KFSE Embodied Carbon Action Plan (ECAP)

March 31, 2025

Introduction:

Kurt Fischer Structural Engineering, Inc (KFSE), is a 15-person firm with offices in Encino, CA, Irvine, CA, and Portland, OR. KFSE is proud to commit to the SE 2050 Program to reduce the impact of building construction on the environment. We support the vision that all structural engineers shall understand, reduce, and ultimately eliminate embodied carbon in their projects by 2050.

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Color Legend
Blue = SE 2050 Requirement or elective
Black = KFSE Response
Green = KFSE Completed Task
Gold = In progress, not completed

Education Plan

- KFSE Carbon Champion for 2025:
  Carl Kloos, S.E., LEED AP is continuing as KFSE's Carbon Champion. Carl is a Vice President and leads KFSE's Portland, OR office. He has 20 years of experience in structural engineering, and has been a LEED Accredited Professional since 2013. From 2017-2023 Carl was member of the Structural Engineering Institute's (SEI) Sustainability Committee, participating in the Disaster Resilience working group.

Within 1 year of signing the SE 2050 commitment, KFSE will:

- Distribute ECAP within your firm upon publishing.
  KFSE will distribute the ECAP immediately via email once finalized.
  Completed 4/22/2022
- Make (1) webinar focused on embodied carbon available to employees.
  KFSE will show the webinar "Embodied Carbon 101: Structure" at one of our monthly lunch-n-learn meetings in the first year of joining.
  Completed 2/23/2023

Action items for 2024:

- Share (1) webinar focused on embodied carbon during our monthly lunch-n-learn series.
  Completed 10/24/2024 – Showed the ACI Performance Based Specifications for Concrete webinar, which is part of our overhaul of our concrete specifications and general notes to allow for less carbon intensive concrete mixes and to have the ability to set concrete embodied carbon budgets.
- Provide a narrative of how the Embodied Carbon Reduction Champion will engage embodied carbon reduction at each office. (intended for multi-office firms).
  KFSE is a small firm, and while we have three offices, the two satellite offices each have two engineers, so we act as one office. Our three offices share general notes and specifications, so our work to overhaul the concrete specifications and general notes will be used by all offices. Additionally, we've been using example projects from each of our teams for our annual LCA and reporting.

Action items for 2025:

- Share (1) webinar focused on embodied carbon during our monthly lunch-n-learn series.
  KFSE will show an embodied carbon focused webinar during our monthly lunch-n-learn series.
- Nominate a minimum of (1) employee per office to participate in a CLF Community Hub and/or task force.
  KFSE's Embodied Carbon Reduction Champion will join the Portland CLF hub for 2025.

Additional potential electives for future years:

- Have one representative of your firm (any employee) attend quarterly external education programs (e.g. webinar, workshop) provided by SE 2050, Carbon Leadership Forum (CLF), or other embodied carbon resources.
  - Completed for 2023, KFSE has regularly attended the Quarterly SE 2050 Signatories calls.
  - Completed for 2024, KFSE has regularly attended the Quarterly SE 2050 Signatories calls.

- Share the SE 2050 library of resources with technical staff.
- Share embodied carbon reduction strategies with your firm as outlined in Top 10 Carbon Reducing Actions for Structural Engineers document produced by SE 2050.
- Nominate a minimum of (1) employee per office to participate in a CLF Community Hub and/or task force.
- Provide narrative outlining plans for minimum (2) firm-wide presentations per year on the topic of embodied carbon.
- Present the document, "How to calculate embodied carbon" to all technical staff.
- Minimum (1) employee attends a presentation or demo of an LCA-based tool used to calculate embodied carbon, such as Tally, Athena IEB, or One Click LCA.
- Initiate an embodied carbon interest group within your firm and outline their goals.
- Provide a narrative of how the Embodied Carbon Reduction Champion will engage embodied carbon reduction at each office. (intended for multi-office firms).
- Propose other actions promoting embodied carbon education and describe their value.

Reporting Plan

Each year KFSE will:

- Submit a minimum of (2) projects per U.S. office with structural engineering services to the SE 2050 Database. You are not required to submit more than (5) total projects across your firm. Offices less than 5 FTE are excluded.
  KFSE will submit (2) projects to the database each year.
  - Completed for 2023. Analysis for (2) projects ready for upload on 7/25/2023
  - Completed for 2024. Analysis for (2) projects ready for upload on 3/14/2024
  - Completed for 2025. Analysis for (2) projects uploaded 3/26/2025

Additional potential electives for future years:

- Submit all of your firm's projects to the SE 2050 database.
- Report a greater percentage of projects than you did the previous year.
- For a project submitted to the database, ask the Architect or Owner if the project has a carbon budget or if there are established project sustainability goals at the project kickoff meeting.
- Propose other actions that promote the reporting of embodied carbon data and describe their value.

