



Potomac
School,
Spangler
Center for
Community
& Athletics

SE 2050
Embodied Carbon
Action Plan 2023

CANNONDESIGN

Part of
a Larger
Firm-Wide
Sustainability
Strategy

From the desk of
Eric Corey Freed,
Director of
Sustainability



Our commitment to SE2050 is part of a larger set of commitments and targets we've set to take responsibility for the impacts of our work.

CannonDesign has a long history of innovation and deep expertise in sustainable design strategies. We are an initial signatory to the AIA 2030 Commitment, tracking our progress toward achieving zero carbon buildings in the next decade. We were also initial signatories for the AIA Healthy Materials Pledge, looking at the lifecycle and impacts of building materials. We're also supporting and invested in the Embodied Carbon Construction Calculator (EC3), and the Mindful Materials Healthy Database (where we are a pilot member).

We are continually working to reduce the energy that our buildings consume have been tracking and reporting our progress annually on that effort. EUI is, therefore, a very important metric for our teams and has elevated building energy use as a key design driver in our work. Our Energy Design process is utilized across all of our projects to achieve a certain baseline of high performance. All of these targets are coordinated and help shape our direction as a firm. Our CEO, our Core Team, and our Board of Directors are all involved framing in these bold strategies to set our firm's growth.

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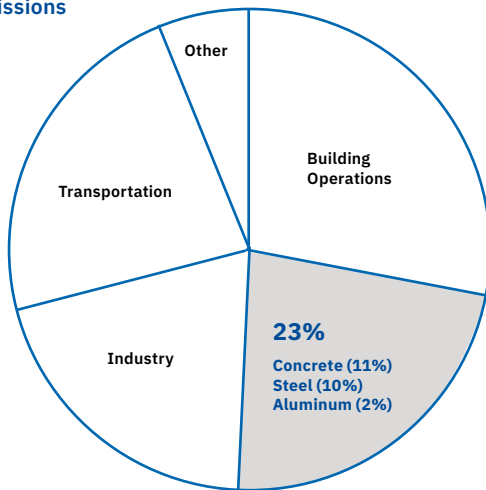
Eric Corey Freed,
RA LEED Fellow, EcoDistricts AP,
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Director of Sustainability

The Connection Between Buildings and Carbon

Historically, operational emissions have been the focus of sustainability efforts in the world of buildings and infrastructure. But what the industry has realized in the last decade is the critical need to also address *embodied carbon emissions*.

In fact, if we take a closer look at annual global carbon emissions, just three materials are responsible for 23% of these emissions: concrete, steel, and aluminum. The consumption of these materials is mostly due to the building industry, and thus the reduction of their embodied carbon emissions is critical to address.

Annual Global CO₂ Emissions



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Data Sources: Global ABC Global Status Report 2018, EIA



The Urgency with Embodied Carbon

Embodied carbon is defined as the greenhouse gases emitted from the manufacturing, transportation, installation, maintenance, and disposal of building materials.

Since embodied carbon is released before and during the construction of a building, it's more critical to reduce than the carbon emissions from operating the building (which continues for years after completion). This is referred to as the "time value of carbon" since the greenhouse gas emissions cut today are worth more than any cuts promised in the future.

By the year 2030, all new buildings, infrastructure and renovations will need to cut their embodied carbon by at least 40% for us to achieve global targets. And by 2050, we'll have to cut our embodied carbon emissions by 100%.

Why This Affects Structural Design

The structural engineering profession needs to carefully reconsider design approaches. Life cycle analyses (LCAs) continue to show that the structural systems of buildings contribute most of a new building's embodied carbon. The majority of these structural emissions are from concrete, closely followed by steel. And most of concrete's emissions are due to the cement (one of the main ingredients in concrete).

