Material appendix to:

Fang, Demi, Peter Wang, Sophia V. Kuhn, Michael A. Kraus, and Caitlin Mueller. “Trans-Typology Design Space Exploration: Using Gradients to Inform Decision-Making in the Design of Spanning Structures.” In Proceedings of the International Association for Shell and Spatial Structures (IASS) Symposium. Zurich, Switzerland, 2024.

This table is an extension of Table 3 in the paper:

Material	Typology and elements	Embodied Carbon Coefficient (A1-A3) (originally reported units), [kg CO_2e/kg]		Material specific weight	Material strength and stiffness
		20^{th} percentile	80^{th} percentile		
Steel plate	Steel girder (primary system)	(~1550 kg CO_2e / metric ton), 1.55 kg CO_2e / kg	(~1650 kg CO_2e / metric ton), 1.65 kg CO_2e / kg	78.5 kN/m^3	$f_t = f_c$ = 36 kN/cm^2 f_y = 34.5 kN/cm^2 E = 20,000 kN/cm^2
Steel hot-rolled section	Steel girder (secondary system) Steel truss (secondary system)	(~650 kg CO_2e / metric ton), 0.650 kg CO_2e / kg	(~850 kg CO_2e / metric ton), 0.850 kg CO_2e / kg		
Steel hollow section	Steel truss (primary system)	(~1400 kg CO_2e / metric ton), 1.40 kg CO_2e / kg	(~1700 kg CO_2e / metric ton), 1.70 kg CO_2e / kg		
Glue-laminated timber	Pair of glulam girders (primary)	(~140 kg CO_2e / m^3), 0.275 kg CO_2e / kg	(~320 kg CO_2e / m^3), 0.628 kg CO_2e / kg	5 kN/m^3	f_t = 1.4 kN/cm^2 f_c = 2.1 kN/cm^2 $E_{parallel}$ = 1160 kN/cm^2
Softwood timber (ECCs of glulam used as a conservative estimate)	Pair of glulam girders (secondary) Timber truss (primary and secondary)	(~140 kg CO_2e / m^3), 0.392 kg CO_2e / kg	(~320 kg CO_2e / m^3), 0.897 kg CO_2e / kg	3.5 kN/m^3	f_t = 1.4 kN/cm^2 f_c = 1.6 kN/cm^2 $E_{parallel}$ = 700 kN/cm^2
Ready-mix concrete, 27.6 MPa (4000 psi) normal weight	Reinforced concrete barrel beam (partial by volume, see Table 2)	(291 kg CO_2e / m^3), 0.121 kg CO_2e / kg	(422 kg CO_2e / m^3), 0.176 kg CO_2e / kg	23.5 kN/m^3	f_t = 2.67 kN/cm^2 (only for simplified model used to calculate live load deflection) f_c = 2.67 kN/cm^2 E = 3500 kN/cm^2
Rebar, fabricated	Reinforced concrete barrel beam (partial by volume, see Table 2)	(739 kg CO_2e / metric ton), 0.739 kg CO_2e / kg	(925 kg CO_2e / metric ton), 0.925 kg CO_2e / kg	77.0 kN/m^3	f_y = 55.2 kN/cm^2

20^{th} and 80^{th} percentile embodied carbon coefficients (A1-A3) from: Carbon Leadership Forum, “2023 Carbon Leadership Forum: North American Material Baselines, Category Appendices v2,” Aug. 2023. [Online]. Available: https://carbonleadershipforum.org/clf-material-baselines-2023/

“~” indicates an approximation, where concluded that not enough EPDs were available to report a precise value at the percentile