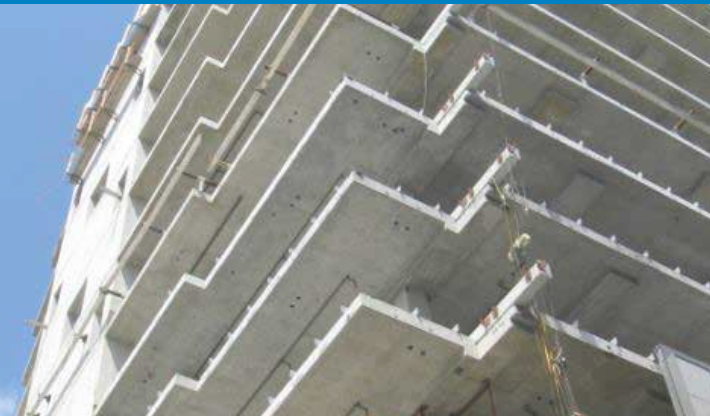


TIPPING

# Embodied Carbon Action Plan



STRUCTURAL  
ENGINEERING  
INSTITUTE



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*Left:* Repurposing and vertically expanding the structure at 633 Folsom significantly reduced the embodied carbon that would be required with a new building



# Our Commitment

Tipping joined the SE 2050 movement in 2021 with our formal commitment to a path of substantive reductions of embodied carbon in structural systems.

Sustainability guides our analysis of every design problem, and is an essential part of every solution.

We take a holistic view at the early stages of structural design and we effectively collaborate with other disciplines to reduce the environmental impact of our projects. We strive to reduce the carbon impact of our structures by:

- designing efficient structural systems with minimal structural material quantities;
- designing cost-effective structural systems appropriate for minimizing life-cycle costs;
- detailing for longevity and adaptability;
- utilizing locally sourced materials whenever possible;
- proactively coordinating with the architect and mechanical engineer on key sustainability considerations
- protecting the building by designing for enhanced seismic performance;
- specifying low-cement concrete and high-recycled-content steel that can meaningfully reduce the greenhouse gas impacts of construction;
- avoiding construction waste and reducing costs; and
- providing expertise in the design of lightweight and longspan structures.



*Left:* Packard Foundation Headquarters, a 2014 AIA COTE Top Ten Green Project, certified LEED Platinum and a zero-net-energy building

# Our Commitment

The SE 2050 Program aligns with Tipping's sustainable design goals and our ongoing efforts to reduce the short- and long-term impact of building construction on the environment. Tipping is part of the growing cadre of firms who are working to combat climate change through education, embodied carbon reduction, and advocacy.

We continue making progress on projects with measured reductions, advocacy, and sharing of our knowledge and data to accelerate widespread adoption of reduced embodied carbon design strategies for the broader industry.

We make concerted efforts to research and analyze alternative, resource-efficient structural systems and materials to support innovation for the built environment, including

- low-cement concrete;
- mass timber;
- resource-efficient wood framing;
- optimized reinforcement grades whenever possible (using higher strength reinforcement);
- unconventional and naturally sourced materials:
  - straw bale
  - rammed earth
  - bamboo; and
- tensile membranes (architectural fabrics & films).



Left: the Tipping office

# Our Commitment

Tipping joined the SE 2050 movement to be a part of the community of designers actively reducing carbon in our built environment.

Our ECAP is refining Tipping's approach to reducing embodied carbon through actionable goals that inform decisions being made by our internal teams, and support conversations with our collaborators and our clients.

Our firm has ambitious goals for our participation in SE 2050, some of which were realized and some of which are ongoing. We have learned a lot from being a part of SE 2050, including the sharing of best practices to reduce embodied carbon, investigating carbon accounting tools, developing our own tools for carbon accounting, promoting our commitment to SE 2050, and continuing to collaborate for more efficient project designs that reduce embodied carbon. For our renewed commitment in 2024, we will continue to develop in-house resources and tools for carbon reduction, and to advocate for carbon reductions to our clients and design partners.