Simple material decisions can help to reduce embodied carbon. Given the high carbon footprint of steel and concrete, finding any way to reduce the carbon impact of these two materials is critical. Some of these strategies that structural engineers can implement include:

- Replacing the Portland Cement content with supplementary cementitious materials like fly ash, slag, or ground glass pozzolans
- Using biogenic materials like Mass Timber and CLT
- Requiring Environmental Product Declarations in project specifications

Executive Summary

The CannonDesign Embodied Carbon Action Plan lays out in detail our plan and goals to ultimately reduce our structural systems' embodied carbon emissions to zero by the year 2050. This Embodied Carbon Action Plan (ECAP) is a primary requirement of our commitment to the SE2050 program, and is organized into the four required sections: Education, Reporting, Reduction Strategies, and Advocacy.

- + Education covers our methods for spreading embodied carbon literacy and conversation throughout the structural engineering department, and the firm.
- + The Reporting section addresses the other primary requirement of SE2050: submittal of project life cycle assessments to the SE2050 Database.
- + Reduction Strategies describes our proposed strategies for reducing embodied carbon in structural systems.
- + Lastly, Advocacy explains how we will spread awareness of reducing structural embodied carbon beyond our firm. We will need the entire construction industry on board with the SE2050 cause if we are to have an actionable impact on carbon reductions.

At the end of each year, the CannonDesign structural group revisits our ECAP to reflect on what worked best, and what can be improved. It is through this honest reflection and our dedication to the strategies laid out in this plan that we can find our path to designing net-zero embodied carbon structures by the year 2050.

Education



CannonDesign structural studio session discussing the SE2050 commitment requirements.

A key component of CannonDesign’s culture is our belief that we work best as a group, uniting the unique knowledge of individual team members across the firm to seek out answers to difficult challenges whenever possible. We believe that the benefits of knowledge sharing are exponential. When multiple team members come together to work out a problem, their combined skill is greater than the simple sum of their individual abilities.

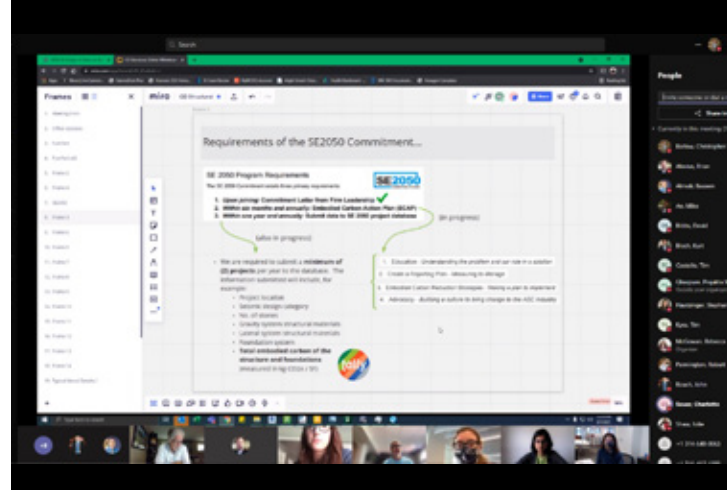
For this reason, CannonDesign has fostered many different avenues for knowledge sharing across our offices to tackle our greatest challenges, including the challenge presented by the impact of our work on the environment. Our educational initiatives include a mix of forums, meetings, and events—some started by firm leadership, and others as “grass-roots” movements led by passionate employees of any level. Below is a list of educational resources our team members regularly engage with to grow our effort to address our environmental impacts.

Structural Studio

This is a monthly meeting with all CannonDesign structural engineers to discuss our current work across offices. Time is set aside in each call for discussion on sustainability to ensure everyone in the group is up-to-date on firm initiatives and strategies.

Embodied Carbon Call

This is a voluntary firm-wide meeting with CannonDesign architects and structural engineers where the firm-wide initiative to reduce embodied carbon is discussed. Meeting topics range from discussions of lessons learned from projects and life cycle assessment demonstrations to education on new technologies aimed at reducing embodied carbon.



