EMBODIED ENVIRONMENTAL IMPACT

DESIGN APPROACH

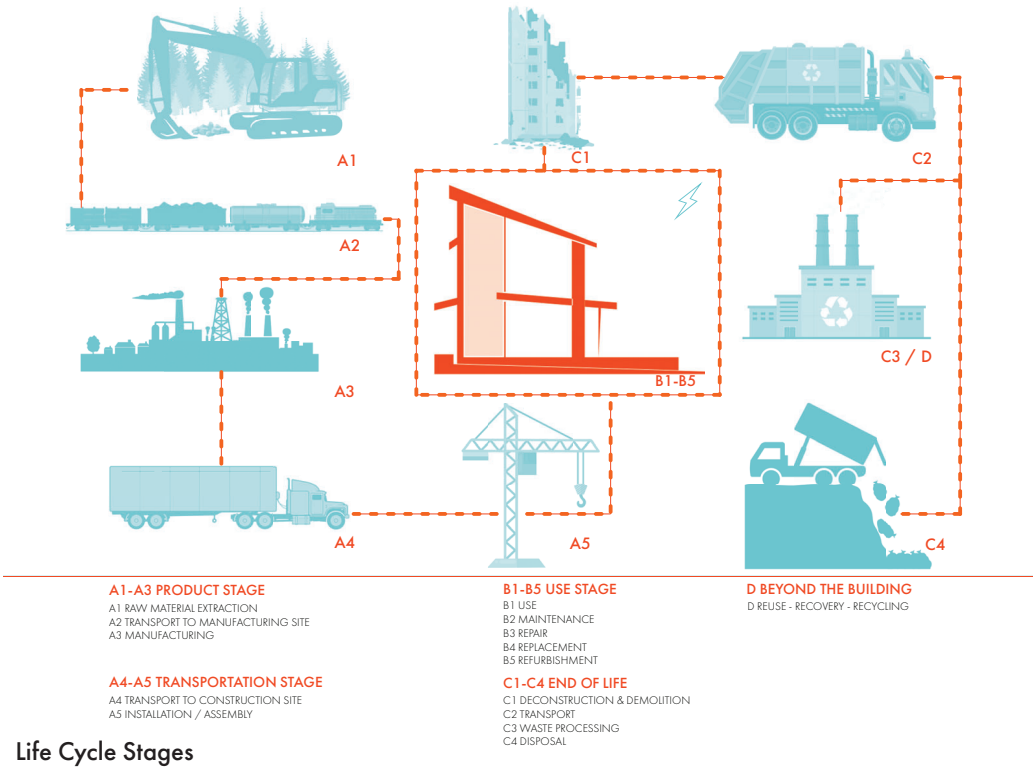
The built environment accounts for 50% of all daily carbon dioxide emissions released worldwide. In 2019, greenhouse gas emissions totaled 6,558 million metric tons of carbon dioxide equivalent (CO2e), or 5,769 million metric tons of CO2e accounting for land sector sequestration. As of 2019, housing accounts for about 34% of these emissions.

By carefully monitoring selected materials, products, finishes, construction methods, and other factors impacting the carbon footprint, the Cardinal Studio team reduced the carbon emissions of the Alley House far below the national average to deliver a net-zero home. The Alley House feels like home while returning to the environment all that it consumes in transportation, manufacturing, construction, and operations.

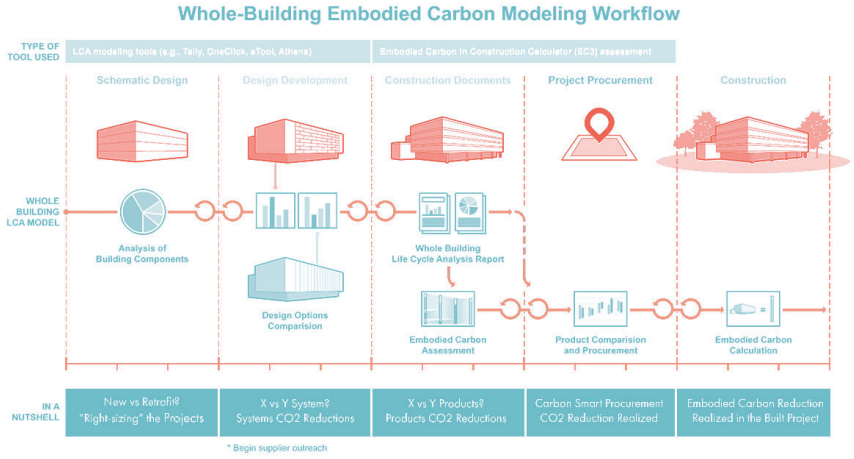
Gathering data on the environmental impact of most products was extremely challenging. Total embodied carbon emissions were calculated using Tally, a reputable life cycle analysis calculation and analysis software. Focusing on a cradle-to-cradle scope, Tally was an invaluable tool in estimating the embodied carbon values produced by the Alley House. However, Tally did not provide the full picture of the embodied environmental impact of the specific materials under consideration by the Cardinal Studio team. To determine this data, the team also used Environmental Product Declarations and other tools such as the Embodied Carbon in Construction Calculator (EC3) Tool.

CONTEST
OVERVIEW

Cardinal Studio is dedicated to understanding appropriate materials for the Alley House. The team researched and took into consideration all materials, from interior details to the overall mass of the home. During the selection of materials, the team focused on creating a sense of "hygge," a Danish way of life that emphasizes finding joy in everyday situations and celebrating coziness, warmth, and family. The team's goal was to create this feeling in an urban environment while also maintaining a carbon footprint noticeably lower than the average home.



Life Cycle Stages



**** Figure by Daniel Overbey, adapted from the Carbon Leadership Forum, University of Washington.**

ANALYSIS
LIFE CYCLE COMPARISON TECHNIQUE

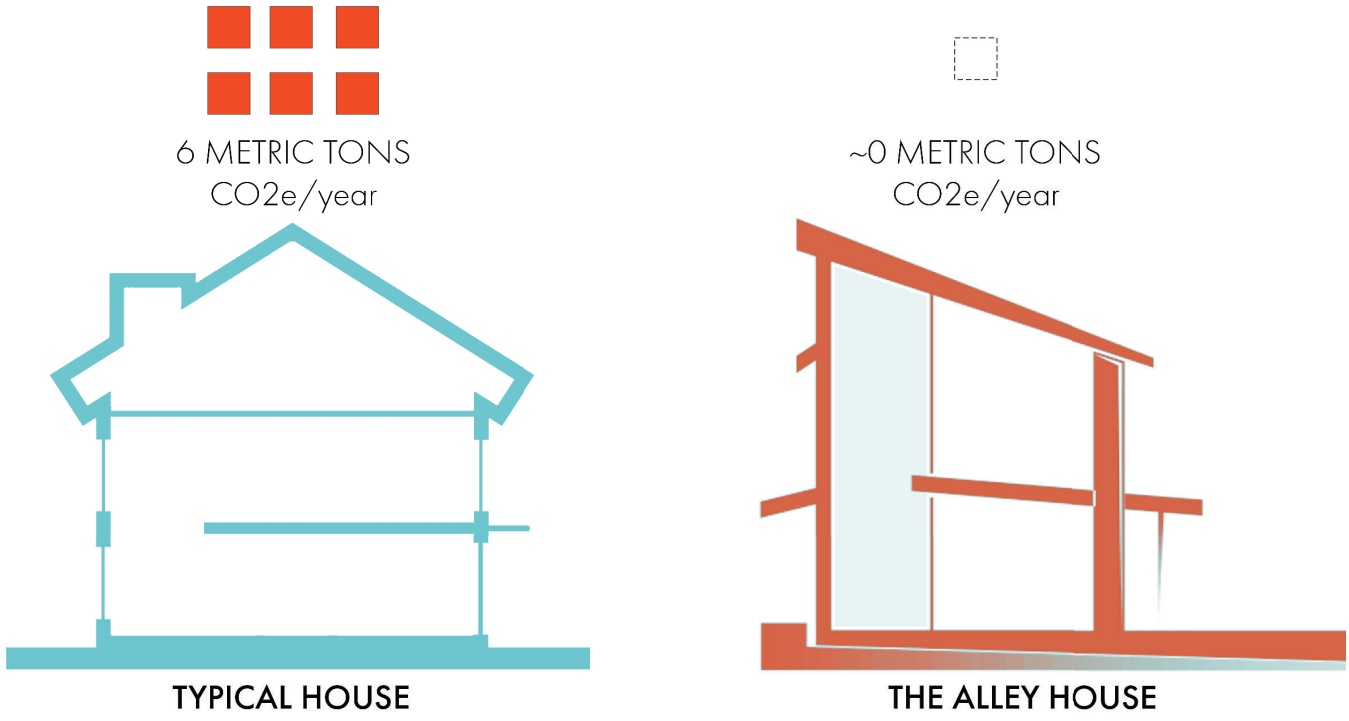
When examining the life cycle of the materials used in the Alley House, Cardinal Studio utilized the life cycle stages defined by the European Standards EN 15878 and EN 15804. Breaking down the material life cycle into fourteen stages, the team carefully examined the embodied environmental impact of each material, from its sourcing to the end of its life or next use. This analysis broadened the team's understanding of the total effect a single material had on the total embodied environment impact of the Alley House. Cardinal Studio followed the principles of Building Information Modeling ("(BIM) and the Whole Building Embodied Carbon Modeling Workflow system.

OPERATIONAL

CARBON EMISSIONS

OVERVIEW OF OPERATION EMISSIONS

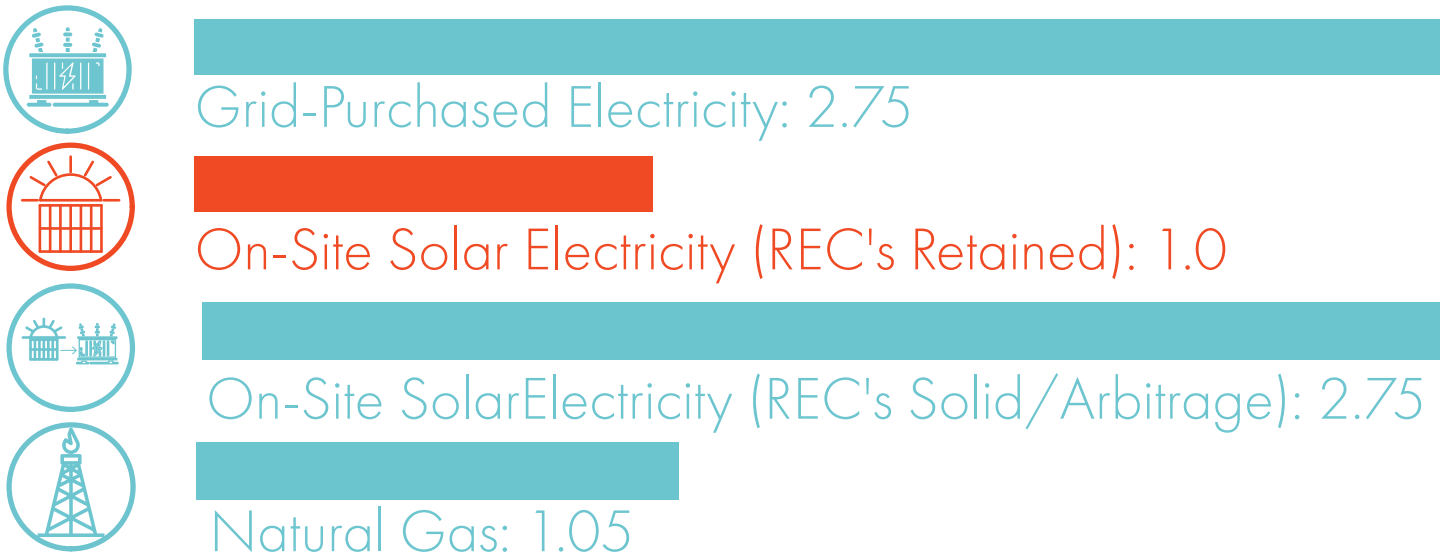
The amount of operational carbon emissions is one of Cardinal Studio's early and primary considerations when trying to minimize the environmental impact of the Alley House. To optimize its energy performance, the Alley House has employed several strategies to be net zero in both energy and carbon consumption.



OPERATIONAL ENERGY COMPARISON

SITE SOURCE

When considering the energy lifecycle of the Alley House, the Cardinal Studio team took into account both the site and source energy to assess the overall carbon efficiency of the design. Source energy tracks the heat and electricity requirements of a building and accounts for any loss from production to the building. However, site energy only tracks the heat and electricity consumed by a building. Because the amount of energy produced equals the amount of carbon emitted, both values must be examined to determine embodied environmental impact. In the west unit of the Alley House, the use of renewable energy in the form of solar panels ensures that no carbon is emitted in the production of the energy consumed by the home. However, the east unit of the Alley House sources energy from the grid; therefore, it was especially important that Cardinal Studio incorporated multiple passive systems to make up for grid consumption and optimize controllable factors such as the plug loads of the home.



Source to Site Ratio

ENERGY USAGE

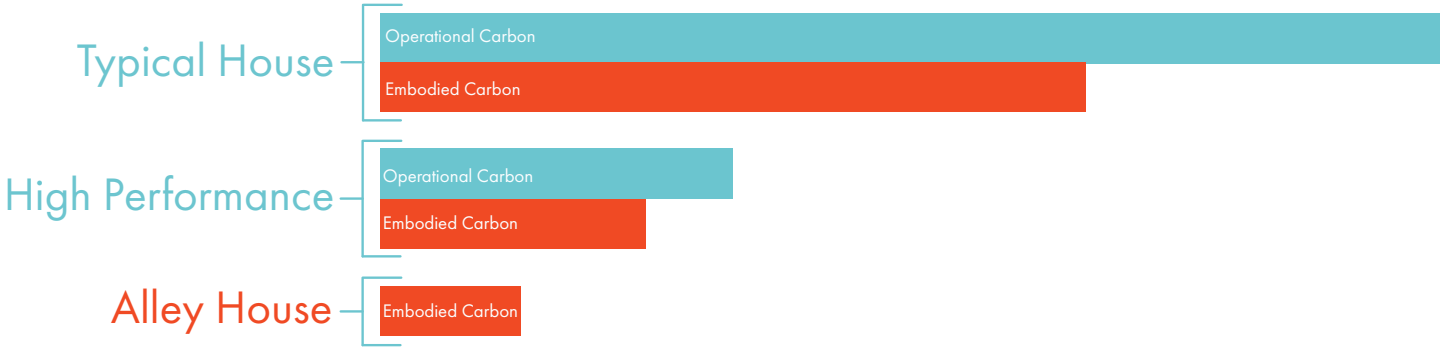
The team paid close attention to the equipment and appliances in the Alley House, specifying only items that were Energy Star Certified. In addition to improved energy efficiency, use of these appliances ensured consideration of lesser-known variables such as reducing refrigerant leaks. In the event of damage to the solar panel system, the team's choice of these appliances ensures that the Alley House would need to rely on grid power or a generator only temporarily, and its efficient appliances would require only minimal energy loads, thus keeping its carbon footprint low even during periods of disruption.

PASSIVE SYSTEMS

Using passive systems in the design of the Alley House reduced its operational CO2 emissions. By prioritizing optimal use of sunlight, thermal massing, and natural ventilation, the Alley House both reduced its need for active systems to operate at a typical rate and reduced the emissions resulting from the active systems.

The west unit's electricity is supplied by renewable solar energy via photovoltaic (PV) panels which produce all the electricity the unit needs. The system also has a battery system to store unused energy throughout the day.

RESULTS OF REDUCING THE OPERATIONAL CARBON

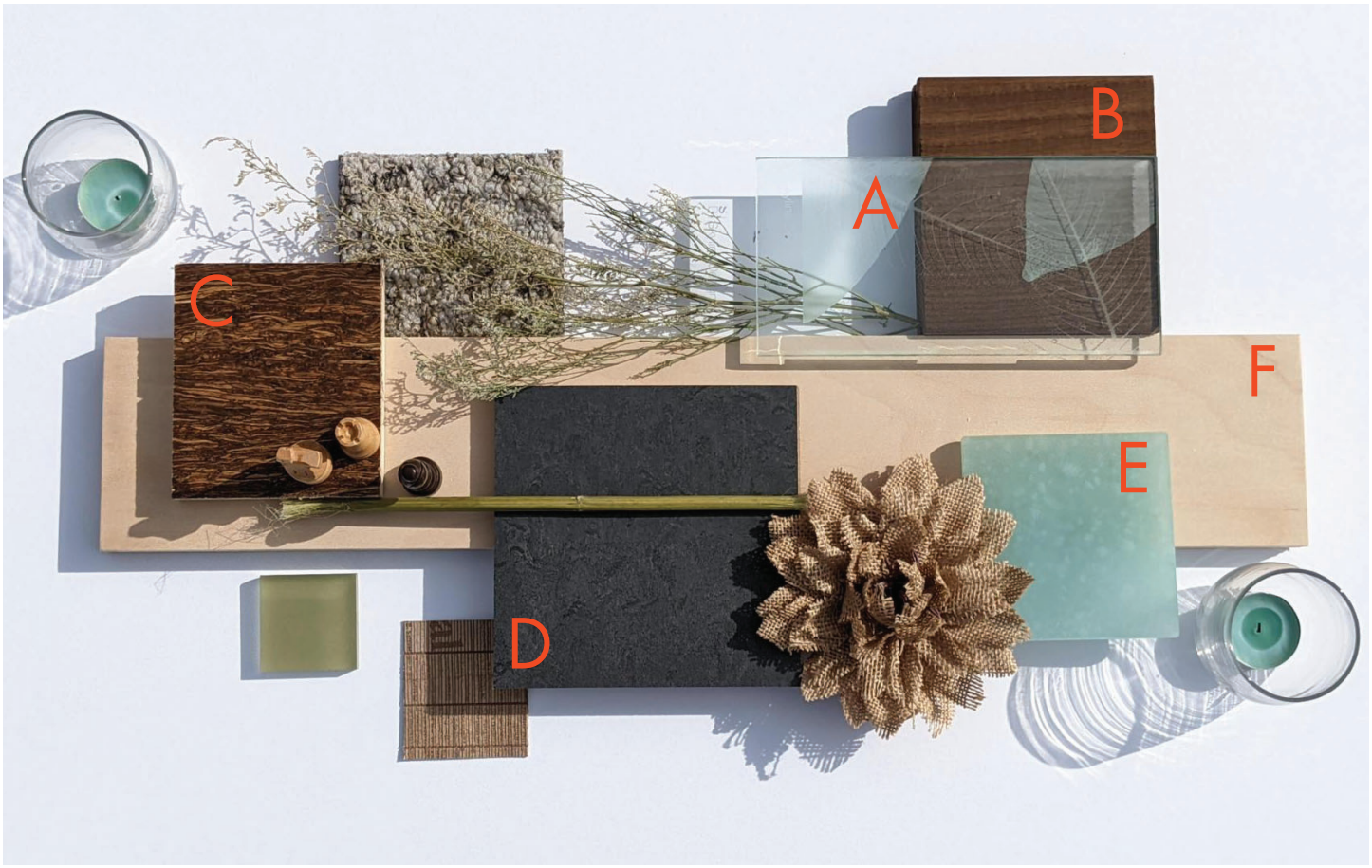


In its effort to reach net zero, Cardinal Studio recognized that carbon output must be minimized not only in operational energy but also in the embodied energy associated with producing, delivering, and installing building materials.

Although embodied energy typically comprises around 15% of an average building's lifetime energy, in high-performance buildings this amount can be cut in half.

THE ALLEY HOUSE

ANALYSIS



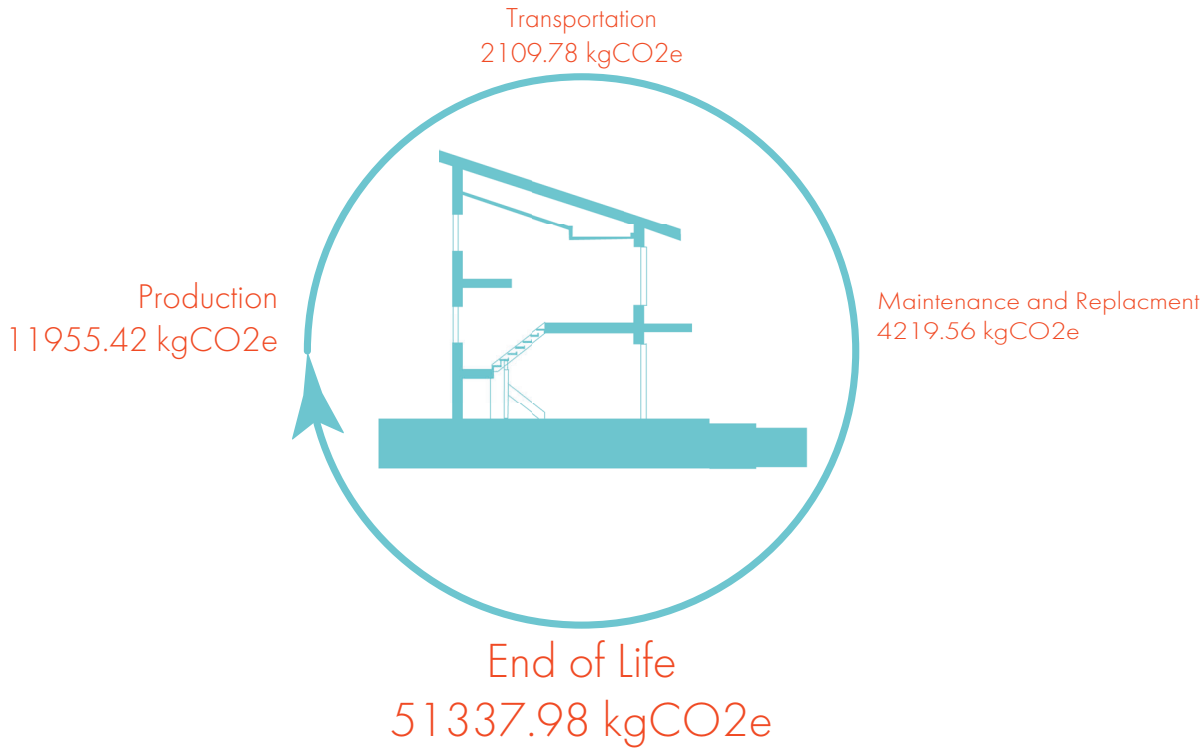
MATERIAL PALETTE

A: Pattern Stamped Glass
B: Thermally Modified Wood
C: Hemp Wood Flooring
D: Volcanic Ash Marmoleum
E: Colored Tinted Glass
F: Birch Veneer Cabinets

OVERVIEW LIFE CYCLE ANALYSIS

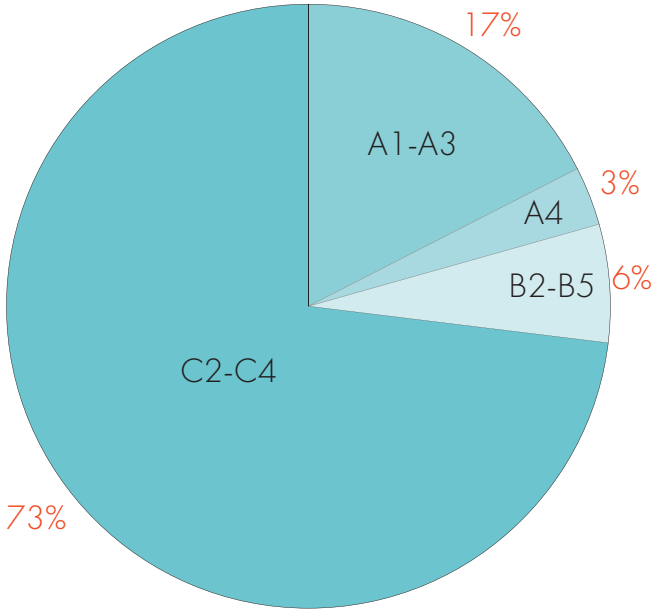
Using Tally and a construction calculator assessment tool, Cardinal Studio was able to monitor the embodied environmental impact of its design decisions. As a result of thorough examination of materials' life cycle analysis, the Alley House greatly reduces the environmental impact of a typical home of equivalent size and scope. The following information summarizes the team's findings on the Global Warming Potential (GWP) of the Alley House as well as considers components that typically contribute most to the carbon footprint of a home, such as envelope insulation and foundation.

