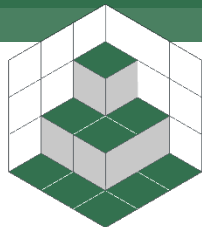


EARLY DESIGN-PHASE EMBODIED CARBON REDUCTIONS

Guidance on an approach for early design-phase global warming potential estimates, using EPDs, to reduce the embodied carbon of buildings.

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INTRODUCTION

The building industry accounts for approximately 42% of annual greenhouse gas emissions, 15% of which come from embodied carbon associated with building materials through their raw material extraction, production, manufacturing, transportation, installation, use, and end-of-life scenarios.¹ With design teams' deep understanding of various systems and materials and how they interact with each other, designers have an opportunity to enact positive change by reducing the embodied carbon of the built environment. Performing embodied carbon estimates of the primary building system and components during the *conceptual* or *schematic* design phases allows for carbon to be part of the design considerations, when major decisions and material selections are made.

Early embodied carbon estimates and Whole Building Life Cycle Assessments (WBLCAs) serve different purposes at different stages of design. Early estimates are conducted during conceptual or schematic phases, when design and supplier information is limited, relying on typical assemblies, approximate material quantities, and generic or industry average data covering impacts from raw material extraction through product manufacturing. They provide preliminary insight into major material and system choices and help identify hot spots (high embodied carbon intensity systems, components, or materials) and reduction opportunities, but they do not capture the total embodied carbon of the as-built building. WBLCA, by contrast, is typically performed once designs are more complete, using comprehensive databases and detailed material and product quantities across all life cycle stages, which enables more accurate accounting, benchmarking, and decisions at the product and component level, though its usefulness early in design is limited by information availability, time, and cost.

Early estimates can also be used to baseline individual systems, such as foundations, enclosures, or floor

assemblies, by calculating carbon intensity (embodied carbon per system, area, or material volume) and setting reduction targets to track as design advances. They are often used to compare design options, for example a building with or without below-grade construction, or alternative transfer podium-slab strategies. For any such comparison, it is important to use a consistent methodology (material scope, system boundary, level of detail) and to ensure each option is functionally equivalent, meaning design criteria, load criteria, and performance requirements (e.g., deflection, acoustic performance, fire resistance rating, vibration performance) and spatial requirements are held constant.²

The ASCE Prestandard for Assessing the Embodied Carbon of Structural Systems for Buildings sets forth three tiers of embodied carbon assessment depending on the goal of the project, with varying levels of specificity and data requirements.³

- **Tier 1:** A simplified, cradle-to-gate assessment of a structural system's embodied carbon, used to inform early-stage decisions.
- **Tier 2:** An intermediate assessment quantifying upfront embodied carbon emissions, used to guide reduction efforts.
- **Tier 3:** A detailed, full lifecycle quantification of embodied emissions, used for green building certification or climate disclosure reporting.

Details of data requirements and scopes associated with each assessment tier are included in the appendix: component category inclusion requirements (Figure A-1), minimum acceptable material quantity data sources (Figure A-2), LCA stages and biogenic carbon inclusion scope (Figure A-3), minimum acceptable carbon data sources (Figure A-4), and acceptable data sources for modules A4 and A5 (Figure A-5).

¹ Architecture 2030. (n.d.). *Architecture 2030 challenge*. Retrieved from <http://www.architecture2030.org>

² <https://www.woodworks.org/resources/developing-a-functionally-equivalent-design-for-comparative-wblca/>

³ ASCE Prestandard: <https://ascelibrary.org/doi/book/10.1061/9780784486399>

DATA FOR EARLY CARBON ESTIMATES

It is recommended for early embodied carbon estimates to use Type III Environmental Product Declarations (EPDs), which report the Life Cycle Assessment (LCA) results of a material or product.⁴ EPDs are governed by product category rules (PCRs), which define the scope, methodology, and reporting requirements to create an EPD for a particular product type.⁵ PCRs vary across different material and product types, and EPDs that are developed using different PCRs should not be directly compared per ISO 21930.⁶ EPDs are currently the most accessible source of environmental impacts for materials and products. Most EPDs report Production Stage (A1-A3) impacts, known as cradle-to-gate, and do not consider the Construction Stage (A4-A5), Use Stage (B1-B7), and End-of-Life Stage (C1-C4), as depicted in Figure 1.⁷