We have internal presentations to share notable Tipping projects, so that new staff members can gain institutional and technical knowledge about important design approaches. One of the projects presented last year was Children's Day School Pre-school, a single story classroom building constructed of mass-plywood panels, glue-laminated beams and columns, and panelized light-framed wood walls. Information presented to staff included lessons learned about mass-timber design, cost estimating, and procurements, as well as a site visit and a discussion with the construction team.

As we move forward, we plan to initiate more carbon accounting across project teams using tools we have internally developed to move us closer towards our longer-term (~5 years) goal to establish Tipping-specific averages of embodied carbon for various project types. We will continue to provide more embodied carbon reduction education, carbon accounting instructions and custom tools and templates to assist more staff to participate in carbon accounting.

For our short-term (1 year) goal, we are focusing on building up our internal carbon database to quantify embodied carbon on our projects based upon project and material type for both new and reuse (renovation and retrofit) projects. We will make progress towards our longer-term (~5 years) goal to make robust comparisons of our averages to industry benchmarks. With our averages confidently established, we will set measurable targets for embodied carbon reduction on all of our future projects and monitor our progress in reaching our long-term reduction targets.

*Left: Children's Day School Preschool new mass-timber building (rendering courtesy Jensen Architects)*



# Education

## Tipping Team Carbon

### SE 2050 Leadership



### Carbon Tracking & Reporting



### Education Initiatives



SE2050 Leadership:  
Bruce Danziger, SE; Ian Kelso, SE;  
Gina Carlson, SE

Carbon Tracking and Reporting:  
Itria Licitra, CE; Jenna Williams;  
Isaac Williams, CE

Education Initiatives:  
Ashley Waite, CE; Joy Wei, SE

Tipping has a long-standing tradition as an organization that is committed to continual learning and nurturing the educational development of our staff.

We view our commitment to the SE 2050 movement as an inspiring opportunity to expand the knowledge base of our employees and clients into an area of our practice that is essential for combating climate change.

Our Education Initiatives team maintains a SE 2050 Slack channel, with Slack being our office's primary form of internal communication. The channel currently hosts the following resources:

- links to the SE 2050 website, published papers, articles, and internal and external presentations;
- tips for adopting sustainability language into project specifications;
- carbon accounting tools and methods for tracking embodied carbon on projects; and
- research into material and technology advancements regarding sustainable design.

Our SE 2050 Slack channel is an on-going, direct source for communication as sustainability related questions arise in the office, and as new techniques and research emerge in the industry.

# Education

To share carbon reduction strategies within our office and with our clients, we published our first two quarterly newsletters in 2023. Content included

- focused strategies for carbon reduction related to concrete and steel construction,
- upcoming Carbon Leadership Forum (CLF) events,
- links to relevant sustainable design articles and/or videos,
- updates on Tipping's carbon accounting measures,
- a "what you can do" section with tips on how each staff level can make a contribution to carbon reductions practices, and
- quick facts related to various sustainable resources.



To reinforce sustainable practices from the concrete newsletter, Team Carbon hosted a lunch-and-learn. The presentation gave our staff the opportunity to engage in a dialogue about carbon reduction strategies in concrete construction.

Following up on our material focused topics, Team Carbon's next newsletter will focus on mass timber construction. As with the concrete presentation, we will reinforce the content provided in the newsletter to our staff and have an open dialogue about the reduction strategies presented. We intend to have at least two newsletter followup lunch-and-learn presentations in the coming year, the first on steel construction and the second on mass timber. We also record these presentations so they can be watched by new employees during onboarding, or by staff who could not attend the presentation.

In the coming year, our firm will focus on increasing our carbon accounting practices within our office. We intend to have a lunch-and-learn that focuses on the in-house tools we have developed to assist with carbon accounting; provide tutorials on how to use the more typical industry carbon accounting programs and plug-ins that are available; discuss EPD libraries available to us; and explain to the staff Tipping's action plan to building up our internal database in order to quantify new and retrofit projects based upon their project and material type. Our intent is to provide the background needed for project teams to become more active in the firm's embodied carbon accounting practice.

