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EMBODIED CARBON ACTION PLAN 2026

SEI
ASCE
STRUCTURAL ENGINEERING INSTITUTE

SE2050
COMMITTING TO NET ZERO

ABOUT US

Established in 2021, Blue Nest is a fresh and growing venture backed by a decade of expertise in structural solutions on projects ranging from stacked shipping containers for a local art gallery to alterations of an existing administration building at the University of Richmond. We have experience across most building sectors with a penchant for structures with uncommon functions, irregular forms or atypical materials.

We work with people bringing new life to the built environment through vertical structures, particularly buildings and innovative projects in terms of their end use or structural design. These people include owners, architects and institutions such as universities and local governments.

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Our Commitment to SE 2050

As a firm, we are dedicated to positively impacting our community and we see sustainability as a key aspect of that positive impact. As part of the teams creating the next generation of buildings, we know we have a responsibility to our clients, their neighbors and future users of these structures. We honor this responsibility by designing enduring buildings that use materials responsibly. Through flexible designs that accommodate future uses, careful detailing to prevent deterioration and the specification of environmentally conscience materials, we are able to bring these ideals to life.

To deepen our commitment to environmental stewardship, we aim to establish a robust framework for tracking and reporting embodied carbon goals. By doing so, we will not only measure the effectiveness of our current initiatives but also identify opportunities for improvement and innovation. Our commitment to the SE2050 program underscores our dedication to reducing embodied carbon in the built environment and our resolve to lead by example in creating a more sustainable future.

Blue Nest Structural Team

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Project Engineer, P.E.

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Embodied Carbon Champion

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Engineer

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EIT

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Elective Documentation Included in the ECAP

Education	a. Included a narrative of how the Embodied Carbon Reduction Champion will engage embodied carbon reduction b. Attended one webinar focused on embodied carbon for structural engineers. c. Incorporated embodied carbon education in our onboarding process for all new employees. d. Created an embodied carbon digital resource in MS Teams to create, share and discuss Embodied Carbon educational resources.
Reporting	a. Submitted two projects per U.S. office with structural engineering services to the SE 2050 Database. b. Included all structural material quantities in our submissions to the SE2050 database.
Reduction	a. Established firm-wide reduction targets in the short-term (<1 year) and long-term (>5 years) b. Incorporated sustainable harvested biogenic materials in two projects. c. Updated our specifications to incorporate embodied carbon performance.
Advocacy	a. Defined ways in which the design team can collaborate to reduce embodied carbon b. Publicly declared firm as a member of the SE 2050 Commitment on our website, LinkedIn, or other social media).

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Education

Continuing Education

a. We trained all the members of Blue Nest Structural on the core concepts and skills required to measure, reduce, and report embodied carbon.

b. We plan to continue attending webinars and seminars hosted by different organizations such Carbon Leadership Forum, SEAMASS, among others to learn about how we can contribute to embodied carbon reduction.

Digital Resource

We created an Embodied Carbon digital resource Microsoft teams for staff to create, share, and discuss Embodied Carbon educational resources.

Research

Our Embodied Carbon Reduction Champion engaged in research about improving general notes and specification for construction documents and continued analysis of embodied carbon base levels for different types of new building including steel, wood and masonry as well as existing buildings.

Engagement

We attended “Tall Mass Timber Design Seminar & CoStar Building Tour” hosted by Woodworks.org and seminar on “Measuring Embodied Carbon for Structures” hosted by SEAMASS. These events helped the engineers at Blue Nest Structural to gain profound knowledge of different materials and how to optimize material specifications in structural documents to reduce embodied carbon

