MASS TIMBER SYSTEM STRUCTURAL MATERIAL QUANTITIES	
MATERIAL CATEGORY	**Sum of Mass Total (kg)**
Floors	**10,796,683**
CLT (Cross laminated timber)	502,556
Coated steel deck, SDI - EPD	1,392
Exterior grade plywood, US	1,911
Steel, concrete reinforcing steel, CMC - EPD	249,551
Steel, reinforcing rod	37,330
Structural concrete, 4001-5000 psi, 0-19% fly ash and/or slag	1,510,570
Structural concrete, 5001-6000 psi, 0-19% fly ash and/or slag	8,493,373
Structure	**8,384,360**
Contruction steel, light structural shapes, CMC - EPD	3,331
Glue laminated timber (Glulam), AWC - EPD	701,845
Hot rolled structural steel, AISC - EPD	4,137
Steel tube, Bull Moose Tube - EPD	25,888
Steel, concrete reinforcing steel, CMC - EPD	267,863
Steel, merchant bar, CMC - EPD	680
Structural concrete, 4001-5000 psi, 30-39% fly ash	21,936
Structural concrete, 5001-6000 psi, 30-39% fly ash	7,358,679
Walls	**2,602,521**
Concrete masonry unit (CMU), hollow-core	6,347
Mortar type S	639
Steel, concrete reinforcing steel, CMC - EPD	80,014
Structural concrete, 5001-6000 psi, 30-39% fly ash	2,508,490
Thickset mortar	6,854
Un-coated cold-formed steel framing products, ClarkDietrich - EPD	177
Grand Total	**21,783,564**

STEEL SYSTEM STRUCTURAL MATERIAL QUANTITIES	
MATERIAL CATEGORY	**Sum of Mass Total (kg)**
Floors	**11,958,486**
Coated steel deck, SDI - EPD	110468.9303
Exterior grade plywood, US	1910.623308
Steel, concrete reinforcing steel, CMC - EPD	249594.1888
Steel, reinforcing rod	37329.70682
Structural concrete, 4001-5000 psi, 0-19% fly ash and/or slag	33591.13543
Structural concrete, 5001-6000 psi, 0-19% fly ash and/or slag	11525591.74
Structure	**8,043,195**
Contruction steel, light structural shapes, CMC - EPD	24194.45281
Hot rolled structural steel, AISC - EPD	296210.9489
Steel tube, Bull Moose Tube - EPD	73880.0838
Steel, concrete reinforcing steel, CMC - EPD	267852.4644
Steel, merchant bar, CMC - EPD	695.1665009
Structural concrete, 4001-5000 psi, 30-39% fly ash	21936.28897
Structural concrete, 5001-6000 psi, 30-39% fly ash	7358425.73
Walls	**2,609,793**
Concrete masonry unit (CMU), hollow-core	6347.47926
Mortar type S	638.9389399
Steel, concrete reinforcing steel, CMC - EPD	80089.06994
Structural concrete, 5001-6000 psi, 30-39% fly ash	2515686.853
Thickset mortar	6854.182027
Un-coated cold-formed steel framing products, ClarkDietrich - EPD	176.5556376
Grand Total	**22,611,475**

CONCRETE SYSTEM STRUCTURAL MATERIAL QUANTITIES	
MATERIAL CATEGORY	**Sum of Mass Total (kg)**
Floors	**13,214,524**
Coated steel deck, SDI - EPD	1,278
Exterior grade plywood, US	1,914
Steel, concrete reinforcing steel, CMC - EPD	228,921
Steel, reinforcing rod	173,206
Structural concrete, 4001-5000 psi, 0-19% fly ash and/or slag	31,424
Structural concrete, 5001-6000 psi, 0-19% fly ash and/or slag	7,455,842
Structural concrete, 5001-6000 psi, 30-39% fly ash	5,321,938
Structure	**8,271,989**
Contruction steel, light structural shapes, CMC - EPD	3,292
Hot rolled structural steel, AISC - EPD	4,128
Steel tube, Bull Moose Tube - EPD	18,798
Steel, concrete reinforcing steel, CMC - EPD	306,410
Structural concrete, 4001-5000 psi, 30-39% fly ash	21,936
Structural concrete, 5001-6000 psi, 30-39% fly ash	7,917,424
Walls	**2,831,628**
Concrete masonry unit (CMU), hollow-core	6,347
Mortar type S	639
Steel, concrete reinforcing steel, CMC - EPD	85,440
Structural concrete, 5001-6000 psi, 30-39% fly ash	2,732,171
Thickset mortar	6,854
Un-coated cold-formed steel framing products, ClarkDietrich - EPD	176
Grand Total	**24,318,140**