KITCHEN INTERIOR RENDERING



GLOBAL WARMING POTENTIAL BY PHASE

Cardinal Studio examined the embodied carbon produced through several stages in the four phases of the life cycle of materials described in the Whole Building Life Cycle Assessment model. Stages A1-A3 include the sourcing and production. Stage A4 includes the transportation. Stages B2-B4 factor in the operations other than energy production. Finally, stages C2-C4 and D identify the emissions created during the end of a material's life. Note that the "End of Life" comprises 73% of the total CO2e produced during the other four phases. While Cardinal Studio expected this phase to be high, the team knew that this number is on the conservative side due to many materials and objects not being listed in stage D, which considers impacts "Beyond the System Boundary" or "Beyond the Building" such as the windows, doors, and many finishes.

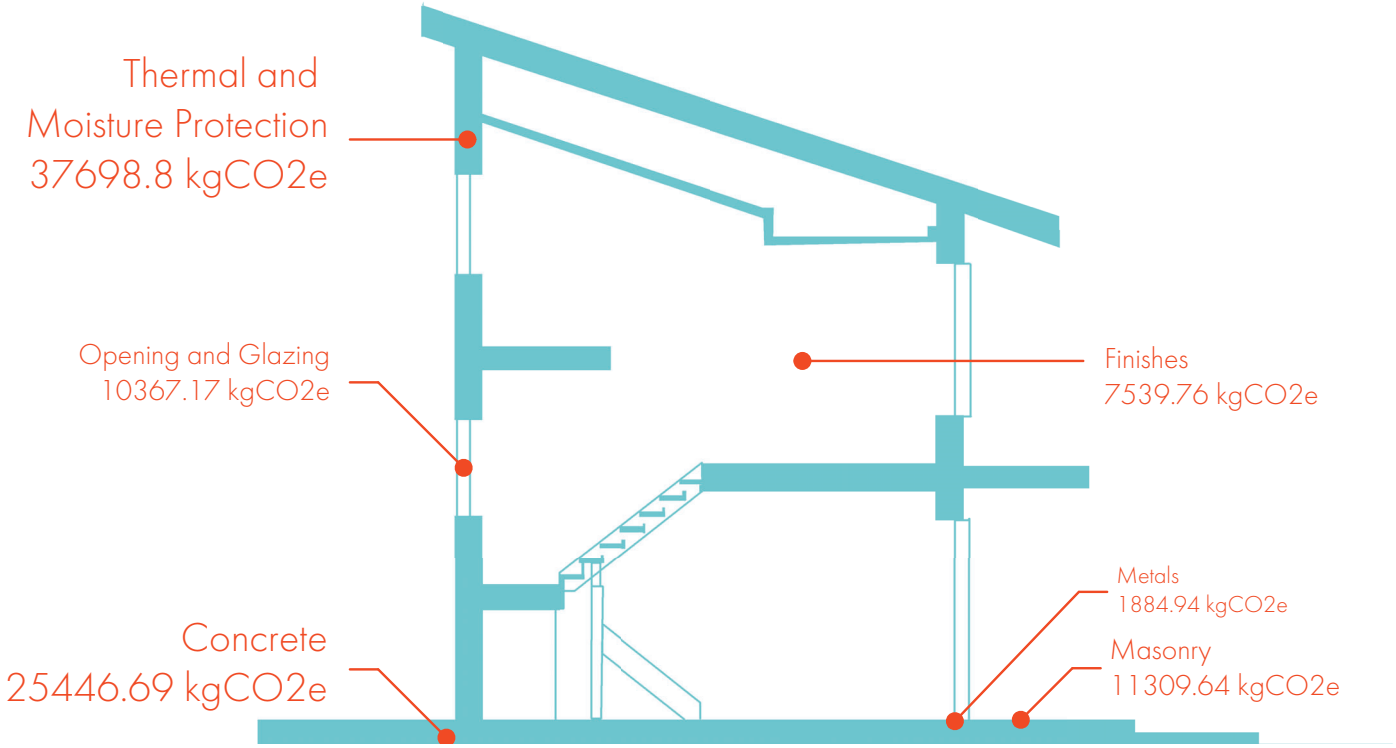


Legend

Life Cycle Stages

- End of Life [C2-C4] 73%
- Production [A1-A3] 17%
- Transportation [A4] 3%
- Maintenance and Replacement [B2-B5] 6%

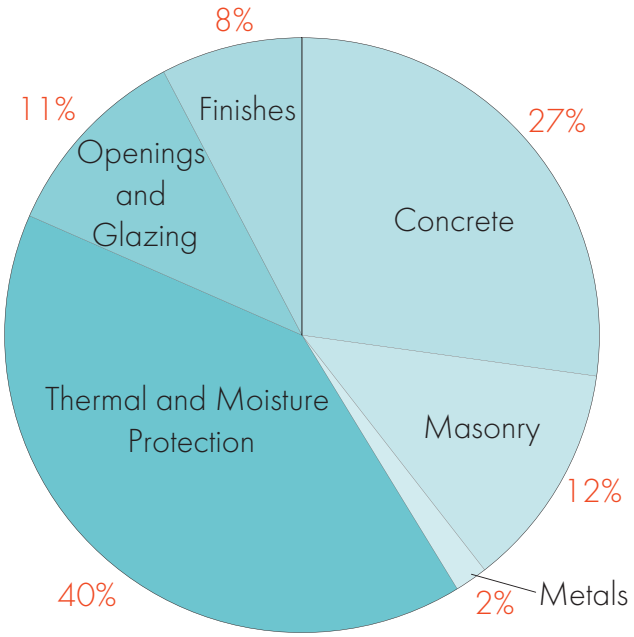
Total: 69,622.74 kgCO2e



GLOBAL WARMING POTENTIAL BY DIVISION

The material by division communicates the Alley House's Global Warming Potential (GWP). Cardinal Studio recognized that the result in this graph shows a substantial contribution towards the GWP from the Thermal and Moisture Protection (40%) and Concrete (27%) divisions.

Thermal and Moisture Protection result is high due to the five inches of continuous insulation in the envelope, a trade-off the team considered when balancing carbon emissions, energy performance, and thermal bridging. Despite the comparatively small amount of concrete used in the Alley House, it still shows the second-highest amount of carbon emissions; even so, this is far less than in a typical home in which concrete is the highest contributor to the total amount of greenhouse gases emitted.

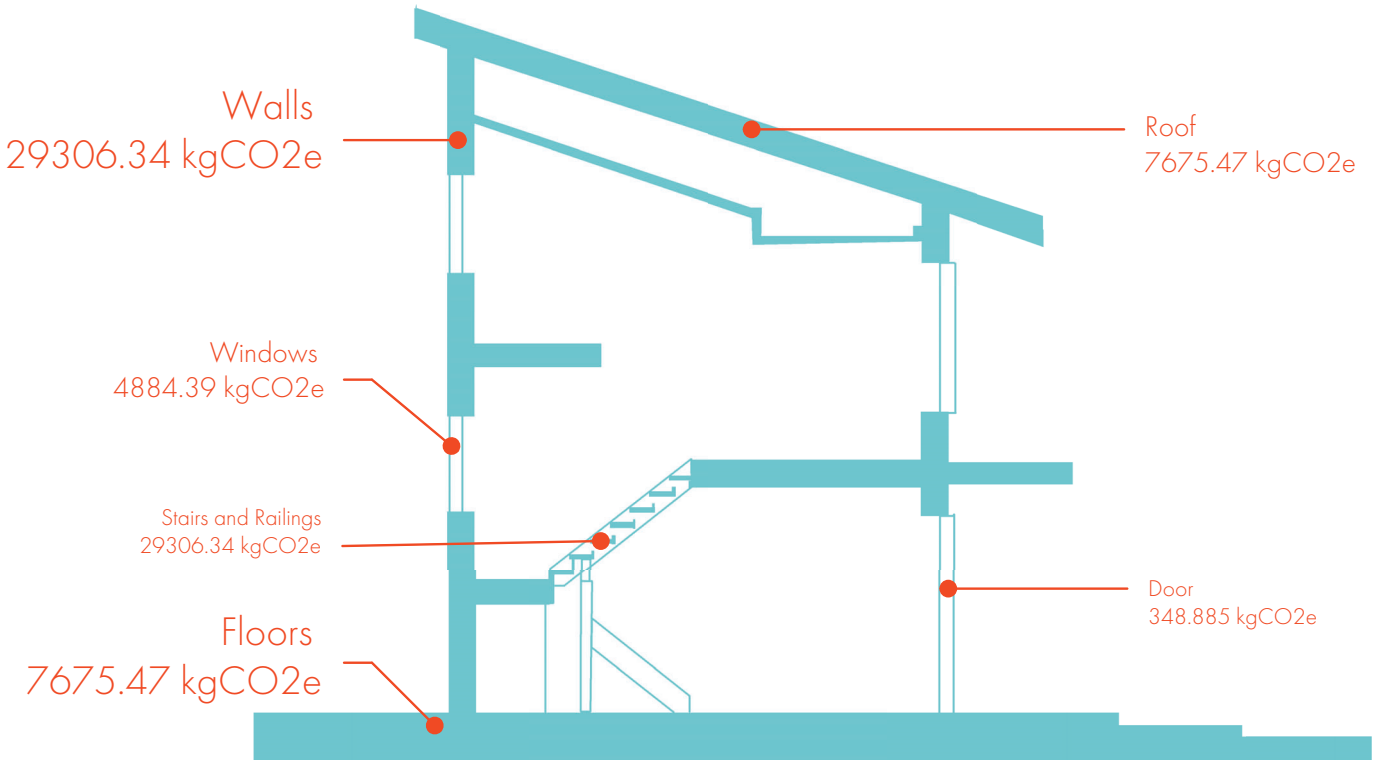


Legend

Divisions

- Thermal and Moisture Protection 40%
- Openings and Glazing 11%
- Finishes 8%
- Concrete 27%
- Masonry 12%
- Metals 2%

Total: 94,247 kgCO2e

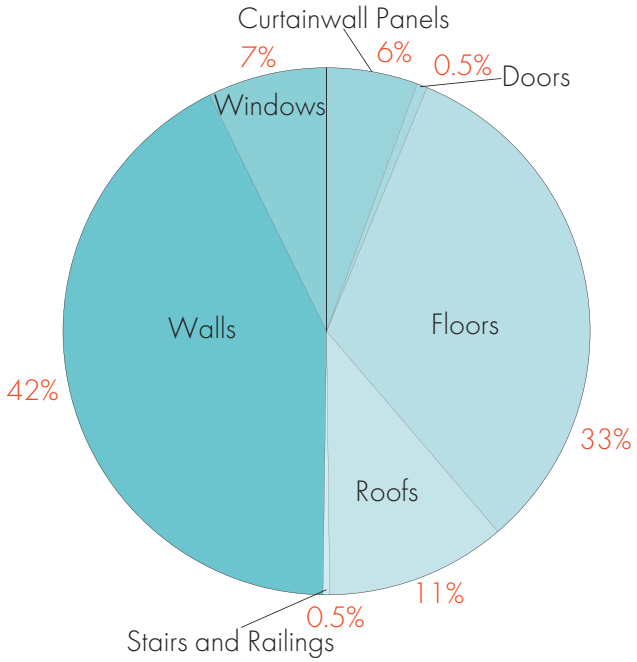


GLOBAL WARMING POTENTIAL BY CATEGORY

By breaking down the carbon emissions by category, the team identified what masses as a whole are contributing the most towards the greenhouse gas emissions. This breakdown is helpful when comparing it to the Division comparison.

An example of this is the process of identifying that the thermal and moisture barriers contribute a large portion of the CO2e in the Alley House and being able to see that reflected in the Wall and Floor division. Many of the high-carbon-emitting categories are related to insulation.

As shown in these charts, Walls (42%), Floors (33%), and the Roof (11%) make up most of the emissions released. The team considered the use of wood as a carbon sink; wood absorbs carbon released into the air and reduced the amount of emissions, especially when calculating the Walls and Roof. This allows our numbers to be reduced, especially when calculating the Walls and Roof.



Legend

Categories

- Walls 42%
- Windows 7%
- Curtainwall Panels 6%
- Doors 0.5%
- Floors 33%
- Roofs 11%
- Stairs and Railings 0.5%

Total: 69,777 kgCO2e

CARBON EMISSIONS

LOOKING CLOSER

Cardinal Studio placed its highest priority on reduction of greenhouse gases when considering materials and products to specify for the Alley House, but the team made strategic compromises. For example, a material choice made on the basis low CO2 emissions cradle to cradle may also result in that product having a lower R-value, decreased durability, or a higher price. By using the tools and processes of Tally and a construction calculator assessment, the team made informed design decisions without compromising the primary goal.

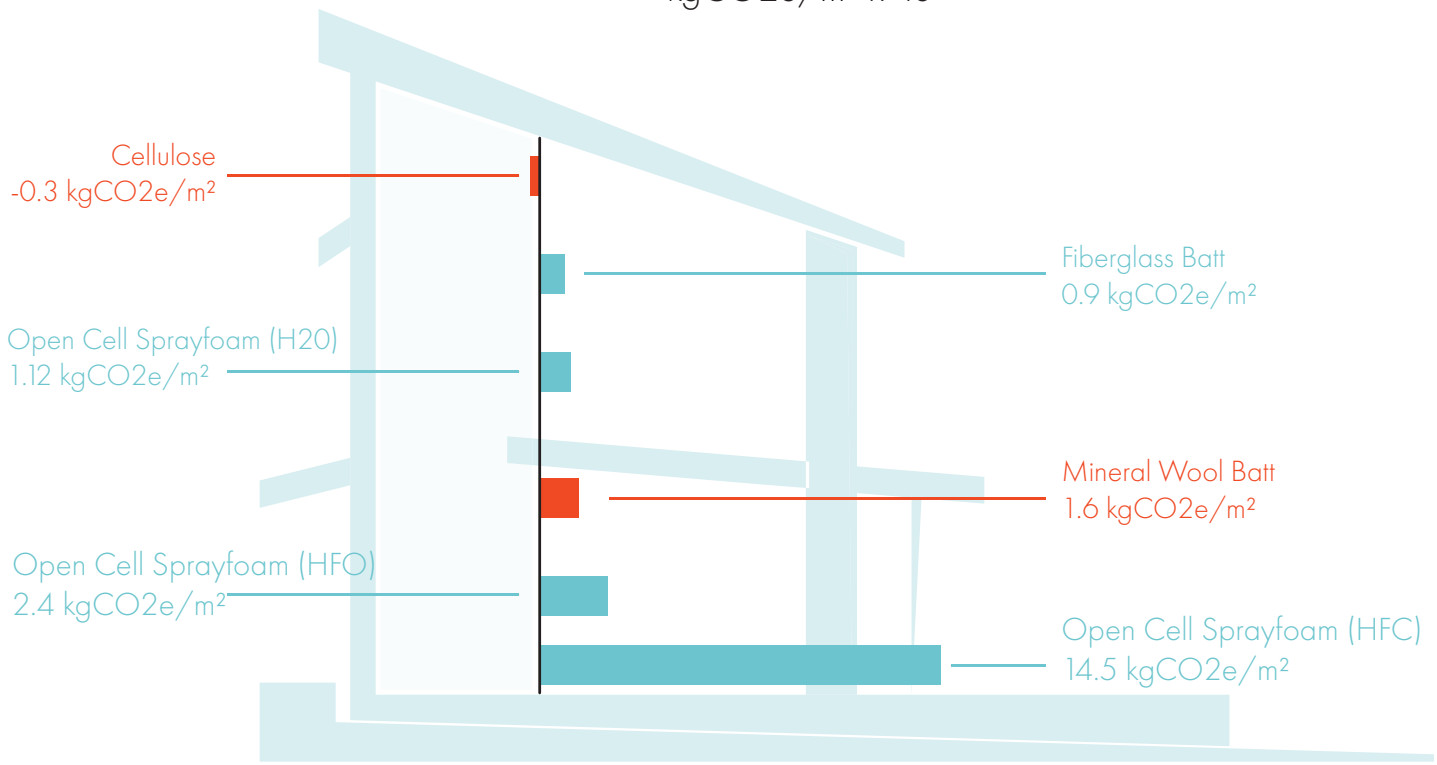
ENVELOPE

Cardinal Studio made optimal use of environmental product declarations and life cycle analysis to finalize product selection for envelope insulation in the Alley House. The interior insulation, cellulose, has a negative global warming potential due to recycled newspaper content and its comparable R-value.

The team balanced factors of carbon emissions and durability when choosing the exterior insulation, mineral wool. While mineral wool batt insulation is not as low in carbon emissions as cellulose, fiberglass, or open cell spray foam (H20), it is extremely durable, moisture resistant, easy to install, and does not mold or mildew. Its environmental product declaration (EPD) is superior when compared to houses that use XPS foam insulation board, an important consideration due to its location on the exterior side of the water barrier. Mineral wool also is lower in carbon emissions than open cell HFO, HFC, and XPS insulation products.

Global Warming Potential of Insulation

kgCO2e/m² R-13

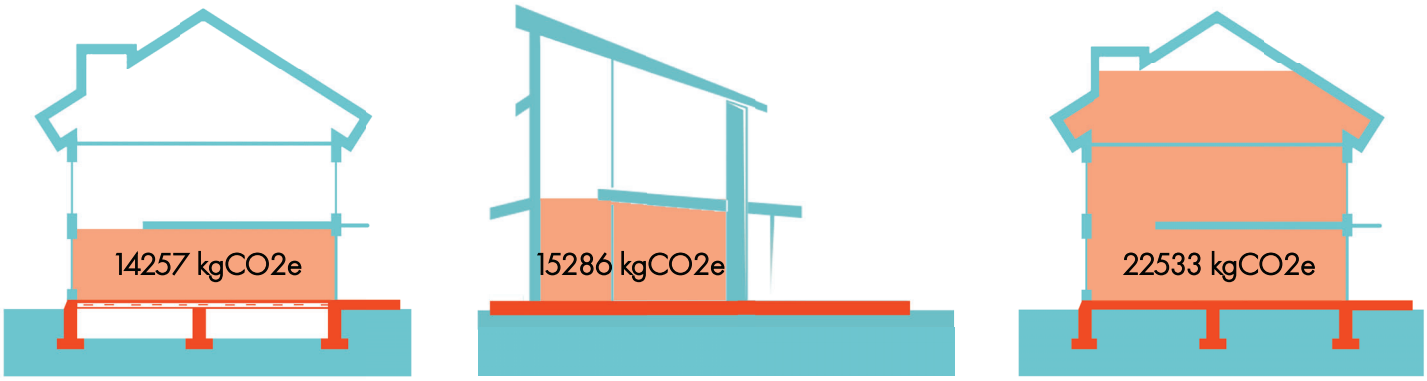


FOUNDATION

The Alley House uses an innovative shallow frost protected slab instead of the traditional footer and foundation wall system. Indianapolis, Indiana, is located in the 5A climate zone, and due to these weather conditions slab-on-grade systems are not typical in the area. The choice of a slab foundation allowed Cardinal Studio to achieve significantly reductions in CO2 emissions, shown in the team's greenhouse gas emissions analysis in the "Material Division" chart. The slab system used in the Alley House is calculated to produce only 15,286 kgCo2e during its lifetime, while a traditional concrete foundation with footers and a concrete slab would produce 22,533 kgCO2e. While use of a traditional concrete foundation with footers and a wood-framed subfloor would produce less CO2e, the difference of only 1,029 kgCo2e is reduced due to the ability of wood to act as a CO2 sink. Cardinal Studio's decision to use the shallow frost protected slab was influenced by the ability of the concrete slab to act as a thermal mass during winter months, both reducing the home's energy consumption and its greenhouse gas emissions produced through energy production. This analysis is an example of a trade-off that makes a full circle and becomes a positive for both variables, ideal when designing a net-zero structure.

Global Warming Potential Foundation Types

kgCO2e



Traditional Concrete Foundation w/Footers and Wood Framed Sub-Floor

Shallow Frost Protected Concrete Slab

Traditional Concrete Foundation w/Footers and Slab-on-Grade

ADVANCED FRAMING

The design of the Alley House structure was heavily influenced by Cardinal Studio's priority to reduce greenhouse gas emissions. The Alley House is constructed using an advanced framing system which reduces significantly the amount of timber needed for construction by requiring only 2 x 6 studs at 24" on center, compared to a typical wood framing wall requiring 2 x 4 studs at 16" on center. This reduction and better optimization of materials not only reduces the cost by up to 30% and labor needed to construct the framing by 20-60%, but also reduces the CO2e produced during the life cycle of each piece of lumber. This savings is reflected in the team's greenhouse gas emissions analysis seen in the "Material Division" chart.

MATERIAL RECLAMATION

Cardinal Studio is expending considerable effort to make use of reclaimed materials in the design of the Alley House. Examples of this can be seen in and around the project as crucial and striking design elements.

The first is featured in the design of the module desk and media center. The walnut tops of both pieces of furniture are reclaimed from a Ball State building and are an integral part of the home's flexible components.

The next element can be seen on the exterior of the Alley House. The team was fortunate to acquire large cuts of Indiana limestone that had been salvaged from the demolition of a local K-12 school. These pieces of limestone veneer were being repurposed for pavers around the home and the retaining wall on the north side of the site.

Rendering Looking East

THERMALLY MODIFIED WOOD

The excessive use of harsh chemicals and products that "produce volatile organic compounds (VOCs) are harmful to both occupants and the environment. Pressure-treated lumber is one of these products and is commonly used in the construction of outdoor design features due to the weather and insect-resistant properties of the product. However, Cardinal Studio used a thermally modified wood product for these applications. Thermally modified wood goes through a process of kiln firing, and the result iis a naturally weather- and insect-resistant, extremely durable piece of lumber that uses no added chemicals. The thermally modified wood used in the Alley House can be seen on the stair towers, pergola, and planters.

