

Charles Pankow Foundation
2022 Annual Report

**Targeting
Carbon
Reduction**



CHARLES PANKOW
FOUNDATION



President's Letter

Greetings from the Charles Pankow Foundation (CPF).

In many ways, 2022 was a year of transition. Covid was declared over, or at least many behaved as such and resumed in-person meetings, including CPF. Our university research laboratories also resumed near-normal operations and made notable progress on several Covid-delayed projects.

It was also a year in which CPF initiated research in practice areas that are new to the Foundation. These included a major multi-year research effort related to building envelope design, carbon and energy efficiency standards, and a series of design-build best-practice guides focusing on water/wastewater and aviation projects, among others. These initiatives resulted in CPF joining forces with new companies, professional associations, and co-funders, including the Lawrence Livermore National Laboratory and Oak Ridge National Laboratories, that represent engineering organizations outside the building industry.

In all, nine new research projects were launched at eight different research universities during the year. Much of the credit for the expanding scope of our research focus is due to the considerable insight and efforts of CPF Board members Glen Bell and Greg Gidez—the latter who received the DBIA's 2022 Brunelleschi Lifetime Achievement Award for his work in helping instill a "triple-bottom-line" approach to design-build project delivery. Speaking of Board members, Emily Guiglielmo joined the Foundation's board in 2022. Emily is Principal in charge of the San Francisco Bay area office of Martin/Martin and is a most welcome addition for her broad structural engineering expertise and commitment to the CPF mission.

One last transition that occurred at the conclusion of the year was the departure of Anne Ellis, CPF's Executive Director for the past five years. Mark Perniconi, who preceded Anne in this role, has stepped in while we conduct a search for Anne's permanent replacement. Anne did a remarkable job for the Foundation during her tenure, helping to diversify the principal investigators, institutions, and ideas receiving our support. We wish her the best in all her future endeavors.

Best wishes to all for a productive and innovative 2023. You are a remarkable group without whom none of the Foundation's achievements would be possible.

Richard M. Kunnath

Richard M. Kunnath, P.E.

Board President, Charles Pankow Foundation

Research Grants Awarded in 2022

RGA #01-22

\$425,000

NORTHEASTERN UNIVERSITY

PI - Jerome F. Hajjar, Ph.D, P.E.

Benjamin W. Schafer, Ph.D

Johns Hopkins University

Matthew Eatherton, Ph.D

Virginia Polytechnic Institute and State University

Onur Avci, Ph.D

West Virginia University

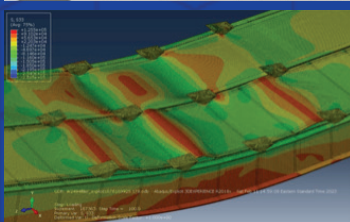
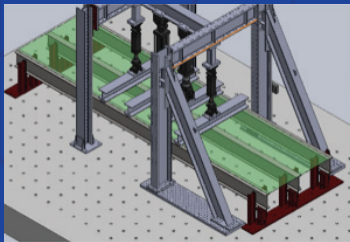
W. Samuel Easterling, Ph.D, P.E.

Iowa State University

Behavior of Modular Steel Plate Floor Assemblies

Industry Collaborators

- American Institute of Steel Construction
- Nucor Steel
- Schuff Steel
- MKA Foundation



RGA #02-22

\$100,672

UNIVERSITY OF WASHINGTON

PI - Renée Cheng, FAIA

Carrie Sturts Dossick, Ph.D, P.E.

Dr. Laura Osburn, Ph.D

Innovative Tool for Owners: Owner Typology Assessment and Project Delivery Method Considerations

Industry Collaborators

- Integrated Project Delivery Alliance
- Chandos
- AIA Project Delivery Knowledge Community

RGA #03-22

\$330,480

UNIVERSITY OF TEXAS

AT SAN ANTONIO

PI - Wassim M. Ghannoum, Ph.D, P.E.

Design Requirements for Mechanically Spliced High-Strength Reinforcing Bars in Hinge Regions

Industry Collaborators

- ACI Foundation
- CRSI Foundation
- NVent
- Splice Sleeve
- Dayton Superior
- Bar Splice
- HRC
- Nucor Seattle
- CMC Meza
- CMC San Antonio and Austin
- Harris Rebar Seattle
- Spartan Reinforcing, New Braunfels