Embodied Carbon Reduction Plan

Within 1 year of signing the SE 2050 commitment, KFSE will:

- Update your specifications to incorporate embodied carbon performance. Include embodied carbon in your submittal review requirements.
  KFSE will update our specification templates to include provisions to document and/or reduce embodied carbon.
  - Not Completed in 2023, this is still a goal and we hope to implement for 2024.
  - Partially Completed in 2024. We extensively overhauled our concrete general notes and specifications to include performance based concrete specifications and adding a section for embodied carbon budgets. For 2025 we will continue with our other material specifications.

Action Items for 2024:

- Update your specifications to incorporate embodied carbon performance. Include embodied carbon in your submittal review requirements.
  Partially Completed in 2024. See above.
- Communicate the embodied carbon impacts of different design options to clients with creative data visualization. Include these visualizations in your Elective Documentation.
  Partially Completed in 2024. We've worked to improve our "Embodied Carbon Scorecard" and have sent it to a couple of clients for permitted projects. We have yet to use this at a schematic design level, but it could be used to present visualizations of the embodied carbon options in the future.

Action Items for 2025:

- Update your specifications to incorporate embodied carbon performance. Include embodied carbon in your submittal review requirements.
  Continue to update specifications for other materials not yet updated.
- Communicate the embodied carbon impacts of different design options to clients with creative data visualization. Include these visualizations in your Elective Documentation.
  Continue to develop Embodied Carbon Scorecard.

Additional potential electives for future years:

- Set clearly stated, firm-wide reduction targets in the short-term (5 years)
- Project case study sharing embodied carbon reduction successes and lessons learned
- Create a project-specific embodied carbon reduction plan.
- Complete an embodied carbon comparison study during the project concept phase.
- Participate in a LEED, ILFI Zero Carbon, or similar project design charrette and speak to potential design considerations impacting embodied carbon.
- Calculate your firm average benchmark for embodied carbon.
- Collaborate with your concrete supplier to reduce embodied carbon in a mix design.
- Work with a contractor during material procurement to meet an embodied carbon performance criteria on at least (1) project.
- Have an Environmental Product Declaration (EPD) created for a project.
- Incorporate biogenic materials on at least one project.
- Submit a Circular Economy Narrative describing how the project supports the circular economy. This can be done by incorporating re-use or design for deconstruction into at least one project.
- Report weight and method of transportation of structural material. Track how much is processed for recycling/salvage and sent to landfill, including material generated during demolition and construction activity. Include at least four material streams (e.g. concrete, metal, wood, gypsum wallboard, paper and cardboard, plastic).
- Integrate embodied carbon mitigation strategies in your General Notes.
- Propose other embodied carbon reduction strategies and describe their value.

Advocacy Plan

Within 1 year of signing the SE 2050 commitment, KFSE will:

- Describe the value of SE 2050 to clients. How can your design teams collaborate to reduce embodied carbon?

KFSE will discuss the SE 2050 commitment with clients.
    - Partial Credit for 2023. We've had discussions with some clients, but will strive for more discussions in 2024.
- Declare your firm as a member of the SE 2050 Commitment with boilerplate proposal language.
  KFSE will review our proposal template to see if the SE 2050 commitment can be included. We will request examples from other SE 2050 signatories. For RFPs that request a qualifications package, we will include a section declaring our firm's commitment to SE 2050.
    - Completed for 2023. We've added language referencing SE2050 in our RFP documents.

- Share your commitment to SE 2050 on your company website.
  KFSE will add a section about SE 2050 to our website.
    - Not Completed for 2023, will be a to do item for 2024.
    - Completed in 2025.

Action Items for 2024:

- Describe the value of SE 2050 to clients. How can your design teams collaborate to reduce embodied carbon?
    - Partial credit for 2024. We discussed embodied carbon and SE 2050 with several architects. Though did not have a lot of success with achieving collaboration focused on embodied carbon reduction.

- Discuss SE 2050 and Carbon Reduction in a presentation to an architecture firm
    - Completed for 2024. On 4/18/24 KFSE had a professional development presentation in an architect's office, in that presentation we covered SE 2050, Carbon Reduction, and showed the architect the structural embodied carbon for one of the projects that we worked on with the firm.

Action Items for 2025:

- Describe the value of SE 2050 to clients. How can your design teams collaborate to reduce embodied carbon?
  KFSE will continue to discuss the SE 2050 commitment with clients.