While EPDs report a variety of environmental impacts, including global warming potential (GWP), acidification potential, ozone depletion, eutrophication potential, smog formation potential, and energy demand, early embodied carbon assessments are primarily focused on understanding the GWP of the design. GWP is a measure of how much heat greenhouse gases (GHGs)

trap in the atmosphere compared to carbon dioxide (CO₂) over a specified period (often 100 years, commonly referred to as GWP₁₀₀). It is the standard measurement for embodied carbon in units of kilograms of carbon dioxide equivalent (kgCO₂eq).⁸

The cradle-to-gate (A1-A3) GWP value reported in an EPD will be referred to as an Embodied Carbon Factor (ECF) throughout this article. ECF is reported in units of kilograms of carbon dioxide equivalent (kgCO₂eq) per declared unit. The declared unit is a defined physical quantity of the product, such as volume, surface area, or weight, and is explicitly defined within an EPD (e.g. NRMCA Rocky Mountain Regional Average 4000psi concrete has an ECF of 301 kgCO₂eq/m³).

EPDs can reflect various levels of product specificity; they can be product-, plant-, or manufacturer-specific or represent regional and/or industry averages. For early embodied carbon estimates, regional- and/or industry-average EPDs are typically used, however product- or manufacturer-specific EPDs should be used if the specific product is known at the time of analysis, or average data is unavailable.

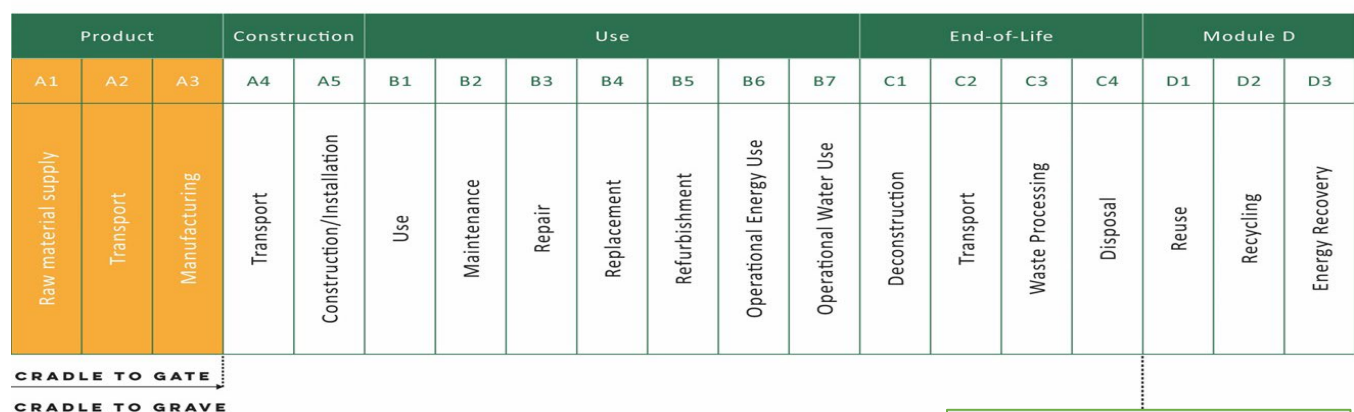


Figure 1: LCA Life Cycle Stages

⁴ Type III EPD established based on ISO 14025:2006 - *Environmental labels and declarations - Type III environmental declarations - Principles and procedures*.

⁵ <https://transparencycatalog.com/na-pcr-catalog-building-products>.

⁶ ISO 21930:2017 International Organization for Standardization. (2017). *ISO 21930:2017 - Sustainability in buildings and civil engineering works - Core rules for*

environmental product declarations of construction products and services.