Rendering Looking North West

ALLEY HOUSE

Full building summary

10/14/2022

Table of Contents

Report Summary

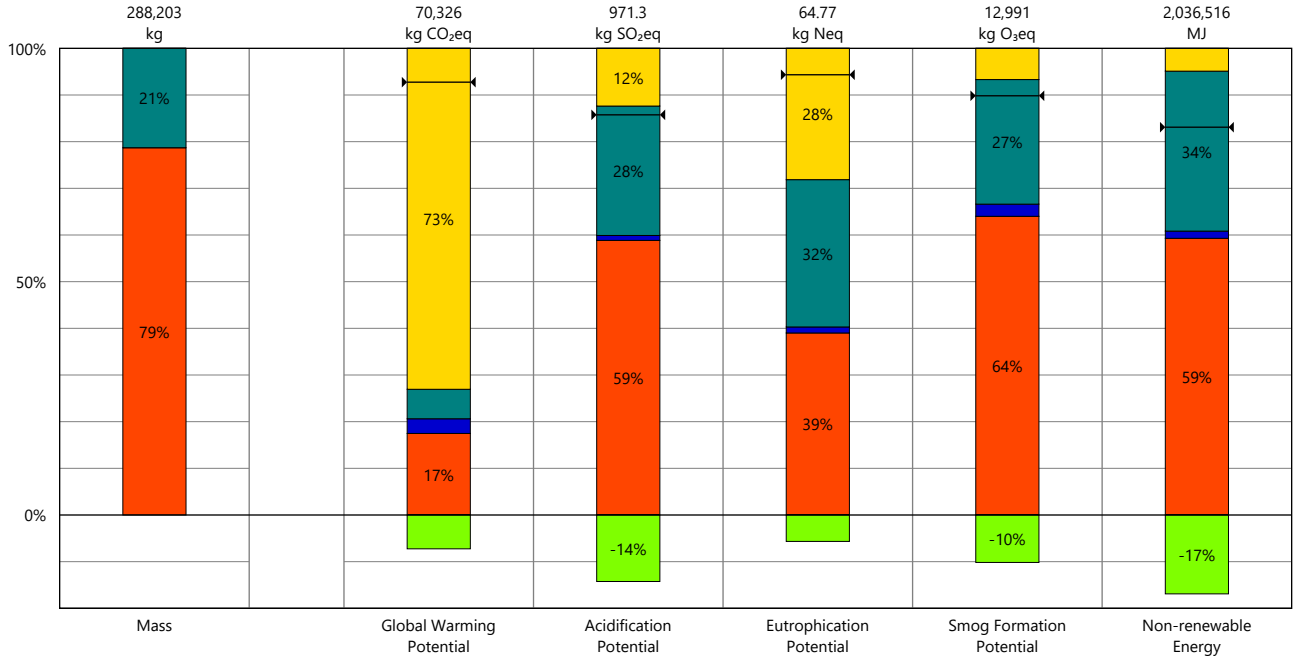
Created with Tally
Non-commercial Version 2022.04.08.01

Goal and Scope of Assessment
Alley House LCA

Author	Spencer.WhitmoreUDCZQ
Company	BSU
Date	10/14/2022
Project	ALLEY HOUSE
Location	201 N TEMPLE AVENUE, INDIANAPOLIS, IN 46201
Gross Area	2700 ft^2
Building Life	60 years
Boundaries	Cradle to grave, inclusive of biogenic carbon; see appendix for a full list of materials and processes

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)	12,288	2,215	4,441	51,382	-5,099
Acidification (kg SO_2eq)	571.5	10.26	269.3	120.1	-138
Eutrophication (kg Neq)	25.26	0.8358	20.44	18.23	-3.67
Smog Formation (kg O_3eq)	8,314	339.2	3,468	869.1	-1,321
Ozone Depletion (kg CFC-11eq)	4.399E-004	7.587E-011	2.812E-004	1.214E-009	7.216E-006
Primary Energy (MJ)	1,891,093	32,213	1,198,869	106,498	-573,991
Non-renewable Energy (MJ)	1,207,382	31,442	698,068	99,624	-344,206
Renewable Energy (MJ)	683,918	779.0	501,179	6,955	-229,097
Environmental Impacts / Area					
Global Warming (kg CO_2eq/m^2)	48.99	8.831	17.70	204.8	-20.3
Acidification (kg SO_2eq/m^2)	2.278	0.04092	1.074	0.479	-0.5519
Eutrophication (kg Neq/m^2)	0.1007	0.003332	0.08151	0.07266	-0.01462
Smog Formation (kg O_3eq/m^2)	33.15	1.352	13.83	3.465	-5.27
Ozone Depletion (kg CFC-11eq/m^2)	1.754E-006	3.025E-013	1.121E-006	4.841E-012	2.877E-008
Primary Energy (MJ/m^2)	7,539	128.4	4,779	424.6	-2,288
Non-renewable Energy (MJ/m^2)	4,813	125.3	2,783	397.2	-1,372
Renewable Energy (MJ/m^2)	2,727	3.105	1,998	27.73	-913

Results per Life Cycle Stage

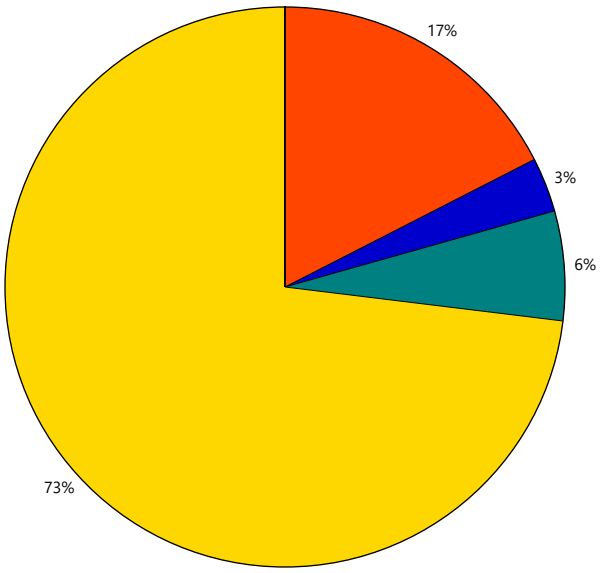


Legend

Net value (impacts + credits)

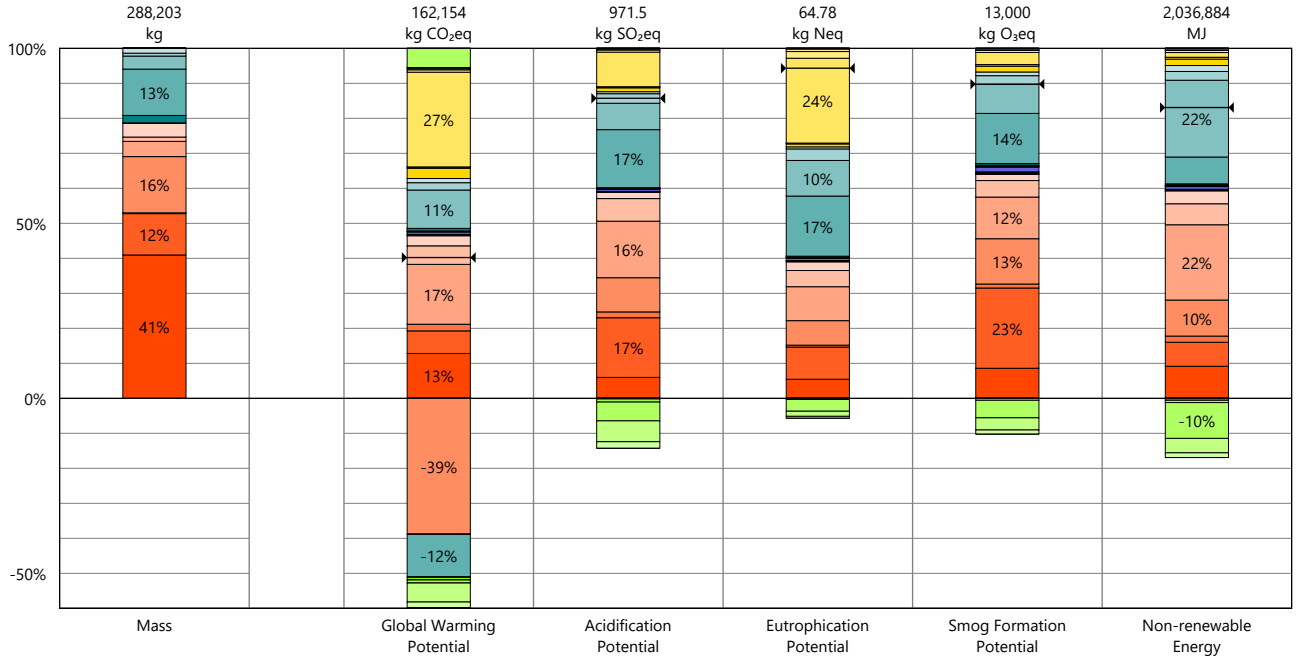
Life Cycle Stages

- Product [A1-A3]
- Transportation [A4]
- Maintenance and Replacement [B2-B5]
- End of Life [C2-C4]
- Module D [D]



Global Warming Potential

Results per Life Cycle Stage, itemized by Division



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Net value (impacts + credits)

Product [A1-A3]

- 03 - Concrete
- 04 - Masonry
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal and Moisture Protection
- 08 - Openings and Glazing
- 09 - Finishes

Transportation [A4]

- 03 - Concrete
- 04 - Masonry
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal and Moisture Protection
- 08 - Openings and Glazing
- 09 - Finishes

Maintenance and Replacement [B2-B5]

- 03 - Concrete
- 04 - Masonry
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal and Moisture Protection
- 08 - Openings and Glazing
- 09 - Finishes

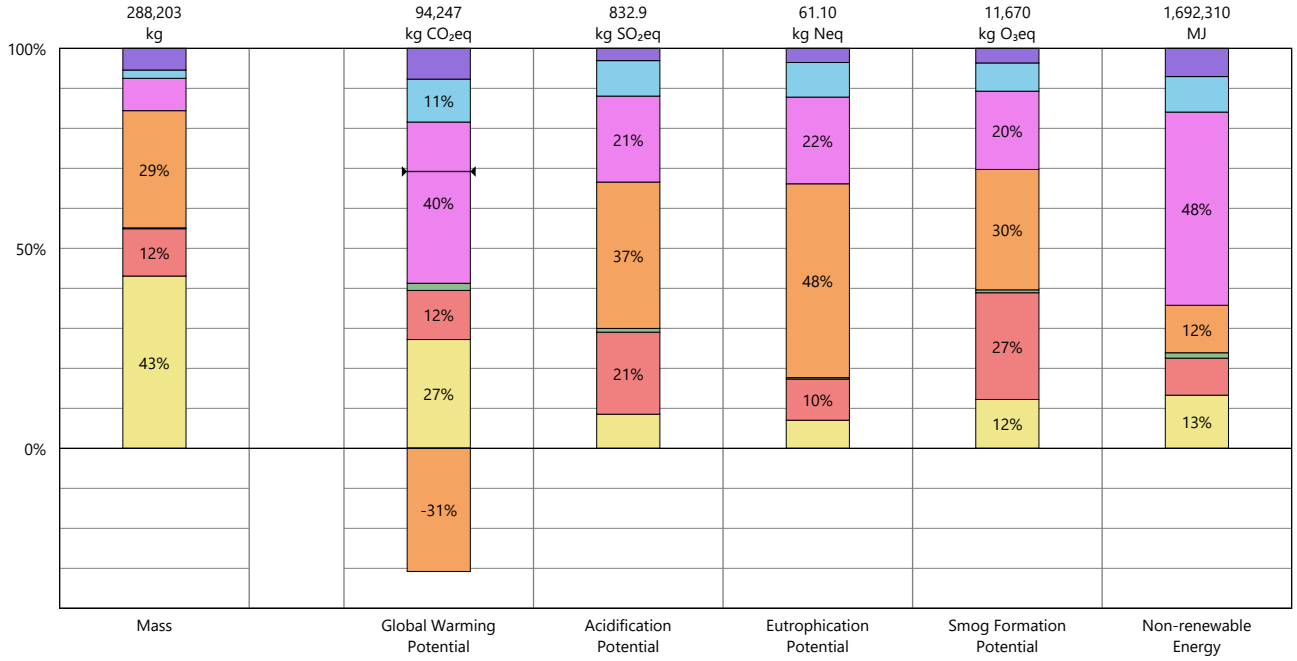
End of Life [C2-C4]

- 03 - Concrete
- 04 - Masonry
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal and Moisture Protection
- 08 - Openings and Glazing
- 09 - Finishes

Module D [D]

- 03 - Concrete
- 04 - Masonry
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal and Moisture Protection
- 08 - Openings and Glazing
- 09 - Finishes

Results per Division

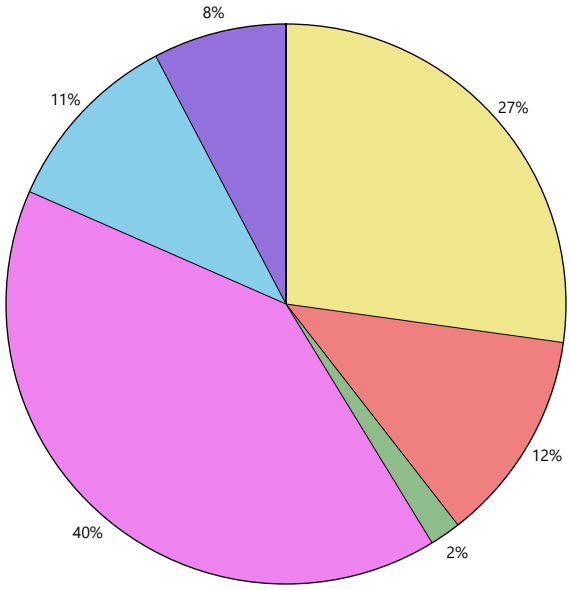


Legend

Net value (impacts + credits)

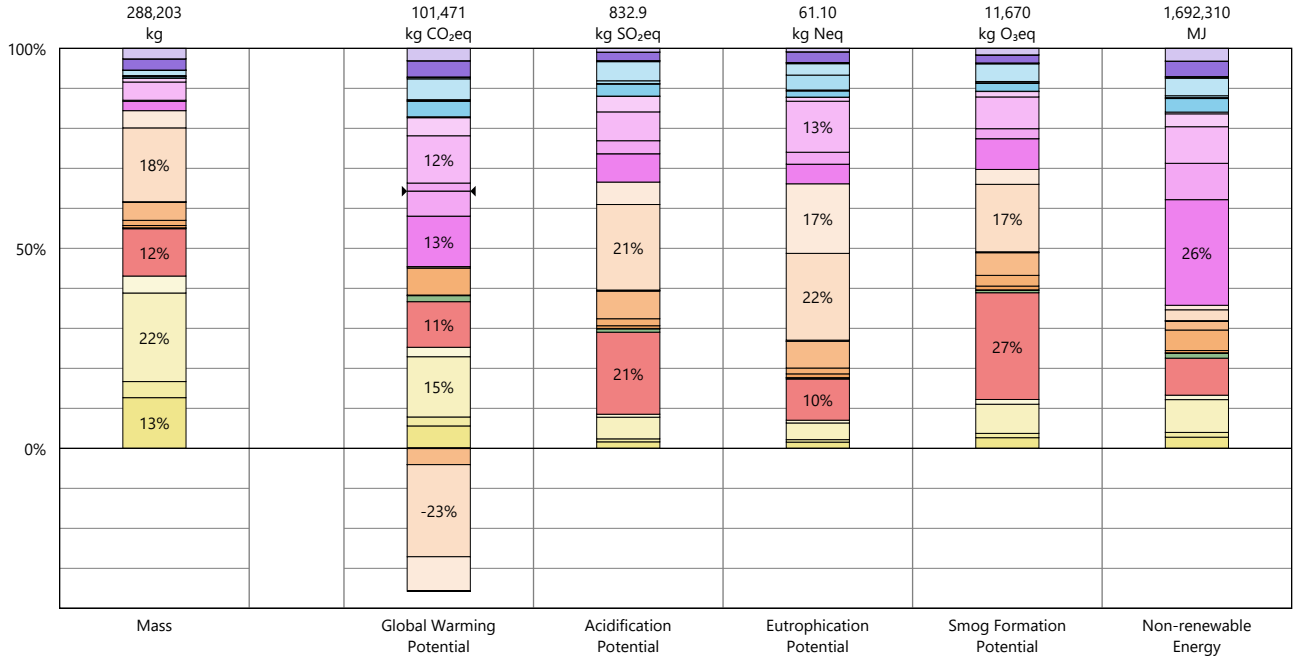
Divisions

- 03 - Concrete
- 04 - Masonry
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal and Moisture Protection
- 08 - Openings and Glazing
- 09 - Finishes



Global Warming Potential

Results per Division, itemized by Tally Entry



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Net value (impacts + credits)

03 - Concrete

- Cast-in-place concrete, structural concrete, 2500 psi
- Cast-in-place concrete, structural concrete, 3000 psi
- Cast-in-place concrete, structural concrete, 4000 psi
- Precast concrete paver

04 - Masonry

- Stone veneer wall, limestone, grouted

05 - Metals

- Aluminum, formed
- Steel, C-stud metal framing

06 - Wood/Plastics/Composites

- Domestic hardwood
- Fiber cement construction panel
- Plywood, exterior grade
- Plywood, interior grade
- Stair, hardwood, tread only
- Wood framing
- Wood framing with insulation

07 - Thermal and Moisture Protection

- Asphalt roofing shingles
- Closed cell, polyurethane foam, spray-applied
- ETFE sheet
- Fiber cement panel
- Mineral wool, board, generic
- Polyethelene sheet vapor barrier (HDPE)

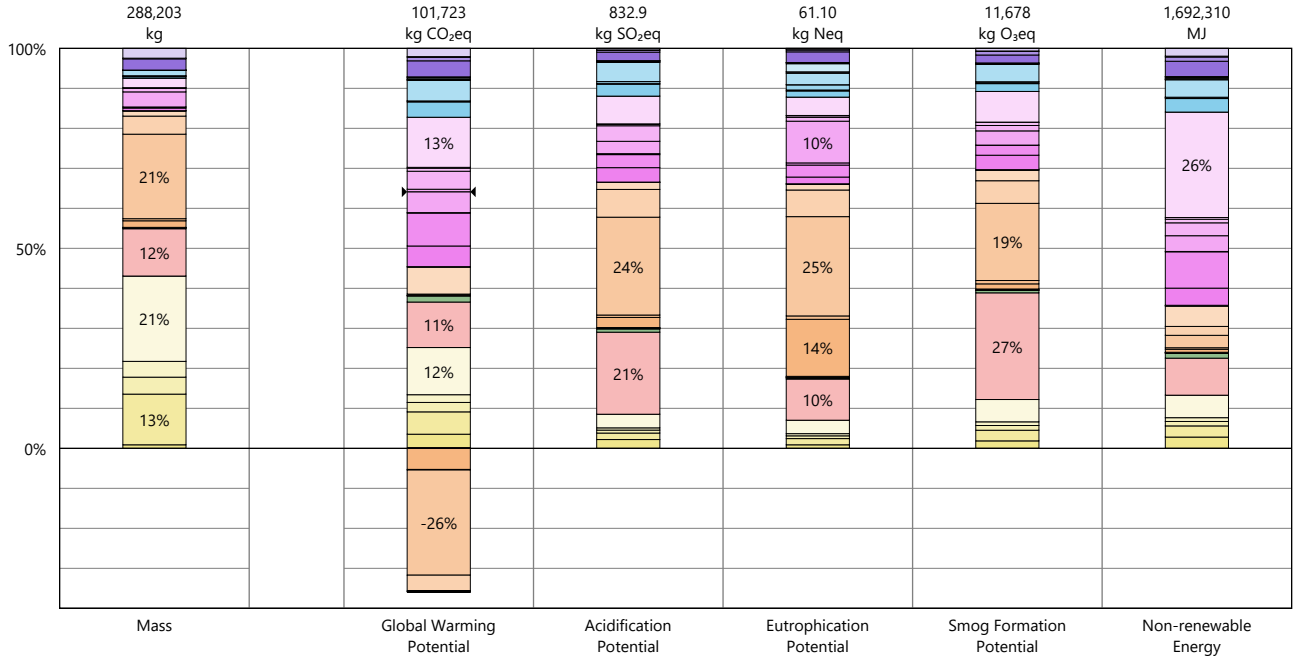
08 - Openings and Glazing

- Curtainwall System (including glazing)
- Door frame, wood
- Door, interior, wood, hollow core, flush
- Glazing, triple pane IGU
- Window frame, aluminum
- Window frame, vinyl

09 - Finishes

- Fiberglass mat gypsum sheathing
- Paint
- Wall board, gypsum

Results per Division, itemized by Material



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Net value (impacts + credits)

03 - Concrete

- Steel, reinforcing rod
- Structural concrete, 2500 psi, Great Lakes Midwest regional average
- Structural concrete, 3000 psi, 0% fly ash and slag
- Structural concrete, 3000 psi, North Central regional average
- Structural concrete, 4000 psi, North Central regional average

04 - Masonry

- Mortar type S
- Stone slab, limestone

05 - Metals

- Aluminum, formed
- Cold formed structural steel
- Paint, exterior metal coating, silicone-based, by area

06 - Wood/Plastics/Composites

- Ash lumber, 2 inch
- Birch lumber, 1 inch
- Cellulose insulation, blown
- Cherry lumber, 1 inch
- Domestic softwood, US, AWC - EPD
- Exterior grade plywood, US
- Fiber cement structural panel, Eternit, Eterplan - EPD
- Interior grade plywood, US, AWC - EPD
- Wood stain, water based

07 - Thermal and Moisture Protection

- Aluminum extrusion, AEC - EPD
- ETFE sheet
- Fasteners, stainless steel
- Fiber cement board
- Mineral wool, high density, NAIMA - EPD
- Paint, exterior acrylic latex
- Polyethelene sheet vapor barrier (HDPE)
- SBS modified asphalt, strip, ARMA - EPD
- Spray polyurethane foam, closed cell (HFO blowing agent), SPFA - EPD

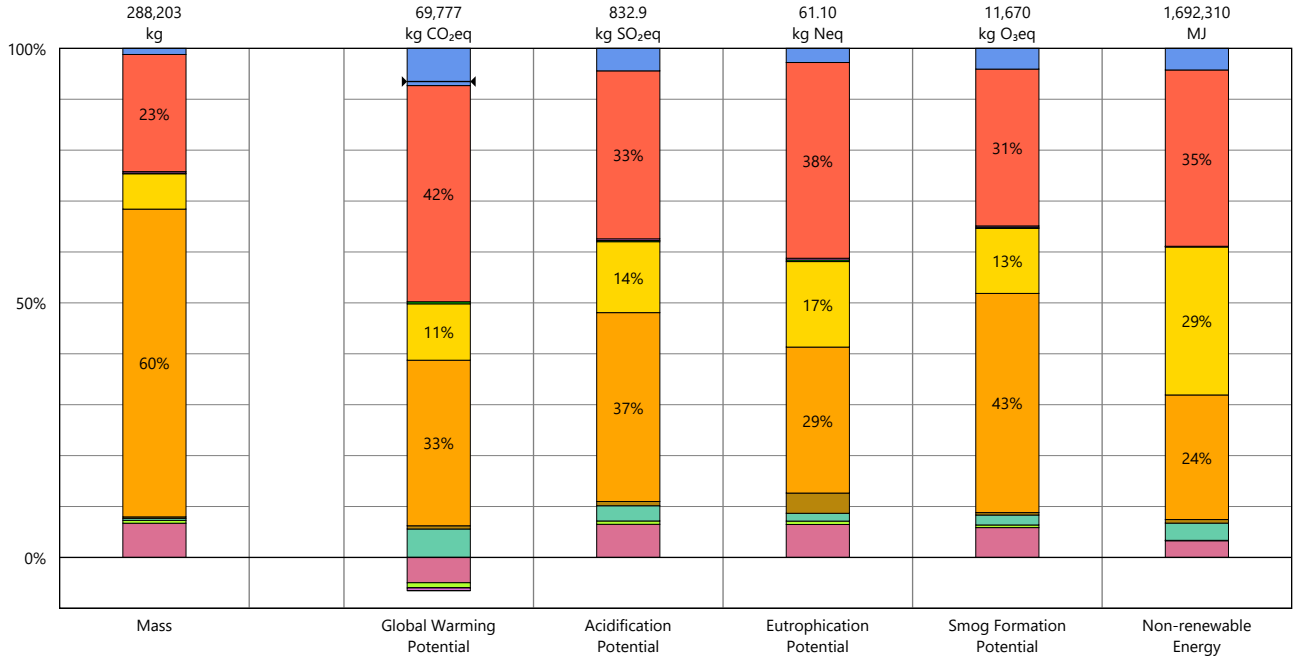
08 - Openings and Glazing

- Curtain wall system, Kawneer, 1600 Wall System - EPD
- Door frame, wood, no door
- Door, interior, wood, hollow core
- Fasteners, galvanized steel
- Glazing, triple, insulated (air)
- Hardware, stainless steel
- Paint, interior acrylic latex
- Stainless steel door hinge
- Window frame, aluminum, powder-coated, operable, insulated
- Window frame, vinyl, fixed
- Wood stain, water based