- Discuss SE 2050 and Carbon Reduction in a presentation to an architecture firm
  KFSE will look to present to another architecture firm with including SE 2050, Carbon Reduction, and potentially adaptive reuse in 2025.

Additional potential electives for future years:

- Give an external presentation on embodied carbon that demonstrates a project success or lessons learned (Tip: Get connected at a CLF local hub near you!).
- With the owner or client, discuss a facility- or product-specific EPD requirement for structural materials.
- Share education opportunities with clients.
- Encourage industry and policy change by promoting and using low-carbon and carbon-sequestering materials.

- Start an embodied carbon community of practice or mentorship program in your office.
- Mentor a firm new to the embodied carbon space.
- Propose alternative methods for advocacy and describe their value.

Lessons Learned/Progress Update

Getting started in SE 2050, the first big task was to determine what method and tools we would use to calculate the embodied carbon for our project. This took longer than expected, but we were able to report our first two projects in July of 2023 (actually uploaded in December due to Database website being down). Our second two project were ready for reporting in March 2024. Our third set of projects were uploaded in March 2025.

To calculate the embodied carbon for our projects, we decided to use a combination of in-house Revit aids and excel combined with EC3. The in-house Revit aid allowed us to calculate the material quantities for primary framing members and slabs. We combined this with additional excel tools to efficiently determine the remaining material quantities for each selected project.

We looked at other methods, but since our clients have not yet been requesting this information, we settled on using EC3 since it is free to use and thus not an additional overhead cost. We are hoping to team in the future with clients that are involved in AIA 2030, and when that happens, we will likely shift to a program like Tally when our carbon reporting becomes a client deliverable.

The next step was to import the data to EC3, which was a straightforward process. After that, we got the embodied carbon data, downloaded the data into an excel file, and then uploaded to the SE 2050 Database.

In our first two years, our calculations were based on the combined gross floor and roof plate area. In 2025, the SEI "Prestandard for Assessing the Embodied Carbon of Structural Systems for Buildings" will be released. In the Prestandard, the IBC defined "Gross Floor Area" is used to determine the carbon intensity. To align all of our data with the building area used in the Prestandard, KFSE has revised all of our carbon intensities and resubmitted to the SE 2050 database.

The six projects we chose to submit to SE 2050 are shown below:

1634 20th Street (224.1 kgCO2e/m2) – 114,790 sf, 5 over 2, light framed on concrete podium with 1 level subterranean parking. 78 units of affordable housing. Santa Monica, CA. Submitted 2023. Revised 2025.

Trancas Canyon Residence (423.5 kgCO2e/m2) – 3,500 sf 1-story single family residence, with concrete flat slab roof and concrete walls. The project was built entirely of concrete following the Malibu fire which completely destroyed the prior house on this site. Malibu, CA. Submitted 2023. Revised 2025.

Manhattan (247.6 kgCO2e/m2) – 104,143 sf, 5 over 2, light framed on concrete podium with 1 level subterranean parking. 60 units. Los Angeles, CA. Submitted 2024. Revised 2025.

Gooseberry Trails (104.4 kgCO2e/m2) – 50 units of townhomes up to 3 levels. All light framed wood construction. One 4-unit 7,895 sf, 3-story structure with daylight basement from the development was submitted. Portland, OR. Submitted 2024. Revised 2025.

Jalmia Drive (215.1 kgCO2e/m2) – 2-story Single family residence with 2,250 sf basement consisting of a light framed wood floor and roof and wood sheated shear walls. Los Angeles, CA. Submitted 2025.

Mission Street 132.3 kgCO2e/m2) – 45,606 SF. 8-story residential structure with retail at the ground level. 7" P.T. concrete floor slabs with concrete shear walls and 24" mat foundation. San Francisco, CA. Submitted 2025.

Our six reported projects can be seen in the diagram below from the SE 2050 website (Figure 1).