Research Grants Awarded in 2022

RGA #04-22

\$333,500

SIMPSON GUMPERTZ & HEGER

PI - Vince Cammalleri

Simpson Gumpertz & Heger

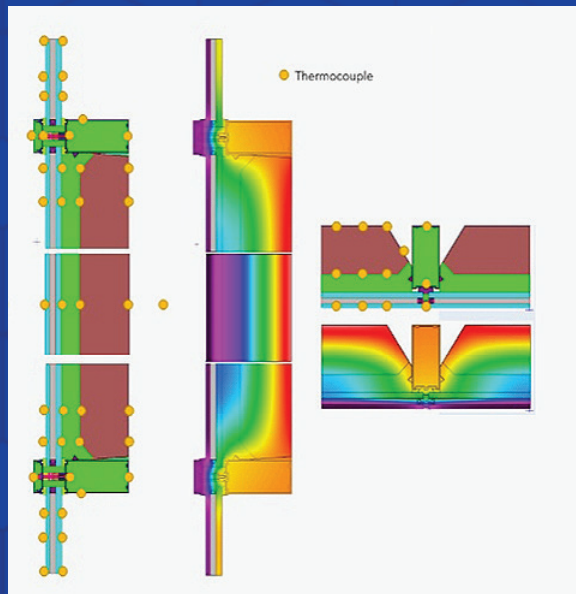
Stephane Hoffman

Morrison Hershfield

John Straube

RDH

Thermal Performance of Spandrel Assemblies in Glazing Systems Research Roadmap, Phase 1



RGA #05-22

\$131,917

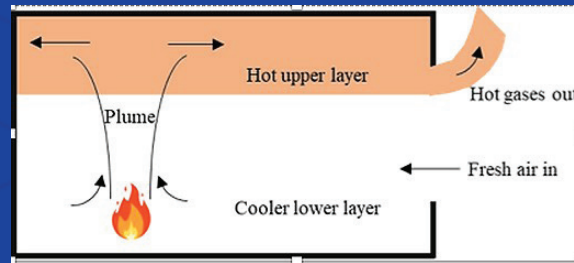
PURDUE UNIVERSITY

PI - Amit H. Varma, Ph.D

Introduction to Performance-Based Structural Fire Design (PBSFD) for Authority Having Jurisdiction (AHJ) Officials

Industry Collaborators

- American Institute of Steel Construction
- MKA Foundation



RGA #06-22

\$100,000

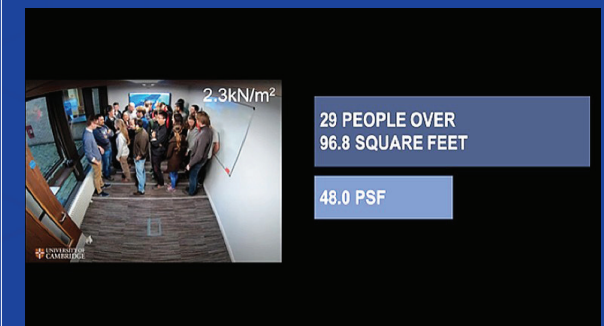
UNIVERSITY OF COLORADO

Ross B. Corotis, Ph.D, P.E.

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

Industry Collaborators

- John D. Hooper - MKA
- Ronald Klemencic - MKA
- PCA Education Foundation
- Sanjay Arwade - University of Massachusetts
- Bruce R. Ellingwood
- Cole Graveen
- Eric Giannini
- James R. Harris
- John Peronto



Research Scope Additions

Amendment to RGA #01-19

\$284,000

**UNIVERSITY OF CALIFORNIA,
BERKELEY**

Jack Moehle, Ph.D

**Foundation Mats with
High Strength Steel Reinforcement**

Industry Collaborators

- ACI Foundation
- CRSI
- MKA Foundation
- Webcor
- Level 10 Construction
- Cascade Steel
- Nvent/Lenton



Amendment to RGA #02-21

\$235,000

UNIVERSITY AT BUFFALO

PI - Michel Bruneau, Ph.D, P.Eng.

**Bolted Splice Details for Composite Plate
Shear Walls—Concrete Filled**

Industry Collaborators

- American Institute of Steel Construction
- MKA Foundation
- Atlas/Zekelman



Amendment to RGA #06-16

\$60,000

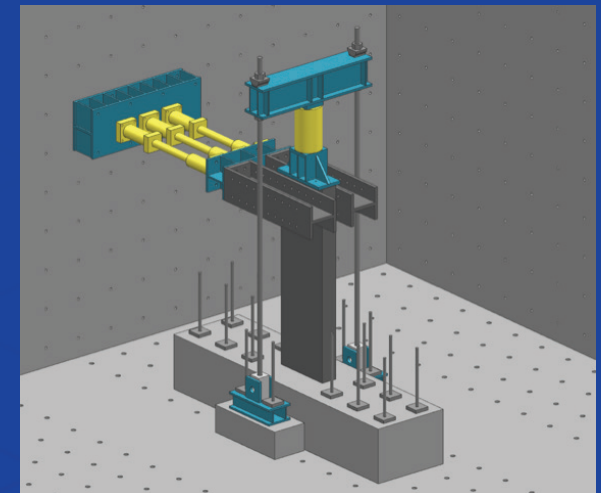
PURDUE UNIVERSITY

PI - Amit H. Varma, Ph.D

**Seismic and Wind Behavior and
Design of Coupled CF-CPSW
Core Walls for Steel Buildings**

Industry Collaborators

- American Institute of Steel Construction
- MKA Foundation



Research Grants Completed in 2022

UNIVERSITY OF CALIFORNIA, DAVIS

Amit M. Kanvinde, Ph.D

**Comprehensive Revision of Design Considerations
for Column Base Connections in Steel Moment Frames**

(RGA #07-18)