09 - Finishes

- Fiberglass mat gypsum sheathing board
- Paint, exterior acrylic latex
- Paint, interior acrylic latex
- Wall board, gypsum, natural

Results per Revit Category

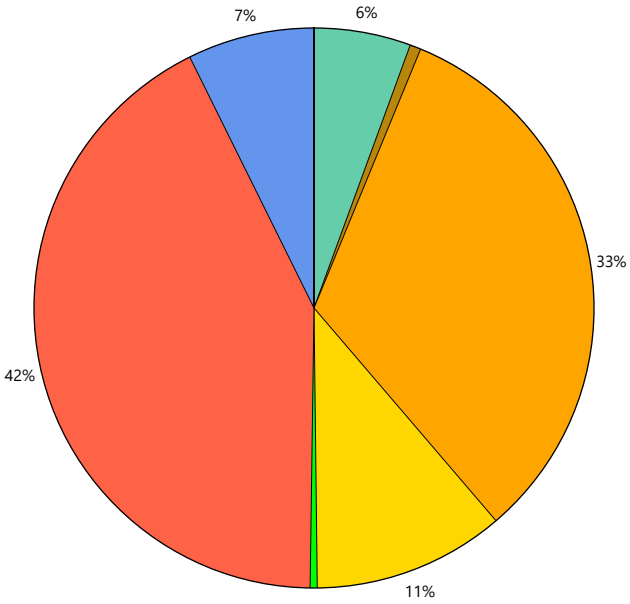


Legend

Net value (impacts + credits)

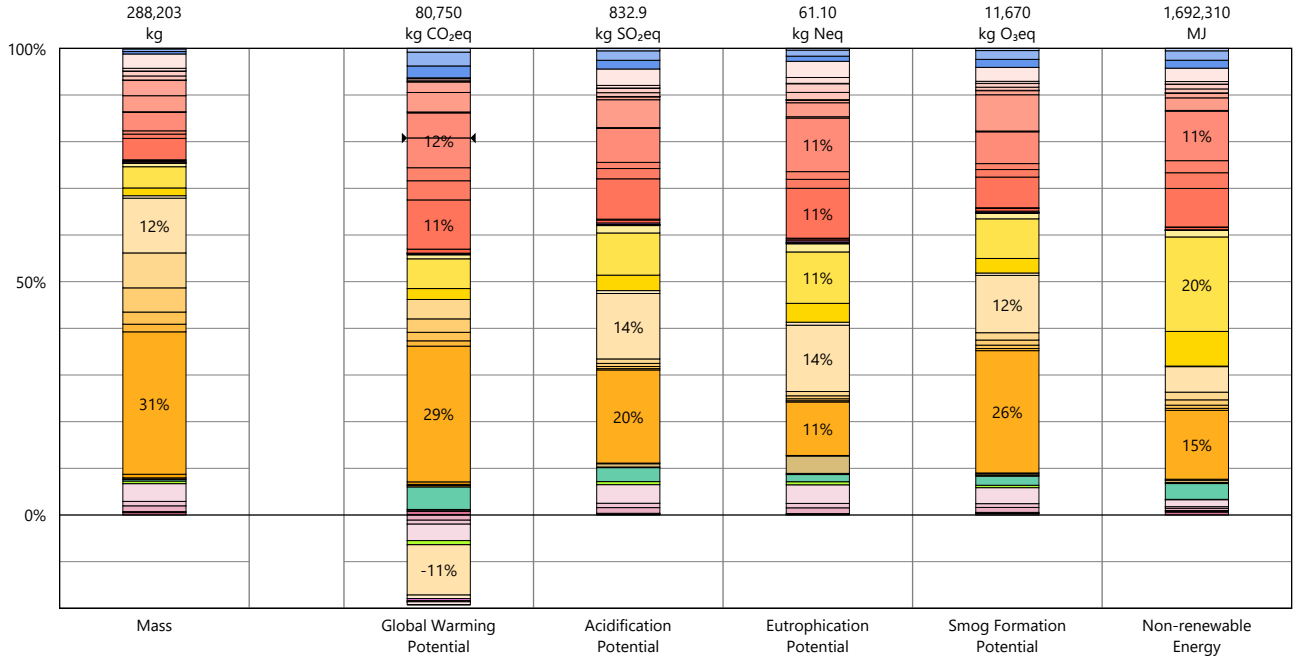
Revit Categories

- Ceilings
- Curtainwall Mullions
- Curtainwall Panels
- Doors
- Floors
- Roofs
- Stairs and Railings
- Structure
- Walls
- Windows



Global Warming Potential

Results per Revit Category, itemized by Family



Legend

Net value (impacts + credits)

Ceilings
- A ceiling
- GWB on Mtl. Stud 2 1/2" 2
- GWB on Mtl. Stud Bulkhead 4-1/4"
- GWB on wood Stud Bulkhead 4" 2
- GWB on wood Stud Bulkhead 4" 3
- UNDER TRUSS CEILING, ZIP FURRING GWB on wood TRUSS

Curtainwall Mullions
- Rectangular Mullion

Curtainwall Panels
- System Panel

Doors
- Cased Opening
- Single-Flush

Floors
- 6" Concrete
- 8" Slab on grade
- interlocking pavment
- interlocking pavment - path between porches
- pervious pavers
- porch flooring
- SOLAR DECATHLON FLOOR
- wood planks 2

Roofs
- Wood Rafter 12" - Asphalt Shingle
- Wood Rafter 12" - Asphalt Shingle 2
- Wood Rafter 12" - STANDING METAL SEAM

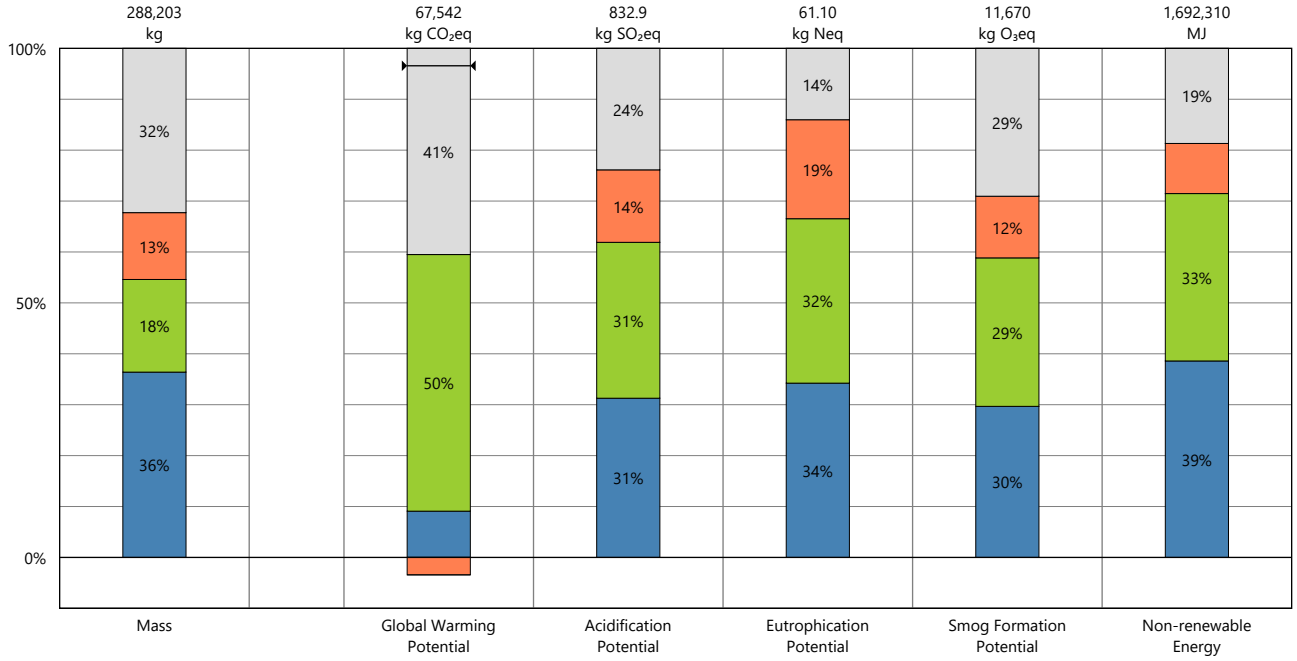
Stairs and Railings
- 7" max riser 11" tread
- 7" max riser 11" tread no back
- 8" x 10"
- 8" x 10" 2 NO RISER

Structure
- Wood Timber Column

Walls
- 1/2" glass wall
- 4" trash can barrier
- Advanced Framing - Exterior
- Advanced Framing - Exterior black planks
- Advanced Framing - Exterior black planks NO CONT. INSULATION
- Advanced Framing - Exterior NO CONT. INSULATION
- Advanced Framing - Exterior WING WALL
- Generic - 6" 3
- Generic - 8" CIP foundation wall
- Interior - 2 1/2" Partition 2
- Interior - 2" Partition
- Interior - 3/4" Partition 2
- Interior - 4 1/2" Partition
- Interior - 4 1/2" Partition INSULATED
- Interior - 4" Partition Furring
- Interior - 6 1/2" Partition
- W9A - (2)2x4 Studs Insulated 1 HR

Windows
- Window-Casement-Pella-Contemporary-Reserve-Fixed
- Window-Casement-Pella-Contemporary-Reserve-Vent
- Window-Casement-Pella-Contemporary-Reserve-Vent awning window

Results per Building Element

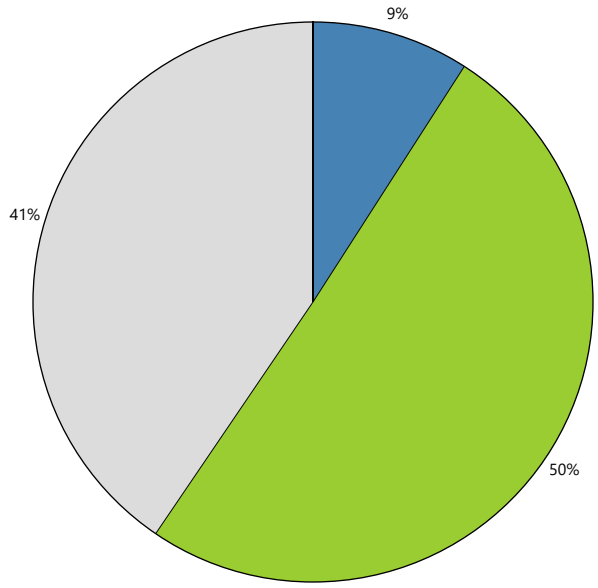


Legend

Net value (impacts + credits)

Building Elements

- Superstructure
- Enclosure
- Interiors
- Undefined



Global Warming Potential

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 63.5% of wood is sent to landfill, 22% to incineration, and 14.5% 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)

LCI Data

MODEL ELEMENTS

Revit Categories
- Ceilings
- Curtainwall Mullions
- Curtainwall Panels
- Doors
- Floors
- Roofs
- Stairs and Railings
- Structure
- Walls
- Windows

The Alley House - Ball State - 2023 SD Build Competition Model_detached

Worksets
- Workset1

Phases
- Existing
- New Construction

PRODUCT [A1-A3]

Materials and components are listed in alphabetical order along with a list of all Revit families and Tally entries in which they occur. The masses given here refer to the quantity of each material used over the building's life-cycle, which includes both Product [A1-A3] and Use [B2-B5] stages.

Additional provided data describing scope boundaries for each life cycle stage may be useful for interpretation of the impacts associated with the specific material or component. Each material or component is listed with its service life, or period of time after installation it is expected to meet the service requirements prior to replacement or repair. This value is indicated in parentheses next to the mass of the material associated with the listed Revit family. Values for transportation distance or service life shown with an asterisk (*) indicate user-defined changes to default values. Values for service life shown with a dagger (†) indicate materials identified by the modeler as existing or salvaged.

Aluminum extrusion, AEC - EPD **1,857.3 kg**

Used in the following Revit families:

Advanced Framing - Exterior	914.0 kg (60 yrs)
Advanced Framing - Exterior NO CONT. INSULATION	911.3 kg (60 yrs)
Advanced Framing - Exterior WING WALL	31.9 kg (60 yrs)

Used in the following Tally entries:
Fiber cement panel

Description:
Extruded aluminum part. Industry-wide EPD from the Aluminum Extruders Council.

Life Cycle Inventory:
For information and quantities, see EPD

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 663 km

End-of-Life Scope:
95% Recovered
5% Landfilled (inert material)

Module D Scope:
Product has 36.4% scrap input while remainder is processed and credited as avoided burden

LCI Source:
RNA: Aluminum extrusion, mill finish - AEC (A1-A3) ts-EPD (2015)
RNA: Primary Aluminum Ingot AA/ts (2010)
RNA: Secondary Aluminum Ingot AA/ts (2010)

EPD Source:
11240237.101.1

EPD Designation Holder:
Aluminum Extruders Council (AEC)

EPD Program Operator:
UL Environment

EPD Expiration:
10/4/2021

Aluminum, formed **489.2 kg**

Used in the following Revit families:

Wood Rafter 12" - STANDING METAL SEAM	489.2 kg (60 yrs)

Used in the following Tally entries:
Aluminum, formed

Description:
Formed aluminum member. Data based on industry-wide EPD for cold-rolled aluminum from the Aluminum Association (EPD ID 4786092064.101.1).

Life Cycle Inventory:
100% Aluminum

LCI Data (continued)

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 663 km

End-of-Life Scope:
95% Recovered
5% Landfilled (inert material)

Module D Scope:
Product has 65% scrap input while remainder is processed and credited as avoided burden

LCI Source:
RNA: Cold Rolled Aluminium ts/AA (2010) [EPD]
GLO: Steel sheet stamping and bending (5% loss) ts (2017)
US: Electricity grid mix ts (2014)
US: Lubricants at refinery ts (2014)
GLO: Compressed air 7 bar (medium power consumption) ts (2014)
RNA: Primary Aluminum Ingot AA/ts (2010)
RNA: Secondary Aluminum Ingot AA/ts (2010)

Ash lumber, 2 inch **253.5 kg**

Used in the following Revit families:

7" max riser 11" tread	126.9 kg (50 yrs†)
7" max riser 11" tread no back	67.5 kg (50 yrs†)
8" x 10"	29.5 kg (50 yrs†)
8" x 10" 2 NO RISER	29.5 kg (50 yrs†)

Used in the following Tally entries:
Stair, hardwood, tread only

Description:
Kiln-dried American Ash hardwood lumber of 2" nominal thickness as produced in the United States, focusing on the main production technologies. Ash is frequently used for mouldings, flooring, furniture, and doors. Link for interactive LCA data tool is provided at the link listed as "EPD Information"
full LCA report is available at
http://naturespackaging.org/wp-content/uploads/2016/02/LifeCycleAssessment-Lumber.pdf.

Life Cycle Inventory:
100% Ash

Product Scope:
Cradle to gate, uncoated

Transportation Distance:
By truck: 383 km

End-of-Life Scope:
14.5% Recovered
22% Incinerated with energy recovery
63.5% Landfilled (wood product waste)

Module D Scope:
Recovered wood products credited as avoided burden.

LCI Source:
US: Ash lumber, 2 inch (673 kg/m^3), kiln-dried ts/AHEC (2017)

EPD Source:
Information

EPD Designation Holder:
American Hardwood Export Council (AHEC)

Birch lumber, 1 inch **106.7 kg**

Used in the following Revit families:

wood planks 2	106.7 kg (50 yrs)

Used in the following Tally entries:
Domestic hardwood

Description:
Kiln-dried American Yellow Birch hardwood lumber of 1" nominal thickness as produced in the northern and southeastern United States, focusing on the main production technologies and region-specific characteristics. Birch is frequently used for furniture, panels, and millwork. Link for interactive LCA data tool is provided at the link listed as "EPD Information"
full LCA report is available at
http://naturespackaging.org/wp-content/uploads/2016/02/LifeCycleAssessment-Lumber.pdf.
Yellow birch should not be confused with paper birch, which is a softwood.

Life Cycle Inventory:
100% Birch

Product Scope:
Cradle to gate, uncoated

Transportation Distance:
By truck: 383 km

End-of-Life Scope:
14.5% Recovered
22% Incinerated with energy recovery
63.5% Landfilled (wood product waste)

Module D Scope:
Recovered wood products credited as avoided burden.

LCI Source:
US: Birch lumber, 1 inch (689 kg/m^3), kiln-dried ts/AHEC (2017)

EPD Source:
Information

EPD Designation Holder:
American Hardwood Export Council (AHEC)

Cellulose insulation, blown **4,727.6 kg**

Used in the following Revit families:

Advanced Framing - Exterior	627.7 kg (60 yrs)
Advanced Framing - Exterior black planks	170.9 kg (60 yrs)
Advanced Framing - Exterior black planks NO CONT. INSULATION	165.0 kg (60 yrs)
Advanced Framing - Exterior NO CONT. INSULATION	625.8 kg (60 yrs)
Advanced Framing - Exterior WING WALL	11.0 kg (60 yrs)
Interior - 2 1/2" Partition 2	12.0 kg (60 yrs)
Interior - 2" Partition	3.4 kg (60 yrs)
Interior - 3/4" Partition 2	0.5 kg (60 yrs)
Interior - 4 1/2" Partition	256.6 kg (60 yrs)
Interior - 4 1/2" Partition INSULATED	304.0 kg (60 yrs)
Interior - 4" Partition Furring	19.2 kg (60 yrs)
Interior - 6 1/2" Partition	252.4 kg (60 yrs)
Wood Rafter 12" - Asphalt Shingle	534.4 kg (60 yrs)
Wood Rafter 12" - Asphalt Shingle 2	1,456.6 kg (60 yrs)
Wood Rafter 12" - STANDING METAL SEAM	288.2 kg (60 yrs)

Used in the following Tally entries:
Wood framing with insulation

Description:
Blown-in cellulose insulation

Life Cycle Inventory:
Waste paper fibers
Boric acid
Boraxpentahydrate

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 1020 km

End-of-Life Scope:
100% Landfilled (biodegradable waste)

LCI Source:
DE: Cellulose fibre blowing insulation material (EN15804 A1-A3) ts (2017)

Cherry lumber, 1 inch **1,511.4 kg**

Used in the following Revit families:

SOLAR DECATHLON FLOOR	1,511.4 kg (50 yrs)

Used in the following Tally entries:
Domestic hardwood

Description:
Kiln-dried American Cherry (black cherry) hardwood lumber of 1" nominal thickness as produced in the northeastern United States, focusing on the main production technologies and region-specific characteristics. Cherry is frequently used for moulding, furniture, doors, panels, and millwork. Link for interactive LCA data tool is provided at the link listed as "EPD Information"
full LCA report is available at
http://naturespackaging.org/wp-content/uploads/2016/02/LifeCycleAssessment-Lumber.pdf.

LCI Data (continued)

Life Cycle Inventory:
100% Cherry

Product Scope:
Cradle to gate, uncoated

Transportation Distance:
By truck: 383 km

End-of-Life Scope:
14.5% Recovered
22% Incinerated with energy recovery
63.5% Landfilled (wood product waste)

Module D Scope:
Recovered wood products credited as avoided burden.

LCI Source:
US: Cherry lumber, 1 inch (561 kg/m³), kiln-dried ts/AHEC (2017)

EPD Source:
Information

EPD Designation Holder:
American Hardwood Export Council (AHEC)

Cold formed structural steel **145.2 kg**

Used in the following Revit families:

GWB on Mtl. Stud 2 1/2" 2	100.4 kg (60 yrs)
GWB on Mtl. Stud Bulkhead 4-1/4"	44.9 kg (60 yrs)

Used in the following Tally entries:
Steel, C-stud metal framing

Description:
Cold-rolled or formed structural steel, such as used in steel studs.

Life Cycle Inventory:
100% Cold rolled steel

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 431 km

End-of-Life Scope:
98% Recovered
2% Landfilled (inert material)

Module D Scope:
Product has 16% scrap input while remainder is processed and credited as avoided burden

LCI Source:
RNA: Steel finished cold rolled coil worldsteel (2007)
GLO: Steel sheet stamping and bending (5% loss) ts (2017)
US: Electricity grid mix ts (2014)
US: Lubricants at refinery ts (2014)
GLO: Compressed air 7 bar (medium power consumption) ts (2014)
GLO: Value of scrap worldsteel (2014)

Curtain wall system, Kawneer, 1600 Wall System - EPD **1,152.4 kg**

Used in the following Revit families:

System Panel	1,152.4 kg (60 yrs)

Used in the following Tally entries:
Curtainwall System (including glazing)

Description:
Thermally broken aluminum curtain wall system by Kawneer INCLUSIVE of glazing units, appropriate for low-to-mid-rise applications, including the 1600, 1620, 1630, 2250, and 7500 curtainwall system lines. Includes mullions, glazing, and all necessary gaskets and sealants. The reference window unit size is 1.5m x 1.6m. EPD representative of conditions in North America.

Life Cycle Inventory:
For information and quantities, see EPD

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 663 km

End-of-Life Scope:
95% recovery rate
5% landfill (inert)

Module D Scope:
Credit given for the avoided burden associated with recovered material

LCI Source:
EPD (US), Kawneer North America (2015)

EPD Source:
47868332121.105.1

EPD Designation Holder:
Kawneer North America

EPD Program Operator:
UL Environment

EPD Expiration:
11/16/2020

Domestic softwood, US, AWC - EPD **60,890.6 kg**

Used in the following Revit families:

4" trash can barrier	450.7 kg (30 yrs)
7" max riser 11" tread	13.0 kg (30 yrs)
8" x 10"	61.6 kg (30 yrs)
8" x 10" 2 NO RISER	54.0 kg (30 yrs)
Advanced Framing - Exterior	1,073.8 kg (30 yrs)
Advanced Framing - Exterior black planks	257.3 kg (30 yrs)
Advanced Framing - Exterior black planks NO CONT. INSULATION	248.4 kg (30 yrs)
Advanced Framing - Exterior NO CONT. INSULATION	942.1 kg (30 yrs)
Advanced Framing - Exterior WING WALL	21.0 kg (30 yrs)
GWB on wood Stud Bulkhead 4" 2	2,793.3 kg (30 yrs)
GWB on wood Stud Bulkhead 4" 3	2,129.9 kg (30 yrs)
Interior - 2 1/2" Partition 2	66.2 kg (30 yrs)
Interior - 2" Partition	18.5 kg (30 yrs)
Interior - 3/4" Partition 2	7.6 kg (30 yrs)
Interior - 4 1/2" Partition	607.1 kg (30 yrs)
Interior - 4 1/2" Partition INSULATED	719.3 kg (30 yrs)
Interior - 4" Partition Furring	45.3 kg (30 yrs)
Interior - 6 1/2" Partition	379.9 kg (30 yrs)
Rectangular Mullion	1,624.6 kg (30 yrs)
SOLAR DECATHLON FLOOR	27,742.2 kg (30 yrs)
UNDER TRUSS CEILING, ZIP FURRING GWB on wood TRUSS	7,557.5 kg (30 yrs)
W9A - (2)2x4 Studs Insulated 1 HR	6,099.0 kg (30 yrs)
Window-Casement-Pella-Contemporary-Reserve-Fixed	0.0 kg (30 yrs)
wood planks 2	1,275.5 kg (30 yrs)
Wood Rafter 12" - Asphalt Shingle	1,376.9 kg (30 yrs)
Wood Rafter 12" - Asphalt Shingle 2	3,752.9 kg (30 yrs)
Wood Rafter 12" - STANDING METAL SEAM	742.5 kg (30 yrs)
Wood Timber Column	830.4 kg (30 yrs)

Used in the following Tally entries:
Wood framing
Wood framing with insulation

Description:
Kiln-dried and planed softwood dimensional lumber for standard framing or planking. Industry-wide EPD from the American Wood Council.