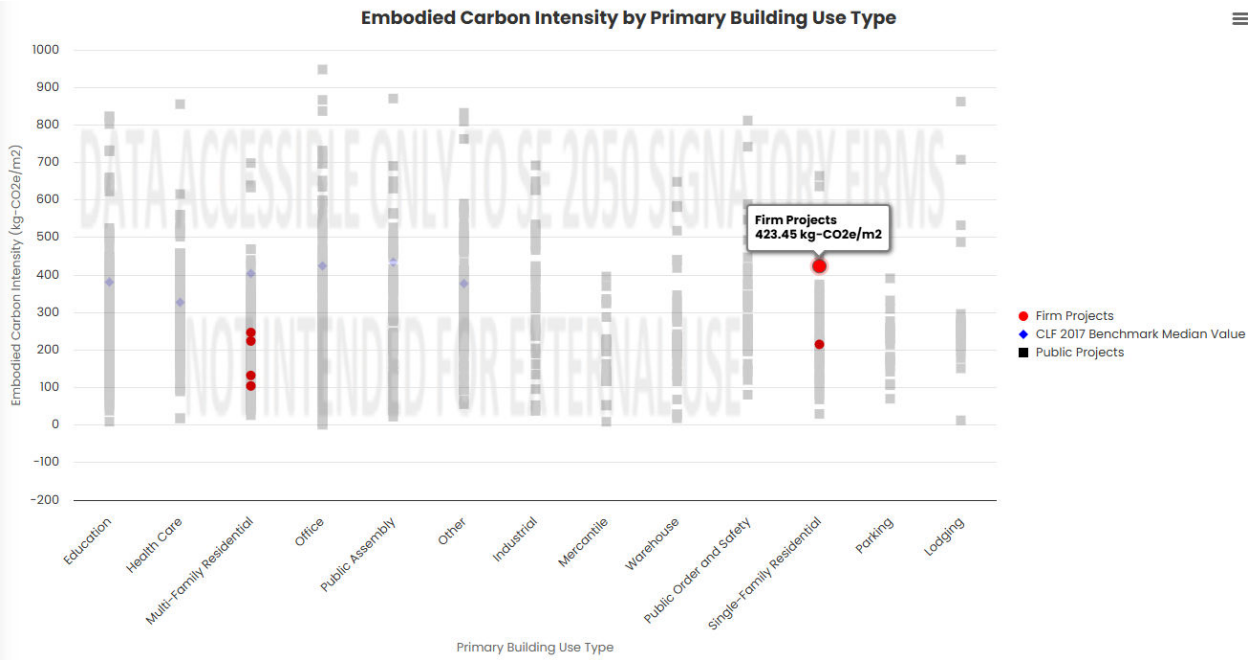

Figure 1 - Embodied Carbon Intensity KFSE Projects as of 3-26-2025

As expected, the all-concrete single family residence was one of the more carbon intensive single family residences in the database. Otherwise, we are pleased to see that our three multifamily projects are on the lower end of the carbon intensity range. The two podium projects have an intensity of 161 kgCO2e/m2 & 186 kgCO2e/m2. As expected, the all light framed wood townhomes have the lowest carbon intensity of 96.4 kgCO2e/m2. Most of the carbon is from the foundations, including the concrete walls in the basement for the daylight basement.

To summarize our carbon intensity findings for clients, we have developed an Embodied Carbon summary sheet. An example can be found in Appendix A.

The example in Appendix A of our 2024 ECAP shows the 1634 20th st project, which is 5 levels of wood over 2 levels of concrete podium with one level of subterranean parking. Wood framing accounted for 54% of the gross area, while concrete was the remaining 46%. As expected, the wood framing, while occupying more

area, is a small fraction of the carbon intensity vs the concrete floors. Wood framing accounted for only 8% of the embodied carbon while concrete and rebar accounted for the remaining 92%. It's known that light framed wood construction is be less carbon intensive than concrete, but this serves as a good reminder that whenever possible it is better from an embodied carbon standpoint to reduce the number of concrete levels in podium construction.

2025 project analysis:
In appendix A we have included our Embodied Carbon Summary Sheet for the two projects that we uploaded this year.

Counterintuitively, Mission Street which is all concrete was on the lower end of the GWP intensity for the multi-family residential sector. This project had very thin PT slabs at 7", so the efficient use of concrete turned out to result in a relatively low embodied carbon intensity. Our other multi-family residential projects typically had 12" mild reinforced slabs for the lower levels and 16" slabs for the podium, so while they had 5 floors of light framed construction the vast majority of the embodied carbon was in the lower-level podium structure and the efficiency of the light framed wood was outweighed by the embodied carbon of the podium.

In 2025, we also encountered an interesting result when looking at the area that is use in the denominator to determine the GWP Intensity. Per the soon to be released Prestandard on embodied carbon determination, we used Gross Floor Area. However, for projects with significant usable area that is outside the building envelope this can penalize the GWP intensity significantly. In Appendix B we have included a quick study investigating this.

Appendix A – Embodied Carbon Summary Sheets for Projects Uploaded in 2025

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Structural Embodied Carbon Summary (Primary Structure Only)

Project Name:	Mission St	Engineer:	DW (LCA by JH/CK)
Project Number:	21010	Date:	1/24/2025

Project Information

Architect: SIA Phase: Construction Documents LCA Stages: A1-A3
Floor Area: 45,500 SF Gross Area: 50,860 SF Location: San Francisco, CA
Summary: 8-story residential structure with retail at the ground level. 7" P.T. concrete floor slabs with concrete shear walls and 24" mat foundation.