Reporting

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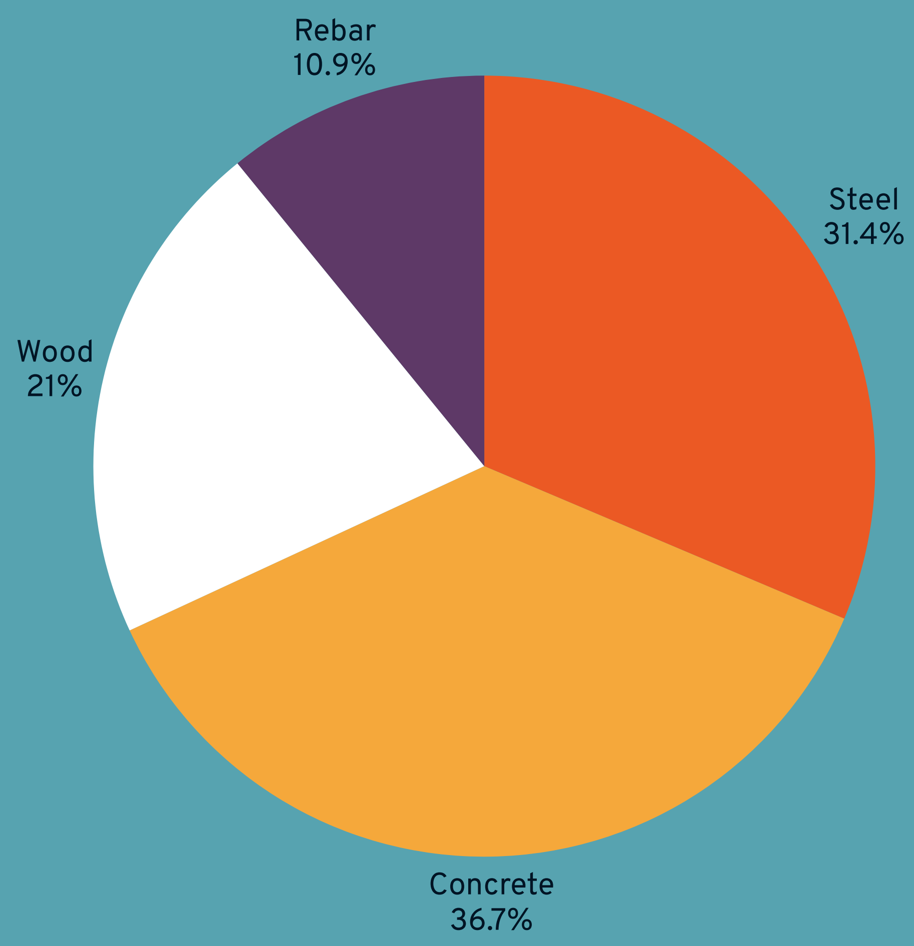
Blue Nest Structural is submitting life-assessment data from two projects for SE2050 commitment. First project is a 3-story commercial office/residential building made up of wood and steel. Another project is a 1- story Child Care center made up of mainly wood. These projects have been selected based on their economic value and size.

Methodology	We requested stakeholder such as contractors to provide product specific environmental product declarations (EPDs). We aim to track as many product specific EPDs as possible which would help us accurately quantify the embodied carbon for the projects that have been completed.
Life-cycle assessment	We used Athena Impact estimator and Beacon to calculate embodied carbon from different structural materials used in the project. We found Athena Impact estimator very useful for conducting life-cycle assessment during the schematic design phase and assess impact of different materials in the overall structural design. Beacon on the other hand provided accurate results for embodied carbon based on the Revit model prepared for the project. Both software had its pros and cons.
Scope	The scope of our data is limited to A1-A3 i.e. product stage.