Life Cycle Inventory:
For information and quantities, see EPD

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 383 km

End-of-Life Scope:
14.5% Recovered
22% Incinerated with energy recovery
63.5% Landfilled (wood product waste)

Module D Scope:
Recovered wood products credited as avoided burden.

LCI Source:
RNA: Softwood lumber CORRIM (2011)

EPD Source:
13CA24184.102.1

LCI Data (continued)

EPD Designation Holder:
American Wood Council and Canadian Wood Council

EPD Program Operator:
UL Environment

EPD Expiration:
4/16/2019

Door frame, wood, no door **64.7 kg**

Used in the following Revit families:

Cased Opening	64.7 kg (30 yrs)

Used in the following Tally entries:
Door frame, wood

Description:
Wood door frame

Life Cycle Inventory:
94% Pine
6% Paint

Product Scope:
Cradle to gate, excludes hardware, jamb, casing, sealant

Transportation Distance:
By truck: 496 km

End-of-Life Scope:
14.5% recovered
22% incinerated with energy recovery
63.5% landfilled (wood product waste)

Module D Scope:
Recovered wood products credited as avoided burden.

LCI Source:
DE: Wooden frame (EN15804 A1-A3) ts (2017)

Door, interior, wood, hollow core **628.8 kg**

Used in the following Revit families:

Single-Flush	628.8 kg (30 yrs)

Used in the following Tally entries:
Door, interior, wood, hollow core, flush

Description:
Interior wood door with hollow core

Life Cycle Inventory:
100% Wood

Product Scope:
Cradle to gate, excludes assembly, frame, hardware, and adhesives

Transportation Distance:
By truck: 496 km

End-of-Life Scope:
14.5% Wood products recovered
22% Wood products incinerated with energy recovery
63.5% Wood products landfilled (wood product waste)

Module D Scope:
Recovered wood products credited as avoided burden.

LCI Source:
RNA: Softwood plywood CORRIM (2011)

ETFE sheet **761.6 kg**

Used in the following Revit families:

Advanced Framing - Exterior black planks	112.1 kg (20 yrs)
Advanced Framing - Exterior black planks NO CONT. INSULATION	108.3 kg (20 yrs)
Advanced Framing - Exterior NO CONT. INSULATION	410.6 kg (20 yrs)
W9A - (2)2x4 Studs Insulated 1 HR	130.5 kg (20 yrs)

Used in the following Tally entries:
ETFE sheet

Description:
ETFE membrane
entry exclusive of adhesive or other co-products

Life Cycle Inventory:
100% ETFE membrane

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 1299 km

End-of-Life Scope:
100% Landfilled (plastic waste)

LCI Source:
DE: Ethylene tetrafluorethylene granulate (ETFE) ts (2017)
GLO: Plastic Film (PE, PP, PVC) ts (2017)
US: Electricity grid mix ts (2014)
US: Thermal energy from natural gas ts (2014)
US: Lubricants at refinery ts (2014)

Exterior grade plywood, US **13,026.9 kg**

Used in the following Revit families:

Advanced Framing - Exterior	1,730.8 kg (30 yrs)
Advanced Framing - Exterior black planks	471.3 kg (30 yrs)
Advanced Framing - Exterior black planks NO CONT. INSULATION	455.1 kg (30 yrs)
Advanced Framing - Exterior NO CONT. INSULATION	1,725.7 kg (30 yrs)
Advanced Framing - Exterior WING WALL	60.4 kg (30 yrs)
SOLAR DECATHLON FLOOR	2,206.5 kg (30 yrs)
UNDER TRUSS CEILING, ZIP FURRING GWB on wood TRUSS	1,288.0 kg (30 yrs)
W9A - (2)2x4 Studs Insulated 1 HR	480.0 kg (30 yrs)
Wood Rafter 12" - Asphalt Shingle	1,080.7 kg (30 yrs)
Wood Rafter 12" - Asphalt Shingle 2	2,945.6 kg (30 yrs)
Wood Rafter 12" - STANDING METAL SEAM	582.7 kg (30 yrs)

Used in the following Tally entries:
Plywood, exterior grade

Description:
Plywood, unfinished

Life Cycle Inventory:
Proxied by interior grade plywood

Product Scope:
Cradle to gate, uncoated

Transportation Distance:
By truck: 468 km

End-of-Life Scope:
14.5% Recovered
22% Incinerated with energy recovery
63.5% Landfilled (wood product waste)

Module D Scope:
Recovered wood products credited as avoided burden.

LCI Source:
RNA: Softwood plywood CORRIM (2011)

Fasteners, galvanized steel **1.1 kg**

Used in the following Revit families:

Cased Opening	1.1 kg (40 yrs)

Used in the following Tally entries:
Door frame, wood

Description:
Galvanized steel part, appropriate for use as fasteners and specialized hardware (bolts, rails, clips, etc.).

Life Cycle Inventory:
100% Galvanized steel

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 1001 km

End-of-Life Scope:
70% Recovered
30% Landfilled (inert material)

Module D Scope:
Product has 16% scrap input while remainder is processed and credited as avoided burden

LCI Data (continued)

LCI Source:
GLO: Steel wire rod worldsteel (2014)
GLO: Steel turning ts (2017)
GLO: Electrolytic galvanisation (1 m^2 steel sheet part, electrolytic) ts (2017)
GLO: Value of scrap worldsteel (2014)

Fasteners, stainless steel **43.3 kg**

Used in the following Revit families:

Advanced Framing - Exterior	9.1 kg (60 yrs)
Advanced Framing - Exterior NO CONT. INSULATION	9.1 kg (60 yrs)
Advanced Framing - Exterior WING WALL	0.3 kg (60 yrs)
Wood Rafter 12" - Asphalt Shingle	6.6 kg (30 yrs)
Wood Rafter 12" - Asphalt Shingle 2	18.1 kg (30 yrs)

Used in the following Tally entries:
Asphalt roofing shingles
Fiber cement panel

Description:
Stainless steel part, appropriate for use as fasteners and specialized hardware (bolts, rails, clips, etc.). Data based on industry-wide EPDs for primary and secondary metal from the World Steel Association.

Life Cycle Inventory:
100% Stainless steel

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 1001 km

End-of-Life Scope:
98% Recovered
2% Landfilled (inert material)

Module D Scope:
Product has 58% scrap input while remainder is processed and credited as avoided burden

LCI Source:
RER: Stainless steel Quarto plate (304) Eurofer (2010)
GLO: Steel turning ts (2017)
US: Electricity grid mix ts (2014)
RER: Stainless steel flat product (304) - value of scrap Eurofer (2010)

Fiber cement board **10,869.8 kg**

Used in the following Revit families:

Advanced Framing - Exterior	5,349.3 kg (50 yrs)
Advanced Framing - Exterior NO CONT. INSULATION	5,333.7 kg (50 yrs)
Advanced Framing - Exterior WING WALL	186.8 kg (50 yrs)

Used in the following Tally entries:
Fiber cement panel

Description:
Medium density fiber cement board, for interior and exterior, as cladding material for curtain-type ventilated facades, roofing, for decorative interior finishing, drywall, foundation base, or permanent formwork. Default thickness 5/16".

Life Cycle Inventory:
40% Cement
10% Cellulose
25% Sand
25% Fly ash

Product Scope:
Cradle to gate, excluding any coatings

Transportation Distance:
By truck: 172 km

End-of-Life Scope:
100% landfilled (10% biodegradable waste, 90% inert waste)

Module D Scope:
Credit associated with energy recovered from landfill gas utilization

LCI Source:
DE: Fly ash (EN15804 A1-A3) ts (2017)
US: Portland cement PCA/ts (2014)
DE: Cellulose fibre boards (EN 15804 A1-A3) ts (2017)
US: Silica sand (Excavation and processing) ts (2017)

Fiber cement structural panel, Eternit, Eterplan - EPD **3,733.9 kg**

Used in the following Revit families:

Advanced Framing - Exterior black planks	734.0 kg (60 yrs)
Advanced Framing - Exterior black planks NO CONT. INSULATION	708.8 kg (60 yrs)
SOLAR DECATHLON FLOOR	2,291.1 kg (60 yrs)

Used in the following Tally entries:
Fiber cement construction panel

Description:
Fiber cement structural construction panel by Eternit. 10 mm thick. EPD representative of German (DE) conditions.

Life Cycle Inventory:
For information and quantities, see EPD.

Product Scope:
Cradle to gate, including packaging

Transportation Distance:
By truck: 172 km

End-of-Life Scope:
100% landfill (inert waste)

LCI Source:
DE: Construction panel Eterplan - Eternit (A1-A3) ts-EPD (2012)

EPD Source:
EPD-ETE-2013211-E

EPD Designation Holder:
Eternit AG

EPD Program Operator:
Institut Bauen und Umwelt (IBU)

EPD Expiration:
1/13/2018

Fiberglass mat gypsum sheathing board **8,058.8 kg**

Used in the following Revit families:

Advanced Framing - Exterior	1,268.0 kg (60 yrs)
Advanced Framing - Exterior black planks	345.3 kg (60 yrs)
Advanced Framing - Exterior black planks NO CONT. INSULATION	333.4 kg (60 yrs)
Advanced Framing - Exterior NO CONT. INSULATION	1,264.3 kg (60 yrs)
Interior - 2 1/2" Partition 2	177.7 kg (60 yrs)
Interior - 2" Partition	24.9 kg (60 yrs)
Interior - 3/4" Partition 2	5.1 kg (60 yrs)
Interior - 4 1/2" Partition	1,629.4 kg (60 yrs)
Interior - 4 1/2" Partition INSULATED	1,930.4 kg (60 yrs)
Interior - 4" Partition Furring	60.8 kg (60 yrs)
Interior - 6 1/2" Partition	1,019.6 kg (60 yrs)

Used in the following Tally entries:
Fiberglass mat gypsum sheathing

Description:
Fiberglass treated gypsum sheathing product appropriate for use in high-moisture environments.

Life Cycle Inventory:
92% Gypsum
8% Fiberglass mat

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 172 km

End-of-Life Scope:
100% Landfilled (inert waste)

LCI Source:
DE: Gypsum plaster board (Moisture resistant) (EN15804 A1-A3) ts (2017)
US: Fiberglass Duct Board NAIMA (2007)

LCI Data (continued)

Glazing, triple, insulated (air) **3,837.0 kg**

Used in the following Revit families:

1/2" glass wall	508.4 kg (40 yrs)
Window-Casement-Pella-Contemporary-Reserve-Fixed	1,497.3 kg (40 yrs)
Window-Casement-Pella-Contemporary-Reserve-Vent	1,515.9 kg (40 yrs)
Window-Casement-Pella-Contemporary-Reserve-Vent awning window	315.4 kg (40 yrs)

Used in the following Tally entries:
Glazing, triple pane IGU

Description:
Glazing, triple, insulated (air filled), 1/8" (4 mm) float glass clear, inclusive of sealant, and spacers

Life Cycle Inventory:
Triple-pane glass IGU (Air filled, with spacer and sealant)

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 940 km

End-of-Life Scope:
100% Landfilled (inert waste)

LCI Source:
DE: Insulation glass compound (3 panes) ts (2017), modified to exclude coating and argon

Hardware, stainless steel **34.9 kg**

Used in the following Revit families:

Single-Flush	34.9 kg (60 yrs)

Used in the following Tally entries:
Door, interior, wood, hollow core, flush

Description:
Finished, cast stainless steel, applicable for door, window or other accessory hardware

Life Cycle Inventory:
100% Stainless steel

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 1001 km

End-of-Life Scope:
98% Recovered
2% Landfilled (inert material)

Module D Scope:
Product has 58% scrap input while remainder is processed and credited as avoided burden

LCI Source:
RER: Stainless steel Quarto plate (304) Eurofer (2010)
DE: Steel cast part machining ts (2017)
US: Electricity grid mix ts (2014)
RER: Stainless steel flat product (304) - value of scrap Eurofer (2010)

Interior grade plywood, US, AWC - EPD **114.1 kg**

Used in the following Revit families:

wood planks 2	114.1 kg (30 yrs)

Used in the following Tally entries:
Plywood, interior grade

Description:
Plywood, unfinished. Industry-wide EPD from the American Wood Council.

Life Cycle Inventory:
For information and quantities, see EPD

Product Scope:
Cradle to gate, uncoated

Transportation Distance:
By truck: 468 km

End-of-Life Scope:
14.5% Recovered
22% Incinerated with energy recovery
63.5% Landfilled (wood product waste)

Module D Scope:
Recovered wood products credited as avoided burden.

LCI Source:
RNA: Softwood plywood CORRIM (2011)

EPD Source:
13CA24184.103.1

EPD Designation Holder:
American Wood Council and Canadian Wood Council

EPD Program Operator:
UL Environment

EPD Expiration:
4/16/2019

Mineral wool, high density, NAIMA - EPD **2,581.2 kg**

Used in the following Revit families:

Advanced Framing - Exterior	2,028.8 kg (60 yrs)
Advanced Framing - Exterior black planks	552.4 kg (60 yrs)

Used in the following Tally entries:
Mineral wool, board, generic

Description:
Rock board, heavy density. Industry-wide EPD from the North America Insulation Manufacturers Association. EPD representative of conditions in North America.

Life Cycle Inventory:
For information and quantities, see EPD

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 172 km

End-of-Life Scope:
100% Landfilled (inert waste)

LCI Source:
US: Rock board insulation (heavy density) NAIMA (2007)

EPD Source:
4786060412.102.1

EPD Designation Holder:
North American Insulation Manufacturer's Association (NAIMA)

EPD Program Operator:
UL Environment

EPD Expiration:
11/8/2018

Mortar type S **0.0 kg**

Used in the following Revit families:

8" Slab on grade	0.0 kg (60 yrs†)
Generic - 6" 3	0.0 kg (60 yrs)

Used in the following Tally entries:
Stone veneer wall, limestone, grouted

Description:
Mortar Type S (medium strength mortar) for use with masonry walls and flooring.

Life Cycle Inventory:
Dried mix: 78% sand
17% cement
4% calcium hydroxide
1% limestone (12% water evaporates on drying)

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 172 km

End-of-Life Scope:
55% Recycled into coarse aggregate
45% Landfilled (inert material)

Module D Scope:
Avoided burden credit for coarse aggregate, includes grinding energy

LCI Data (continued)

LCI Source:
DE: Siliceous sand (grain size 0/2) ts (2017)
DE: Cement (CEM I 32.5) (EN15804 A1-A3) ts (2017)
DE: Gravel (Grain size 2/32) (EN15804 A1-A3) ts (2017)
US: Tap water from groundwater ts (2017)

Paint, exterior acrylic latex **811.0 kg**

Used in the following Revit families:

A ceiling	98.7 kg (10 yrs)
Advanced Framing - Exterior	182.8 kg (10 yrs)
Advanced Framing - Exterior NO CONT. INSULATION	182.3 kg (10 yrs)
Advanced Framing - Exterior WING WALL	6.4 kg (10 yrs)
GWB on Mtl. Stud 2 1/2" 2	19.2 kg (10 yrs)
GWB on Mtl. Stud Bulkhead 4-1/4"	12.8 kg (10 yrs)
GWB on wood Stud Bulkhead 4" 2	53.1 kg (10 yrs)
GWB on wood Stud Bulkhead 4" 3	40.5 kg (10 yrs)
UNDER TRUSS CEILING, ZIP FURRING GWB on wood TRUSS	141.7 kg (10 yrs)
W9A - (2)2x4 Studs Insulated 1 HR	57.9 kg (10 yrs)
Window-Casement-Pella-Contemporary-Reserve-Vent	15.6 kg (10 yrs)

Used in the following Tally entries:
Fiber cement panel
Paint
Wall board, gypsum

Description:
Acrylic-based latex paint for exterior applications. Associated reference table includes primer.

Life Cycle Inventory:
20.5% Binding agent
35% Pigments and fillers
40% Water
4.5% Organic solvents

Product Scope:
Cradle to gate, including emissions during application

Transportation Distance:
By truck: 642 km

End-of-Life Scope:
100% to landfill (plastic waste)

LCI Source:
DE: Application paint emulsion (building, exterior, white) ts (2017)

Paint, exterior metal coating, silicone-based, by area **5.3 kg**

Used in the following Revit families:

Wood Rafter 12" - STANDING METAL SEAM	5.3 kg (30 yrs)

Used in the following Tally entries:
Aluminum, formed

Description:
Silicone-based metal paint, with a default coating thickness of 100 microns

Life Cycle Inventory:
23% Binding agent
35% Pigments and fillers
40% Water
1.5% Organic solvents

Product Scope:
Cradle to gate, including emissions during application

Transportation Distance:
By truck: 642 km

End-of-Life Scope:
100% to landfill (plastic waste)

LCI Source:
DE: Application coating silicone (building, exterior, white) ts (2017)

Paint, interior acrylic latex **103.6 kg**

Used in the following Revit families:

Single-Flush	34.1 kg (7 yrs)
W9A - (2)2x4 Studs Insulated 1 HR	69.5 kg (7 yrs)

Used in the following Tally entries:
Door, interior, wood, hollow core, flush
Wall board, gypsum

Description:
Acrylic-based paint for interior applications

Life Cycle Inventory:
21% Binding agent
35% Pigments and fillers
42% Water
2% Organic solvents

Product Scope:
Cradle to gate, including emissions during application

Transportation Distance:
By truck: 642 km

End-of-Life Scope:
100% to landfill (plastic waste)

LCI Source:
DE: Application paint emulsion (building, interior, white, wear resistant) ts (2017)

Polyethelene sheet vapor barrier (HDPE) **89.8 kg**

Used in the following Revit families:

Advanced Framing - Exterior	35.2 kg (60 yrs)
Advanced Framing - Exterior black planks	9.6 kg (60 yrs)
Advanced Framing - Exterior black planks NO CONT. INSULATION	9.3 kg (60 yrs)
Advanced Framing - Exterior NO CONT. INSULATION	35.1 kg (60 yrs)
Advanced Framing - Exterior WING WALL	0.6 kg (60 yrs)

Used in the following Tally entries:
Polyethelene sheet vapor barrier (HDPE)

Description:
Polyethelene sheet vapor barrier (HDPE) membrane
entry exclusive of adhesive or other co-products

Life Cycle Inventory:
100% Polyethylene film

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 1299 km

End-of-Life Scope:
10.5% Recycled into HDPE
89.5% Landiflled (plastic waste)

Module D Scope:
Avoided burden credit includes processing

LCI Source:
US: Polyethylene High Density Granulate (PE-HD) ts (2017)
GLO: Plastic Film (PE, PP, PVC) ts (2017)
US: Electricity grid mix ts (2014)
US: Thermal energy from natural gas ts (2014)
US: Lubricants at refinery ts (2014)

SBS modified asphalt, strip, ARMA - EPD **6,735.5 kg**

Used in the following Revit families:

Wood Rafter 12" - Asphalt Shingle	1,807.9 kg (20 yrs)
Wood Rafter 12" - Asphalt Shingle 2	4,927.6 kg (20 yrs)

Used in the following Tally entries:
Asphalt roofing shingles

Description:
SBS-modified asphalt shingle assembly, including starter strip and hip and ridge shingles. User to add any felt underlayment, fiberglass leak barrier, flashing, vents, nails, laminating adhesives, and sealant. Industry-wide EPD from the Asphalt Roofing Manufacturers Association.

Life Cycle Inventory:
For information and quantities, see EPD.

LCI Data (continued)

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 172 km

End-of-Life Scope:
5% recycled into bitumen (includes grinding energy and avoided burden credit)
95% landfilled (inert waste)

LCI Source:
RNA: Asphalt shingles, asphalt shingle roofing system component - ARMA (A1-A3) ts (2012)

EPD Source:
4787168709.101.1

EPD Designation Holder:
Asphalt Roofing Manufacturers Association (ARMA)

EPD Program Operator:
UL Environment

EPD Expiration:
10/28/2021

Spray polyurethane foam, closed cell (HFO blowing agent), SPFA - EPD **0.0 kg**

Used in the following Revit families:

Window-Casement-Pella-Contemporary-Reserve-Fixed	0.0 kg (60 yrs)
Window-Casement-Pella-Contemporary-Reserve-Vent	0.0 kg (60 yrs)
Window-Casement-Pella-Contemporary-Reserve-Vent awning window	0.0 kg (60 yrs)

Used in the following Tally entries:
Closed cell, polyurethane foam, spray-applied

Description:
Two-component polyurethane mixture insulation spray applied at installation site. Closed-cell, or medium density foam, (ccSPF) provides a water-resistant insulation, air-sealing, water vapor control and delivers added structural performance to the building envelope. HFO blowing agent is used. R Value: 6.2 ($ft^2hr°F/Btu$)/in

Life Cycle Inventory:
For information and quantities, see EPD

Product Scope:
Cradle to gate, includes emission of blowing agent during use (24% of total blowing agent)

Transportation Distance:
By truck: 1683 km

End-of-Life Scope:
100% landfilled (plastic), including emission of blowing agent (16% of total blowing agent
50% of blowing agent remains in product after disposal)

Module D Scope:
Energy recovered from landfilling of packaging waste

LCI Source:
EPD (US), SPFA (2018)

EPD Source:
ASTM-EPD085

EPD Designation Holder:
Spray Polyurethane Foam Alliance

EPD Program Operator:
ASTM International

EPD Expiration:
10/29/2023

Stainless steel door hinge **48.6 kg**

Used in the following Revit families:

Single-Flush	48.6 kg (30 yrs)

Used in the following Tally entries:
Door, interior, wood, hollow core, flush

Description:
Stainless steel and aluminum door and window hinge. Data based on product-specifc EPD from FSB.

Life Cycle Inventory:
See EPD

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 1001 km

End-of-Life Scope:
98% Recovered
2% Landfilled (inert material)

Module D Scope:
Product has a 0% scrap input while remainder is processed and credited as avoided burden.

LCI Source:
DE: Door and window hinge - FV S+B PE-EPD (2009)
RER: Stainless steel flat product (304) - value of scrap Eurofer (2010)

EPD Source:
EPD-FSB-2010111-D

EPD Designation Holder:
Franz Schneider

EPD Program Operator:
Institut Bauen and Umwelt (IBU)

EPD Expiration:
1/14/2016

Steel, reinforcing rod **2,548.5 kg**

Used in the following Revit families:

6" Concrete	41.4 kg (60 yrs)
8" Slab on grade	2,331.3 kg (60 yrs)
Generic - 8" CIP foundation wall	175.9 kg (60 yrs)

Used in the following Tally entries:
Cast-in-place concrete, structural concrete, 3000 psi
Cast-in-place concrete, structural concrete, 4000 psi

Description:
Common unfinished tempered steel rod suitable for structural reinforcement (rebar)

Life Cycle Inventory:
100% Steel rebar

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 431 km

End-of-Life Scope:
70% Recovered
30% Landfilled (inert material)

Module D Scope:
Product has a 16.4% scrap input while remainder is processed and credited as avoided burden.

LCI Source:
GLO: Steel rebar worldsteel (2014)

Stone slab, limestone **34,073.4 kg**

Used in the following Revit families:

8" Slab on grade	24,150.1 kg (60 yrs)
Generic - 6" 3	9,923.3 kg (60 yrs)

Used in the following Tally entries:
Stone veneer wall, limestone, grouted

Description:
Cut limestone slab, such as for use in a veneer wall assembly.