LCA Results

Embodied Carbon By Material:

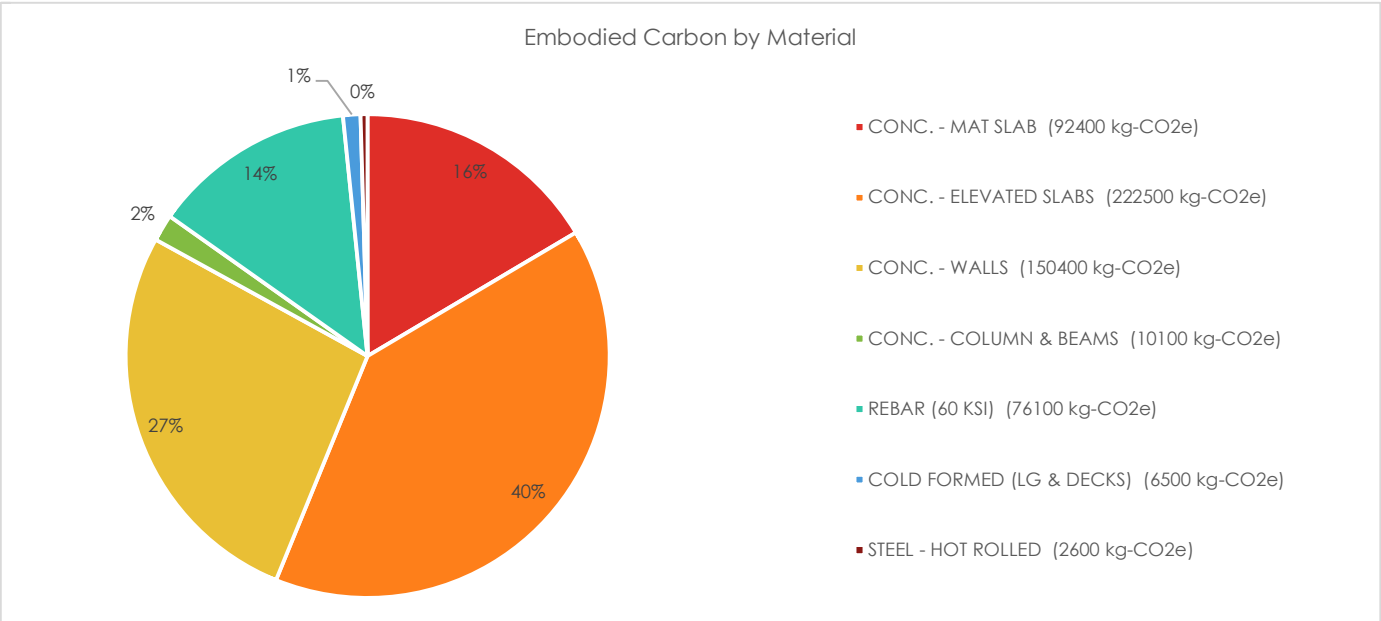
CONC. - MAT SLAB	92400 kg-CO2e
CONC. - ELEVATED SLABS	222500 kg-CO2e
CONC. - WALLS	150400 kg-CO2e
CONC. - COLUMN & BEAMS	10100 kg-CO2e
REBAR (60 KSI)	76100 kg-CO2e
COLD FORMED (LG & DECKS)	6500 kg-CO2e
STEEL - HOT ROLLED	2600 kg-CO2e

Embodied by Masterspec Division:

03 21 00 Reinf. Bars	475400 kg-CO2e
03 30 00 C.I.P. Concrete	76100 kg-CO2e
05 40 00 C.F. Metal	6500 kg-CO2e
05 12 00 Steel Framing	2600 kg-CO2e