UNIVERSITY OF CINCINNATI

Bahram Shahrooz, Ph.D, P.E.

Normal- and High-Strength Continuously Wound Ties

(RGA #02-19)

Silver Bullets or Targeted Darts?

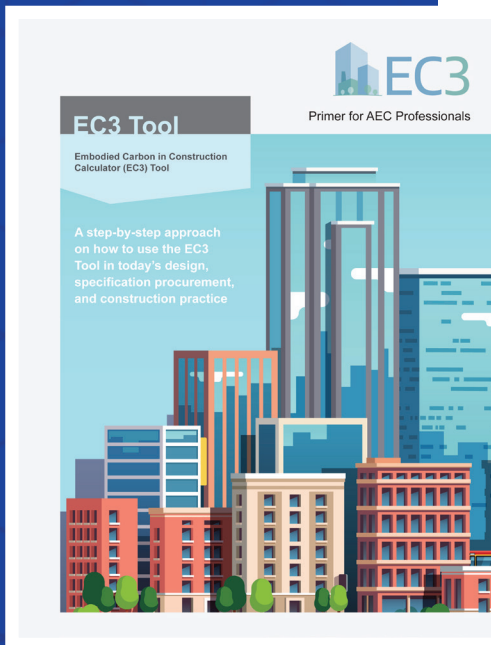
CPF's Approach to Reducing Carbon Emissions in the Design and Construction of Buildings

Few would argue that the single most pressing issue facing society today is climate change, and in particular the carbon emissions causing the change in climate. The AEC industry can be a significant contributor to solutions to reduce carbon emissions through its efforts in the design and construction of the built environment. Despite what is being represented by the popular media and politicians, there is no one silver bullet to address this problem. We at the Charles Pankow Foundation have responded by taking on challenging and impactful research and innovation issues related to the AEC industry that provide solutions to reduce carbon emissions in ways that are not always apparent. We call these solutions "Targeted Darts."

Our mission at the Charles Pankow Foundation is to "Provide the AEC Industry with a Better Way to Design and Build Buildings." By being a catalyst to develop solutions to achieve this goal through focused research, we have in the past and will continue in the future to provide tools and methods that result not only in better buildings, but in lower carbon emissions in the design and construction of buildings (Embodied Carbon) and better performance of the buildings once put into use (Operational Carbon). All research from the grants we have funded is made available to the public at no cost.

CPF has taken on carbon reduction efforts head on. We sponsored research that promotes water re-use in urban buildings (RGA #05-16). We sponsored a series of research grants that resulted in what is known as the Embodied Carbon Calculator for Construction, or EC3 (RGA #06-18). EC3 has provided the industry with an open-source tool to evaluate the embodied carbon impact of alternative designs and building materials. We continue to challenge building codes, many of which have not been updated for decades, through rigorous research that ensures we are not putting materials and labor into buildings that are not needed—probably the most effective way to reduce embodied carbon (RGA #06-22).

CPF has always been a quiet contributor to carbon emission reduction since we began research initiation and funding in 2004. We are always looking for the next "Targeted Dart" to combat climate change. What we have learned in our 19-year history is that any meaningful progress in reducing carbon emissions requires hard work in the form of impactful and focused research best done as a collaboration between academia and industry. We always welcome your ideas and collaborations to continue our mission to "Provide the AEC Industry with a Better Way to Design and Build Buildings."



Case Studies



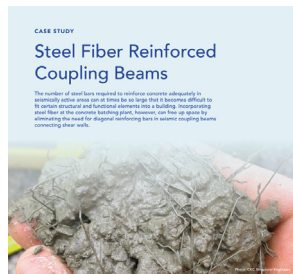
Target: Water Conservation and Reuse

As population growth and climate change increase the strains on water supplies and water infrastructure, the need for on-site reuse of non-potable water becomes increasingly imperative, particularly in the drought-stricken Western United States. A Pankow Foundation grant was used to marshal input from industry professionals, public agency representatives, architects, engineers, manufacturers, and others to craft guidance on the permitting, design, operations, and maintenance of on-site systems to capture water that would otherwise be wasted. The *On-Site Non-Potable Water Reuse Practice Guide* provides project developers with the tools to determine whether, and how, water resources such as condensate, stormwater, and wastewater can be captured and recycled for non-potable reuse.