Life Cycle Inventory:
100% Limestone

Product Scope:
Cradle to gate
excludes mortar
anchors, ties, and metal accessories outside of scope (<1% mass)

Transportation Distance:
By truck: 217 km

End-of-Life Scope:
55% Recycled into coarse aggregate

LCI Data (continued)

45% Landfilled (inert material)

Module D Scope:
Avoided burden credit for coarse aggregate, includes grinding energy

LCI Source:
DE: Natural stone slab, flexible, facade (EN15804 A1-A3) ts (2017)

Structural concrete, 2500 psi, Great Lakes Midwest regional average 36,509.0 kg

Used in the following Revit families:

pervious pavers	14,932.7 kg (60 yrs)
porch flooring	21,576.3 kg (60 yrs)

Used in the following Tally entries:
Cast-in-place concrete, structural concrete, 2500 psi

Description:
Structural concrete, 2500 psi, Great Lakes Midwest regional average. Mix design matches National Ready-Mix Concrete Association (NRMCA) Industry-wide EPD.

Life Cycle Inventory:
Coarse aggregate: 45%, Sand: 38%, Portland cement PCA - EPD: 9%, Water: 7%, Fly ash: 1%, Expanded slag: 1%, Admixture: <1%

Product Scope:
Cradle to gate
Anchors, ties, and metal accessories outside of scope (<1% mass)

Transportation Distance:
By truck: 24 km

End-of-Life Scope:
55% Recycled into coarse aggregate
45% Landfilled (inert material)

Module D Scope:
Avoided burden credit for coarse aggregate, includes grinding energy

LCI Source:
US: Portland cement PCA/ts (2014)
DE: Pumice gravel (grain size 4/16) (EN15804 A1-A3) ts (2017)
DE: Gravel (Grain size 2/32) (EN15804 A1-A3) s (2017)
DE: Fly ash (EN15804 A1-A3) ts (2017)
DE: Slag-tap granulate (EN15804 A1-A3) ts (2017)
DE: Expanded clay (EN15804 A1-A3) ts (2017)
DE: alcium nitrate ts (2017)
DE: Sodium ligninsulfonate ts (2017)
DE: Sodium naphtalene sulfonate [estimated] ts (2017)
US: Sodium hydroxide (caustic soda) ix (100%) ts (2017)
US: Colophony (rosin, refined) from CN pine gum rosin ts (2017)
US: Tap water from groundwater ts (2017)
US: Electricity grid mix s (2014)
US: Natural gas mix ts (2014)
US: Diesel mix at filling station (100% fossil) ts (2014)
US: Liquefied Petroleum Gas (LPG) (70% propane 30% utane) ts (2014)
US: Light fuel oil at refinery ts (2014)

Structural concrete, 3000 psi, 0% fly ash and slag 12,221.9 kg

Used in the following Revit families:

interlocking pavment	4,713.9 kg (30 yrs)
interlocking pavment - path between porches	7,508.0 kg (30 yrs)

Used in the following Tally entries:
Precast concrete paver

Description:
Structural concrete, 3000 psi, 0% fly ash and slag. Mix design matches National Ready-Mix Concrete Association (NRMCA) Industry-wide EPD.

Life Cycle Inventory:
Coarse aggregate: 44%, Sand: 36%, Portland cement PCA - EPD: 13%, Water: 7%, Admixture: <1%

Product Scope:
Cradle to gate
Anchors, ties, and metal accessories outside of scope (<1% mass)

Transportation Distance:
By truck: 24 km

End-of-Life Scope:
55% Recycled into coarse aggregate
45% Landfilled (inert material)

Module D Scope:
Avoided burden credit for coarse aggregate, includes grinding energy

LCI Source:
US: Portland cement PCA/ts (2014)
DE: Pumice gravel (grain size 4/16) (EN15804 A1-A3) ts (2017)
DE: Gravel (Grain size 2/32) (EN15804 A1-A3) s (2017)
DE: Fly ash (EN15804 A1-A3) ts (2017)
DE: Slag-tap granulate (EN15804 A1-A3) ts (2017)
DE: Expanded clay (EN15804 A1-A3) ts (2017)
DE: alcium nitrate ts (2017)
DE: Sodium ligninsulfonate ts (2017)
DE: Sodium naphtalene sulfonate [estimated] ts (2017)
US: Sodium hydroxide (caustic soda) ix (100%) ts (2017)
US: Colophony (rosin, refined) from CN pine gum rosin ts (2017)
US: Tap water from groundwater ts (2017)
US: Electricity grid mix s (2014)
US: Natural gas mix ts (2014)
US: Diesel mix at filling station (100% fossil) ts (2014)
US: Liquefied Petroleum Gas (LPG) (70% propane 30% utane) ts (2014)
US: Light fuel oil at refinery ts (2014)

Structural concrete, 3000 psi, North Central regional average 11,376.2 kg

Used in the following Revit families:

6" Concrete	2,166.2 kg (60 yrs)
Generic - 8" CIP foundation wall	9,210.0 kg (60 yrs)

Used in the following Tally entries:
Cast-in-place concrete, structural concrete, 3000 psi

Description:
Structural concrete, 3000 psi, North Central regional average. Mix design matches National Ready-Mix Concrete Association (NRMCA) Industry-wide EPD.

Life Cycle Inventory:
Coarse aggregate: 44%, Sand: 37%, Portland cement PCA - EPD: 10%, Water: 8%, Fly ash: 2%, Expanded slag: <1%, Admixture: <1%

Product Scope:
Cradle to gate
Anchors, ties, and metal accessories outside of scope (<1% mass)

Transportation Distance:
By truck: 24 km

End-of-Life Scope:
55% Recycled into coarse aggregate
45% Landfilled (inert material)

Module D Scope:
Avoided burden credit for coarse aggregate, includes grinding energy

LCI Source:
US: Portland cement PCA/ts (2014)
DE: Pumice gravel (grain size 4/16) (EN15804 A1-A3) ts (2017)
DE: Gravel (Grain size 2/32) (EN15804 A1-A3) s (2017)
DE: Fly ash (EN15804 A1-A3) ts (2017)
DE: Slag-tap granulate (EN15804 A1-A3) ts (2017)
DE: Expanded clay (EN15804 A1-A3) ts (2017)
DE: alcium nitrate ts (2017)
DE: Sodium ligninsulfonate ts (2017)
DE: Sodium naphtalene sulfonate [estimated] ts (2017)
US: Sodium hydroxide (caustic soda) ix (100%) ts (2017)
US: Colophony (rosin, refined) from CN pine gum rosin ts (2017)
US: Tap water from groundwater ts (2017)
US: Electricity grid mix s (2014)
US: Natural gas mix ts (2014)
US: Diesel mix at filling station (100% fossil) ts (2014)
US: Liquefied Petroleum Gas (LPG) (70% propane 30% utane) ts (2014)
US: Light fuel oil at refinery ts (2014)

LCI Data (continued)

Structural concrete, 4000 psi, North Central regional average **61,484.6 kg**

Used in the following Revit families:
- 8" Slab on grade — 61,484.6 kg (60 yrs)

Used in the following Tally entries:
Cast-in-place concrete, structural concrete, 4000 psi

Description:
Structural concrete, 4000 psi, North Central regional average. Mix design matches National Ready-Mix Concrete Association (NRMCA) Industry-wide EPD.

Life Cycle Inventory:
Coarse aggregate: 42%, Sand: 35%, Portland cement PCA - EPD: 12%, Water: 8%, Fly ash: 2%, Expanded slag: <1%, Admixture: <1%

Product Scope:
Cradle to gate
Anchors, ties, and metal accessories outside of scope (<1% mass)

Transportation Distance:
By truck: 24 km

End-of-Life Scope:
55% Recycled into coarse aggregate
45% Landfilled (inert material)

Module D Scope:
Avoided burden credit for coarse aggregate, includes grinding energy

LCI Source:
US: Portland cement PCA/ts (2014)
DE: Pumice gravel (grain size 4/16) (EN15804 A1-A3) ts (2017)
DE: Gravel (Grain size 2/32) (EN15804 A1-A3) s (2017)
DE: Fly ash (EN15804 A1-A3) ts (2017)
DE: Slag-tap granulate (EN15804 A1-A3) ts (2017)
DE: Expanded clay (EN15804 A1-A3) ts (2017)
DE: alcium nitrate ts (2017)
DE: Sodium ligninsulfonate ts (2017)
DE: Sodium naphtalene sulfonate [estimated] ts (2017)
US: Sodium hydroxide (caustic soda) ix (100%) ts (2017)
US: Colophony (rosin, refined) from CN pine gum rosin ts (2017)
US: Tap water from groundwater ts (2017)
US: Electricity grid mix s (2014)
US: Natural gas mix ts (2014)
US: Diesel mix at filling station (100% fossil) ts (2014)
US: Liquefied Petroleum Gas (LPG) (70% propane
30% utane) ts (2014)
US: Light fuel oil at refinery ts (2014)

Wall board, gypsum, natural **7,086.5 kg**

Used in the following Revit families:
- A ceiling — 1,369.7 kg (30 yrs)
- GWB on Mtl. Stud 2 1/2" 2 — 266.0 kg (30 yrs)
- GWB on Mtl. Stud Bulkhead 4-1/4" — 177.7 kg (30 yrs)
- GWB on wood Stud Bulkhead 4" 2 — 736.3 kg (30 yrs)
- GWB on wood Stud Bulkhead 4" 3 — 561.4 kg (30 yrs)
- UNDER TRUSS CEILING, ZIP FURRING GWB on wood TRUSS — 1,965.8 kg (30 yrs)
- W9A - (2)2x4 Studs Insulated 1 HR — 2,009.6 kg (30 yrs)

Used in the following Tally entries:
Wall board, gypsum

Description:
Natural gypsum board

Life Cycle Inventory:
100% Gypsum wallboard (Gypsum, Boric acid, Cement, Glass fibres, Ferrochrome-lignine sulfonate, Silane, Polyglucose, Perlite, Paper, Casein glue)

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 172 km

End-of-Life Scope:
100% Landfilled (inert waste)

LCI Source:
DE: Gypsum wallboard (EN15804 A1-A3) ts (2017)

Window frame, aluminum, powder-coated, operable, insulated **74.1 kg**

Used in the following Revit families:
- Window-Casement-Pella-Contemporary-Reserve-Vent — 23.1 kg (45 yrs)
- Window-Casement-Pella-Contemporary-Reserve-Vent awning window — 51.0 kg (45 yrs)

Used in the following Tally entries:
Window frame, aluminum

Description:
Aluminum insulated operable window frame

Life Cycle Inventory:
100% Aluminum

Product Scope:
Cradle to gate, excludes hardware, casing, sealant

Transportation Distance:
By truck: 568 km

End-of-Life Scope:
95% Aluminum recovered
5% Aluminum landfilled (inert material)

Module D Scope:
Product has 36.4% scrap input while remainder is processed and credited as avoided burden

LCI Source:
DE: Aluminium frame profile, powder coated (EN15804 A1-A3) ts (2017)
modified with: RNA: Aluminum extrusion, mill finish - AEC ts (2015)
DE: Top coat powder (aluminium) (EN15804 A1-A3) ts (2017)
RNA: Secondary Aluminum Ingot AA/ts (2010)
RNA: Primary Aluminum Ingot AA/ts (2010)

Window frame, vinyl, fixed **66.0 kg**

Used in the following Revit families:
- Window-Casement-Pella-Contemporary-Reserve-Vent — 66.0 kg (30 yrs)

Used in the following Tally entries:
Window frame, vinyl

Description:
Vinyl fixed window frame inclusive of steel bracing

Life Cycle Inventory:
46% PVC part
54% metal reinforcement (Zinc-coated steel)

Product Scope:
Cradle to gate, excludes hardware, casing, sealant

Transportation Distance:
By truck: 496 km

End-of-Life Scope:
100% Landfilled (plastic waste)

LCI Source:
DE: Window frame PVC-U (EN15804 A1-A3) ts (2017)

Wood stain, water based **78.5 kg**

Used in the following Revit families:
- Cased Opening — 4.2 kg (10 yrs)
- SOLAR DECATHLON FLOOR — 70.3 kg (10 yrs)
- wood planks 2 — 4.0 kg (10 yrs)

Used in the following Tally entries:
Domestic hardwood
Door frame, wood

Description:
Semi-transparent stain for interior and exterior wood surfaces

Life Cycle Inventory:
60% Water
28% Acrylate resin
7% Acrylate emulsion
5% Dipropylene glycol
1.3% NMVOC emissions

Product Scope:
Cradle to gate, including emissions during application

Transportation Distance:
By truck: 642 km

LCI Data (continued)

End-of-Life Scope:
38.7% solids to landfill (plastic waste)

LCI Source:
US: Tap water from groundwater ts (2017)
US: Acrylate resin (solvent-systems) ts (2017)
DE: Acrylate (emulsion) ts (2017)
US: Dipropylene glycol by product propylene glycol via PO hydrogenation ts (2017)

Tally Version	Non-commercial Version 2022.04.08.01
Author	Spencer.WhitmoreUDCZQ
Company	BSU
Date	10/14/2022
Project	ALLEY HOUSE
Location	201 N TEMPLE AVENUE, INDIANAPOLIS, IN 46201
Gross Area	2700 ft²
Building Life	60 years
Boundaries	Cradle to grave, inclusive of biogenic carbon
Goal and Scope of Assessment	Alley House LCA
Revit Categories	Ceilings Curtainwall Mullions Curtainwall Panels Doors Floors Roofs Stairs and Railings Structure Walls Windows
Revit Models	
Model Name	The Alley House - Ball State - 2023 SD Build Competition Model_detached
Worksets	Workset1 Existing
Phases	New Construction

Row Labels	Values Sum of Acidification Potential Total (kgSO2eq)	Sum of Eutrophication Potential Total (kgNeq)	Sum of Global Warming Potential Total (kgCO2eq)
The Alley House - Ball State - 2023 SD Build Competition Model_detached	832.87	61.10	65,227.12
Grand Total	**832.87**	**61.10**	**65,227.12**

Sum of Ozone Depletion Potential Total (CFC-11eq)	Sum of Smog Formation Potential Total (kgO3eq)	Sum of Primary Energy Demand Total (MJ)	Sum of Non-renewable Energy Demand Total (MJ)	Sum of Renewable Energy Demand Total (MJ)	Sum of Mass Total (kg)
7.28E-04	11,669.97	2,654,681.95	1,692,310.25	963,734.55	288,202.57
7.28E-04	**11,669.97**	**2,654,681.95**	**1,692,310.25**	**963,734.55**	**288,202.57**

Row Labels	Values Sum of Acidification Potential Total (kgSO2eq)	Sum of Eutrophication Potential Total (kgNeq)	Sum of Global Warming Potential Total (kgCO2eq)	Sum of Ozone Depletion Potential Total (CFC-11eq)	Sum of Smog Formation Potential Total (kgO3eq)
[A1-A3] Product	571.53	25.26	12,287.66	4.40E-04	8,314.16
[A4] Transportation	10.26	0.84	2,215.17	7.59E-11	339.17
[B2-B5] Maintenance and Replacement	269.35	20.44	4,441.01	2.81E-04	3,468.32
[C2-C4] End of Life	120.14	18.23	51,382.31	1.21E-09	869.12
[D] Module D	-138.43	-3.67	-5,099.03	7.22E-06	-1,320.80
Grand Total	**832.87**	**61.10**	**65,227.12**	**7.28E-04**	**11,669.97**

Sum of Primary Energy Demand Total (MJ)	Sum of Non-renewable Energy Demand Total (MJ)	Sum of Renewable Energy Demand Total (MJ)	Sum of Mass Total (kg)
1,891,092.76	1,207,382.26	683,917.79	226,828.49
32,213.26	31,442.41	778.96	
1,198,868.65	698,067.70	501,179.31	61,374.07
106,497.85	99,623.81	6,955.29	
-573,990.56	-344,205.93	-229,096.80	
2,654,681.95	**1,692,310.25**	**963,734.55**	**288,202.57**

Row Labels	Values Sum of Acidification Potential Total (kgSO2eq)	Sum of Eutrophication Potential Total (kgNeq)	Sum of Global Warming Potential Total (kgCO2eq)	Sum of Ozone Depletion Potential Total (CFC-11eq)	Sum of Smog Formation Potential Total (kgO3eq)
[A1-A3] Product	**571.53**	**25.26**	**12,287.66**	**4.40E-04**	**8,314.16**
03 - Concrete	58.10	3.53	20,781.24	-2.19E-05	1,116.65
04 - Masonry	165.60	5.96	10,460.53	7.19E-09	2,981.42
05 - Metals	16.21	0.35	3,090.63	4.76E-06	148.24
06 - Wood/Plastics/Composites	94.89	4.53	63,040.06	3.73E-06	1,682.02
07 - Thermal and Moisture Protection	156.91	6.28	27,735.56	2.59E-04	1,547.14
08 - Openings and Glazing	62.74	3.00	8,582.81	3.78E-05	613.76
09 - Finishes	17.09	1.60	4,676.96	1.56E-04	224.94
[A4] Transportation	**10.26**	**0.84**	**2,215.17**	**7.59E-11**	**339.17**
03 - Concrete	0.98	0.08	211.30	7.24E-12	32.35
04 - Masonry	1.87	0.15	403.71	1.38E-11	61.81
05 - Metals	0.10	0.01	21.22	7.27E-13	3.25
06 - Wood/Plastics/Composites	5.19	0.42	1,120.27	3.84E-11	171.53
07 - Thermal and Moisture Protection	0.89	0.07	191.84	6.57E-12	29.37
08 - Openings and Glazing	0.72	0.06	155.04	5.31E-12	23.74
09 - Finishes	0.52	0.04	111.80	3.83E-12	17.12
[B2-B5] Maintenance and Replacement	**269.35**	**20.44**	**4,441.01**	**2.81E-04**	**3,468.32**
03 - Concrete	3.05	0.21	1,192.27	2.00E-10	67.42
04 - Masonry	0.00	0.00	0.00	0.00E+00	0.00
05 - Metals	0.05	0.00	3.35	1.94E-12	0.30
06 - Wood/Plastics/Composites	160.94	11.13	19,871.34	1.27E-06	1,861.73
07 - Thermal and Moisture Protection	73.26	6.59	17,768.96	2.54E-04	1,077.71
08 - Openings and Glazing	26.47	2.14	3,394.56	2.56E-05	324.07
09 - Finishes	5.58	0.38	1,953.20	6.02E-10	137.09
[C2-C4] End of Life	**120.14**	**18.23**	**51,382.31**	**1.21E-09**	**869.12**
03 - Concrete	10.72	0.54	4,687.51	4.27E-10	213.26
04 - Masonry	3.12	0.16	674.65	1.24E-10	62.01
05 - Metals	0.01	0.00	1.32	2.43E-13	0.13
06 - Wood/Plastics/Composites	95.90	15.70	43,885.28	3.86E-10	448.72

07 - Thermal and Moisture Protection	5.85	1.24	1,090.99	1.56E-10	80.95
08 - Openings and Glazing	2.15	0.44	528.51	2.65E-11	16.84
09 - Finishes	2.41	0.14	514.05	9.45E-11	47.21
[D] Module D	**-138.43**	**-3.67**	**-5,099.03**	**7.22E-06**	**-1,320.80**
03 - Concrete	-1.82	-0.06	-1,237.40	9.51E-06	-4.39
04 - Masonry	0.22	0.01	29.61	-6.61E-11	9.27
05 - Metals	-8.51	-0.15	-1,433.18	1.36E-06	-68.18
06 - Wood/Plastics/Composites	-52.20	-2.18	8,886.46	-1.10E-07	-651.11
07 - Thermal and Moisture Protection	-57.89	-0.95	-8,795.06	-1.23E-06	-452.43
08 - Openings and Glazing	-18.22	-0.35	-2,549.45	-2.31E-06	-153.96
09 - Finishes	0.00	0.00	0.00	0.00E+00	0.00
Grand Total	**832.87**	**61.10**	**65,227.12**	**7.28E-04**	**11,669.97**

Sum of Primary Energy Demand Total (MJ)	Sum of Non-renewable Energy Demand Total (MJ)	Sum of Renewable Energy Demand Total (MJ)	Sum of Mass Total (kg)
1,891,092.76	**1,207,382.26**	**683,917.79**	**226,828.49**
197,785.81	186,663.99	11,145.52	118,029.20
158,100.48	139,700.85	18,604.06	34,073.38
48,109.43	35,978.27	12,137.28	637.10
737,917.37	209,652.97	528,786.70	46,298.69
521,398.40	438,189.85	82,548.50	12,555.11
142,641.70	122,239.25	20,428.49	3,552.00
85,139.57	74,957.07	10,267.25	11,683.02
32,213.26	**31,442.41**	**778.96**	
3,072.74	2,999.21	74.30	
5,870.77	5,730.29	141.96	
308.58	301.20	7.46	
16,291.07	15,901.23	393.94	
2,789.73	2,722.97	67.46	
2,254.62	2,200.67	54.52	
1,625.75	1,586.84	39.31	
1,198,868.65	**698,067.70**	**501,179.31**	**61,374.07**
9,995.72	9,310.81	683.67	6,110.95
0.00	0.00	0.00	0.00
65.97	55.69	10.16	2.66
611,896.89	156,219.76	455,808.26	38,140.26
478,859.18	446,807.36	32,287.70	10,754.94
60,677.23	50,972.92	9,721.65	2,393.94
37,373.65	34,701.17	2,667.87	3,971.31
106,497.85	**99,623.81**	**6,955.29**	
39,723.92	37,145.11	2,624.74	
11,550.88	10,801.26	763.24	
22.64	21.15	1.49	
29,420.96	27,559.13	1,867.75	

	14,585.83	13,630.09	961.59	
	2,384.63	2,230.53	155.82	
	8,809.00	8,236.53	580.65	
	-573,990.56	**-344,205.93**	**-229,096.80**	
	-10,812.43	-11,276.46	456.61	
	255.21	367.99	-114.15	
	-20,674.36	-13,516.26	-7,159.69	
	-365,475.20	-208,384.40	-156,326.40	
	-135,170.86	-83,984.41	-51,185.24	
	-42,112.92	-27,412.39	-14,767.94	
	0.00	0.00	0.00	
	2,654,681.95	**1,692,310.25**	**963,734.55**	**288,202.57**

Row Labels	Values Sum of Acidification Potential Total (kgSO2eq)	Sum of Eutrophication Potential Total (kgNeq)	Sum of Global Warming Potential Total (kgCO2eq)	Sum of Ozone Depletion Potential Total (CFC-11eq)	Sum of Smog Formation Potential Total (kgO3eq)
[A1-A3] Product	**571.53**	**25.26**	**12,287.66**	**4.40E-04**	**8,314.16**
Ceilings	15.87	0.69	-10,315.41	4.67E-06	274.90
Curtainwall Mullions	1.50	0.06	-1,356.54	6.48E-09	25.91
Curtainwall Panels	36.99	1.11	5,716.09	2.27E-06	314.62
Doors	4.51	0.97	-5.24	3.55E-05	43.37
Floors	211.36	9.40	3,730.67	-1.86E-05	3,890.51
Roofs	46.89	1.92	-5,636.02	5.35E-06	618.18
Stairs and Railings	0.12	0.00	-107.36	5.13E-10	2.05
Structure	0.77	0.03	-693.41	3.31E-09	13.25
Walls	234.78	10.27	18,403.21	4.11E-04	2,906.02
Windows	18.74	0.81	2,551.67	3.64E-08	225.35
[A4] Transportation	**10.26**	**0.84**	**2,215.17**	**7.59E-11**	**339.17**
Ceilings	0.82	0.07	176.35	6.04E-12	27.00
Curtainwall Mullions	0.08	0.01	16.99	5.82E-13	2.60
Curtainwall Panels	0.19	0.02	41.72	1.43E-12	6.39
Doors	0.06	0.00	12.82	4.39E-13	1.96
Floors	3.95	0.32	853.15	2.92E-11	130.63
Roofs	1.33	0.11	286.79	9.82E-12	43.91
Stairs and Railings	0.01	0.00	1.34	4.60E-14	0.21
Structure	0.04	0.00	8.68	2.97E-13	1.33
Walls	3.38	0.28	729.78	2.50E-11	111.74
Windows	0.41	0.03	87.55	3.00E-12	13.41
[B2-B5] Maintenance and Replacement	**269.35**	**20.44**	**4,441.01**	**2.81E-04**	**3,468.32**
Ceilings	32.39	2.23	-2,388.54	1.51E-07	422.36
Curtainwall Mullions	3.27	0.23	-454.15	6.49E-09	36.96
Curtainwall Panels	0.00	0.00	0.00	0.00E+00	0.00
Doors	4.35	1.16	336.16	2.56E-05	44.98
Floors	70.83	4.95	-7,493.34	2.98E-07	860.41
Roofs	63.12	3.57	5,944.25	5.45E-06	872.05

