Charles Pankow Foundation

2023 Annual Report

Co-Funding Fuels Innovation To New Heights

CHARLES PANKOW
FOUNDATION

President’s Letter

Every year has its share of opportunities and challenges, and 2023 was no exception. With the worst of COVID behind us, the AEC industry got back to work, including in-person conferences and meetings, a resumption of laboratory-based research, and a much-welcomed re-focus on important initiatives. Not everything is the same (think Zoom meetings and work-from-home days), but they are close enough to give us great optimism going forward.

There were several important events for CPF this past year, including the addition of two new board members and the hiring of a new Executive Director. We were delighted to welcome Laura Stagner and Catriona Winter to the Board of Directors in 2023.

- Laura brings a keen understanding of the Federal government as the recently retired Assistant Commissioner for the Office of Project Delivery (OPD) for the U.S. General Services Administration (GSA). In this role, she led the successful consolidation of project management functions that were distributed throughout GSA into the OPD, evolving an organization that was responsible for capital projects into an organization that is now responsible for all projects, including capital, small, and reimbursable.
- Catriona is a Senior Vice President with Clark Construction Group LLC, where she leads a suite of integrated project development and preconstruction services. Catriona also serves as a board member of Women in Construction (WIC) Mid-Atlantic and is an elected trustee for the National Building Museum.

Both are welcome additions for their considerable industry experiences and dedication to the CPF mission.

2023 also brought the (re)retirement of our Executive Director, Mark Perniconi, and the hiring of Stuart Harrison as our new Executive Director. We are very grateful to Mark for coming out of a comfortable retirement to keep the ship on course during his tenure. As for Stuart, we could not be happier and more grateful to find a leader of his competence and commitment to the CPF mission. Through the years, CPF has been uncommonly blessed with a succession of outstanding individuals, and Stuart is no exception. If you have not already met him, I hope you will have an opportunity at a future industry gathering, or maybe just a call to introduce yourself.

Lastly, another thanks to our association and corporate partners, academic leaders, and supporters for another great year. Together we are showing the industry what can be achieved with dedicated commitment. Project Partnering Fuels Innovation!

Richard M. Kunnath

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

Research Grants Awarded in 2023

RGA #01-23
Thermal Performance of Spandrel Assemblies in Glazing Systems, Phase 2

Wei Lam, P.E.

RDH Building Science Inc.

RGA #02-23
FEMA P695 Study on Post-Tensioned Mass Timber Rocking Wall Lateral Systems

Shiling Pei, Ph.D.

Colorado School of Mines

RGA #03-23
Fast Floor: Behavior of Modular Steel Plate Floor Assemblies (Phase 2)

Jerome Hajjar, Ph.D., P.E.

Northeastern University

RGA #04-23
Steel/Mass Timber Hybrid Diaphragms and Vibration

Erica Fischer, Ph.D.

Oregon State University

Research Grants Completed in 2023

RGA #06-16
Seismic and Wind Behavior and Design of Coupled CF-CPSW Core Walls for Steel Buildings

Amit H. Varma, Ph.D.
Purdue University

There is increasing interest in the use of coupled concrete-filled composite plate shear walls (CF-CPSW) core wall structures for the design of high-rise steel buildings, particularly to optimize their design for wind or seismic load combinations. Coupled CF-CPSW core wall structures leverage steel pre-fabrication in the shop and stay-in-place formwork to reduce the time spent at the site, thus improving the construction schedule. Five connection configurations were developed and evaluated, including bolted connections using blind bolts, bolted connections using high-strength threaded rods and pipe sleeves, bolted connections using high-strength bolts and welded nuts, bolted connections using blind bolts, and bolted connections using high-strength threaded rods and pipe sleeves. The results from the study indicate that the connection types can be effective in connecting C-PSW/CFs and can be used in the wind design to save both expense and time of construction. Structurally, the connections can achieve and exceed nominal strengths and follow predictable load-deformation behavior.