ARCHITECTURAL ELEMENTS MATERIAL QUANTITIES	
MATERIAL CATEGORY	**Sum of Mass Total (kg)**
Ceilings	**24,768**
Acoustic ceiling tile (ACT), mineral fiber board	147
Glass wool unfaced batt, Knauf, EcoBatt - EPD	2,681
Softwood veneer	787
Suspended grid	31
Un-coated cold-formed steel framing products, ClarkDietrich - EPD	585
Wall board, gypsum, natural	20,537
Curtainwall Mullions	**13,055**
Aluminum extrusion, AEC - EPD	13,055
Curtainwall Panels	**43,025**
Glazing, double, insulated (air)	26,666
Spandrel, glass, insulated (1 core)	16,358
Roofs	**43,393**
Fiberglass mat gypsum sheathing board	27,405
Softwood veneer	682
TPO membrane, 60 mils, SPRI - EPD	4,758
Un-coated cold-formed steel framing products, ClarkDietrich - EPD	213
XPS insulation, Foamular average, Owens Corning - EPD	10,335
Structure	**7,792**
Hot rolled structural steel, AISC - EPD	2,282
Steel tube, Bull Moose Tube - EPD	5,510
Walls	**490,790**
Brick, generic	138,801
Fasteners, galvanized steel	346
Fiberglass mat gypsum sheathing board	2,355
Fluid applied synthetic polymer air barrier	2,338
Galvanized steel	240,374
Interior grade plywood, US, AWC - EPD	19
Mineral wool, high density, NAIMA - EPD	48,752
Mortar type N	17,324
Steel, sheet	11,527
Un-coated cold-formed steel framing products, ClarkDietrich - EPD	475
Wall board, gypsum, natural	24,230
XPS insulation, Foamular average, Owens Corning - EPD	4,248
Windows	**53,274**
Aluminum storefront system, YKK AP - EPD	6,437
Glazing, double, insulated (air)	22,219
Spandrel, glass, insulated (1 core)	24,618
Grand Total	**676,098**

Calculation Methodology

LIFE CYCLE ASSESSMENT METHODS

The following provides a description of terms and methods associated with the use of Tally to conduct life cycle assessment for construction works and construction products. Tally methodology is consistent with LCA standards ISO 14040-14044, ISO 21930:2017, ISO 21931:2010, EN 15804:2012, and EN 15978:2011. For more information about LCA, please refer to these standards or visit www.choosetally.com.

Studied objects

The life cycle assessment (LCA) results reported represent an analysis of a single building, multiple buildings, or a comparative analysis of two or more building design options. The assessment may represent the complete architectural, structural, and finish systems of the building(s) or a subset of those systems. This may be used to compare the relative environmental impacts associated with building components or for comparative study with one or more reference buildings. Design options may represent a full or partial building across various stages of the design process, or they may represent multiple schemes of a full or partial building that are being compared to one another across a range of evaluation criteria.

Functional unit and reference unit

A functional unit is the quantified performance of a product, building, or system that defines the object of the study. The functional unit of a single building should include the building type (e.g. office, factory), relevant technical and functional requirements (e.g. regulatory requirements, energy performance), pattern of use (e.g. occupancy, usable floor area), and the required service life. For a design option comparison of a partial building, the functional unit is the complete set of building systems or products that perform a given function. It is the responsibility of the modeler to assure that reference buildings or design options are functionally equivalent in terms of scope and relevant performance. The expected life of the building has a default value of 60 years and can be modified by the modeler.