TOTAL **560600 kg-CO2e**

GWP Intensity **118.6 kg-CO2e/m2**



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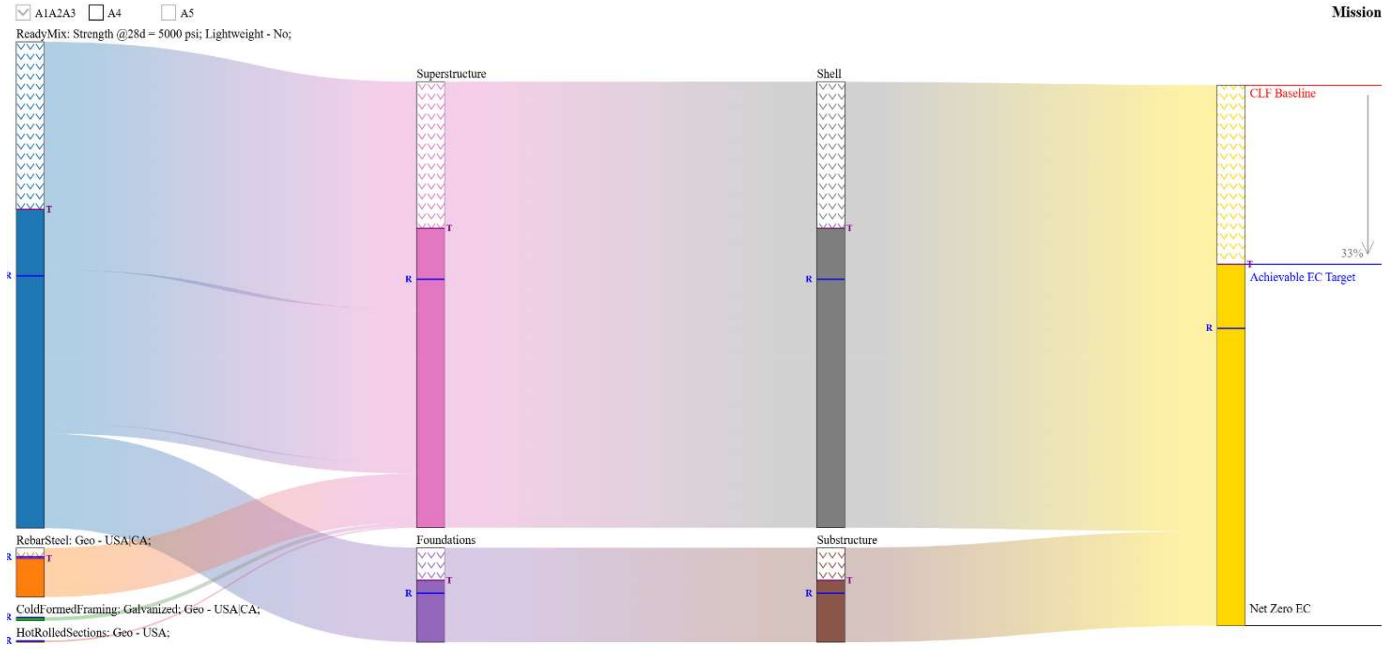

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Structural Embodied Carbon Summary (Primary Structure Only)

Project Name:	2709 Jalmia Drive	Engineer:	KF/PT (LCA by JH)
Project Number:	20185	Date:	1/24/2025

Project Information

Architect:	MR	Phase:	Construction Documents	LCA Stages:	A1-A3
Floor Area:	5,920 SF	Gross Area:	8,188 SF	Location:	Los Angeles, CA

Summary: 2-story Single family residence with 2,250 sf basement consisting of a light framed wood floor and roof and wood sheated shear walls.

LCA Results

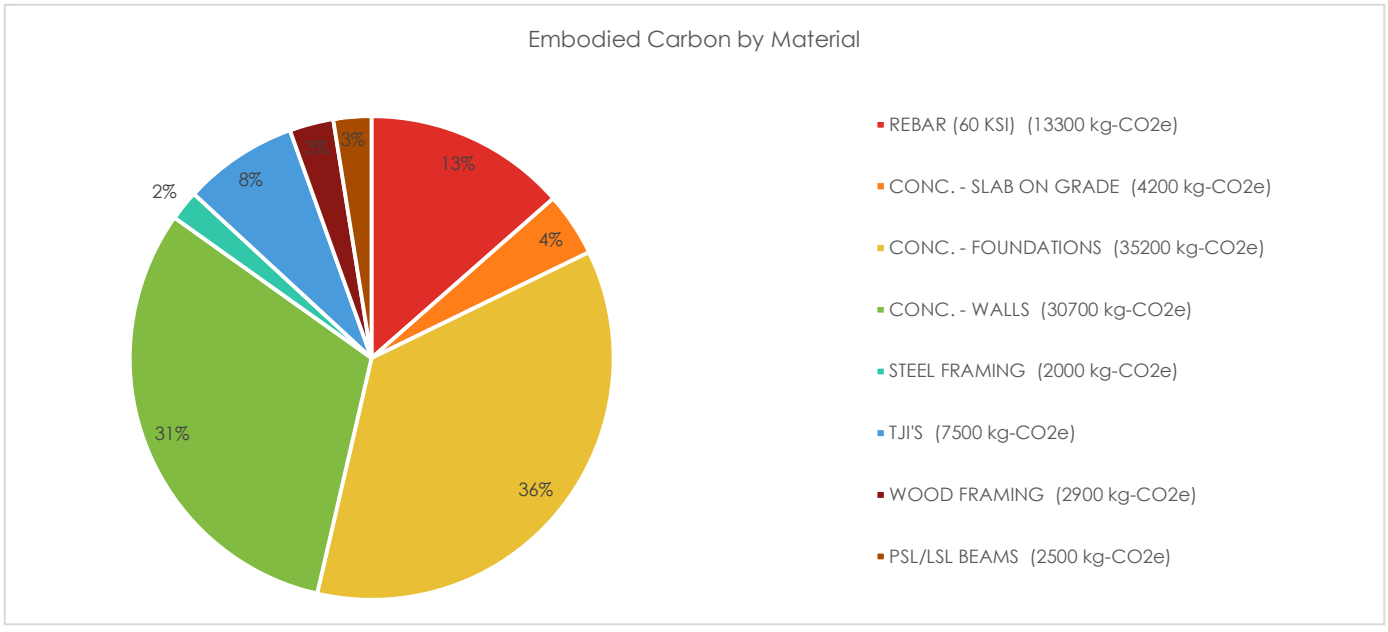
Embodied Carbon By Material:

REBAR (60 KSI)	13300 kg-CO2e
CONC. - SLAB ON GRADE	4200 kg-CO2e
CONC. - FOUNDATIONS	35200 kg-CO2e
CONC. - WALLS	30700 kg-CO2e
STEEL FRAMING	2000 kg-CO2e
TJI'S	7500 kg-CO2e
WOOD FRAMING	2900 kg-CO2e
PSL/LVL BEAMS	2500 kg-CO2e
PLYWOOD/OSB	3500 kg-CO2e
TOTAL	**98300 kg-CO2e**

Embodied by Masterspec Division:

03 30 00 CIP CONC.	70100 kg-CO2e
03 21 00 REBAR	13300 kg-CO2e
05 12 00 Steel Framing	2000 kg-CO2e
06 17 33 Wood I-Joists	7500 kg-CO2e
06 11 00 Wood Framing	2900 kg-CO2e
06 17 00 PSL/LVL'S	2500 kg-CO2e
06 16 00 SHEATHING	3500 kg-CO2e

GWP Intensity **129.2 kg-CO2e/m2**



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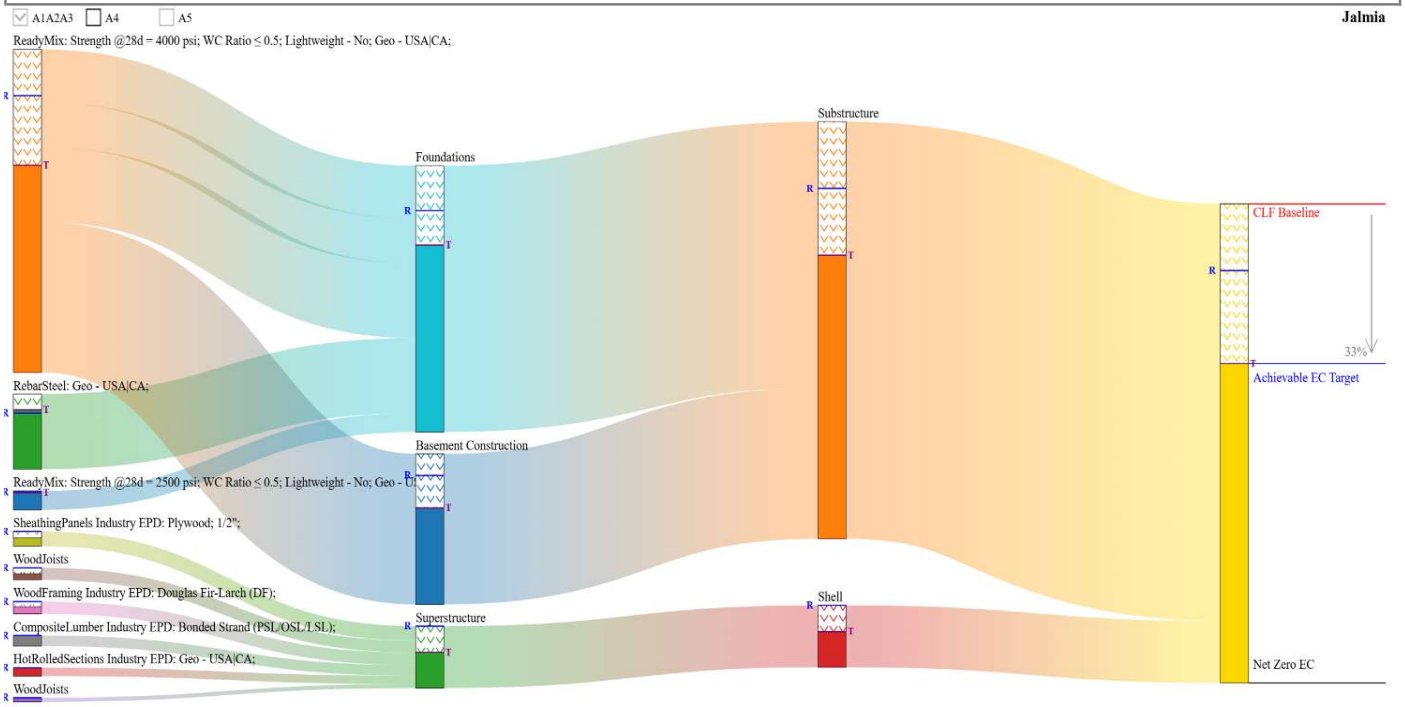