Stairs and Railings	1.55	0.14	-15.43	6.42E-10	26.17
Structure	1.67	0.12	-232.14	3.32E-09	18.89
Walls	72.56	7.18	6,008.99	2.50E-04	938.34
Windows	19.60	0.87	2,735.22	3.64E-08	248.15
[C2-C4] End of Life	**120.14**	**18.23**	**51,382.31**	**1.21E-09**	**869.12**
Ceilings	14.88	1.38	7,611.99	7.85E-11	82.19
Curtainwall Mullions	1.69	0.16	885.41	6.77E-12	8.45
Curtainwall Panels	0.19	0.01	40.10	7.39E-12	3.69
Doors	1.55	0.40	402.45	3.27E-12	5.22
Floors	46.82	3.83	22,826.63	6.36E-10	420.87
Roofs	20.79	5.12	7,276.47	1.50E-10	116.54
Stairs and Railings	0.66	0.06	341.32	2.65E-12	3.30
Structure	0.86	0.08	452.58	3.46E-12	4.32
Walls	32.34	7.16	11,470.47	3.12E-10	217.61
Windows	0.36	0.03	74.88	1.38E-11	6.92
[D] Module D	**-138.43**	**-3.67**	**-5,099.03**	**7.22E-06**	**-1,320.80**
Ceilings	-9.77	-0.41	1,444.07	1.40E-06	-122.73
Curtainwall Mullions	-1.11	-0.05	194.95	-2.34E-09	-13.83
Curtainwall Panels	-12.45	-0.20	-1,901.52	-8.54E-08	-96.57
Doors	-3.52	-0.11	-304.20	-2.21E-06	-39.90
Floors	-23.99	-0.98	2,773.82	8.80E-06	-278.20
Roofs	-16.08	-0.45	-142.97	-5.51E-07	-160.67
Stairs and Railings	-0.43	-0.02	65.22	-9.15E-10	-5.41
Structure	-0.57	-0.02	99.65	-1.20E-09	-7.07
Walls	-68.26	-1.39	-6,984.32	-1.15E-07	-578.93
Windows	-2.26	-0.04	-343.72	-1.55E-08	-17.48
Grand Total	**832.87**	**61.10**	**65,227.12**	**7.28E-04**	**11,669.97**

Sum of Primary Energy Demand Total (MJ)	Sum of Non-renewable Energy Demand Total (MJ)	Sum of Renewable Energy Demand Total (MJ)	Sum of Mass Total (kg)
1,891,092.76	**1,207,382.26**	**683,917.79**	**226,828.49**
116,676.73	36,258.76	80,469.93	9,629.04
11,453.45	2,201.34	9,260.24	812.30
84,704.23	73,986.55	10,729.20	1,152.44
15,370.26	8,890.75	6,468.22	411.02
596,307.98	373,336.87	223,336.66	151,575.08
310,629.32	195,736.97	115,035.34	10,269.33
906.43	174.21	732.86	64.29
5,854.51	1,125.23	4,733.43	415.21
711,262.16	480,732.08	230,143.35	50,762.83
37,927.69	34,939.49	3,008.56	1,736.95
32,213.26	**31,442.41**	**778.96**	
2,564.47	2,503.11	62.01	
247.02	241.11	5.97	
606.67	592.15	14.67	
186.37	181.91	4.51	
12,406.61	12,109.72	300.01	
4,170.48	4,070.68	100.85	
19.55	19.08	0.47	
126.27	123.25	3.05	
10,612.62	10,358.67	256.63	
1,273.20	1,242.74	30.79	
1,198,868.65	**698,067.70**	**501,179.31**	**61,374.07**
131,972.55	50,079.77	81,931.40	9,727.76
12,191.92	2,903.02	9,297.08	812.30
0.00	0.00	0.00	0.00
15,175.61	8,807.25	6,358.17	405.41
271,910.04	75,400.07	196,641.04	22,651.03
395,314.55	321,812.95	73,553.33	9,746.11

	8,546.86	3,110.49	5,437.04	317.79
	6,231.98	1,483.90	4,752.26	415.21
	316,573.16	196,667.79	120,038.00	15,551.10
	40,951.98	37,802.46	3,170.99	1,747.36
	106,497.85	**99,623.81**	**6,955.29**	
	6,127.20	5,738.08	390.94	
	491.44	460.57	30.87	
	688.01	643.06	45.41	
	223.80	210.36	13.33	
	56,449.24	52,805.73	3,697.05	
	13,082.26	12,231.22	852.63	
	192.26	180.19	12.08	
	251.20	235.43	15.78	
	27,709.30	25,919.43	1,812.62	
	1,283.13	1,199.74	84.58	
	-573,990.56	**-344,205.93**	**-229,096.80**	
	-67,419.58	-39,186.83	-28,096.66	
	-7,749.36	-4,402.67	-3,330.44	
	-29,156.69	-17,978.04	-11,236.28	
	-7,674.43	-6,189.71	-1,494.50	
	-167,093.25	-99,558.00	-67,213.52	
	-71,032.49	-42,014.57	-28,911.49	
	-3,031.69	-1,722.40	-1,302.93	
	-3,961.14	-2,250.46	-1,702.37	
	-211,590.14	-127,658.60	-83,771.45	
	-5,281.80	-3,244.64	-2,037.16	
	2,654,681.95	**1,692,310.25**	**963,734.55**	**288,202.57**

Row Labels	Values Sum of Acidification Potential Total (kgSO2eq)	Sum of Eutrophication Potential Total (kgNeq)	Sum of Global Warming Potential Total (kgCO2eq)	Sum of Ozone Depletion Potential Total (CFC-11eq)	Sum of Smog Formation Potential Total (kgO3eq)
03 - Concrete	71.03	4.30	25,634.92	-1.24E-05	1,425.28
04 - Masonry	170.81	6.29	11,568.50	7.26E-09	3,114.52
05 - Metals	7.85	0.22	1,683.34	6.13E-06	83.74
06 - Wood/Plastics/Composites	304.72	29.61	-29,019.40	4.89E-06	3,512.89
07 - Thermal and Moisture Protection	179.01	13.24	37,992.29	5.12E-04	2,282.74
08 - Openings and Glazing	73.85	5.29	10,111.46	6.11E-05	824.44
09 - Finishes	25.59	2.16	7,256.01	1.56E-04	426.37
Grand Total	**832.87**	**61.10**	**65,227.12**	**7.28E-04**	**11,669.97**

Sum of Primary Energy Demand Total (MJ)	Sum of Non-renewable Energy Demand Total (MJ)	Sum of Renewable Energy Demand Total (MJ)	Sum of Mass Total (kg)
239,765.76	224,842.66	14,984.84	124,140.15
175,777.34	156,600.40	19,395.13	34,073.38
27,832.27	22,840.04	4,996.70	639.76
1,030,051.09	200,948.69	830,530.25	84,438.95
882,462.28	817,365.87	64,680.01	23,310.05
165,845.26	150,230.98	15,592.54	5,945.94
132,947.96	119,481.60	13,555.08	15,654.33
2,654,681.95	**1,692,310.25**	**963,734.55**	**288,202.57**

Row Labels	Values Sum of Acidification Potential Total (kgSO2eq)	Sum of Eutrophication Potential Total (kgNeq)	Sum of Global Warming Potential Total (kgCO2eq)	Sum of Ozone Depletion Potential Total (CFC-11eq)
03 - Concrete	**71.03**	**4.30**	**25,634.92**	**-1.24E-05**
Cast-in-place concrete, structural concrete, 2500 psi	13.51	0.95	5,682.50	8.49E-10
Cast-in-place concrete, structural concrete, 3000 psi	6.21	0.38	2,271.55	-1.06E-06
Cast-in-place concrete, structural concrete, 4000 psi	45.11	2.55	15,285.71	-1.14E-05
Precast concrete paver	6.19	0.42	2,395.16	3.77E-10
04 - Masonry	**170.81**	**6.29**	**11,568.50**	**7.26E-09**
Stone veneer wall, limestone, grouted	170.81	6.29	11,568.50	7.26E-09
05 - Metals	**7.85**	**0.22**	**1,683.34**	**6.13E-06**
Aluminum, formed	6.85	0.17	1,527.28	1.89E-07
Steel, C-stud metal framing	1.00	0.05	156.06	5.94E-06
06 - Wood/Plastics/Composites	**304.72**	**29.61**	**-29,019.40**	**4.89E-06**
Domestic hardwood	5.58	0.58	-65.95	-5.33E-10
Fiber cement construction panel	14.59	0.89	6,883.00	2.46E-06
Plywood, exterior grade	57.81	4.07	-4,044.18	2.01E-06
Plywood, interior grade	0.51	0.04	-35.41	1.76E-08
Stair, hardwood, tread only	1.48	0.16	341.54	-5.99E-10
Wood framing	178.02	13.25	-23,361.73	3.48E-07
Wood framing with insulation	46.74	10.63	-8,736.66	5.26E-08
07 - Thermal and Moisture Protection	**179.01**	**13.24**	**37,992.29**	**5.12E-04**
Asphalt roofing shingles	58.97	2.99	12,795.68	9.30E-06
Closed cell, polyurethane foam, spray-applied	0.00	0.00	0.00	0.00E+00
ETFE sheet	27.13	1.83	8,389.13	3.74E-04
Fiber cement panel	60.02	7.79	11,994.63	7.47E-06
Mineral wool, board, generic	32.39	0.58	4,577.48	1.22E-04
Polyethelene sheet vapor barrier (HDPE)	0.51	0.05	235.38	6.71E-11
08 - Openings and Glazing	**73.85**	**5.29**	**10,111.46**	**6.11E-05**
Curtainwall System (including glazing)	24.93	0.94	3,896.39	2.18E-06
Door frame, wood	1.09	0.15	257.19	-3.91E-09
Door, interior, wood, hollow core, flush	5.86	2.28	184.79	5.89E-05

Glazing, triple pane IGU	39.79	1.74	5,277.10	2.11E-09
Window frame, aluminum	1.72	0.13	315.07	5.05E-08
Window frame, vinyl	0.46	0.05	180.91	4.96E-09
09 - Finishes	**25.59**	**2.16**	**7,256.01**	**1.56E-04**
Fiberglass mat gypsum sheathing	17.62	1.63	4,080.91	1.56E-04
Paint	0.14	0.01	31.68	1.68E-11
Wall board, gypsum	7.83	0.53	3,143.43	7.98E-10
Grand Total	**832.87**	**61.10**	**65,227.12**	**7.28E-04**

Sum of Smog Formation Potential Total (kgO3eq)	Sum of Primary Energy Demand Total (MJ)	Sum of Non-renewable Energy Demand Total (MJ)	Sum of Renewable Energy Demand Total (MJ)	Sum of Mass Total (kg)
1,425.28	**239,765.76**	**224,842.66**	**14,984.84**	**124,140.15**
310.60	50,280.30	47,229.77	3,047.50	36,508.96
125.79	21,399.67	20,090.92	1,314.36	11,593.42
850.74	148,002.79	138,768.36	9,296.59	63,815.86
138.16	20,082.99	18,753.61	1,326.40	12,221.91
3,114.52	**175,777.34**	**156,600.40**	**19,395.13**	**34,073.38**
3,114.52	175,777.34	156,600.40	19,395.13	34,073.38
83.74	**27,832.27**	**22,840.04**	**4,996.70**	**639.76**
69.45	25,209.46	20,436.43	4,772.83	494.51
14.29	2,622.81	2,403.60	223.87	145.25
3,512.89	**1,030,051.09**	**200,948.69**	**830,530.25**	**84,438.95**
110.55	34,697.84	9,511.40	25,242.80	1,692.38
312.41	94,431.93	86,769.01	7,777.68	3,733.88
660.50	186,371.23	37,643.97	148,467.94	13,026.95
5.78	1,632.04	329.65	1,300.12	114.08
21.57	5,316.96	1,650.50	3,671.54	253.50
1,968.16	544,772.49	45,959.90	499,880.77	53,205.10
433.92	162,828.60	19,084.27	144,189.40	12,413.06
2,282.74	**882,462.28**	**817,365.87**	**64,680.01**	**23,310.05**
897.50	460,324.14	447,009.22	13,452.59	6,760.32
0.00	0.00	0.00	0.00	0.00
291.46	171,199.84	153,626.58	17,802.47	761.61
926.44	186,423.78	154,788.40	30,703.11	13,117.08
157.37	57,020.16	54,562.17	2,612.18	2,581.20
9.97	7,494.37	7,379.50	109.67	89.83
824.44	**165,845.26**	**150,230.98**	**15,592.54**	**5,945.94**
228.12	56,842.21	57,243.72	-447.00	1,152.44
19.88	6,551.58	3,978.19	2,585.85	70.01
35.76	16,730.03	7,922.37	8,763.88	746.42

	513.73	77,508.55	73,798.72	3,793.81	3,836.99
	19.70	4,903.17	4,272.51	601.03	74.08
	7.26	3,309.72	3,015.47	294.97	66.00
	426.37	**132,947.96**	**119,481.60**	**13,555.08**	**15,654.33**
	231.83	74,629.07	64,859.65	9,855.93	8,058.80
	3.72	701.94	630.73	70.59	15.61
	190.81	57,616.95	53,991.23	3,628.55	7,579.92
	11,669.97	**2,654,681.95**	**1,692,310.25**	**963,734.55**	**288,202.57**

Row Labels	Values Sum of Acidification Potential Total (kgSO2eq)	Sum of Eutrophication Potential Total (kgNeq)	Sum of Global Warming Potential Total (kgCO2eq)
03 - Concrete	**71.03**	**4.30**	**25,634.92**
Steel, reinforcing rod	18.30	0.54	3,592.72
Structural concrete, 2500 psi, Great Lakes Midwest regional average	13.51	0.95	5,682.50
Structural concrete, 3000 psi, 0% fly ash and slag	6.19	0.42	2,395.16
Structural concrete, 3000 psi, North Central regional average	4.65	0.33	1,965.32
Structural concrete, 4000 psi, North Central regional average	28.37	2.05	11,999.21
04 - Masonry	**170.81**	**6.29**	**11,568.50**
Mortar type S	0.00	0.00	0.00
Stone slab, limestone	170.81	6.29	11,568.50
05 - Metals	**7.85**	**0.22**	**1,683.34**
Aluminum, formed	6.74	0.17	1,520.58
Cold formed structural steel	1.00	0.05	156.06
Paint, exterior metal coating, silicone-based, by area	0.11	0.00	6.71
06 - Wood/Plastics/Composites	**304.72**	**29.61**	**-29,019.40**
Ash lumber, 2 inch	1.48	0.16	341.54
Birch lumber, 1 inch	0.36	0.04	-6.50
Cellulose insulation, blown	21.03	8.71	-5,362.06
Cherry lumber, 1 inch	5.01	0.52	-152.48
Domestic softwood, US, AWC - EPD	203.73	15.17	-26,736.34
Exterior grade plywood, US	57.81	4.07	-4,044.18
Fiber cement structural panel, Eternit, Eterplan - EPD	14.59	0.89	6,883.00
Interior grade plywood, US, AWC - EPD	0.51	0.04	-35.41
Wood stain, water based	0.21	0.02	93.02
07 - Thermal and Moisture Protection	**179.01**	**13.24**	**37,992.29**
Aluminum extrusion, AEC - EPD	30.05	1.03	5,253.06
ETFE sheet	27.13	1.83	8,389.13
Fasteners, stainless steel	2.01	0.33	98.20
Fiber cement board	25.72	6.37	5,945.80
Mineral wool, high density, NAIMA - EPD	32.39	0.58	4,577.48

Paint, exterior acrylic latex	3.39	0.25	753.69
Polyethelene sheet vapor barrier (HDPE)	0.51	0.05	235.38
SBS modified asphalt, strip, ARMA - EPD	57.82	2.80	12,739.56
Spray polyurethane foam, closed cell (HFO blowing agent), SPFA - EPD	0.00	0.00	0.00
08 - Openings and Glazing	**73.85**	**5.29**	**10,111.46**
Curtain wall system, Kawneer, 1600 Wall System - EPD	24.93	0.94	3,896.39
Door frame, wood, no door	1.07	0.15	249.41
Door, interior, wood, hollow core	4.30	0.80	-158.52
Fasteners, galvanized steel	0.01	0.00	2.55
Glazing, triple, insulated (air)	39.79	1.74	5,277.10
Hardware, stainless steel	1.28	0.21	55.04
Paint, interior acrylic latex	0.32	0.02	86.27
Stainless steel door hinge	-0.05	1.24	202.01
Window frame, aluminum, powder-coated, operable, insulated	1.72	0.13	315.07
Window frame, vinyl, fixed	0.46	0.05	180.91
Wood stain, water based	0.01	0.00	5.24
09 - Finishes	**25.59**	**2.16**	**7,256.01**
Fiberglass mat gypsum sheathing board	17.62	1.63	4,080.91
Paint, exterior acrylic latex	4.01	0.29	891.80
Paint, interior acrylic latex	0.66	0.03	175.85
Wall board, gypsum, natural	3.31	0.21	2,107.46
Grand Total	**832.87**	**61.10**	**65,227.12**

Sum of Ozone Depletion Potential Total (CFC-11eq)	Sum of Smog Formation Potential Total (kgO3eq)	Sum of Primary Energy Demand Total (MJ)	Sum of Non-renewable Energy Demand Total (MJ)	Sum of Renewable Energy Demand Total (MJ)	Sum of Mass Total (kg)
-1.24E-05	**1,425.28**	**239,765.76**	**224,842.66**	**14,984.84**	**124,140.15**
-1.24E-05	217.68	50,634.38	47,669.98	3,040.82	2,548.51
8.49E-10	310.60	50,280.30	47,229.77	3,047.50	36,508.96
3.77E-10	138.16	20,082.99	18,753.61	1,326.40	12,221.91
2.95E-10	107.24	17,083.81	16,027.73	1,055.17	11,376.20
1.83E-09	651.61	101,684.27	95,161.57	6,514.96	61,484.57
7.26E-09	**3,114.52**	**175,777.34**	**156,600.40**	**19,395.13**	**34,073.38**
0.00E+00	0.00	0.00	0.00	0.00	0.00
7.26E-09	3,114.52	175,777.34	156,600.40	19,395.13	34,073.38
6.13E-06	**83.74**	**27,832.27**	**22,840.04**	**4,996.70**	**639.76**
1.89E-07	68.85	25,077.52	20,325.06	4,752.52	489.18
5.94E-06	14.29	2,622.81	2,403.60	223.87	145.25
3.89E-12	0.60	131.94	111.37	20.31	5.33
4.89E-06	**3,512.89**	**1,030,051.09**	**200,948.69**	**830,530.25**	**84,438.95**
-5.99E-10	21.57	5,316.96	1,650.50	3,671.54	253.50
-1.23E-10	6.92	1,988.46	510.35	1,471.71	106.68
2.22E-09	149.62	84,136.22	12,445.36	71,981.63	4,727.58
-1.75E-09	97.78	30,287.17	6,625.73	23,722.01	1,511.40
3.99E-07	2,252.46	623,464.87	52,598.81	572,088.54	60,890.58
2.01E-06	660.50	186,371.23	37,643.97	148,467.94	13,026.95
2.46E-06	312.41	94,431.93	86,769.01	7,777.68	3,733.88
1.76E-08	5.78	1,632.04	329.65	1,300.12	114.08
1.34E-09	5.85	2,422.22	2,375.32	49.08	74.30
5.12E-04	**2,282.74**	**882,462.28**	**817,365.87**	**64,680.01**	**23,310.05**
1.26E-06	421.12	82,209.74	72,523.98	8,757.36	1,857.25
3.74E-04	291.46	171,199.84	153,626.58	17,802.47	761.61
1.45E-05	3.66	1,955.38	1,560.05	400.10	43.35
5.12E-09	415.27	86,674.40	66,588.44	20,094.60	10,869.81
1.22E-04	157.37	57,020.16	54,562.17	2,612.18	2,581.20

	4.01E-10	88.48	16,701.82	15,007.56	1,679.71	371.45
	6.71E-11	9.97	7,494.37	7,379.50	109.67	89.83
	1.04E-06	895.41	459,206.57	446,117.59	13,223.92	6,735.55
	0.00E+00	0.00	0.00	0.00	0.00	0.00
	6.11E-05	**824.44**	**165,845.26**	**150,230.98**	**15,592.54**	**5,945.94**
	2.18E-06	228.12	56,842.21	57,243.72	-447.00	1,152.44
	2.37E-10	19.42	6,372.11	3,806.16	2,578.23	64.72
	9.73E-08	35.19	9,153.49	1,873.98	7,254.23	628.77
	-4.22E-09	0.13	43.13	38.33	4.86	1.11
	2.11E-09	513.73	77,508.55	73,798.72	3,793.81	3,836.99
	9.41E-06	2.25	1,114.66	872.93	240.69	34.93
	4.60E-11	6.22	2,052.19	1,855.68	196.54	34.11
	4.94E-05	-7.90	4,409.69	3,319.78	1,072.41	48.61
	5.05E-08	19.70	4,903.17	4,272.51	601.03	74.08
	4.96E-09	7.26	3,309.72	3,015.47	294.97	66.00
	7.53E-11	0.33	136.34	133.70	2.76	4.18
	1.56E-04	**426.37**	**132,947.96**	**119,481.60**	**13,555.08**	**15,654.33**
	1.56E-04	231.83	74,629.07	64,859.65	9,855.93	8,058.80
	4.74E-10	104.69	19,762.17	17,757.46	1,987.49	439.51
	9.38E-11	12.68	4,183.24	3,782.66	400.64	69.53
	2.47E-10	77.16	34,373.48	33,081.84	1,311.02	7,086.49
	7.28E-04	**11,669.97**	**2,654,681.95**	**1,692,310.25**	**963,734.55**	**288,202.57**

Row Labels	Values Sum of Acidification Potential Total (kgSO2eq)	Sum of Eutrophication Potential Total (kgNeq)	Sum of Global Warming Potential Total (kgCO2eq)	Sum of Ozone Depletion Potential Total (CFC-11eq)	Sum of Smog Formation Potential Total (kgO3eq)	Sum of Primary Energy Demand Total (MJ)
Ceilings	54.18	3.95	-3,471.54	6.22E-06	683.73	189,921.38
Curtainwall Mullions	5.44	0.40	-713.34	1.06E-08	60.10	16,634.47
Curtainwall Panels	24.93	0.94	3,896.39	2.18E-06	228.12	56,842.21
Doors	6.95	2.43	441.99	5.89E-05	55.64	23,281.61
Floors	308.98	17.52	22,690.92	-9.51E-06	5,024.22	769,980.63
Roofs	116.05	10.26	7,728.52	1.02E-05	1,490.00	652,164.10
Stairs and Railings	1.91	0.19	285.09	2.43E-10	26.32	6,633.41
Structure	2.78	0.21	-364.63	5.44E-09	30.72	8,502.82
Walls	274.80	23.49	29,628.13	6.60E-04	3,594.78	854,567.10
Windows	36.85	1.70	5,105.59	5.73E-08	476.34	76,154.21
Grand Total	**832.87**	**61.10**	**65,227.12**	**7.28E-04**	**11,669.97**	**2,654,681.95**