The reference unit is the full collection of processes and materials required to produce a building or portion thereof and is quantified according to the given goal and scope of the assessment over the full life of the building. If construction impacts are included in the assessment, the reference unit also includes the energy, water, and fuel consumed on the building site during construction. If operational energy is included in the assessment, the reference unit includes the electrical and thermal energy consumed on site over the life of the building.

Data source

Tally utilizes a custom designed LCA database that combines material attributes, assembly details, and architectural specifications with environmental impact data resulting from the collaboration between KieranTimberlake and thinkstep. LCA modeling was conducted in GaBi 8.5 using GaBi 2018 databases and in accordance with GaBi databases and modeling principles.

The data used are intended to represent the US and the year 2017. Where representative data were unavailable, proxy data were used. The datasets used, their geographic region, and year of reference are listed for each entry. An effort was made to choose proxy datasets that are technologically consistent with the relevant entry.

Data quality and uncertainty

Uncertainty in results can stem from both the data used and their application. Data quality is judged by: its measured, calculated, or estimated precision; its completeness, such as unreported emissions; its consistency, or degree of uniformity of the methodology applied on a study serving as a data source; and geographical, temporal, and technological representativeness. The GaBi LCI databases have been used in LCA models worldwide in both industrial and scientific applications. These LCI databases have additionally been used both as internal and critically reviewed and published studies. Uncertainty introduced by the use of proxy data is reduced by using technologically, geographically, and/or temporally similar data. It is the responsibility of the modeler to appropriately apply the predefined material entries to the building under study.

System boundaries and delimitations

The analysis accounts for the full cradle to grave life cycle of the design options studied across all life cycle stages, including material manufacturing, maintenance and replacement, and eventual end of life. Optionally, the construction impacts and operational energy of the building can be included within the scope. Product stage impacts are excluded for materials and components indicated as existing or salvaged by the modeler. The modeler defines whether the boundary includes or excludes the flow of biogenic carbon, which is the carbon absorbed and generated by biological sources (e.g. trees, algae) rather than from fossil resources.

Architectural materials and assemblies include all materials required for the product's manufacturing and use including hardware, sealants, adhesives, coatings, and finishing. The materials are included up to a 1% cut-off factor by mass except for known materials that have high environmental impacts at low levels. In these cases, a 1% cut-off was implemented by impact.

Calculation Methodology

LIFE CYCLE STAGES

The following describes the scope and system boudaries used to define each stage of the life cycle of a building or building product, from raw material acquisition to final disposal. For products listed in Tally as Environmental Product Declarations (EPD), the full life cycle impacts are included, even if the published EPD only includes the Product stage [A1-A3].

Product [EN 15978 A1 - A3]

This encompasses the full manufacturing stage, including raw material extraction and processing, intermediate transportation, and final manufacturing and assembly. The product stage scope is listed for each entry, detailing any specific inclusions or exclusions that fall outside of the cradle to gate scope. Infrastructure (buildings and machinery) required for the manufacturing and assembly of building materials are not included and are considered outside the scope of assessment.

Transportation [EN 15978 A4]

This counts transportation from the manufacturer to the building site during the construction stage and can be modified by the modeler.

Construction Installation [EN 15978 A5] (Optional)

This includes the anticipated or measured energy and water consumed on-site during the construction installation process, as specified by the modeler.

Maintenance and Replacement [EN 15978 B2-B5]

This encompasses the replacement of materials in accordance with their expected service life. This includes the end of life treatment of the existing products as well as the cradle to gate manufacturing and transportation to site of the replacement products. The service life is specified separately for each product. Refurbishment of materials marked as existing or salvaged by the modeler is also included.

Operational Energy [EN 15978 B6] (Optional)

This is based on the anticipated or measured energy and natural gas consumed at the building site over the lifetime of the building, as indicated by the modeler.