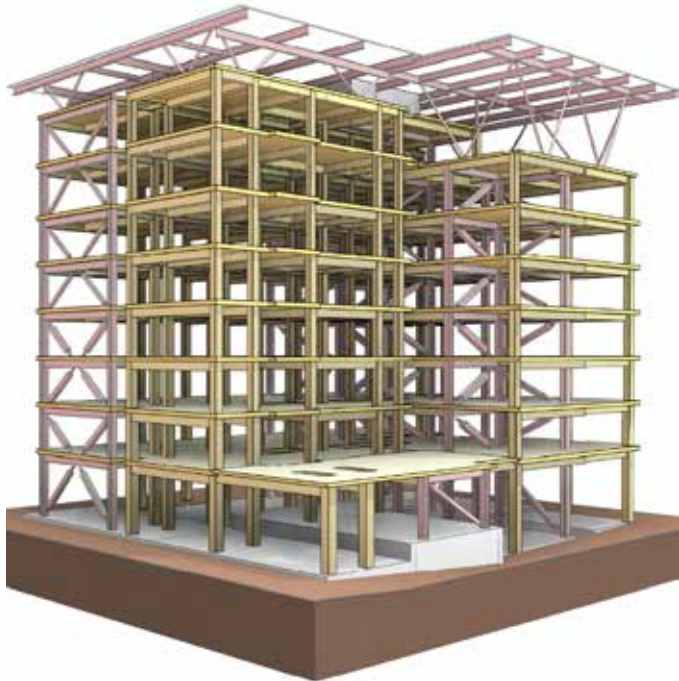
Beyond the Team Carbon internal task group, Tipping actively encourages employees to seek further education about embodied carbon reduction practices. We provide opportunities for staff to attend external webinars and conferences that focus on sustainability and embodied carbon reduction through the use of Tipping's annual employee professional development allowance.

*Left:* Tipping staff on a site visit at Children's Day School Preschool, getting an in-person look at mass timber construction

# Education

In 2024, our intention is to incorporate more firm and industry based embodied carbon comparisons into our early conversations with our clients.

Tipping often begins projects with structural system studies, helping our clients fully understand the possibilities unique to their project offered by concrete, structural steel, and hybrid mass timber; including a qualitative comparison of each system as it relates to embodied carbon intensity. As we focus on building our firm's internal project embodied carbon database for various project types and material systems, we hope to be able to provide more accurate and specific quantitative comparisons of the embodied carbon intensities of the various systems under consideration in initial discussions.



## Tipping's Website

Tipping is delighted to be involved in the SE 2050 Commitment Program. We have highlighted our participation on our company website to spread awareness of this initiative to the general public. Our dedicated sustainability page features:

- a summary of our commitment to SE 2050;
- a link to our newsletters; and
- a link to our Embodied Carbon Action Plan (ECAP), to be updated annually.

As we continue to expand on our educational initiatives, the website will be updated to share our progress externally.

## Completed Education Electives

Tipping continues to actively pursue several electives. In 2023, we

- distributed our latest ECAP within our firm;
- recorded our two lunch-and-learn presentations on embodied carbon and made them available to employees;
- shared the SE 2050 library or resources with technical staff through our Slack channel and newsletters;
- nominated an employee to participate in a CLF Community Hub;
- provided a narrative outlining plans for the two firm-wide presentations that occurred on the topic of embodied carbon; and
- continued the work of the embodied carbon interest group within our firm, which meets regularly and helps guide our process of embodied carbon reduction.

## Upcoming Education Electives

We will continue to play an active role in spreading awareness of SE 2050 to the broader office and promote embodied carbon education. See Elective Documentation section for upcoming 2024 education electives.



# Carbon Tracking and Reporting

Tipping has an established practice model to produce efficient, innovative designs and smart solutions that reduce both cost and embodied energy.