Embodied Carbon JIVE Page

JIVE is an internal “social media” webpage visible to all CannonDesign employees with sub-spaces dedicated to employee resources and project delivery methods, and a space specifically dedicated to sustainability. At any time, an employee can visit the “Sustainability - Embodied Carbon” page on JIVE to see what others are currently doing to address embodied carbon. Our colleagues can also watch employee-led tutorials on how to use tools such as Tally, read guides on performing life cycle assessments, browse documentation from SE 2050, access links to external resources such as the BSA’s “Embodied Carbon 101” webinar recording, and more.

It is within this space that we have shared the news of CannonDesign’s Commitment to SE2050 alongside our 2021–2022 Embodied Carbon Action Plan. We will also be posting this current year’s plan and all future plans on JIVE.

CannonDesign Academy

CannonDesign employees of every discipline are offered professional development opportunities through our internal CannonDesign Academy webinar series. These webinars cover a range of topics across the architectural, engineering, and

construction spectrum. To educate more of our employees about embodied carbon reduction strategies, we hosted our own introductory webinar on embodied carbon, as well as a follow-up webinar specifically covering embodied carbon in structures in collaboration with our architecture colleagues in November 2022. A recording of this webinar, along with other webinars on embodied carbon, will continue to be hosted on Jive and promoted to all CannonDesign employees.

Improve Engagement with Architectural Colleagues

As engineers in an interdisciplinary firm, we have the unique advantage of working directly with architects as our fellow colleagues and partners. This setup also places an obligation on us to educate our design partners on embodied carbon in structures. While we will continue to grow our library of webinars and presentations, we also will keep in mind our wider audience and strive to bring them on board to the goals of the SE2050 program.

2021-2022 In Review

Achievements

- + Distributed the Embodied Carbon Action Plan firmwide
- + Presented a live webinar on embodied carbon in structures firmwide, with a recording posted internally
- + Hosted Structural Studio every month, which includes an open forum to discuss sustainability topics within our discipline
- + Held bi-weekly embodied carbon meetings to discuss firmwide embodied carbon strategies with MEP engineers, architects and planners
- + Continually updated our Embodied Carbon Jive page with new resources and information to share with our colleagues

Lessons Learned

To meet our embodied carbon goals, we needed a team that consisted not only of good technical thinkers, but effective communicators as well. To have the greatest impact, we will continue to make sure that our embodied carbon reduction journey is well communicated and digestible to a wide audience.

Engaging with other disciplines in the hybrid in-office and work-from-home environment required new ways of thinking about how we communicate. Thankfully, CannonDesign has always been ahead of the curve thanks to our company’s Single-Firm, Multi-Office structure. Use of live document and sharing tools such as Microsoft OneDrive, Microsoft Teams, Miro, and Bluebeam has also continued to be crucial in this effort.

Reporting

CannonDesign is committed to measuring, tracking, and reporting embodied carbon data and contributing to the SE2050 database. We believe tracking and reporting this data is a critical step toward educating others on the impact the structure has on the total embodied carbon of a project and ultimately reducing the structural contribution to a project’s carbon footprint.

Measure and Report

To measure the embodied carbon of our structures, we will continue to utilize the Life Cycle Assessment software, Tally, and focus on the life cycle stages from cradle to gate (A1-A3). By using Tally in conjunction with our projects’ Revit models, we will assess a project’s embodied carbon at the end of the Construction Documents phase, when the structure is fully defined.

Our Specifications are being updated to require Environmental Product Declarations (EPDs) on all projects. In the case that

none are available we will work with the contractor to obtain them, and as a last resort we will utilize the standard values in Tally to inform our measurements. By using these methods for measurement, we anticipate contributing a minimum of five (5) projects to the SE2050 database. In addition to reporting our GWP intensity, we also anticipate reporting Structural Material Quantities (SMQs) to the SE2050 database for all projects submitted in 2022-2033.