End of Life [EN 15978 C2-C4]

This includes the relevant material collection rates for recycling, processing requirements for recycled materials, incineration rates, and landfilling rates. The impacts associated with landfilling are based on average material properties, such as plastic waste, biodegradable waste, or inert material. Stage C2 encompasses the transport from the construction site to end-of-life treatment based on national averages. Stages C3-C4 account for waste processing and disposal, i.e., impacts associated with landfilling or incineration.

Module D [EN 15978 D]

This accounts for reuse potentials that fall beyond the system boundary, such as energy recovery and recycling of materials. Along with processing requirements, the recycling of materials is modeled using an avoided burden approach, where the burden of primary material production is allocated to the subsequent life cycle based on the quantity of recovered secondary material. Incineration of materials includes credit for average US energy recovery rates.

PRODUCT	CONSTRUCTION	USE	END-OF-LIFE	MODULE D
A1. Extraction	**A4. Transport (to site)**	B1. Use	C1. Demolition	**D. Benefits and loads beyond the system boundary from:**
A2. Transport (to factory)	***A5. Construction Installation***	**B2. Maintenance**	**C2. Transport (to disposal)**	**1. Reuse**
A3. Manufacturing		**B3. Repair**	**C3. Waste processing**	**2. Recycling**
		B4. Replacement	**C4. Disposal**	**3. Energy recovery**
		B5. Refurbishment		
		B6. Operational energy		
		B7. Operational water		

Life-Cycle Stages as defined by EN 15978. Processes included in Tally modeling scope are shown in bold. Italics indicate optional processes.

Calculation Methodology

ENVIRONMENTAL IMPACT CATEGORIES

A characterization scheme translates all emissions and fuel use associated with the reference flow into quantities of categorized environmental impact. As the degree that the emissions will result in environmental harm depends on regional ecosystem conditions and the location in which they occur, the results are reported as impact potential. Potential impacts are reported in kilograms of equivalent relative contribution (eq) of an emission commonly associated with that form of environmental impact (e.g. kg CO_2eq).

The following list provides a description of environmental impact categories reported according to the TRACI 2.1 characterization scheme, the environmental impact model developed by the US EPA to quantify environmental impact risk associated with emissions to the environment in the United States. TRACI is the standard environmental impact reporting format for LCA in North America. Impacts associated with land use change and fresh water depletion are not included in TRACI 2.1. For more information on TRACI 2.1, reference Bare 2010, EPA 2012, and Guinée 2001. For further description of measurement of environmental impacts in LCA, see Simonen 2014.

Acidification Potential (AP) kg SO_2eq

A measure of emissions that cause acidifying effects to the environment. The acidification potential is a measure of a molecule's capacity to increase the hydrogen ion (H^+) concentration in the presence of water, thus decreasing the pH value. Potential effects include fish mortality, forest decline, and the deterioration of building materials.

Eutrophication Potential (EP) kg Neq

A measure of the impacts of excessively high levels of macronutrients, the most important of which are nitrogen (N) and phosphorus (P). Nutrient enrichment may cause an undesirable shift in species composition and elevated biomass production in both aquatic and terrestrial ecosystems. In aquatic ecosystems, increased biomass production may lead to depressed oxygen levels caused by the additional consumption of oxygen in biomass decomposition.

Global Warming Potential (GWP) kg CO_2eq

A measure of greenhouse gas emissions, such as carbon dioxide and methane. These emissions are causing an increase in the absorption of radiation emitted by the earth, increasing the natural greenhouse effect. This may, in turn, have adverse impacts on ecosystem health, human health, and material welfare.

Ozone Depletion Potential (ODP) kg CFC-11eq

A measure of air emissions that contribute to the depletion of the stratospheric ozone layer. Depletion of the ozone leads to higher levels of UVB ultraviolet rays reaching the earth's surface with detrimental effects on humans and plants. As these impacts tend to be very small, ODP impacts can be difficult to calculate and are prone to a larger margin of error than the other impact categories.