We continuously evaluate carbon accounting methodologies and tools that integrate carbon reduction opportunities into our existing practice methods. We believe that rapid and accurate material quantity and carbon estimates during the initial phases of design provide one of the most effective opportunities for carbon reduction.



## Early Design Stage Tracking

We have combined quantity estimating methods with rapid carbon accounting tools and a pre-vetted “carbon library” of our most commonly used structural materials to facilitate rapid approximations of embodied carbon during early design. Our goal for 2024 is to apply this rapid carbon estimating process to many of our new projects in order to continue calibrating our own internal “carbon baselines” and to more effectively identify carbon reduction strategies early for clients.

## Early Design Stage Action Items

- Ongoing training of junior staff in accurate early phase quantity estimating;
- ongoing updates to our in-house “carbon library” of common structural materials to update EPD data and improve initial phase (A1-A3) carbon estimates, including updates to the latest Carbon Leadership Forum benchmark data; and
- support **all** design teams in rapid carbon estimating procedures and tools to facilitate early accounting on a wider range of firm-wide projects.

## Later Design Stage Tracking and Validation

While a nimble carbon estimating process during early design maximizes opportunities for impactful reductions, a more detailed process must also be deployed later in design to confirm initial estimates and validate the efficacy of reduction strategies and design decisions. To this end, Tipping is continuing to develop our capacity to pair detailed BIM modeling with embodied carbon estimating tools. This is currently being done most often using Revit and in-house carbon estimating libraries.

*Previous page:* Timber model of Woolsey Gardens.

*Left:* Currently in design, Woolsey Gardens will be one of the first Type IV-C to be built in California, a code category that allows for timber structures up to 9 stories and 85' tall.

# Carbon Tracking and Reporting



## Later Design Stage Action Items

- Expand training of staff in the use of Revit for material quantity estimates that can be paired with carbon accounting tools to confirm total carbon estimates for structural systems;
- evaluate and update default modeling standards to better integrate with efficient and accurate carbon accounting processes;
- upload complete carbon accounting for projects across a wider segment of firm-wide production teams to the SE 2050 database in 2025; and
- explore options for how our structural data can better support WBLCA efforts, when they are pursued by the broader project team.

## Completed Tracking and Reporting Electives

Tipping is actively pursuing the completion of several electives. Below is a summary of completed electives in 2023:

- we created a carbon reporting plan defining how we measure, track, and report carbon data;
- we continued to develop and improve our in-house “carbon library” of most commonly used materials and their carbon contents, linked to current EPD data;
- we created in-house tools for rapid accounting of early stage carbon using both Excel and in-house custom calculation software; and
- we submitted three additional projects to the SE 2050 database.

## Upcoming Tracking and Reporting Electives

See Elective Documentation section for upcoming 2024 reporting electives.

*Left:* Green concrete specified on the San Francisco Public Utility Headquarters decreased the project's carbon footprint by 7.4 million pounds of CO<sub>2</sub> emissions.



# Embodied Carbon Reduction Strategies

Embodied carbon reduction of structural materials is the ultimate goal of the SE 2050 program.

We use external resources, such as SE2050, CLF, and IStrucE, as well as our own internal carbon tracking data, to identify and set strategies. We demonstrate leadership by applying and further developing best practices through design and collaboration with the design community. We advocate for mentorship from the leadership of SE 2050, CLF, Built Environment Declares (BED), Structural Engineers Declare (IStructE), Net Zero Bridges Group and others to learn about international best practice for the reduction of embodied carbon and to limit our environmental impacts. We have been convening quarterly videoconferences with BED, IStructE, the Net Zero Bridges Group, AISC and Nucor.