⁷ Life cycle stages are described in the article Introduction to Whole Building Life Cycle Assessment: The Basics: <https://www.woodworks.org/resources/introduction-to-whole-building-life-cycle-assessment-the-basics/>.

⁸ <https://www.epa.gov/ghgemissions/understanding-global-warming-potentials>.

BIOGENIC CARBON

When performing an early embodied carbon assessment that includes bio-based materials, such as wood products, it is imperative to understand biogenic carbon; the carbon sequestered by all biological materials during their lifetime.⁹ As shown in Figure 2, wood consists of approximately 50% elemental carbon by dry mass.¹⁰ In the case of wood products, carbon is stored in the wood fibers throughout the life of the product, thereby keeping the carbon out of the atmosphere until it reaches an end of life stage that releases the carbon. At the end of the building's life, the carbon stored in the wood products is either partially emitted via decomposition in a landfill, completely emitted through incineration, and/or exported to another product or building via recycling or reuse where the carbon will continue to be stored until the product is landfilled or incinerated.¹¹



Figure 2:
*Wood carbon
content by mass.*

It is important to quantify both the *biogenic carbon content* stored in the wood products of the building, and the amount of biogenic carbon anticipated to be released beyond the lifetime of the building. The biogenic carbon entering an LCA system at the beginning of a product's life and the subsequent

emissions out of the system at the end of product life are commonly referred to as *biogenic carbon flows*. Accounting for both *biogenic carbon content* and *biogenic carbon flows* encourages designing for long-life, adaptability, and deconstructability.

Although North American wood product EPDs are generally cradle-to-gate (A1-A3), they typically report *biogenic carbon flows* throughout the full cradle-to-grave life cycle to (conservatively) account for end-of-life effects per ISO 21930 and their governing PCRs.¹² For transparency, *biogenic carbon flows* are reported separately from fossil-based GWP emissions (GWP associated with burning fossil fuels). The amount of *biogenic carbon content* of a product is the total amount of biogenic carbon stored at the beginning of the product's life, which is reported in modules A1-A3. This value is equal and opposite to the assumed biogenic carbon emission out of a product at its end of life, reported in modules C3/C4.¹³ Assumed biogenic emissions out of a product is also sometimes reported in stage A3, balancing out the biogenic emissions stored in stage A1, as a way to account for biogenic flows in a cradle-to-gate EPD. This method is often referred to as “-1/+1”; the biogenic carbon is subtracted from a product's initial A1 GWP, as the material is acting as a carbon sink, then added back in an equal part under the assumption that all biogenic carbon is released through decomposition or incineration at the end of the product's useful life. Refer to the ASCE Prestandard for Assessing the Embodied Carbon of Structural Systems for Buildings, Chapter 4.6.2 for a detailed description of *biogenic carbon content* and *biogenic carbon flows*, and a method on how to calculate its impact on building GWP.

⁹ For a discussion on the inclusion of biogenic carbon in LCAs, see the article When to Include Biogenic Carbon in an LCA: <https://www.woodworks.org/resources/when-to-include-biogenic-carbon-in-an-lca/>

¹⁰ Dovetail Partners, Inc (2013). Carbon in Wood Products – The Basics

¹¹ How to Include Biogenic Carbon in an LCA: <https://www.woodworks.org/resources/how-to-include-biogenic-carbon-in-an-lca/>.