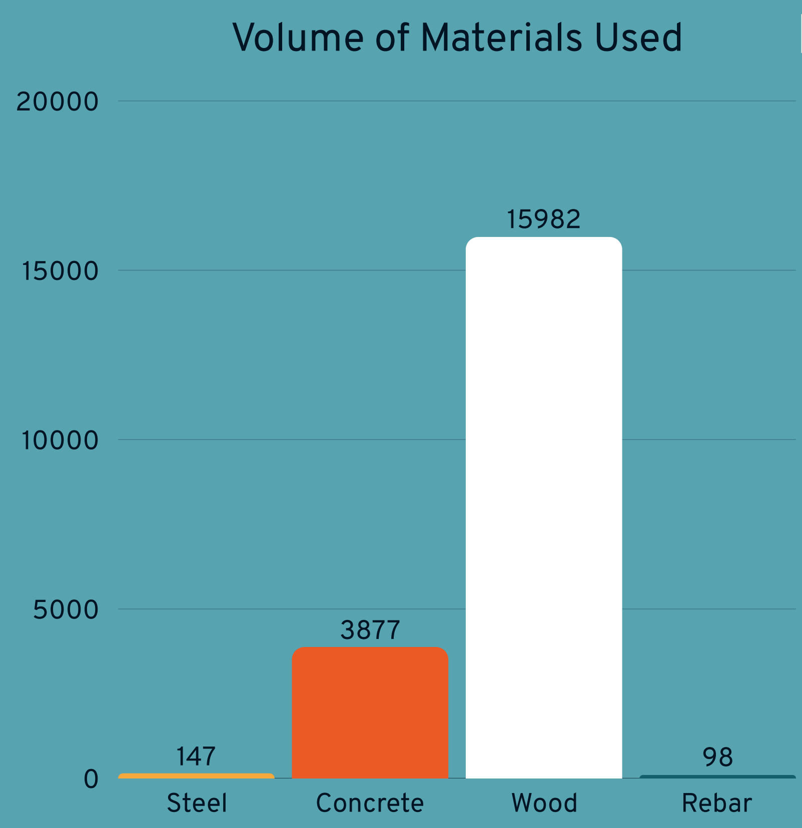
Case Study 1: Granite

We designed a new 3-story commercial building with an approximately 17,015 square foot area for office and residential space. The building is constructed of steel beams and columns with cross laminated timber as floor and roof decking. The exterior walls was designed with a combination of store front and 6-inch cold formed steel bypass studs. The foundation walls was composed of 8-inch CMU and we used reinforced concrete spread foundations that occur below the walls and the columns. This is the first project in the year 2025, in which we utilized wood products with biogenic carbon. During Design Development phase we used Athena Impact Estimator to calculate green house emission and embodied carbon for an assess the impact of use of different materials. Our initial analysis indicated that total embodied carbon from different structural members was 182,287 kg CO_2 eq.

% of Embodied Carbon from different materials



On the other hand, after preparing the construction documents, we reanalyzed embodied carbon from this project using Beacon. Based on the life cycle analysis in Beacon, the building has an estimated 77 kg CO_2/m^2 (15.8 Lb. CO_2/ft^2) of embodied carbon which falls under the benchmark of low-carbon buildings. If we look at the pie chart and bar chart, although we used 15,982 cubic feet of wood products, it responsible for only 21% of total embodied carbon. While even if concrete and steel volumes are lower, it accounts for 68% of total embodied carbon in this project. Overall, beacon analysis indicated that the total embodied carbon from different structural members was 156,315 Kg CO_2 eq.



Lessons Learned

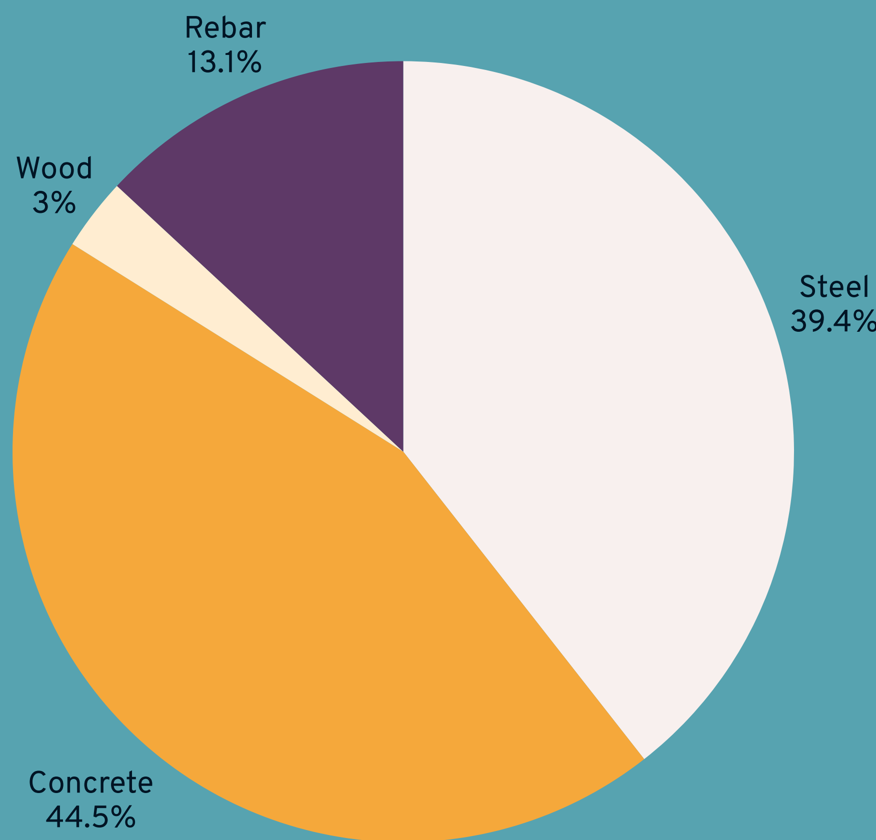
In this project, there were several lessons learned from sustainability perspective. A few lessons includes:

- By analyzing embodied carbon at an early design stage, it helped us become more aware of the structural materials with the most significant environmental impact and reveal the disproportionate impact of certain materials relative to their volumetric quantity on a project.
- We evaluated an entirely mass timber scheme as well as a hybrid steel and mass timber system. Due to an overall height limitation imposed by the sites zoning and the desire to provide a high end product with high ceilings, the hybrid system that allowed for shallower member sizes was chosen.
- A significant driver of the embodied carbon was the lateral system and the space plan of the building. To maximize natural light, openness, and the site constraints the majority of the lateral loads were resisted by CLT shear walls at the stair, elevator and mechanical core along one edge of the building. This eccentric concentration of the lateral restraint resulted in torsion and a less efficient system. In addition, exposed CLT shear walls were a key element of the architectural design and it was critical the panel wasn't bandaged with steel straps and plates between panels and at each floor level. In order to achieve this we had to take a significant reduction in the response modification coefficient, R, which resulted in seismic controlling the lateral design instead of wind, and increased the mat foundation size below the elevator and stair core.
- The CLT wood species played a significant role in the owners desired aesthetic and created both structural and environmental design impacts. Finish selection typically occurs later in a project, but we learned for CLT projects it needs to occur early. A switch from southern pine to spruce pine fur floor panels late in the project resulted in a thicker floor system. Due to the specific gravity of the species the weights were comparable, but the panels had to be shipped to Virginia from Montana instead of Alabama, tripling the distance they had to travel.

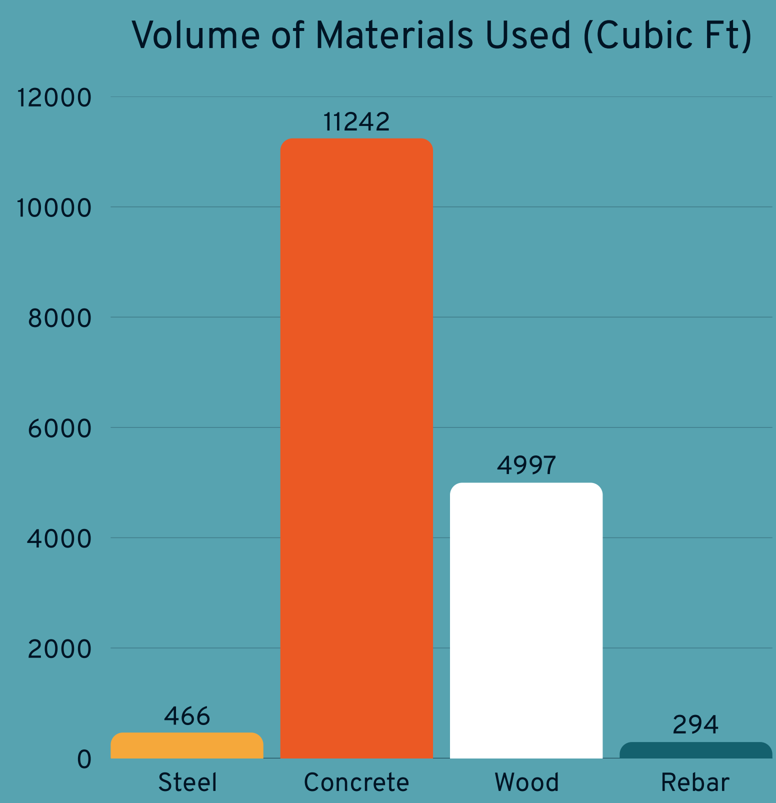
CASE STUDY 2: CIT CHILD CARE CENTER

We designed a new 1-story commercial building with an approximately 76,000 square foot area for Chickahominy Indian Tribe (CIT). This building will serve as an education center/child care center in Virginia. The building is constructed of hybrid roof framing including parallel chord wood trusses, traditional wood trusses and glulam beams supported on wood bearing walls, steel columns and glulam posts . The roof finish included a mix of OSB wood sheathing and Tectum E-panel deck. The foundation was designed as shallow foundation with CMU walls. This is the second project in the year 2025, in which we utilized wood project with biogenic carbon. During Schematic Design phase we used Athena Impact Estimator to calculate green house emission and embodied carbon for an assess the impact of use of different materials. Our initial analysis indicated that total embodied carbon from different structural members was 129,116 kg CO_2 eq.