Research Grants Completed in 2023

RGA #05-18

Development of Large High-Strength Headed Reinforcing Bars

David Darwin, Ph.D., P.E.
University of Kansas

This research expands the available data on the anchorage strength of high-strength headed reinforcing bars to include the largest sizes currently permitted in the ACI Building Code, No. 14 and No. 18, and uses those results to verify the applicability of the currently proposed design criteria. Forty-two large-scale simulated beam-column joint specimens containing No. 11, No. 14, and No. 18 hooked and headed bars were tested. Of the 42 specimens, 12 contain hooked bars and 30 contain headed bars. The effects of bar size, bar spacing, bar location, embedment length, confining transverse reinforcement in the joint region, placement of bars within the cross-section, concrete compressive strength, compression strut angle, and effective beam depth on anchorage strength were investigated. Results of the tests will be used to propose modifications to current code provisions with the goal of broadening the application of headed bars and significantly reducing congestion in reinforced concrete members.

Research Grants Completed in 2023

RGA #05-19

Steel Coupling Beams in Low-Seismic and Wind Applications

Bahram Shahrooz, Ph.D., P.E.
University of Cincinnati

This research focused on coupled core wall (CCW) systems that utilize structural rolled and/or built-up steel coupling beams in low-seismic and wind applications. When the beam shear demands in CCW systems become relatively large, a typical reinforced concrete beam is no longer adequate, and it is common to use either a concrete-encased structural steel coupling beam or simply a steel coupling beam. However, the current requirements for the analysis, design, and detailing for steel- and concrete-encased steel coupling beams for high-seismic applications fall short with respect to applications for wind events. The detailing of the coupling beam along its span and within the embedded region was evaluated to allow for minimal inelastic coupling beam demands during wind events.