¹² ISO 21930: [ISO 21930:2017 - Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services](https://www.iso.org/standard/68542.html)

¹³ Understanding the Carbon Numbers in a Wood EPD: <https://www.woodworks.org/resources/understanding-the-carbon-numbers-in-a-wood-epd/>

CALCULATING EARLY EMBODIED CARBON

To perform embodied carbon estimates, online tools, including Building Transparency's EC3 tool, SE2050's ECOM tool, and WoodWorks' Carbon Calculator, or simple tabulations using Excel spreadsheets can be used.¹⁴

Because there is no code or standard for performing an embodied carbon estimate, it is recommended to follow the standards that exist for LCAs and WBLCAs as guidance. These standards include ISO 14040, 14044, 14025, and 21930 and guidance documents such as the ASCE Prestandard for Assessing the Embodied Carbon of Structural Systems for Buildings (see appendix). In general, LCAs have 4 phases: goal and scope definition, inventory analysis, impact assessment, and interpretation.¹⁵ Goal definition is critical, as this will inform the purpose of the assessment, appropriate scope, and level of detail. The goal will also help define the scope of functional equivalency for the purpose of comparison.

A general step-by-step process to perform an embodied carbon estimate is described here:

1. Goal & Scope Definition

- a. Define the goal of the assessment.
- b. Define the material scope and system boundary of the assessment.

2. Inventory Analysis

- a. Compile material quantities (consider functional equivalency if the assessment is comparative).
- b. Compile appropriate EPDs.
- c. Record the declared units, embodied carbon factors (ECF), and embodied carbon biogenic carbon factors (ECF_{bio}) from EPDs.

3. Impact Assessment

- a. Calculate GWP of each material (GWP_M) and biogenic carbon content of each component (GWP_{bio}).
- b. Sum GWP_M of materials to calculate the system GWP (GWP_S) and GWP_{bio} to calculate the biogenic carbon stored in the building.

4. Interpretation

- a. Interpret the results.
- b. Confirm the goal is met and iterate as required.
- c. Inform design decisions to achieve embodied carbon reductions.

The following generic formulas are provided to illustrate the embodied carbon calculations. As noted above, biogenic carbon content can either be calculated using the biogenic carbon content (ECF_{bio}) from an EPD or estimated assuming approximately 50% elemental carbon per dry mass of the wood fibers.

¹⁴ Carbon Accounting Tools for Structural Systems: <https://www.woodworks.org/resources/calculating-the-embodied-carbon-of-different-structural-systems/>

¹⁵ Introduction to Whole Building Life Cycle Assessment: The Basics: <https://www.woodworks.org/resources/introduction-to-whole-building-life-cycle-assessment-the-basics/>



Embodied Carbon:

$$\text{Equation 1: } GWP_{M1} [kgCO_2eq] = ECF_1 [kgCO_2eq/m^3] * QTY [ft^3] * \text{Unit Conversion } [m^3/ft^3]$$

$$\text{Equation 2: } GWP_{S1} [kgCO_2eq] = GWP_{M1} [kgCO_2eq] + GWP_{M2} [kgCO_2eq] + GWP_{M3} [kgCO_2eq] [+ \text{etc.}]$$

GWP_{Mx} = Cradle-to-gate Global Warming Potential impact of Material x

ECF_x = Cradle-to-gate Embodied Carbon Factor cited from EPD for Material x (declared unit of m³ is used for example)

QTY = Designed Material Quantity cited from design professional (ft³ is used for example)

Unit Conversion = Declared unit/declared material unit (m³/ft³ is used for example)

GWP_{Sx} = Global Warming Potential impact of all materials in system x

Biogenic Carbon Content:

$$\text{Equation 3a: } GWP_{bio1} [kgCO_2] = ECF_{bio1} [kgCO_2/m^3] * QTY [ft^3] * \text{Unit Conversion } [m^3/ft^3]$$

$$\text{Equation 3b: } GWP_{bio1} [kgCO_2] = (-1) * C [kgC/kg] * M [kg] * (1 - MC [\%]/100) * 44/12 [kgCO_2/kgC]$$

GWP_{biox} = Biogenic carbon content of Material x

ECF_{biox} = Embodied Carbon Biogenic Carbon Factor cited from EPD for Material x (declared unit of m³ is used for example)

C = Biogenic carbon content per unit of biobased material (0.5 kgC/kg for harvested wood products)

M = Mass of biobased material within the assessment scope

MC = Moisture content of biobased material

WORKED EXAMPLE

A hypothetical structural system for a multistory residential building will be used to demonstrate the early embodied carbon estimate process.