## Embodied Carbon Reduction Strategies Initiatives

Our goals for the third year continue to be focused on education, gathering more embodied carbon project data, further developing carbon reduction tactics on our projects and progressing our reporting and tracking to establish carbon reduction targets across our portfolio of projects. We will continue to learn from and share with the SE 2050 community to advance best practices for carbon reduction. We have formed a "buddy" relationship with Aspect Structural Engineers meeting quarterly by videoconferencing to discuss our collective SE 2050 actions and lessons learned. We have already had 5 "buddy" meetings with Aspect Structural Engineers.

## Completed Embodied Carbon Reduction Strategy Electives

Below are some of the carbon reduction electives we addressed in 2022 & 2023:

- Specifying green concrete mixes that include supplementary cementitious materials and using higher strength reinforcement to reduce the embodied carbon of reinforced concrete;
- using mass timber on multiple projects; and
- initiating projects with embodied carbon reduction studies to evaluate options and sharing the schemes and outcomes with the design team.

*Left:* The David Brower Center's high sustainable goals achieved LEED Platinum and was recognized as an AIA COTE Top 10 Green Projects.



# Embodied Carbon Reduction Strategies

Tipping strives to reduce the carbon footprint of our projects, aligning with the goals of the reduction strategy electives.

## Upcoming Embodied Carbon Reduction Strategy Electives

We will continue to target embodied carbon reductions. We are collecting more data to make progress towards our goal to establish a “carbon baseline” for Tipping-specific averages of embodied carbon for various project types with our

- firm-wide reduction targets in the short-term (<1 year): we are focusing on building up our internal carbon database to quantify our projects based upon project and material type for both new and reuse (renovation and retrofit) projects.
- firm-wide reduction targets in the long-term (>5 years): to make robust comparisons of our averages to industry benchmarks. With our averages confidently established, we will set measurable targets for embodied carbon reduction on all of our future projects and monitor our progress in reaching our long term reduction targets.

See Elective Documentation section for upcoming 2024 reduction electives.



*Left:* For the LEED Platinum Certified UC Berkeley Chou Hall, we specified low-cement concrete and high-recycled-content steel, and designed resilient and cost-effective seismic systems to minimize life-cycle costs.

# Advocacy

Positive change will come with industry-wide adoption. We recognize that our collective impact reaches beyond any individual firm.



In 2024, our advocacy goals continue to focus on sharing carbon reduction strategies with the industry and promoting our efforts to reduce embodied carbon.

We promote our commitment to SE 2050 and our efforts to reduce embodied carbon. We share our experience and knowledge within our firm, within the design community, and beyond.

Our SE 2050 Champion, Bruce Danziger, teaches at several institutions of higher learning where he integrates structural engineering sustainability and embodied carbon reduction into the courses' curriculum to expose architecture and engineering students to structural sustainability and embodied carbon reduction. Bruce was a keynote speaker at the 2023 TensiNantes symposium on The Pathways to Zero Carbon for Tensioned Membrane Architecture: ongoing actions and next steps. Bruce was also featured on the Lightweight + Durable podcast along with Engineer Architect Zehra Eryuk to discuss potential carbon reduction benefits of architectural membranes.

## Completed Embodied Carbon Advocacy Electives

Our completed 2022 & 2023 advocacy electives include

- sharing our commitment to SE 2050 on our company website;
- including proposal language that declares our firm as a member of the SE 2050 commitment;
- teaching innovative and sustainable design to the next generation of design professionals at institutions of higher education and industry events;

*Left:* Bruce Danziger with Engineer Architect Zehra Eryuk and journalist Marie Crabié on the Lightweight + Durable podcast.

# Advocacy

- collaborating with an international team of experts to develop and disseminate best practices for embodied carbon accounting and reduction for lightweight tensile membrane structures;
- delivering presentations for architects including strategies for implementing mass timber design that focus on efficiency and constructability.
- In 2023, we presented carbon reduction strategies to:
  - a group of students at SFSU;
  - Tensinet as a keynote speaker at TensiNantes June 2023 (Tensinet is a European based multidisciplinary association for all parties interested in tensioned membrane construction);
  - International Association of Spatial Structures (IASS) Working Group 6 (WG6) Tensioned Membranes annual 2023 meeting;

- Lightweight + Durable podcast: Carbon Footprint: How lightness could be an advantage in the construction sector compared to other traditional material;
- Fabritecture Structures leadership and engineering staff.
- attending local CLF events and actively participate in these events;
- promoting SE 2050 in our external-facing communications; and
- developing our embodied carbon community of practice and mentorship in our office.