Update Revit Material Libraries – Redux

While we were able to complete our Revit Material Library updates in our first year, we would like to continue to advance this initiative by mapping the new materials to all employees who will run Tally in the future. This initiative will make the LCA process easier for new users in our firm and will continue to remove any barriers for running project LCAs in the future.

Internal Database

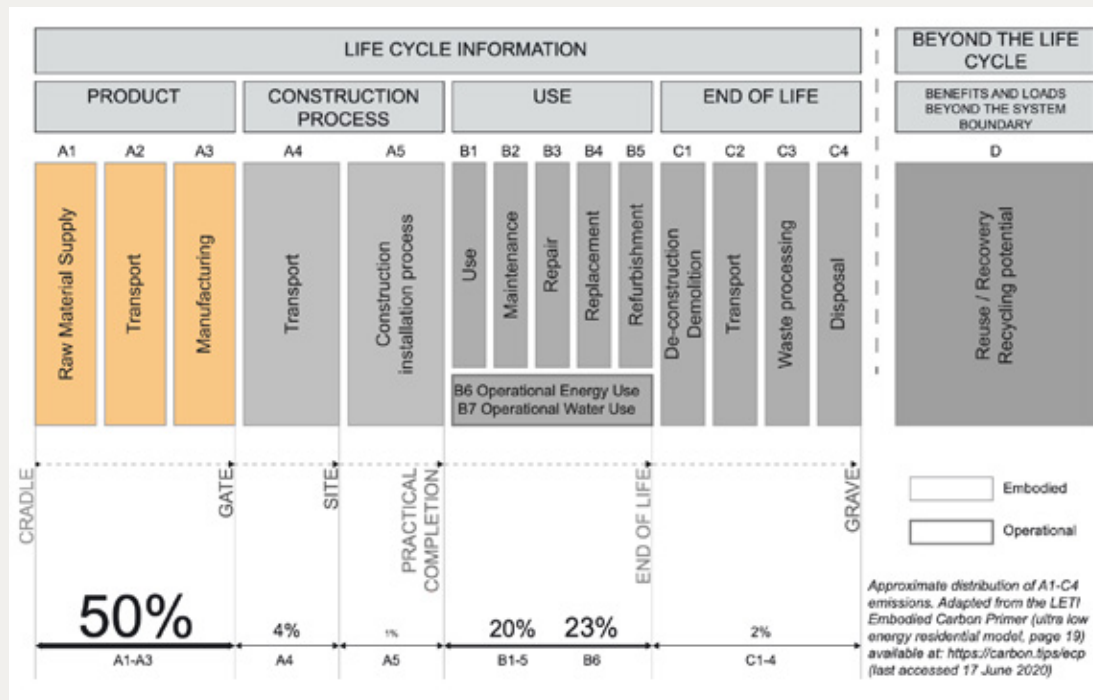
We plan to develop an internal database for storing embodied carbon metrics from CannonDesign structural projects. This database of information will allow us to track progress in our journey to reduce embodied carbon, and will ultimately enable us to report the percentage of projects we are submitting to the SE2050 database each year.

Achievements

In our first year we were able to achieve all our reporting goals:

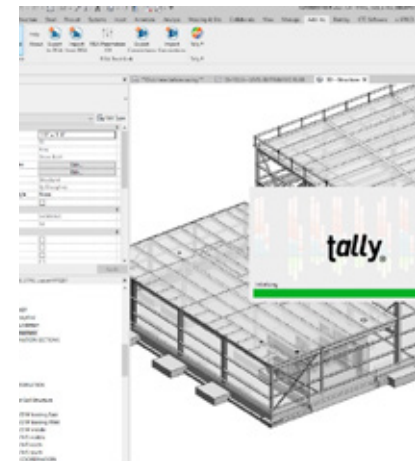
- + Submitted five (5) life cycle assessments (LCAs) to the SE2050 database
- + Updated our Revit Material Library
- + Presented to the firm about Embodied Carbon and Reduction Strategies
- + Trained (2) additional structural engineers to perform LCAs

↓ We will measure embodied carbon through the product manufacturing stages (A1-A3) of the structure life cycle.