Research Grants Completed in 2023

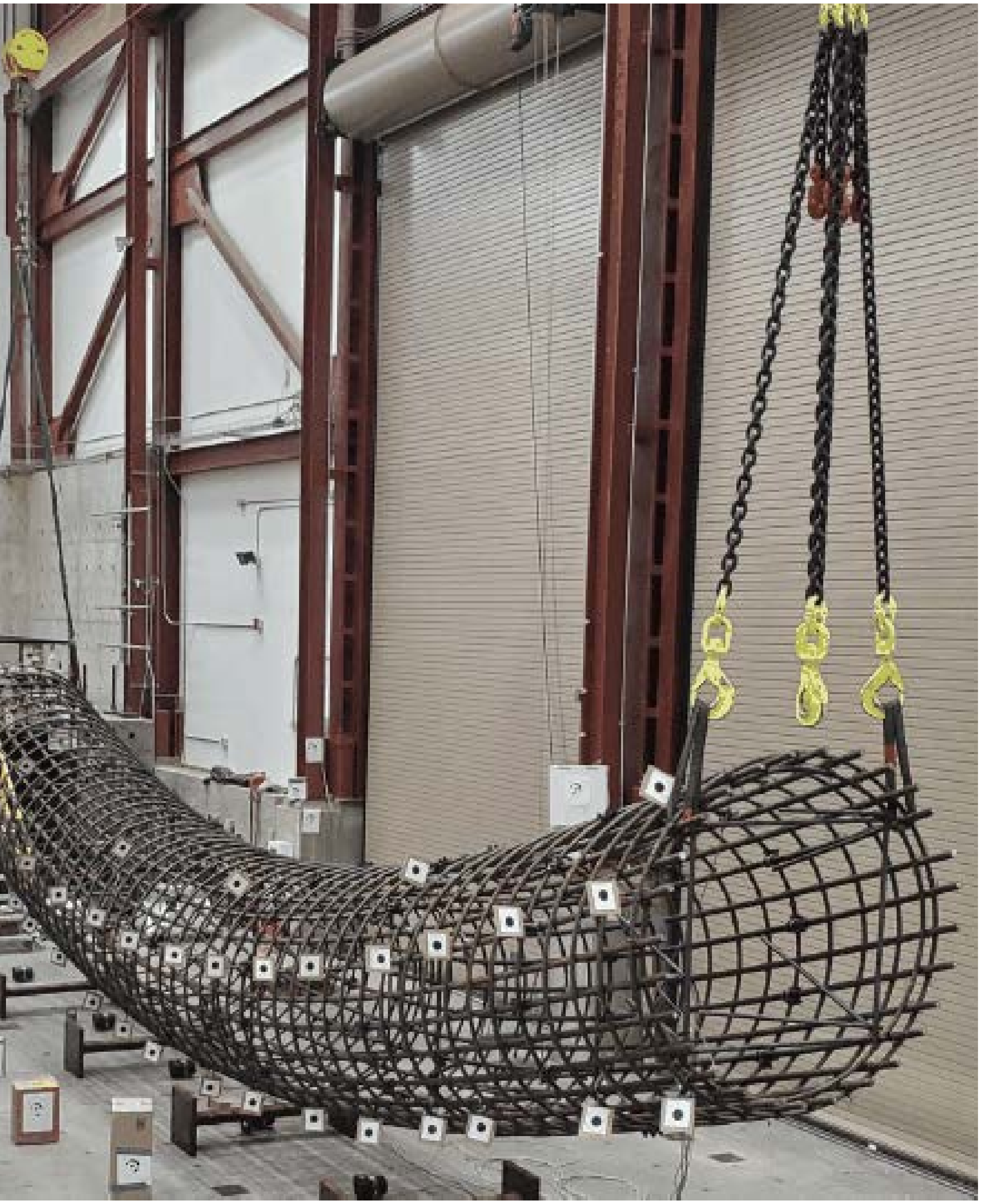
RGA #06-19

Nonlinear Wind Design of Steel-Reinforced Concrete (SRC) Coupling Beams

Christopher Motter, Ph.D., P.E.
Washington State University

Steel-reinforced concrete (SRC) coupling beams, an alternative to rebar-reinforced concrete coupling beams, reduce reinforcement congestion in the coupled walls and simplify construction. Current design guidelines for SRC coupling beams consider nonlinear response to seismic demands. Traditionally, however, there has been a lack of research on the behavior and residual deformation capacity of SRC coupling beams subjected to many loading cycles at modest peak ductility demands. This research addresses this research gap by characterizing the nonlinear response of SRC coupling beams under wind demands in order to design for modest coupling beam nonlinearity using the ASCE/SEI Prestandard for Performance Based Wind Design (ASCE, 2019).

Research Grants Completed in 2023



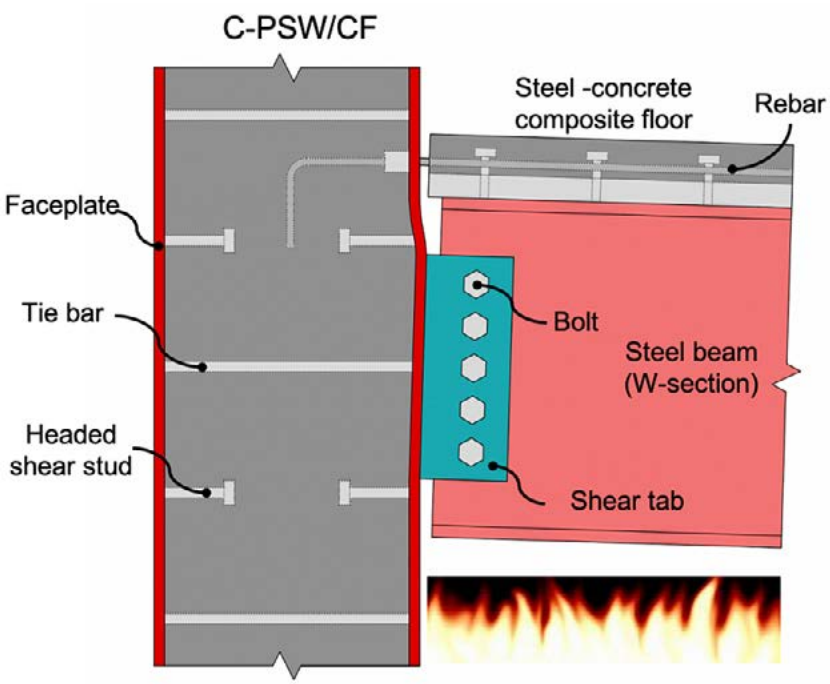
RGA #01-20

Improving the Safety of Rebar Cages by Using Innovative Connectors

American Society of Civil Engineers Construction Institute/University of Nevada, Reno

Rebar cages are the skeleton of reinforced concrete components commonly used in building construction. Deep foundations in many types of buildings and civil works utilize cast-in-drilled-hole (CIDH) piles and/or slurry wall foundations (SWF). Historically, the industry has lacked proper engineering design and detailing procedure to safeguard the stability of rebar cages in various construction stages. This research examined the behavior of CIDH/SWF rebar cages using innovative mechanical connectors (U-bolts, threaded rod with plate, and wire rope connectors) during various types of loading conditions. The findings will help inform industry design guidelines for fabrication and site handling of large rebar cages utilizing innovative mechanical connectors.