1. Goal & Scope Definition

The goal of this study is to compare the embodied carbon impact of three different structural systems to identify the system with the lowest embodied carbon as well as reduction opportunities for each system, which include a post and beam mass timber system, cold-formed steel bearing wall system, and flat plate concrete system.

The material scope of the embodied carbon estimate includes only the primary structural components of a typical floor bay, i.e., beams, columns, bearing walls, and floor plates, as is shown in Figure 3. Structural connections and stud rails are excluded from the estimate because they are beyond the level of detail for early design. Additionally, their corresponding material quantities are small compared to the primary components. Although fire resistance, acoustic performance, aesthetics, and assembly depth are factors of functional equivalency and influence the structural design, this estimate focuses on structural materials only; architectural

components of these assemblies are excluded from the scope.

Schematic-level designs and resulting material quantities were determined from a structural narrative. Each system was designed using the same loading criteria, deflection performance, and vibration performance. Framing scheme, span lengths, and support locations were optimized for each system and therefore vary.

The LCA system boundary was determined to be cradle-to-gate (A1-A3), focusing on the manufacturing impacts of the systems and materials.

2. Inventory Analysis

EPDs for the materials represented in the three structural systems can be found in Figure 4. It is important to note there are two material instances where industry average EPDs were not used (gypcrete topping slab and CLT panel in the mass timber system). For both instances, no industry average EPDs were available at the time of the study; instead, representative manufacturer EPDs were selected.¹⁶

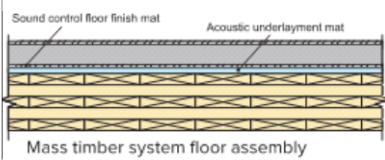
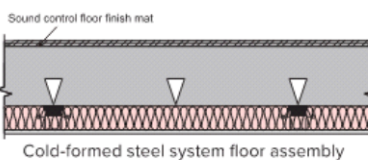
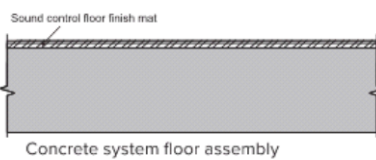
Structural System	Mass Timber	Steel	Concrete
Reference Floor Assembly	 Mass timber system floor assembly	 Cold-formed steel system floor assembly	 Concrete system floor assembly
Bay Size	18'x15' column grid	21' demising wall spacing x 1' tributary width	30'x25' column grid
Structural Components	6.9" CLT panel with 1 1/2" gypcrete topping slab and 0.42psf reinforcing (6x6-W2.9xW2.9)	2" metal deck with 3 1/2" concrete topping slab (5 1/2" total thicknesses) and 0.76psf reinforcing (#3@12"OC each way)	8" PT concrete slab with 3.25psf reinforcing (1.25psf post-tensioned tendons and 2psf reinforcing bar)
	8 3/4"x16 1/2" beams 14 1/4"x15" columns	6" cold formed steel studs @12"OC	24"x24" columns reinforced with 30plf reinforcing bar

Figure 3: Scope and design of the three different structural system

¹⁶ Steel system is a one-way spanning slab design, the width of the bay considered was 1 ft.

3. Impact Assessment

Figure 4 shows the calculations and results of the embodied carbon estimate, using the formulas provided above, for all three structural systems.

4. Interpretation

The mass timber structural system has the lowest GWP intensity of all three systems, with a 49% reduction compared to the steel system and a 63% reduction compared to the concrete system, excluding biogenic carbon content (Figure 5).

The mass timber structural system stores more than four times the amount of carbon it emits during manufacturing, offering a significant carbon sequestration benefit. This highlights the importance of planning for the building's end of life to ensure long-term carbon storage. Although the biogenic carbon remains stored throughout the building's service life and potentially beyond, its retention ultimately depends on how the building is dismantled or disposed of. To preserve these climate benefits, designers are encouraged to incorporate strategies for adaptability, deconstruction, and reuse.