Smog Formation Potential (SFP) kg O_3eq

A measure of ground level ozone, caused by various chemical reactions between nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in sunlight. Human health effects can result in a variety of respiratory issues, including increasing symptoms of bronchitis, asthma, and emphysema. Permanent lung damage may result from prolonged exposure to ozone. Ecological impacts include damage to various ecosystems and crop damage.

Primary Energy Demand (PED) MJ (lower heating value)

A measure of the total amount of primary energy extracted from the earth. PED tracks energy resource use, not the environmental impacts associated with the resource use. PED is expressed in energy demand from non-renewable resources and from renewable resources. Efficiencies in energy conversion (e.g. power, heat, steam, etc.) are taken into account when calculating this result.

Non-Renewable Energy Demand MJ (lower heating value)

A measure of the energy extracted from non-renewable resources (e.g. petroleum, natural gas, etc.) contributing to the PED. Non-renewable resources are those that cannot be regenerated within a human time scale. Efficiencies in energy conversion (e.g. power, heat, steam, etc.) are taken into account when calculating this result.

Renewable Energy Demand MJ (lower heating value)

A measure of the energy extracted from renewable resources (e.g. hydropower, wind energy, solar power, etc.) contributing to the PED. Efficiencies in energy conversion (e.g. power, heat, steam, etc.) are taken into account when calculating this result.

LCI Data

END-OF-LIFE [C2-C4]

A Life Cycle Inventory(LCI) is a compilation and quantification of inputs and outputs for the reference unit.The following LCI provides a summary of all energy, construction, transportation, and material inputs present in the study. Materials are listed in alphabetical order along with a list of all Revit families and Tally entries in which they occur, along with any notes and system boundaries accompanying their database entries.Each entry lists the detailed scope for the LCI data sources used from the GaBi LCI database and identifies the LCI data source.

For LCI data sourced from an Environmental Product Declaration (EPD), the product manufacturer, EPD identification number, and Program Operator are listed. Where the LCI source does not provide data for all life cycle stages, default North American average values are used. This is of particular importance for European EPD sources, as EPD data are generally only provided for the product stage, and North American average values are used for the remaining life cycle stages.

Where specific quantities are associated with a data entry, such as user inputs, energy values, or material mass, the quantity is listed on the same line as the title of the entry.

TRANSPORTATION [A4]

Default transportation values are based on the three-digit material commodity code in the 2012 Commodity Flow Survey by the US Department of Transportation Bureau of Transportation Statistics and the US Department of Commerce where more specific industry-level transportation is not available.

Transportation by Barge

Scope:
The data set represents the transportation of 1 kg of material from the manufacturer location to the building site by barge.

LCI Source:
GLO: Average ship, 1500t payload capacity/ canal ts (2017)
US: Diesel mix at filling station ts (2014)

Transportation by Container Ship

Scope:
The data set represents the transportation of 1 kg of material from the manufacturer location to the building site by container ship.

LCI Source:
GLO: Container ship, 27500 dwt payload capacity, ocean going ts (2017)
US: Heavy fuel oil at refinery (0.3wt.% S) ts (2014)

Transportation by Rail

Scope:
The data set represents the transportation of 1 kg of material from the manufacturer location to the building site by cargo rail.

LCI Source:
GLO: Rail transport cargo - Diesel, average train, gross tonne weight 1000t / 726t payload capacity ts (2017)
US: Diesel mix at filling station ts (2014)

Transportation by Truck

Scope:
The data set represents the transportation of 1 kg of material from the manufacturer location to the building site by diesel truck.

LCI Source:
US: Truck - Trailer, basic enclosed / 45,000 lb payload - 8b ts (2017)
US: Diesel mix at filling station ts (2014)

LCI Data (continued)

END-OF-LIFE [C2-C4]

Specific end-of-life scenarios are detailed for each entry based on the US construction and demolition waste treatment methods and rates in the 2016 WARM Model by the US Environmental Protection Agency except where otherwise specified. Heterogeneous assemblies are modeled using the appropriate methodologies for the component materials.