## Upcoming Embodied Carbon Advocacy Electives

In 2024, our advocacy goals continue to focus on sharing carbon reduction strategies with the industry and promoting our efforts to reduce embodied carbon. See Elective Documentation section for upcoming 2024 advocacy electives.

In April 2024, Bruce Danziger will be a keynote speaker (via Zoom) on Pathways towards zero carbon for tension membrane architecture at the Textile Roofs Workshop in Berlin. In September 2024, Bruce will give a presentation on Pathways towards zero carbon for tension membrane architecture (via Zoom) at the Lightweight Structures Association Australia (LSAA) conference in Melbourne.



Left: Principal Leo Panian presented the benefits of green concrete to a multi-disciplinary audience at the 2020 Design Colloquium.



# Elective Documentation

The education, reporting, reduction and advocacy electives for 2024 are described in the elective documentation list below:

## Education Electives

Tipping is actively pursuing the completion of the following education electives for 2024:

- distribute our latest ECAP within our firm and incorporate its distribution as part of the firm's onboarding process for new employees;
- provide a narrative outlining plans for three firm-wide presentations on the topic of embodied carbon reduction strategies and accounting tools;
- record our lunch-and learn presentations and make them available to employees;
- continue to share the SE 2050 library or resources with technical staff through our Slack channel and quarterly newsletter; and
- continue the work of the embodied carbon interest group within our firm that meets regularly and helps guide our process of embodied carbon reduction.

## Reporting Electives

Tipping is actively pursuing the completion of the following reporting electives for 2024:

- submit a minimum of (2) projects with structural engineering services to the SE 2050 Database;
- describe how different project teams or managers are measuring and reporting embodied carbon; and
- compare the embodied carbon emissions from multiple projects across our firm. Analyze and document what data or pieces of information are most important and communicate the findings to our firm.

## Reduction Electives

Tipping is actively pursuing the completion of the following reduction electives for 2024:

- set clearly stated, firm-wide reduction targets in the short-term (<1 year) and long-term (>5 years);
- collecting data to make progress towards our goal to establish a "carbon baseline" for Tipping-specific averages of embodied carbon for various project types;
- further development and implementation of workflows that makes it easier to make early design decisions based on embodied carbon by providing more embodied carbon reduction education, carbon accounting instructions and custom tools and templates to help more staff participate in carbon accounting;
- more carbon accounting across project teams using tools we have internally developed;
- promoting the use of mass timber (MT), and supplementary cementitious materials (SCM) on our projects;
- further development and dissemination of best practices for embodied carbon accounting and reduction for lightweight tensile membrane structures;
- participate in a project design charrette and speak to potential design considerations impacting embodied carbon;
- incorporating additional language to update our specifications targeting carbon reduction; and
- communicating the embodied carbon impacts of different design options to clients with creative data visualization.

# Elective Documentation

## Advocacy Electives

Tipping is actively pursuing the completion of the following advocacy electives for 2024:

- Describe the value of SE 2050 to clients, including proposal language that declares our firm as a member of the SE 2050 commitment;
- continue to publicly declare our firm as a member of the SE 2050 Commitment Program on our website;
- give external presentations on embodied carbon reduction;
- encourage industry and policy change by promoting and using low-carbon and carbon sequestering materials;