Research Grants Completed in 2023



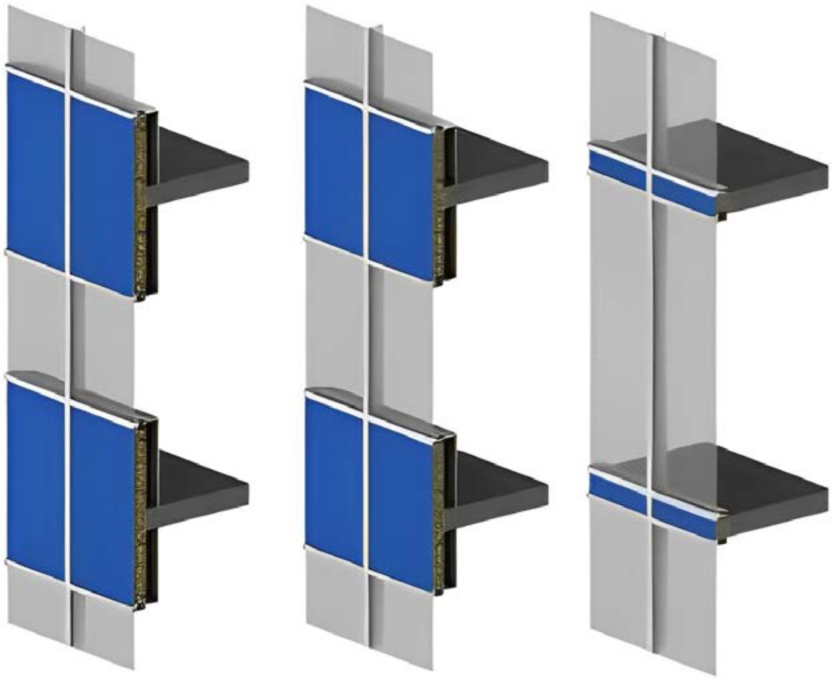
RGA #03-20

Composite Floor-to-SpeedCore Wall Systems: Performance-Based Fire Resistance and Design

Amit H. Varma, Ph.D.
Purdue University

Composite plate shear wall/concrete filled (C-PSW/CF), also referred to as SpeedCore walls, is used in commercial high-rise buildings for its modularity and construction schedule contraction. The cross-section of C-PSW/CF consists of concrete infill sandwiched between the steel faceplates, where the steel plates are tied together by steel tie bars. During a fire event in buildings, elevated temperatures can result in a deterioration in the mechanical properties of the steel and concrete, which can lead to stability-related failure of structural components. This research developed performance-based, fire-resistant design provisions for the complete floor system, consisting of composite floors, SpeedCore walls, and wall-to-floor connections. The design provisions consider both standard and design fire scenarios. Design methods account for the complexities of behavior, including thermal deformations (expansion/contraction, bowing); restraints, including axial and flexural deformations and forces induced in the connections; and connection limit states, including fracture failure.

Research Grants Completed in 2023



RGA #04-22

Thermal Performance of Spandrel Assemblies in Glazing Systems, Phase 1

Vince Cammalleri, M.Eng
Simpson Gumpertz & Heger

The current state of practice for evaluating spandrel assembly thermal performance is lacking, and analytical approaches are inconsistent. Building codes and standards are also inadequate, leading to variable design execution on projects. While energy codes have become more stringent, spandrel assembly technologies have largely remained the same. There is a need for improved design guidelines to bring consistency to calculation methods; to identify opportunities to improve materials, details, and systems; and to inform future code provisions. This is Phase 1 of a four-phase research program to produce a design guidance document. Phase 1 - Design Test Program jumpstarts this effort by conducting a literature search of available information on the topic, a survey of stakeholders to understand the scope and prevalence of different spandrel systems, an energy study, a computational fluids dynamics analysis to explore cavity airflow impacts, and the specification of the test program to be conducted in subsequent phases.