End-of-Life Landfill

Scope:

Materials for which no recycling or incineration rates are known, no recycling occurs within the US at a commercial scale, or which are unable to be recycled are landfilled. This includes glass, drywall, insulation, and plastics. The solids contents of coatings, sealants, and paints are assumed to go to landfill, while the solvents or water evaporate during installation. Where the landfill contains biodegradable material, the energy recovered from landfill gas utilization is reflected as a credit in Module D.

LCI Source:

US: Glass/inert on landfill ts (2017)
US: Biodegradable waste on landfill, post-consumer ts (2017)
US: Plastic waste on landfill, post-consumer ts (2017)

Concrete End-of-Life

Scope:

Concrete (or other masonry products) are recycled into aggregate or general fill material or they are landfilled. It is assumed that 55% of the concrete is recycled. Module D accounts for both the credit associated with off-setting the production aggregate and the burden of the grinding energy required for processing.

LCI Source:

US: Diesel mix at refinery ts (2014)
GLO: Fork lifter (diesel consumption) ts (2016)
EU - 28 Gravel 2/32 ts (2017)
US: Glass/inert on landfill ts (2017)

Metals End-of-Life

Scope:

Metal products are modeled using the avoided burden approach. The recycling rate at end of life is used to determine how much secondary metal can be recovered after having subtracted any scrap input into manufacturing (net scrap). Net scrap results in an environmental credit in Module D for the corresponding share of the primary burden that can be allocated to the subsequent product system using secondary material as an input. If the value in Module D reflects an environmental burden, then the original product (A1-A3) contains more secondary material than is recovered.

LCI Source:

Aluminum - RNA: Primary Aluminum Ingot AA/ts (2010)
Aluminum - RNA: Secondary Aluminum Ingot AA/ts (2010)
Brass - GLO: Zinc mix ts (2012)
Brass - GLO: Copper (99.99% cathode) ICA (2013)
Brass - EU-28: Brass (CuZn20) ts (2017)
Copper - DE: Recycling potential copper sheet ts (2016)
Steel - GLO: Value of scrap worldsteel (2014)
Zinc - GLO: Special high grade zinc IZA (2012)

Wood End-of-Life

Scope:

End of Life waste treatment methods and rates for wood are based on the 2014 Municipal Solid Waste and Construction Demolition Wood Waste Generation and Recovery in the United States report by Dovetail Partners, Inc. It is assumed that 65.5% of wood is sent to landfill, 17.5% to incineration, and 17.5% to recovery.

LCI Source:

US: Untreated wood in waste incineration plant ts (2017)
US: Wood product (OSB, particle board) waste in waste incineration plant ts (2017)
US: Wood products (OSB, particle board) on landfill, post-consumer ts (2017)
US: Untreated wood on landfill, post-consumer ts (2017)
RNA: Softwood lumber CORRIM (2011)

Report Summary

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Commercial Version 2020.06.09.01

Author	CFH
Company	KL&A ENGINEERS AND BUILDERS
Date	2/8/2021
Project	PLATTE FIFTEEN
Location	DENVER, CO
Gross Area	237014 ft^2
Building Life	60 years
Boundaries	Cradle to grave, inclusive of biogenic carbon; see appendix for a full list of materials and processes

Goal and Scope of Assessment
Structural LCA to compare the CLT and glulam framing system with other proposed systems. Enclosure, finishes, and other architectural elements are not included. This LCA includes biogenic carbon.