- continue to support our Tipping Team Carbon office leadership efforts for embodied carbon reduction and sustainability mentorship in our office;
- plan for more effective early conversations with owners, architects, and contractors to advocate for more sustainable design;
- teach innovative and sustainable design to the next generation of design professionals at institutions of higher education and industry events;
- present best practices for embodied carbon accounting and reduction for lightweight tensile membrane structures to international professional organizations including Tensinet, Textile Roofs, LSAA and IASS;
- forge new relationships and strengthen existing relationships with like-minded design professionals, builders, and clients;
- attend and actively participate in local CLF events;
- participate as a committee member of the AIA COTE;
- buddy with like-minded SE 2050 signatories to share our SE 2050 experiences and best practices towards reducing embodied carbon;
- Advocate for mentorship and collaboration with quarterly videoconference meetings with the leadership of SE 2050, CLF, Built Environment Declares (BED), Structural Engineers Declare (IStructE), Net Zero Bridges Group and others to learn about international best practice for the reduction of embodied carbon and to limit our environmental impacts; and
- support Lightweight Footprint's efforts to establish a vertically integrated (international and across disciplines) platform for lightweight tensioned membrane structures similar to the SE 2050 Commitment Program.



Left: The Berkeley Public Library West Branch earned LEED Platinum certification.

# Lessons Learned

Over the previous year, we have learned many valuable lessons regarding embodied carbon reduction that will inform our strategies in the coming year.

- Establishing firm specific embodied carbon project type baseline averages will take several years.
- Monitoring reduction targets based upon firm specific embodied carbon project type baseline averages will also take several years (baseline averages first have to be established).
- Comparing our projects' embodied carbon to industry averages is possible and we are seeing an early trend (with limited data so far) that our projects have less embodied carbon compared to the averages. This underestimates the impacts of high seismicity (for most of our projects) on embodied carbon average baseline quantities.
- We have been following the developments in policy (AB 2446, CALGreen, Danish embodied carbon limits for buildings, etc.) with the anticipation that code requirements will help us guide our projects towards solutions that significantly reduce embodied carbon. Our goals are to stay ahead of policy in specifying and helping develop more sustainable structural engineering solutions that reduce embodied carbon.

- The amount of information available can be overwhelming and we strive to curate this information to help our staff learn more effective methods to reduce embodied carbon on our projects. We circulate internal SE 2050 newsletters and have 'brown bag' meetings to distill relevant information and help guide our staff at different levels of experience to implement specific methods and tools to reduce embodied carbon on our projects.
- Conversations with contractors are ongoing and trying to get contractors on board with our SE 2050 goals is challenging. Getting contractors, clients and design teams to align as early as possible on projects is necessary. Early alignment helps avoid the dilution of goals that inevitably challenges sustainable aspirations.
- Multiple projects with architects with high sustainability goals are requesting that we insert GWP requirements (GWP maximum values for concrete to achieve CLF low targets) in our concrete specifications instead of specifying 'recipes'. Validating what is supplied for actual performance (e.g. finishing requirements) could require additional construction time that may have not been anticipated leading to costly change orders. This is a challenge for us to transition from very specific specifications to more general performance based specifications. As we move towards more performance based material specifications with GWP limits, this requires more intense collaboration with Contractors to check that what will be delivered to the site aligns with expectations for schedule, budget, performance and quality.
- Sometimes sustainability goals are in conflict with commercial goals and we need to balance both. As engineers, our leverage often comes from providing high quality technical knowledge so that our clients can make the best informed decisions. Gathering and distilling high quality data to empower us to give high quality advice is how we aspire to balance our sustainability and business goals.



*Left:* Tipping Team Carbon leaders Gina Carlson and Ian Kelso discussing a project with colleagues Leo Panian and José Sánchez





# TIPPING

Founded in 1983 | State of California SBE | County of Alameda Certified SLEB | 40 total staff | 17 licensed Structural Engineers | 60+ affordable housing projects | 58 Excellence in Structural Engineering Awards | 2 Living Building Challenge projects | 22 LEED Platinum projects | 22 LEED Gold projects | 6 projects with LEED innovation points from Tipping innovations | 9 Net-Zero-Energy projects | 9 AIA COTE Top Ten green projects | Signatory of SE 2050