Target: More Sustainable Structural Fire Designs

In the U.S., fireproofing has traditionally been undertaken separately from structural engineering, with the result that many buildings are not engineered to optimally protect the structure or its occupants in the event of fire. With funding from the Pankow Foundation, four firms redesigned existing buildings using structural engineering to enhance resilience against fire. A direct outgrowth of this project, *Performance-Based Structural Fire Design* demonstrates how practitioners can carry out and evaluate a performance-based structural fire design following the criteria outlined in the ASCE 7-16 Standard. In addition to improving the structural fire protection, performance-based methods can better calibrate the amount and location of fireproofing required—thus reducing the building’s construction time and embodied carbon footprint.



Target: Use of Less Reinforcing Material

The volume of steel reinforcement required in traditional seismic coupling beams can lead to rebar congestion and design/construction difficulties. Use of steel fiber in place of diagonal bars in the seismic coupling beams offers the potential to free up space for concrete, reduce the volume of reinforcing material, and improve construction time—while providing ample seismic support. With funding from the Charles Pankow Foundation and technical assistance from academicians and steel fiber manufacturers, testing was conducted to inform development of design guidance that would allow for incorporation of steel fiber in sufficient quantities directly at the concrete batching plant so as to eliminate the need for diagonal bars in the seismic coupling beams. This testing proved that steel fiber reinforcement could provide the ductility, shear capacity, and strength required of concrete shear walls in seismically active areas—and is now permitted for use in such applications in California.



Ongoing Research

Target: Thermal Performance of the Building Envelope

Effective thermal performance of the building envelope is of great importance to a structure's overall energy efficiency. Curtain wall systems, commonly used in modern buildings as the outer non-structural walls for weather protection, incorporate transparent and/or translucent materials as well as opaque areas known as spandrel assemblies that hide building features. Current methods for assessing the thermal performance of spandrel assemblies is lacking, with no consensus on how to perform thermal modeling and a lack of guidance in building codes and standards. In 2022 CPF hosted two industry forums for curtain wall suppliers to encourage their material support for research on this issue. The Foundation continues to solicit industry support for funding, materials, and technical expertise to fabricate and test spandrel assemblies for thermal performance. This research is expected to generate guidance to improve the design of such assemblies' thermal performance and, ultimately, to inform changes to building codes and standards.



Applied Research

Target: More Efficient Construction Methods

One of the most effective methods for lowering the carbon footprint of a building is to reduce the time, labor, and materials associated with its construction. Conventional high-rise structural systems commonly use a reinforced concrete core surrounded by steel framing, which requires considerable temporary formwork to serve as the mold during concrete placement. After years of research and development, CPF and partners Magnusson Klemencic Associates, the American Institute of Steel Construction, Purdue University, the Steel Institute of New York, and the University at Buffalo developed the SpeedCore modular framing system. Relying on the use of prefabricated modular steel sandwich panels, stacked onsite and field-filled with concrete, SpeedCore saw its first application in the redevelopment of Seattle's Rainier Square, a 58-story high-rise. Use of SpeedCore allowed construction to be completed 43 percent faster than conventional methods, cutting 10 months from what would typically have been expected to take 32 months to complete. For this achievement, the project received the American Society of Civil Engineers' 2022 Outstanding Civil Engineering Achievement Award.

Charles Pankow Foundation Leadership Team



Richard M. Kunnath P.E., NAC
Board President



Timothy P. Murphy, Esq.
*Board Secretary and
Chief Financial Officer*



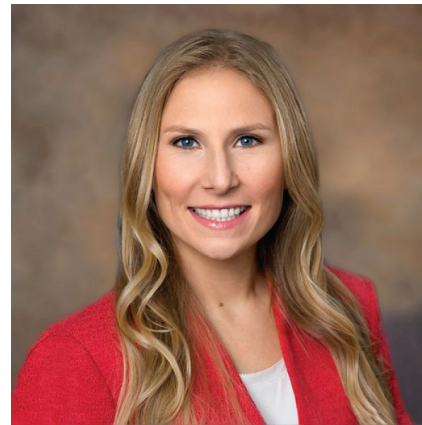
**Ron Klemencic P.E., S.E., Hon.
A.I.A., Dist.M.ASCE, NAC, NAE**
Board Director



**Glenn Bell, P.E., S.E., CEng, F.SEI,
F.ASCE, FStructE**
Board Director



Greg Gidez, FAIA, FDBIA
Board Director



Emily Guglielmo, P.E., S.E., F.SEI
Board Director



**Anne Ellis, P.E., Hon.M.ACI,
F.ASCE, NAC**
Executive Director



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