Source: <https://www.istructe.org/IStructE/media/Public/TSE-Archive/2020/A-brief-guide-to-calculating-embodied-carbon.pdf>

↓ The Revit plugin Tally will be used to measure structural embodied carbon.



Reduction Strategies:

Continued Focus on Education

Setting a strong baseline of knowledge will allow us to develop meaningful carbon reduction strategies. Sustainability practices and goals will be highlighted at monthly structural group meetings with the aim of improving embodied carbon “literacy” so our engineers can confidently discuss the subject on project teams in the future.

Tally is the LCA software of choice for CannonDesign. Our aim is to have one person from each of the four structural offices trained to conduct an LCA using Tally. We will also study using Epic or OneClick LCA during the SD phase on one project to run bay studies for preliminary embodied carbon information.

The Potomac School Center for Athletics and Community incorporated biogenic material into the structure. Glulam beams at the roof level are supported by pairs of sloping and tapered, round glulam columns at the mezzanine level.



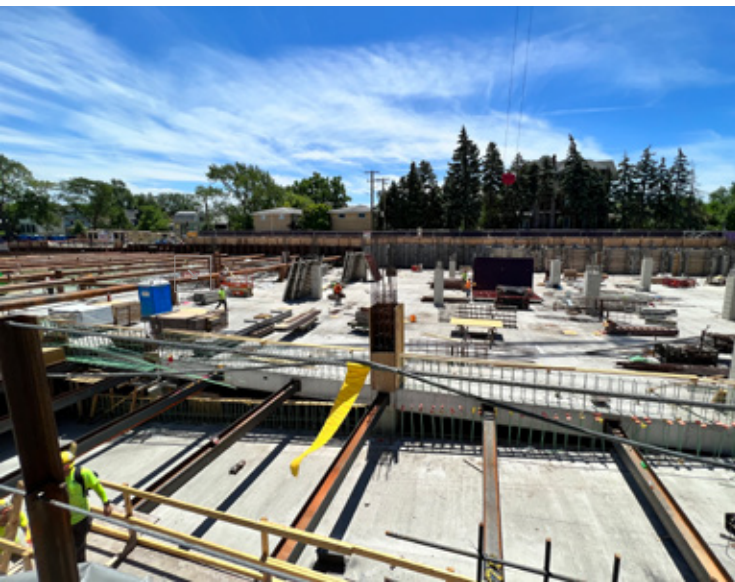
2021-2022 In Review

Achievements

- + Updated our project manual specifications for steel and concrete (updates are undergoing final reviews at the time of this publication)
- + Used carbon dioxide mineralization technology for all concrete mixes on (1) project
- + Required concrete mix-specific EPDs on (1) project



The structural design for the Northwestern Medicine Old Irving Park AOC in Chicago used carbon dioxide mineralization and mix-specific EPDs to reduce the carbon footprint of the entire building by 11%.



Specifications

CannonDesign has an existing firm-wide Embodied Carbon committee, which has begun to implement changes to project manual specifications, primarily for architectural specifications. Conversations have begun between the structural engineering group and Embodied Carbon committee regarding updates to the steel and concrete specifications; converting this dialogue into meaningful specification modifications is a primary goal within the first few years of our firms' commitment to SE2050. Our goal for the upcoming year is to finish updates to our cast-in-place concrete specification to incorporate GWP limits and performance-based concrete mix designs, and to require EPDs for structural steel and concrete mixes.

Biogenic Materials

CannonDesign structural will aim to incorporate biogenic materials on at least three projects annually. Our engineers have experience with the design of conventional wood framing, wood trusses, and exposed timber framing. We are actively pursuing opportunities and aim to build our mass timber design experience within our first few years of commitment to SE2050. In the meantime, we aim to commit time to updating our universal grid case studies to incorporate mass timber and embodied carbon.