Environmental Impact Totals	**Product Stage [A1-A3]**	**Construction Stage [A4]**	**Use Stage [B2-B5]**	**End of Life Stage [C2-C4]**	**Module D [D]**
Global Warming (kg CO_2eq)	3,210,624	271,526	0	1,801,736	382,081
Acidification (kg SO_2eq)	16,726	1,258	0	7,236	-180
Eutrophication (kg Neq)	1,207	102.4	0	1,492	-5.99
Smog Formation (kg O_3eq)	317,045	41,574	0	55,087	2,692
Ozone Depletion (kg CFC-11eq)	0.07513	9.300E-009	0	8.524E-008	-0.00179
Primary Energy (MJ)	6.461E+007	3,948,559	0	7,657,175	-3,158,000
Non-renewable Energy (MJ)	4.731E+007	3,854,072	0	7,163,826	-636,647
Renewable Energy (MJ)	1.731E+007	95,482	0	500,886	-2,534,213
Environmental Impacts / Area					
Global Warming (kg CO_2eq/m^2)	145.8	12.33	0	81.83	17.35
Acidification (kg SO_2eq/m^2)	0.7596	0.05714	0	0.3286	-0.008162
Eutrophication (kg Neq/m^2)	0.0548	0.004652	0	0.06775	-2.719E-004
Smog Formation (kg O_3eq/m^2)	14.40	1.888	0	2.502	0.1222
Ozone Depletion (kg CFC-11eq/m^2)	3.412E-006	4.223E-013	0	3.871E-012	-8.128E-008
Primary Energy (MJ/m^2)	2,934	179.3	0	347.7	-143
Non-renewable Energy (MJ/m^2)	2,149	175.0	0	325.3	-28.9
Renewable Energy (MJ/m^2)	786.0	4.336	0	22.75	-115

Report Summary

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Commercial Version 2020.06.09.01

Author	CFH
Company	KL&A ENGINEERS AND BUILDERS
Date	2/8/2021
Project	PLATTE FIFTEEN
Location	DENVER, CO
Gross Area	237014 ft^2
Building Life	60 years
Boundaries	Cradle to grave, inclusive of biogenic carbon; see appendix for a full list of materials and processes

Goal and Scope of Assessment
Structural LCA to compare the composite steel deck and steel beam framing system with other proposed systems. Enclosure, finishes, and other architectural elements are not included. This LCA includes biogenic carbon.

Environmental Impact Totals	Product Stage [A1-A3]	Construction Stage [A4]	Use Stage [B2-B5]	End of Life Stage [C2-C4]	Module D [D]
Global Warming (kg CO_2eq)	5,969,609	55,132	0	435,976	118,325
Acidification (kg SO_2eq)	16,271	255.5	0	2,009	334.6
Eutrophication (kg Neq)	1,124	20.80	0	102.1	15.86
Smog Formation (kg O_3eq)	307,847	8,442	0	39,903	8,581
Ozone Depletion (kg CFC-11eq)	0.006575	1.888E-009	0	7.979E-008	-7.014E-004
Primary Energy (MJ)	5.394E+007	801,743	0	7,430,286	1,019,745
Non-renewable Energy (MJ)	5.049E+007	782,558	0	6,947,865	1,157,596
Renewable Energy (MJ)	3,459,073	19,387	0	490,942	-140,196
Environmental Impacts / Area					
Global Warming (kg CO_2eq/m^2)	271.1	2.504	0	19.80	5.374
Acidification (kg SO_2eq/m^2)	0.7389	0.0116	0	0.09125	0.0152
Eutrophication (kg Neq/m^2)	0.05106	9.447E-004	0	0.004635	7.201E-004
Smog Formation (kg O_3eq/m^2)	13.98	0.3834	0	1.812	0.3897
Ozone Depletion (kg CFC-11eq/m^2)	2.986E-007	8.575E-014	0	3.624E-012	-3.186E-008
Primary Energy (MJ/m^2)	2,450	36.41	0	337.4	46.31
Non-renewable Energy (MJ/m^2)	2,293	35.54	0	315.5	52.57
Renewable Energy (MJ/m^2)	157.1	0.8805	0	22.30	-6.37

Report Summary

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Commercial Version 2020.06.09.01

Author	CFH
Company	KL&A ENGINEERS AND BUILDERS
Date	2/8/2021
Project	PLATTE FIFTEEN
Location	DENVER, CO
Gross Area	237014 ft^2
Building Life	60 years
Boundaries	Cradle to grave, inclusive of biogenic carbon; see appendix for a full list of materials and processes

Goal and Scope of Assessment
Structural LCA to compare the concrete framing system with other proposed systems. Enclosure, finishes, and other architectural elements are not included. This LCA includes biogenic carbon.