This assessment shows carbon reduction opportunities which include selecting the lowest impact material system, focusing on hot spots, and specifying lower embodied carbon products within each material category. There also is an opportunity to coordinate with the design team on optimal structural layout or grids to realize material efficiencies. For instance, concrete makes up a significant portion of the GWP impact for all three systems; thus, it is a clear hot spot in each system and reduction strategies such as cement replacement with supplemental cementitious materials should be considered.

While there are limitations in these early carbon calculations, such as scope limitations (i.e. not including foundation systems, connections, fire protection, finishes) and system boundary limitations (i.e. not including transportation impacts, construction impacts, and end-of-life scenarios), they are incredibly useful to inform a project's direction and goals. By focusing on, and quantifying, embodied carbon at an early design stage, project teams can make more informed decisions that may significantly reduce the overall carbon footprint of the building.

Total System GWP with Material Contributions

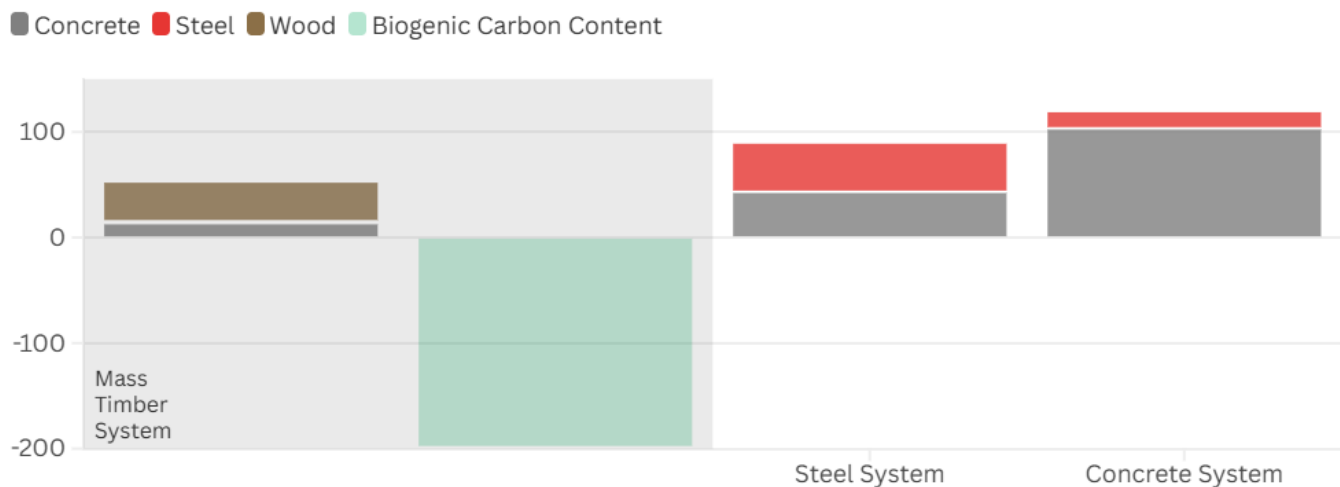


Figure 4: Total structural system GWP by material impact, including biogenic carbon content.