Annual Reflections & Project Checklist

At the culmination of each year, a recap meeting will be conducted to collect thoughts and experiences to streamline successful strategies and formulate new ones. We will use the meeting notes to draft an annual review narrative which will help form our ECAP for the following year.

This reflections meeting will also be used to formulate a pre-design checklist to be used in the preliminary stages of each project. This checklist will help determine which carbon-reducing strategies are attainable and what additional goals we should be aiming for. Checklist items will be based on such things as the selected structural materials, project location, building program, and other physical or geometric building characteristics.

Advocacy

Advocacy for the SE2050 commitment is a crucial part of making industry-wide changes to reduce embodied carbon. Beyond sharing embodied carbon knowledge with our architecture colleagues, we plan to share our commitment to SE2050, and the greater impact our industry has on embodied carbon reductions, through several external media.

↓ Washington University School of Medicine in St. Louis – Neuroscience Building



Read more about CannonDesign's SE2050 initiative on our website here!



Social Media

Over the next year, we will strive to share at least one post within our Instagram page that discusses the embodied carbon reduction strategies used on a project or the overall embodied carbon within structural materials to educate and promote the SE2050 initiative.

External Web Posts

In addition to educating colleagues through our internal website (JIVE), we will use CannonDesign's external website to share knowledge on embodied carbon reduction strategies with our clients, our A/E/C partners, and the public. At the beginning of 2022 we announced our commitment to SE 2050 and provided a link to our first Embodied Carbon Action plan. An updated link to our 2023 Embodied Carbon Action plan will also be included for the public to view our next detailed commitment plan.

Structural Involvement at Sustainability Kickoff and Project Initiation

CannonDesign already incorporates a Sustainability Kickoff meeting into the start of every project. However, this meeting has typically been restricted to the architects and energy modeling team. Advocating for regular structural engineering involvement in these kickoff meetings to provide input related to embodied carbon reduction strategies will continue to be a top priority going into our second year of the SE2050 Commitment. For project initiation, we will

update our Schematic Design narrative to include verbiage about our specification updates for carbon reductions, highlight our commitment to SE2050, and share our plan to run LCAs on new construction projects. We are also looking to research and include initial design information on the use of mass timber in the Schematic Design narrative.

Structure & Embodied Carbon' Slip Sheet

Our existing marketing documentation regarding the sustainability of structural systems is a brief "Mass Timber Design Guide." This includes basic information on mass timber as a structural system mainly for use in advocating mass timber construction during project pursuits.

We plan on sharing the importance of embodied carbon reduction strategies with our project teams, clients, and contractors to emphasize our responsibility of addressing this issue. This will be done with our creation of a "slip sheet," intended to give outside stakeholders a glimpse into the scope of strategies structural engineers can take to make embodied carbon reductions. In addition to client outreach, we'd also be able to use these embodied carbon slip sheets during career fairs and general firm recruiting.

After the creation of this slip sheet, we plan to have our marketing team use the information presented to write formal proposal language detailing our structural engineering group's dedication to embodied carbon reductions.

2021-2022 IN REVIEW

ACHIEVEMENTS

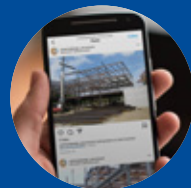
In our first year, we focused our efforts on internal advocacy and have achieved the following advocacy goals.

- + Post CannonDesign's commitment to SE 2050 to the external website
- + Promote carbon-sequestering materials through utilization in project work

LESSONS LEARNED

Our initial strategy for advocating for the SE2050 commitment was to create physical marketing materials in order to share information to our internal team, clients, and owners. However, over the past year our group focused heavily on education and advocating via introductory embodied carbon presentations and conversations without the use of these marketing materials.

Moving into our second year of the commitment, we learned that we should refocus our efforts into developing these marketing materials to make facilitating these conversations and presentations easier and more streamlined.