Environmental Impact Totals	Product Stage [A1-A3]	Construction Stage [A4]	Use Stage [B2-B5]	End of Life Stage [C2-C4]	Module D [D]
Global Warming (kg CO_2eq)	5,845,665	50,284	0	477,764	223,508
Acidification (kg SO_2eq)	14,879	233.0	0	2,202	551.7
Eutrophication (kg Neq)	1,109	18.97	0	111.8	24.83
Smog Formation (kg O_3eq)	304,585	7,699	0	43,743	11,997
Ozone Depletion (kg CFC-11eq)	-8.757E-004	1.722E-009	0	8.747E-008	-0.001433
Primary Energy (MJ)	5.140E+007	731,230	0	8,145,676	1,934,830
Non-renewable Energy (MJ)	4.794E+007	713,732	0	7,616,785	2,146,923
Renewable Energy (MJ)	3,453,480	17,682	0	538,209	-213,579
Environmental Impacts / Area					
Global Warming (kg CO_2eq/m^2)	265.5	2.284	0	21.70	10.15
Acidification (kg SO_2eq/m^2)	0.6757	0.01058	0	0.1	0.02506
Eutrophication (kg Neq/m^2)	0.05038	8.616E-004	0	0.005079	0.001128
Smog Formation (kg O_3eq/m^2)	13.83	0.3497	0	1.987	0.5448
Ozone Depletion (kg CFC-11eq/m^2)	-3.977E-008	7.821E-014	0	3.972E-012	-6.507E-008
Primary Energy (MJ/m^2)	2,334	33.21	0	369.9	87.87
Non-renewable Energy (MJ/m^2)	2,177	32.41	0	345.9	97.50
Renewable Energy (MJ/m^2)	156.8	0.803	0	24.44	-9.7

Report Summary

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Author	CFH
Company	KL&A ENGINEERS & BUILDERS
Date	2/24/2021
Project	PLATTE FIFTEEN
Location	DENVER, CO
Gross Area	237014 ft^2
Building Life	60 years
Boundaries	Cradle to grave, inclusive of biogenic carbon; see appendix for a full list of materials and processes

Goal and Scope of Assessment
Architectural LCA including vertical enclosures, ceiling finishes, and roof enclosure. This LCA includes biogenic carbon.

Environmental Impact Totals	Product Stage [A1-A3]	Construction Stage [A4]	Use Stage [B2-B5]	End of Life Stage [C2-C4]	Module D [D]
Global Warming (kg CO_2eq)	2,063,222	15,222	0	155,677	-239,654
Acidification (kg SO_2eq)	6,527	70.53	0	83.62	-963
Eutrophication (kg Neq)	360.3	5.743	0	8.110	-21.8
Smog Formation (kg O_3eq)	81,126	2,331	0	1,555	-9,095
Ozone Depletion (kg CFC-11eq)	0.6472	5.213E-010	0	1.291E-004	9.345E-004
Primary Energy (MJ)	1.731E+007	221,359	0	281,555	-2,803,097
Non-renewable Energy (MJ)	1.595E+007	216,062	0	263,629	-2,251,780
Renewable Energy (MJ)	1,372,134	5,353	0	18,118	-549,036
Environmental Impacts / Area					
Global Warming (kg CO_2eq/m^2)	93.70	0.6913	0	7.070	-10.9
Acidification (kg SO_2eq/m^2)	0.2964	0.003203	0	0.003798	-0.04374
Eutrophication (kg Neq/m^2)	0.01636	2.608E-004	0	3.683E-004	-9.914E-004
Smog Formation (kg O_3eq/m^2)	3.684	0.1058	0	0.07062	-0.4131
Ozone Depletion (kg CFC-11eq/m^2)	2.939E-005	2.368E-014	0	5.861E-009	4.244E-008
Primary Energy (MJ/m^2)	786.0	10.05	0	12.79	-127
Non-renewable Energy (MJ/m^2)	724.3	9.812	0	11.97	-102
Renewable Energy (MJ/m^2)	62.31	0.2431	0	0.8228	-24.9