TEAM CARBON

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	Design			EPD				GWP _H (A1-A3)		GWP _S (A1-A3)	GWP _{bio}		Net System GWP
	Bay Size	Structural Material Description	Material Quantity	Name (Author)	Declared Unit	ECF _f (A1-A3)	ECF _{bio}	kgCO ₂ eq	kgCO ₂ eq/m ²	kgCO ₂ eq/m ²	kgCO ₂	kgCO ₂ /m ²	kgCO ₂ eq/m ²
						kgCO ₂ eq/Declared Unit	kgCO ₂ /Declared Unit						
Mass Timber	18'x15' = 270 ft ² (25.08 m ²)	1 1/2" thick gypcrete topping slab	33.75ft ² x 120pcf = 4050 lbs = 1837kg	USG Levelrock Brand 2500 Floor Underlayment (USG Corporation)	1000kg	185	--	340	13.6	51.8	--	--	-146
		6x6-W2.9xW2.9 welded wire fabric	270ft ² x 0.42psf = 113.4 lbs = 51.4kg	Steel Reinforcement Bar (Concrete Reinforcing Steel Institute)	1000kg	854	--	43.9	1.75		--	--	
		6.3" thick CLT deck	155.25ft ² = 4.40m ²	Smartlam CLT (Smartlam North America)	1m ³	178	-905	783	31.2		-3982	-159	
		8 3/4" x 16 1/2" Glulam beam, 1/2 beam on each end of bay, total (1) beam with 15' length	15.0ft ² = 0.42m ²	U.S Glue Laminated Timber (American Wood Council)	1m ³	154.43	-1141	64.9	2.59		-479	-19.1	
		14 1/2" x 15" Glulam column, 1/4 column on each end of each beam, total (1) column with 10' height	15.1ft ² = 0.43m ²	U.S Glue Laminated Timber (American Wood Council)	1m ³	154.43	-1141	66.4	2.65		-491	-19.6	
Steel	21'x1' = 21ft ² (1.95m ²)	2VL 22 ga metal deck	21ft ² x 1.56psf = 32.8lbs = 14.9kg	Steel Roof and Floor Deck (Steel Deck Institute)	1000kg	2320	--	34.6	17.7	88.8	--	--	88.8
		4000psi concrete deck, 5 1/2" total deck thickness, 4.5036" equivalent thickness concrete	7.88ft ² = 0.22m ²	Ready Mixed Concrete NRMCA 4000-00-FA/SL (National Ready Mixed Concrete Association)	1m ³	383.6	--	84.4	43.3		--	--	
		#3@12"OC each way reinforcing bar	21ft ² x 0.76psf = 15.96lbs = 7.2kg	Steel Reinforcement Bar (Concrete Reinforcing Steel Institute)	1000kg	854	--	6.15	3.15		--	--	
		CFS bearing wall, 600S250-97 studs @12"OC at each end of deck, total (1) stud with 10' height	39.8lbs = 18.1kg	Cold-formed Steel Framing (Steel Framing Industry Association)	1000kg	2650	--	48.0	24.6		--	--	
Concrete	30'x25' = 750 ft ² (69.68 m ²)	8" thick 5000psi concrete slab	500ft ² = 14.2m ²	Ready Mixed Concrete NRMCA 5000-00-FA/SL (National Ready Mixed Concrete Association)	1m ³	468.89	--	6660	95.6	119	--	--	119
		PT Tendons and Reinforcing bar in concrete slab, 3.25psf reinforcing 1.25psf PT and 2psf rebar	750ft ² x 3.25psf = 2437.5lbs = 1105.6kg	Steel Reinforcement Bar (Concrete Reinforcing Steel Institute)	1000kg	854	--	944	13.6		--	--	
		24"x24" 6000psi concrete columns, 1/4 column on each end of each beam, total (1) column with 10' height	40ft ² = 1.1m ²	Ready Mixed Concrete NRMCA 6000-00-FA/SL (National Ready Mixed Concrete Association)	1m ³	493.67	--	543	7.79		--	--	
		Reinforcing bar in concrete columns, 30plf rebar with 10' height	30plf x 10ft = 300lbs = 136.1kg	Steel Reinforcement Bar (Concrete Reinforcing Steel Institute)	1000kg	854	--	116	1.67		--	--	

Figure 5: Tabulated data and GWP calculations for all three structural systems assemblies.

CONCLUSION

Design teams, engineers, and consultants are encouraged to quantify the embodied carbon and biogenic carbon content of their designs as early as possible to have the greatest opportunity to pursue reductions. In the worked example above, the mass timber system achieved a 49% reduction in GWP relative to the cold-formed steel system and a 63% reduction relative to the concrete system, while storing more than four times the carbon it emitted

during manufacturing. These calculations, which are relatively simple to perform, can provide valuable insights to inform design decisions, material efficiencies, system and material selections, and carbon reduction strategies. The consultant is encouraged to begin early coordination of reduction strategies with the design and construction teams, which will influence the design, bid, and procurement process.