Research Grants Completed in 2023

RGA #06-22

Assembly Live Load Consistency for Buildings: Gateway to Reducing Embedded Energy

Ross Corotis, Ph.D., P.E.
University of Colorado, Boulder

Modern office usage often contains work spaces for meeting, gathering, and collaboration. The current standard for minimum design loads and associated criteria for buildings and other structures does not directly address this situation. Interpretation has led to conflicting requirements for the design loads of such spaces, including the possibility of assigning them as assembly areas. This can lead to overdesign and uneconomical structures. This research reviews historical office surveys with an emphasis on assembly spaces, presents the results of a Delphi of design firms throughout the United States, and contains a stochastic maximum load analysis. These various assessments lead to a consistent evaluation of plausible loads for such spaces, and a recommendation for a new sub-category under the Office Loads heading in the ASCE/SEI 7 Standard live load table. The study recommends treating these spaces similarly to general offices, with a basic live load of 2.39 kN/m2 (50 psf) and permissible live load reduction as is currently in the Standard for offices.

Research Grants Updated in 2023

RGA #01-19
Foundation Mats with High-Strength Steel Reinforcement
Jack Moehle, Ph.D., P.E.

University of California, Berkeley

RGA #03-19
Seismic Precast Concrete Wall and Frame Structures with Short-Grouted Ductile Rebar Connections
Yahya (Gino) Kurama, Ph.D., P.E.

University of Notre Dame

RGA #02-21
Bolted Splice Details for Composite Plate Shear Walls—Concrete Filled
Michael Bruneau, Ph.D.

University of Buffalo

RGA #03-21
Expanded Guides to Managing the Design Phase of Design-Build Projects
Bryan Franz, Ph.D.

University of Florida

RGA #04-21
Expanded Guides to Managing the Design Phase of Design-Build Projects + Playbooks + Editorial Production
Jennifer Shane, Ph.D.

Iowa State University

RGA #05-21
Expanded Guides to Managing the Design Phase of Design-Build Projects + Playbooks
Susan Bogus Halter, Ph.D., P.E.

University of New Mexico

RGA #01-22
Fast Floor Behavior of Modular Steel Plate Floor Assemblies
Jerome Hajjar, Ph.D., P.E.

Northeastern University

RGA #03-22
Design Requirements for Mechanically Spliced High-Strength Reinforcing Bars in Hinge Regions
Wassim Ghannoum, Ph.D., P.E.

University of Texas, Austin

2023 Funding Partners

AIA Building Performance Knowledge Community (AIA-BPKC)
American Concrete Institute Foundation (ACIF)
American Institute of Steel Construction (AISC)
American Society of Civil Engineers (ASCE)
ARUP
Atlas Tube
Cives Steel
Clark Construction
Concrete Reinforcing Steel Institute (CRSI)
Concrete Reinforcing Steel Institute Foundation (CRSIF)
Construction Industry Institute (CII)
DCI Engineers
Glass Coatings and Concepts (GCC)
Haskell Construction
Hensel Phelps
Herrick Steel
Holmes Structural & Fire Engineering
International Association of Foundation Drilling (ADSC-IAFD)
International Institute of Building Enclosure Consultants (IIBEC)
Kiewit
KL&A Engineers and Builders
KPFF Consulting Engineers
Maffei Engineering
Magnusson Klemencic Associates Foundation (MKAF)
Martin / Martin
Metals Fabrication
National Glass Association
NUCOR
Owen Steel
Pankow Builders
Parsons
Process Industry Practices (PIP)
Schuff Steel
Siefert Associates
Simpson Gumpertz & Heger (SGH)
Softwood Lumber Board
StructureCraft
TimberLab
Wiss, Janney, Elstner Associates (WJE)

Project Partnering Fuels Innovation!

At the Charles Pankow Foundation, partnering is key for the success of our projects. This combined effort creates game-changing advances that integrate and streamline design and construction processes. An excellent example is our recent Research Grant Agreement 03-23—Phase 2 of the highly innovative project FastFloor, which is studying the behavior of modular steel plate floor assemblies. During project development, we reached out to industry with outstanding results and participation: 9 companies and entities committed to fund 98 percent of the project cost! This partnership indeed does fuel the innovation that is FastFloor.

Charles Pankow Foundation Board of Directors

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