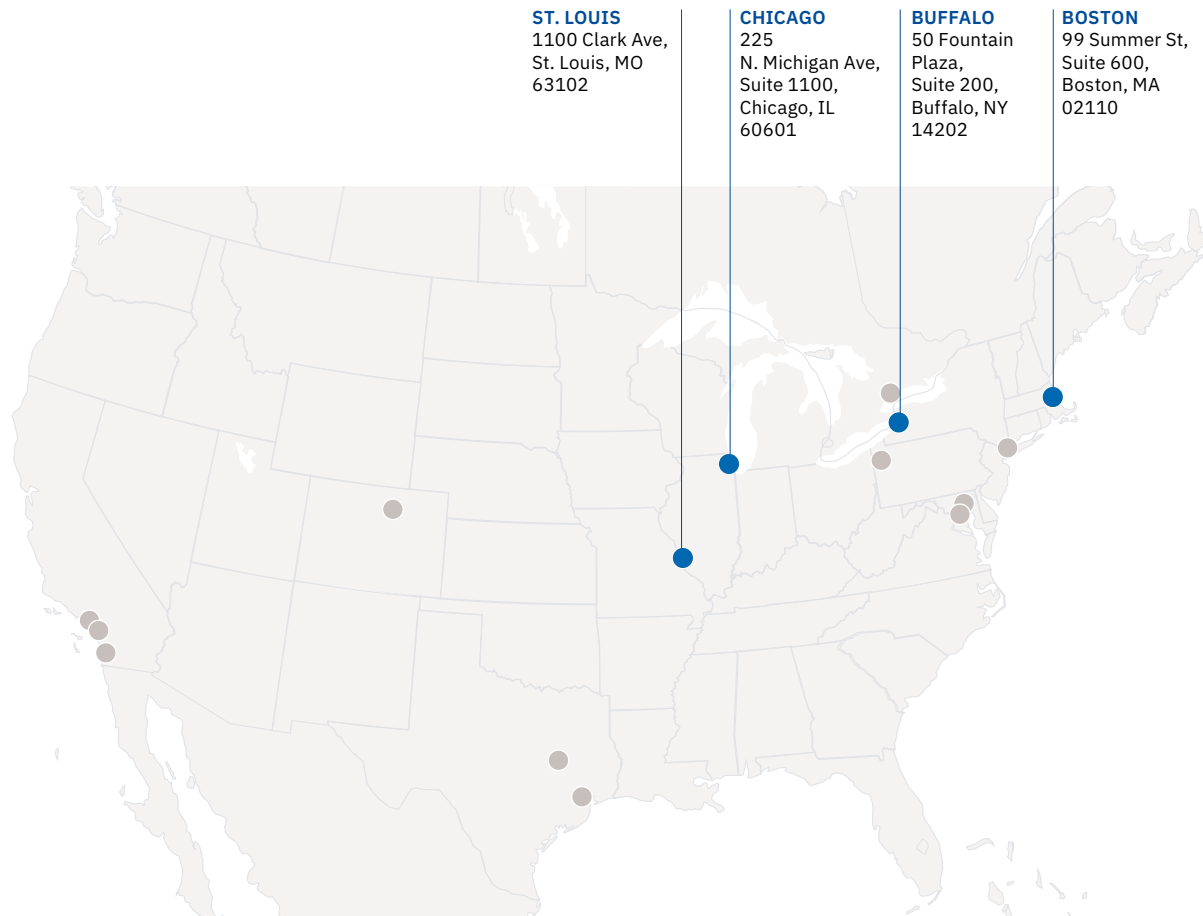
Follow us!

You can keep an eye on what we're up to on Instagram:

cannondesign_structural

Contributors

CannonDesign is a global design firm with structural engineering in four of our U.S. Offices: Boston, Buffalo, Chicago, and St. Louis. Contact information for each of the structural offices can be found below.



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