APPENDIX: ASCE PRESTANDARD TABLES

Table 3-1. Component Category Classification Scope by Assessment Tier.

Assessment Type	Primary	Accessory	Ancillary
Tier 1	Included	Optional	Optional
Tier 2	Included	Included	Optional
Tier 3	Included	Included	Included

Figure A-1: Component category inclusion requirements by assessment tier

Table 3-2. Minimum Acceptable Data Sources for Determining Material Quantities.

Assessment Type	Manual Approximation	Quantity Takeoff from Design Documentation	Contractor Submittals or Procurement Records
Tier 1	A	A	A
Tier 2	P	A	A
Tier 3*	N	P	A

Note: A = Allowed; P = Permitted at Tier 2 only for accessory and ancillary components where the information is not included in the documentation of the design. Permitted at Tier 3 only for accessory and ancillary components where Contractor Submittals or Procurement Records are not available or are incomplete; and N = Not allowed.

*See Table 3-1 for additional information on minimum scope requirements.

Figure A-2: Minimum acceptable material quantity data sources by assessment tier

Table 4-1. Required, Optional, and Excluded Life Cycle Stages and Biogenic Carbon Content for Each Assessment Tier.

Assessment Tier	Life Cycle Stages									Biogenic Carbon Content ^c
	Product Stage (A)			Use Stage (B)			End-of-Life Stage (C)		Module D ^b	
	A1–A3	A4	A5 ^a	B1	B2–B5	B6–B7	C1	C2–C4		
Tier 1	I	O	O	O	O	X	O	O	O	I
Tier 2	I	I	I	O	O	X	O	O	O	I
Tier 3	I	I	I	O	I	X	I	I	O	I

Note: I = Included; O = Optional to include; and X = Excluded.

^aModule A5 is divided into three submodules, each with specific requirements. Refer to Section 4.5.3.

^bModule D is considered optional at all Tiers.

^cBiogenic carbon content is calculated and tracked separately from the Life Cycle Stages. Refer to Section 4.6.2 for the treatment of biogenic carbon content and biogenic carbon flows.

Figure A-3: LCA stages and Biogenic Carbon inclusion scope by assessment tier



Table 4-2. Acceptable Sources of Carbon Data (Modules A1 to A3).

Tier	Global Secondary Data	Region-Specific Secondary Data	Industry-Average EPD, Industry-Wide EPD, or Third-Party Baselines	Region-Specific EPD, Region-Specific Benchmark, or EPD of Acceptable Proxy Material	Product-Specific EPD*
Tier 1	A	A	A	A	A
Tier 2	N	P	P	P	A
Tier 3	N	N	N	N	A

Note: A = Allowed; P = Permitted data source only when more accurate data sources are not available; and N = Not allowed.

*Product-specific refers to the confirmed product specified in Construction Documents. Supply chain-specific and Facility-specific EPDs are types of Product-specific EPDs that are always allowed due to their increased level of specificity.

Figure A- 4: Minimum acceptable carbon data sources by assessment tier

Table 4-3. Acceptable Sources of Carbon Data for Module A4 and Module A5.

Assessment Type	Project-Specific Estimation ^a	Contractor-Calculated ^b
Tier 1	A	A
Tier 2	A	A
Tier 3	N	A

Note: A = Allowed; P = Permitted data source when allowed data sources are not available; and N = Not allowed.

^aThe project-specific estimation should include a project-specific measurement multiplied by an industry-standard factor. In no instance shall a general amplification factor be applied to the A1 to A3 total. Project-specific considerations including region, material and construction methods should be considered in the estimation. Refer to Section 4.5 for additional information.

^bThe Contractor-Calculated approach shall include data measured and documented by the contractor during construction.

Figure A- 5: Acceptable data sources for modules A4 and A5