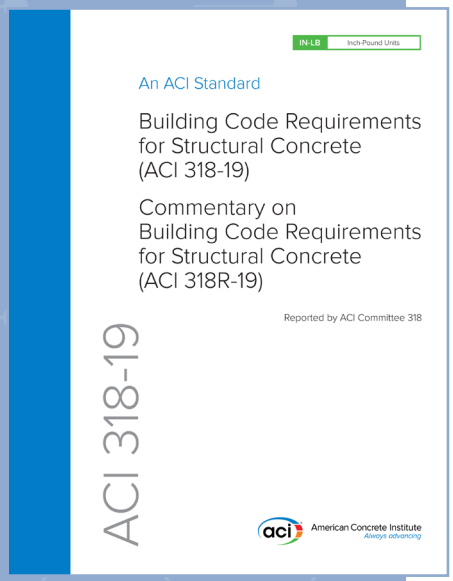


Image courtesy of American Concrete Institute

Paving the Way for High-Strength Steel Reinforcing

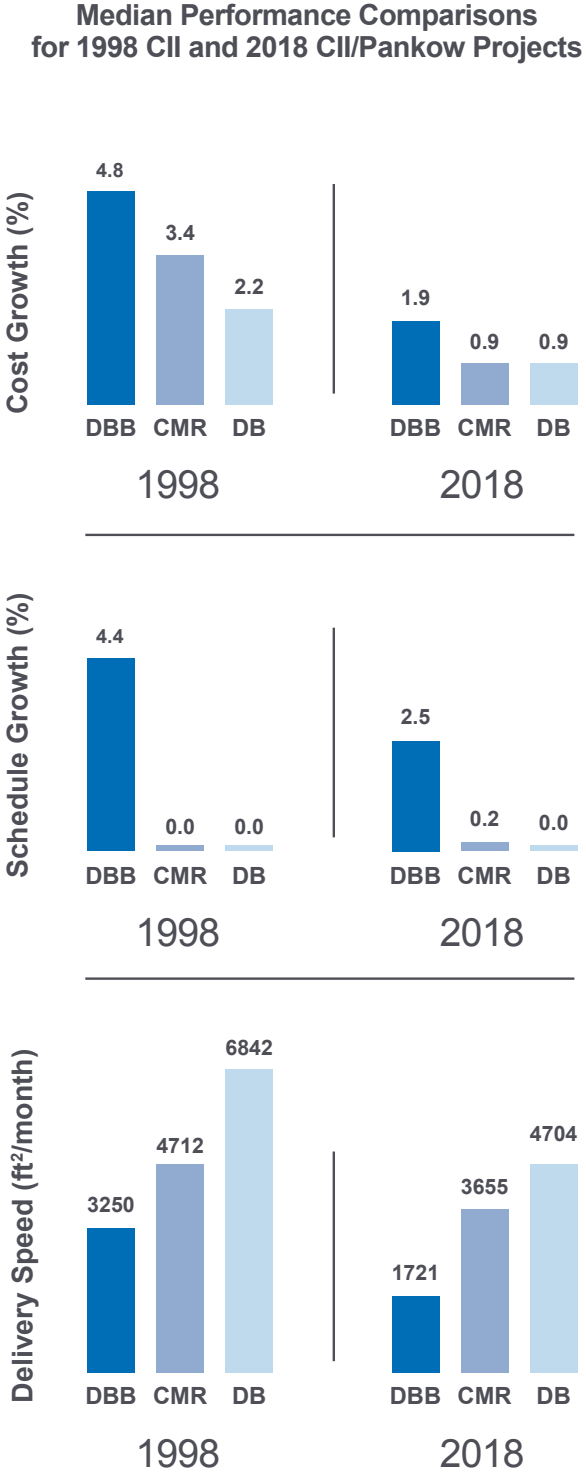
What does it take to get advanced construction materials into the marketplace?

Consider the example of high-strength steel reinforcing that can provide yield strength greater than 60,000 psi and is as much as twice as strong compared to what is currently being used in reinforced concrete.

Since 2011, the Foundation, along with industry partners ACI Foundation and CRSI, has awarded over $3 million in grants to a variety of research institutions to fund the development of an industry roadmap and 15 subsequent research projects. The Foundation's investment helped demonstrate the acceptable performance of these advanced materials and provided the critical information needed for the adoption of provisions for select uses of high-strength steel in the American Concrete Institute 318-19, Building Code Requirements for Structural Concrete and Commentary.

These code provisions help designers, builders and owners capitalize on technology advancements. From the research roadmap to Code provisions, this concerted industry effort paved the way for an advanced technology that can help achieve simpler, faster and safer construction.

> *One of the ACI Building Code Committee's main goals for this code cycle is adoption of high-strength reinforcement. High-strength steel has different behavior characteristics that can only be explored and resolved through research. Charles Pankow Foundation has provided leadership and funding to get the research done. The cooperative effort between the Building Code Committee and the Foundation will lead to safer, more efficient and better performing buildings.*
>
> – Jack Moehle, Ph.D., P.E., Chair of ACI 318 and Professor of Structural Engineering, UC Berkeley



Updated January 2019

Succeeding at **SCALE**

Design-Build Delivers Outcomes

Design-build has been positioned as an innovative means to develop and deliver construction projects. But has the approach delivered on its promises?

The Foundation partnered with the Construction Industry Institute (CII) to fund a study conducted by the University of Colorado, Boulder that confirmed the positive impact of the design-build (DB) approach compared to design-bid-build (DBB) and construction manager at risk (CMR) project delivery systems.

The study — "Revisiting Project Delivery Performance" — evaluated 212 contemporary projects and utilized benchmarks for unit cost, delivery speed, cost and schedule reliability and compared them to the results from 351 projects used in a similar 1998 survey.

The results showed that design-build projects continue to be delivered faster and with greater reliability in cost and schedule performance.

Download the Revisiting Project Delivery Performance study.

> *The design and construction industry is vital to our economy, yet our efficiency and productivity hasn't improved like other industries. Innovation has to drive those improvements. The only way we can innovate is through research to validate our ideas.*
>
> – Lisa Washington, Executive Director/CEO
> Design-Build Institute of America

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