Appendix B – Comparison Study of GFA vs. Total Occupiable Area on GWP Intensity

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Date: 3/30/2025

Comparison study of GFA vs. total occupiable area on GWP Intensity

PROJECT	GFA (PER IBC)	TOTAL OCCUPIABLE AREA (FLOOR & ROOF)	GWP	INTENSITY (PER GFA)	INTENSITY (PER TOTAL OCC. AREA)	PERCENT PENALTY
[UNIT]	SQUARE FEET	SQUARE FEET	kg-CO2e	kg-CO2e/m^2	kg-CO2e/m^2	%
20TH ST	82622 SF	114790 SF	1720000	224.1	161.3	38.9%
MANHATTAN	78571 SF	104143 SF	1800000	246.6	186.0	32.5%
MISSION	45606 SF	50858 SF	560600	132.3	118.6	11.5%

Purpose of Study:
To investigate the relationship between using GFA vs the area of occupiable floor and roof to calculate embodied carbon intensity for multi-family projects. Unoccupied roof area is excluded from both methods.

Building Summary:
The three above projects are all multi-family projects, and they all contain a significant portion of usable area that is part of the above grade structure but outside the perimeter of the exterior walls. Some of this area is for balconies, other is for corridors that are outside the building envelope, and some of the area is for occupied roof decks. Here is a quick summary for each project:
20th Street - Santa Monica, CA. 5 over 2 plus 1 level below grade. Most of the roof surface is accessible roof deck. All the corridors for the type III light framed wood structure are outside the building envelope.
Manhattan - Los Angeles, CA. 5 over 2 plus 1 level below grade. The entire roof deck is accessible.
Mission - San Francisco, CA. 8-story w/ 7" PT flat plate. Part of the roof is accessible, some of the unit have balconies.

Analysis:
The amount of usable floor area that is outside the building envelope can have a significant impact on the embodied carbon intensity. For 20th Street, if the entire usable floor plate is used, the carbon intensity is reduced by 28%. Or the GFA method results in a 39% penalty. Manhattan saw a 32.5% penalty and Mission saw a 11.5% penalty.

Conclusion
Is GFA the best area to use to determine the carbon intensity? Or could using the accessible floor and roof area be a better area to use?

GFA is a good metric as it is a code defined term that is likely easily available for all projects.

However, GFA does not count all the area of structure that is usable to the project. For example, on the 20th Street project is was a decision by the architect to not enclose the corridors. The architect also wanted to provide outdoor spaces for the occupants through a number of accessible roof decks. In particular, the corridors could have easily been located indoors by shifting the exterior wall line. If this was done, the carbon intensity would go down because the GFA, which is in the denominator, would increase. However, moving the corridors to interior space would actually be worse from an environmental standpoint as it would create additional space the would need to be conditioned. So it would look like an enclosed corridor structure is more environmentally friendly, when it is a worse configuration.
The same is true of the roof decks, in particular above the concrete podium. These could have easily been covered with a light framed roof to create an enclosed amenity space, which would have minimal added embodied carbon relative to the concrete podium slab below. But with the increased GFA the enclosed amenity space alternative would appear to have a lower embodied carbon intensity vs the open air roof deck, while again it is adding to the volume of conditioned space and actually resulting in a structure that will result in increased carbon emissions.

From this limited study, it seems that the IBC defined GFA might not be the best floor area to use to determine the carbon intensity.