% of Embodied Carbon from different materials



On the other hand, after preparing the construction documents, we reanalyzed embodied carbon from this project using Beacon. Based on the life cycle analysis in Beacon, the building has an estimated 252 kg CO_2/m^2 (51.6 Lb. CO_2/ft^2) of embodied carbon which falls under the benchmark of low-carbon buildings. If we look at the pie chart and bar chart, although we used 4,997 cubic feet of wood, it responsible for only 3% of total embodied carbon. While concrete and steel accounts for 85% of total embodied carbon in this project. The results clearly showed the value of using biogenic carbon wood products in structural engineering.



Lessons Learned

Like every other projects, there were several lessons learned from sustainability perspective in this project. A few lessons includes:

- By analyzing embodied carbon at an early stage of design, it helped us become more aware of environmental impact of materials used in structural members of the building.
- Although we aimed to use glulam beams throughout the building to reduce the carbon footprint of the structural members, there were limitations in terms of cost and engineering feasibility.
- Our design team learned how to design glulam beam and posts, and Tectum panels to resist gravity and lateral loads. We believe that this knowledge is transferable to our future projects.
- Although tectum E-panel wood deck had sustainability benefits, it was highly prone to damages from moisture. As a result, it was not used in outdoor spaces like porch to avoid potential structural failures.
- Life cycle analysis in Athena helped us understand the overall life cycle impact of materials being used in the building in Schematic Design (SD) phase. Since we didn't have any Revit Model during this phase, Athena was a reliable and affordable option to get accurate results for SD phase. However, one of the limitations of modelling different structural components in Athena was that it was tedious and time consuming.

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Reduction Strategies

Short-Term Strategies

- Create a baseline from different projects to measure year-to-year progress and identify where reductions are realistically achievable.
- Use LCA tools such as Athena to compare structural options during schematic design of large scale projects to identify most suitable sustainable products.
- Integrate embodied carbon data in general notes to inform owners and stakeholders about the sustainability metrics of structural drawings.

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Long-Term Strategies

1. Create a low-carbon material specification library by developing standard low-carbon steel, timber, and concrete specifications based on regionally available products

2. Standardize embodied carbon analysis across all large scale projects at schematic design and final construction documentation phase. Track year-to-year change in low carbon material utilization.

3. Work with structural material suppliers from Richmond and other cities in Virginia to request for Environmental Product Declarations (EPDs) for concrete, steel, masonry and timber products.

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Advocacy/Knowledge Sharing Narrative

1

Social Media Platforms: We aim to continue sharing educational content about sustainability efforts related to reducing embodied carbon, adaptive reuse of buildings and regenerative design in our Website, Instagram and LinkedIn.

2

Collaboration: We aim to continue collaborating with suppliers, architects or contractors to identify opportunities for low carbon specifications and material procurement.

3

Client Engagement: We also aim to continue to discuss with clients the importance of product-specific EPD's in an effort to make embodied carbon reduction part of the project scope

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Lessons Learned

Last year, as a firm committed to SE 2050, we set out to achieve five short-term goals. Some of these goals were successfully met, while progress continues on the others. Our first goal was to research sustainable materials and revise our specifications based on material availability. As a result, we incorporated sustainably harvested, biogenic materials such as glulam and cross-laminated timber into two large-scale commercial projects. After gaining in-depth knowledge of these products through seminars, webinars, and discussions with material suppliers, we were able to design structural members more effectively and significantly reduced the embodied carbon of the buildings.

Our second goal was to use additional embodied-carbon analysis tools during the design phase. Initially, we used Beacon to calculate the embodied carbon of our designs. However, one of its limitations is that it cannot be used during the schematic design phase to evaluate structural material options and their environmental impacts. Since Beacon was dependent on completed Revit model, we needed to use an independent software where we can analyze embodied carbon by feeding information about the building to the software. So, we used Athena Impact estimator, which made it easier to analyze embodied carbon for different materials in the schematic design phase. It provided us with comprehensive results and diagrams which helped us chose structural materials wisely.

Another goal we achieved was that we implemented building reuse and preserved existing structures through retrofits and adaptive reuse over demolition in more than 20 projects. From transforming barn structure to wedding venue and old church to a hybrid residential and office space, we analyzed reusability of existing structural members of the building to reduce use of new structural materials and achieve circular economy in our design. On the other hand, we are still making progress on collaborating with architects and owners who value sustainability principles through different networking events, seminars and CLF events.

While celebrating achievements, we recognize ongoing challenges and reiterate our enduring commitment to SE2050 net zero carbon efforts. We aim to engage stakeholders to align with our sustainability goals as early as possible to ensure better collaboration. Strategic collaborations with key partners will expand our reach and collective influence, contributing to the overall success in advancing reduction in embodied carbon.