Sum of Non-renewable Energy Demand Total (MJ)	Sum of Renewable Energy Demand Total (MJ)	Sum of Mass Total (kg)
55,392.89	134,757.63	19,356.80
1,403.37	15,263.72	1,624.60
57,243.72	-447.00	1,152.44
11,900.56	11,349.73	816.43
414,094.39	356,761.25	174,226.11
491,837.25	160,630.65	20,015.44
1,761.56	4,879.52	382.07
717.34	7,802.15	830.43
586,019.37	268,479.14	66,313.93
71,939.78	4,257.76	3,484.31
1,692,310.25	**963,734.55**	**288,202.57**

Row Labels	Values Sum of Acidification Potential Total (kgSO2eq)	Sum of Eutrophication Potential Total (kgNeq)
Ceilings	**54.18**	**3.95**
A ceiling	1.54	0.11
GWB on Mtl. Stud 2 1/2 2	0.99	0.05
GWB on Mtl. Stud Bulkhead 4-1/4	0.51	0.03
GWB on wood Stud Bulkhead 4 2	10.17	0.75
GWB on wood Stud Bulkhead 4 3	7.76	0.57
UNDER TRUSS CEILING, ZIP FURRING GWB on wood TRUSS	33.21	2.44
Curtainwall Mullions	**5.44**	**0.40**
Rectangular Mullion: 2 x 10 wood	2.16	0.16
Rectangular Mullion: 2 x 6 wood	3.27	0.24
Curtainwall Panels	**24.93**	**0.94**
System Panel: 1/4 Glazed, tempered	24.93	0.94
Doors	**6.95**	**2.43**
Cased Opening: Cased Opening 2'6 x 6'	0.53	0.07
Cased Opening: Cased Opening 6' x 8'	0.56	0.08
Single-Flush: 30 x 80	3.74	1.45
Single-Flush: 34 x 80	2.12	0.82
Floors	**308.98**	**17.52**
6 Concrete	1.18	0.07
8 Slab on grade	166.18	7.00
interlocking pavment	2.39	0.16
interlocking pavment - path between porches	3.80	0.26
pervious pavers	5.53	0.39
porch flooring	7.99	0.56
SOLAR DECATHLON FLOOR	116.77	8.68
wood planks 2	5.15	0.39
Roofs	**116.05**	**10.26**
Wood Rafter 12 - Asphalt Shingle	27.61	2.47
Wood Rafter 12 - Asphalt Shingle 2	75.25	6.73

Wood Rafter 12 - STANDING METAL SEAM	13.20	1.07
Stairs and Railings	**1.91**	**0.19**
7 max riser 11 tread	0.78	0.08
7 max riser 11 tread no back	0.39	0.04
8 x 10	0.38	0.03
8 x 10 2 NO RISER	0.35	0.03
Structure	**2.78**	**0.21**
Wood Timber Column: 6 x 6	2.78	0.21
Walls	**274.80**	**23.49**
1/2 glass wall	5.27	0.23
4 trash can barrier	1.51	0.11
Advanced Framing - Exterior	72.03	6.53
Advanced Framing - Exterior black planks	18.32	1.17
Advanced Framing - Exterior black planks NO CONT. INSULATION	10.99	1.01
Advanced Framing - Exterior NO CONT. INSULATION	60.64	7.01
Advanced Framing - Exterior WING WALL	1.42	0.18
Generic - 6 3	49.75	1.83
Generic - 8 CIP foundation wall	5.03	0.31
Interior - 2 1/2 Partition 2	0.66	0.07
Interior - 2 Partition	0.13	0.02
Interior - 3/4 Partition 2	0.04	0.00
Interior - 4 1/2 Partition	6.74	0.95
Interior - 4 1/2 Partition INSULATED	7.98	1.13
Interior - 4 Partition Furring	0.37	0.06
Interior - 6 1/2 Partition	4.62	0.77
W9A - (2)2x4 Studs Insulated 1 HR	29.31	2.12
Windows	**36.85**	**1.70**
Window-Casement-Pella-Contemporary-Reserve-Fixed: 4' x 4' fixed	4.00	0.17
Window-Casement-Pella-Contemporary-Reserve-Fixed: 4' x 4' fixed 2	1.00	0.04
Window-Casement-Pella-Contemporary-Reserve-Fixed: 4' x 4' fixed THIN WALL	3.00	0.13
Window-Casement-Pella-Contemporary-Reserve-Fixed: 53x41	3.77	0.16
Window-Casement-Pella-Contemporary-Reserve-Fixed: 53x41 thin wall	3.77	0.16
Window-Casement-Pella-Contemporary-Reserve-Vent awning window: 35 x 23 W3 2	2.23	0.12
Window-Casement-Pella-Contemporary-Reserve-Vent awning window: 35 x 23 W3 2 thin wall	2.23	0.12
Window-Casement-Pella-Contemporary-Reserve-Vent: 35 x 23 W3	1.20	0.08

Window-Casement-Pella-Contemporary-Reserve-Vent: 35 x 23 W3 3 thin wall	0.60	0.04
Window-Casement-Pella-Contemporary-Reserve-Vent: 35 x 23 W3 THIN WALL	0.60	0.04
Window-Casement-Pella-Contemporary-Reserve-Vent: 3571 - 35 x 59 W2	7.30	0.32
Window-Casement-Pella-Contemporary-Reserve-Vent: 3571 - 35 x 59 W2 thin wall	7.16	0.31
Grand Total	**832.87**	**61.10**

Sum of Global Warming Potential Total (kgCO2eq)	Sum of Ozone Depletion Potential Total (CFC-11eq)	Sum of Smog Formation Potential Total (kgO3eq)	Sum of Primary Energy Demand Total (MJ)	Sum of Non-renewable Energy Demand Total (MJ)	Sum of Renewable Energy Demand Total (MJ)	Sum of Mass Total (kg)
-3,471.54	**6.22E-06**	**683.73**	**189,921.38**	**55,392.89**	**134,757.63**	**19,356.80**
607.67	1.54E-10	38.43	11,083.16	10,383.17	699.87	1,468.43
225.89	4.10E-06	17.34	3,965.42	3,677.96	290.66	385.60
127.03	1.83E-06	9.40	2,247.93	2,089.41	159.94	235.37
-899.83	1.84E-08	123.99	34,558.12	7,994.35	26,619.79	3,582.60
-686.15	1.40E-08	94.54	26,351.72	6,095.96	20,298.48	2,731.85
-2,846.14	2.49E-07	400.03	111,715.02	25,152.04	86,688.90	10,952.95
-713.34	**1.06E-08**	**60.10**	**16,634.47**	**1,403.37**	**15,263.72**	**1,624.60**
-283.95	4.24E-09	23.92	6,621.47	558.62	6,075.83	646.69
-429.39	6.40E-09	36.18	10,013.00	844.75	9,187.88	977.92
3,896.39	**2.18E-06**	**228.12**	**56,842.21**	**57,243.72**	**-447.00**	**1,152.44**
3,896.39	2.18E-06	228.12	56,842.21	57,243.72	-447.00	1,152.44
441.99	**5.89E-05**	**55.64**	**23,281.61**	**11,900.56**	**11,349.73**	**816.43**
125.97	-1.92E-09	9.74	3,208.94	1,948.50	1,266.54	34.29
131.22	-2.00E-09	10.14	3,342.64	2,029.69	1,319.31	35.72
117.95	3.76E-05	22.83	10,678.74	5,056.83	5,593.96	476.44
66.84	2.13E-05	12.93	6,051.29	2,865.54	3,169.91	269.98
22,690.92	**-9.51E-06**	**5,024.22**	**769,980.63**	**414,094.39**	**356,761.25**	**174,226.11**
432.55	-2.02E-07	23.95	4,074.91	3,825.69	250.28	2,207.61
23,485.07	-1.14E-05	3,058.20	272,587.92	249,761.52	23,043.21	87,965.94
923.79	1.45E-10	53.29	7,745.81	7,233.08	511.58	4,713.87
1,471.37	2.31E-10	84.87	12,337.18	11,520.53	814.82	7,508.04
2,324.23	3.47E-10	127.04	20,565.40	19,317.68	1,246.47	14,932.71
3,358.27	5.02E-10	183.56	29,714.91	27,912.09	1,801.03	21,576.25
-8,707.44	2.03E-06	1,433.10	406,142.27	92,452.89	314,335.47	33,821.38
-596.92	2.59E-08	60.21	16,812.23	2,070.91	14,758.39	1,500.31
7,728.52	**1.02E-05**	**1,490.00**	**652,164.10**	**491,837.25**	**160,630.65**	**20,015.44**
1,888.29	2.67E-06	363.55	162,627.95	125,702.38	37,001.51	4,806.62
5,146.72	7.29E-06	990.88	443,258.82	342,614.49	100,851.35	13,100.93

693.52	2.84E-07	135.58	46,277.34	23,520.38	22,777.79	2,107.89
285.09	**2.43E-10**	**26.32**	**6,633.41**	**1,761.56**	**4,879.52**	**382.07**
165.31	-2.15E-10	11.28	2,796.21	837.81	1,961.21	139.99
90.94	-1.60E-10	5.74	1,415.63	439.44	977.55	67.49
12.75	3.33E-10	4.79	1,249.70	245.44	1,006.09	91.09
16.09	2.84E-10	4.51	1,171.87	238.87	934.67	83.49
-364.63	**5.44E-09**	**30.72**	**8,502.82**	**717.34**	**7,802.15**	**830.43**
-364.63	5.44E-09	30.72	8,502.82	717.34	7,802.15	830.43
29,628.13	**6.60E-04**	**3,594.78**	**854,567.10**	**586,019.37**	**268,479.14**	**66,313.93**
699.17	2.80E-10	68.06	10,269.16	9,777.65	502.65	508.37
-197.92	2.95E-09	16.67	4,615.22	389.36	4,234.90	450.74
8,514.43	1.24E-04	767.34	198,169.13	139,741.24	58,127.56	13,219.49
3,314.83	8.83E-05	187.83	72,390.91	56,955.73	15,533.93	2,652.91
2,254.92	6.02E-05	148.85	58,119.21	43,722.47	14,460.24	2,028.30
9,481.82	2.30E-04	794.17	243,894.43	179,293.21	64,301.94	11,440.14
167.33	1.38E-07	20.18	4,529.85	2,932.29	1,581.39	318.44
3,369.13	2.11E-09	907.05	51,192.20	45,607.24	5,648.51	9,923.30
1,839.01	-8.58E-07	101.84	17,324.77	16,265.22	1,064.08	9,385.81
47.30	3.45E-06	7.94	2,536.44	1,518.61	1,021.80	255.85
0.65	4.83E-07	1.51	479.93	225.06	255.72	46.77
-1.27	9.87E-08	0.44	132.78	48.66	84.36	13.12
267.47	3.16E-05	77.46	25,872.89	14,314.03	11,604.32	2,493.16
316.88	3.75E-05	91.76	30,652.43	16,958.29	13,748.01	2,953.73
-10.83	1.18E-06	4.03	1,368.11	579.02	791.83	125.29
63.29	1.98E-05	51.37	17,823.25	9,198.66	8,658.68	1,651.88
-498.07	6.42E-05	348.27	115,196.39	48,492.61	66,859.24	8,846.64
5,105.59	**5.73E-08**	**476.34**	**76,154.21**	**71,939.78**	**4,257.76**	**3,484.31**
529.90	2.12E-10	51.59	7,782.95	7,410.43	380.95	385.29
132.47	5.30E-11	12.90	1,945.74	1,852.61	95.24	96.32
397.42	1.59E-10	38.69	5,837.21	5,557.82	285.71	288.97
499.77	2.00E-10	48.65	7,340.43	6,989.09	359.29	363.38
499.77	2.00E-10	48.65	7,340.43	6,989.09	359.29	363.38
325.29	1.75E-08	27.89	4,872.58	4,503.11	362.72	183.18
325.29	1.75E-08	27.89	4,872.58	4,503.11	362.72	183.18
232.15	1.04E-08	15.71	3,778.99	3,468.45	307.74	111.86

	116.07	5.20E-09	7.86	1,889.49	1,734.23	153.87	55.93
	116.07	5.20E-09	7.86	1,889.49	1,734.23	153.87	55.93
	981.53	3.97E-10	96.19	14,653.14	13,914.18	753.46	706.25
	949.86	3.80E-10	92.47	13,951.20	13,283.45	682.87	690.64
	65,227.12	**7.28E-04**	**11,669.97**	**2,654,681.95**	**1,692,310.25**	**963,734.55**	**288,202.57**

Row Labels	Values Sum of Acidification Potential Total (kgSO2eq)	Sum of Eutrophication Potential Total (kgNeq)	Sum of Global Warming Potential Total (kgCO2eq)	Sum of Ozone Depletion Potential Total (CFC-11eq)
Ceilings	**54.18**	**3.95**	**-3,471.54**	**6.22E-06**
Plywood, exterior grade	5.72	0.40	-399.85	1.99E-07
Steel, C-stud metal framing	1.00	0.05	156.06	5.94E-06
Wall board, gypsum	5.71	0.39	2,252.38	5.72E-10
Wood framing	41.76	3.11	-5,480.13	8.17E-08
Curtainwall Mullions	**5.44**	**0.40**	**-713.34**	**1.06E-08**
Wood framing	5.44	0.40	-713.34	1.06E-08
Curtainwall Panels	**24.93**	**0.94**	**3,896.39**	**2.18E-06**
Curtainwall System (including glazing)	24.93	0.94	3,896.39	2.18E-06
Doors	**6.95**	**2.43**	**441.99**	**5.89E-05**
Door frame, wood	1.09	0.15	257.19	-3.91E-09
Door, interior, wood, hollow core, flush	5.86	2.28	184.79	5.89E-05
Floors	**308.98**	**17.52**	**22,690.92**	**-9.51E-06**
Cast-in-place concrete, structural concrete, 2500 psi	13.51	0.95	5,682.50	8.49E-10
Cast-in-place concrete, structural concrete, 3000 psi	1.18	0.07	432.55	-2.02E-07
Cast-in-place concrete, structural concrete, 4000 psi	45.11	2.55	15,285.71	-1.14E-05
Domestic hardwood	5.58	0.58	-65.95	-5.33E-10
Fiber cement construction panel	8.95	0.55	4,223.33	1.51E-06
Plywood, exterior grade	9.79	0.69	-685.00	3.41E-07
Plywood, interior grade	0.51	0.04	-35.41	1.76E-08
Precast concrete paver	6.19	0.42	2,395.16	3.77E-10
Stone veneer wall, limestone, grouted	121.06	4.46	8,199.37	5.15E-09
Wood framing	97.09	7.23	-12,741.32	1.90E-07
Roofs	**116.05**	**10.26**	**7,728.52**	**1.02E-05**
Aluminum, formed	6.85	0.17	1,527.28	1.89E-07
Asphalt roofing shingles	58.97	2.99	12,795.68	9.30E-06
Plywood, exterior grade	20.45	1.44	-1,430.88	7.12E-07
Wood framing	8.16	0.61	-1,071.38	1.60E-08
Wood framing with insulation	21.62	5.06	-4,092.19	2.36E-08

Stairs and Railings	**1.91**	**0.19**	**285.09**	**2.43E-10**
Stair, hardwood, tread only	1.48	0.16	341.54	-5.99E-10
Wood framing	0.43	0.03	-56.45	8.42E-10
Structure	**2.78**	**0.21**	**-364.63**	**5.44E-09**
Wood framing	2.78	0.21	-364.63	5.44E-09
Walls	**274.80**	**23.49**	**29,628.13**	**6.60E-04**
Cast-in-place concrete, structural concrete, 3000 psi	5.03	0.31	1,839.01	-8.58E-07
ETFE sheet	27.13	1.83	8,389.13	3.74E-04
Fiber cement construction panel	5.64	0.34	2,659.67	9.51E-07
Fiber cement panel	60.02	7.79	11,994.63	7.47E-06
Fiberglass mat gypsum sheathing	17.62	1.63	4,080.91	1.56E-04
Glazing, triple pane IGU	5.27	0.23	699.17	2.80E-10
Mineral wool, board, generic	32.39	0.58	4,577.48	1.22E-04
Plywood, exterior grade	21.85	1.54	-1,528.45	7.61E-07
Polyethelene sheet vapor barrier (HDPE)	0.51	0.05	235.38	6.71E-11
Stone veneer wall, limestone, grouted	49.75	1.83	3,369.13	2.11E-09
Wall board, gypsum	2.12	0.13	891.04	2.26E-10
Wood framing	22.36	1.66	-2,934.48	4.38E-08
Wood framing with insulation	25.12	5.57	-4,644.48	2.90E-08
Windows	**36.85**	**1.70**	**5,105.59**	**5.73E-08**
Closed cell, polyurethane foam, spray-applied	0.00	0.00	0.00	0.00E+00
Glazing, triple pane IGU	34.52	1.51	4,577.94	1.83E-09
Paint	0.14	0.01	31.68	1.68E-11
Window frame, aluminum	1.72	0.13	315.07	5.05E-08
Window frame, vinyl	0.46	0.05	180.91	4.96E-09
Wood framing	0.00	0.00	0.00	0.00E+00
Grand Total	**832.87**	**61.10**	**65,227.12**	**7.28E-04**

Sum of Smog Formation Potential Total (kgO3eq)	Sum of Primary Energy Demand Total (MJ)	Sum of Non-renewable Energy Demand Total (MJ)	Sum of Renewable Energy Demand Total (MJ)	Sum of Mass Total (kg)
683.73	**189,921.38**	**55,392.89**	**134,757.63**	**19,356.80**
65.30	18,426.52	3,721.86	14,679.03	1,287.97
14.29	2,622.81	2,403.60	223.87	145.25
142.45	41,080.86	38,486.28	2,594.12	5,442.88
461.68	127,791.18	10,781.14	117,260.61	12,480.70
60.10	**16,634.47**	**1,403.37**	**15,263.72**	**1,624.60**
60.10	16,634.47	1,403.37	15,263.72	1,624.60
228.12	**56,842.21**	**57,243.72**	**-447.00**	**1,152.44**
228.12	56,842.21	57,243.72	-447.00	1,152.44
55.64	**23,281.61**	**11,900.56**	**11,349.73**	**816.43**
19.88	6,551.58	3,978.19	2,585.85	70.01
35.76	16,730.03	7,922.37	8,763.88	746.42
5,024.22	**769,980.63**	**414,094.39**	**356,761.25**	**174,226.11**
310.60	50,280.30	47,229.77	3,047.50	36,508.96
23.95	4,074.91	3,825.69	250.28	2,207.61
850.74	148,002.79	138,768.36	9,296.59	63,815.86
110.55	34,697.84	9,511.40	25,242.80	1,692.38
191.69	57,942.35	53,240.47	4,772.30	2,291.07
111.87	31,567.31	6,376.09	25,147.30	2,206.49
5.78	1,632.04	329.65	1,300.12	114.08
138.16	20,082.99	18,753.61	1,326.40	12,221.91
2,207.46	124,585.13	110,993.15	13,746.62	24,150.08
1,073.42	297,114.96	25,066.19	272,631.34	29,017.68
1,490.00	**652,164.10**	**491,837.25**	**160,630.65**	**20,015.44**
69.45	25,209.46	20,436.43	4,772.83	494.51
897.50	460,324.14	447,009.22	13,452.59	6,760.32
233.69	65,940.49	13,318.91	52,529.82	4,609.10
90.26	24,983.49	2,107.74	22,924.74	2,440.01
199.10	75,706.53	8,964.95	66,950.67	5,711.50

26.32	**6,633.41**	**1,761.56**	**4,879.52**	**382.07**
21.57	5,316.96	1,650.50	3,671.54	253.50
4.76	1,316.46	111.06	1,207.97	128.57
30.72	**8,502.82**	**717.34**	**7,802.15**	**830.43**
30.72	8,502.82	717.34	7,802.15	830.43
3,594.78	**854,567.10**	**586,019.37**	**268,479.14**	**66,313.93**
101.84	17,324.77	16,265.22	1,064.08	9,385.81
291.46	171,199.84	153,626.58	17,802.47	761.61
120.72	36,489.57	33,528.53	3,005.38	1,442.81
926.44	186,423.78	154,788.40	30,703.11	13,117.08
231.83	74,629.07	64,859.65	9,855.93	8,058.80
68.06	10,269.16	9,777.65	502.65	508.37
157.37	57,020.16	54,562.17	2,612.18	2,581.20
249.63	70,436.91	14,227.12	56,111.79	4,923.39
9.97	7,494.37	7,379.50	109.67	89.83
907.05	51,192.20	45,607.24	5,648.51	9,923.30
48.36	16,536.09	15,504.94	1,034.43	2,137.04
247.22	68,429.10	5,773.04	62,790.23	6,683.12
234.82	87,122.07	10,119.32	77,238.72	6,701.56
476.34	**76,154.21**	**71,939.78**	**4,257.76**	**3,484.31**
0.00	0.00	0.00	0.00	0.00
445.66	67,239.38	64,021.07	3,291.17	3,328.62
3.72	701.94	630.73	70.59	15.61
19.70	4,903.17	4,272.51	601.03	74.08
7.26	3,309.72	3,015.47	294.97	66.00
0.00	0.00	0.00	0.00	0.00
11,669.97	**2,654,681.95**	**1,692,310.25**	**963,734.55**	**288,202.57**

Row Labels	Values Sum of Acidification Potential Total (kgSO2eq)	Sum of Eutrophication Potential Total (kgNeq)	Sum of Global Warming Potential Total (kgCO2eq)	Sum of Ozone Depletion Potential Total (CFC-11eq)	Sum of Smog Formation Potential Total (kgO3eq)	Sum of Primary Energy Demand Total (MJ)
Enclosure	255.02	19.74	34,047.06	5.02E-04	3,403.60	721,774.70
Interiors	118.58	11.88	-2,315.00	2.23E-04	1,413.34	422,231.43
Superstructure	260.45	20.92	6,137.19	1.23E-05	3,462.79	1,153,984.73
Undefined	198.81	8.57	27,357.86	-9.38E-06	3,390.25	356,691.09
Grand Total	**832.87**	**61.10**	**65,227.12**	**7.28E-04**	**11,669.97**	**2,654,681.95**

Sum of Non-renewable Energy Demand Total (MJ)	Sum of Renewable Energy Demand Total (MJ)	Sum of Mass Total (kg)
556,457.20	164,975.40	52,452.70
166,578.78	256,162.53	37,830.84
653,061.77	501,900.56	104,898.43
316,212.49	40,696.06	93,020.60
1,692,310.25	**963,734.55**	**288,202.57**

Row Labels	Values Sum of Acidification Potential Total (kgSO2eq)	Sum of Eutrophication Potential Total (kgNeq)	Sum of Global Warming Potential Total (kgCO2eq)
Ceilings	**54.18**	**3.95**	**-3,471.54**
Cold formed structural steel	1.00	0.05	156.06
Domestic softwood, US, AWC - EPD	41.76	3.11	-5,480.13
Exterior grade plywood, US	5.72	0.40	-399.85
Paint, exterior acrylic latex	3.34	0.25	742.55
Wall board, gypsum, natural	2.37	0.15	1,509.83
Curtainwall Mullions	**5.44**	**0.40**	**-713.34**
Domestic softwood, US, AWC - EPD	5.44	0.40	-713.34
Curtainwall Panels	**24.93**	**0.94**	**3,896.39**
Curtain wall system, Kawneer, 1600 Wall System - EPD	24.93	0.94	3,896.39
Doors	**6.95**	**2.43**	**441.99**
Door frame, wood, no door	1.07	0.15	249.41
Door, interior, wood, hollow core	4.30	0.80	-158.52
Fasteners, galvanized steel	0.01	0.00	2.55
Hardware, stainless steel	1.28	0.21	55.04
Paint, interior acrylic latex	0.32	0.02	86.27
Stainless steel door hinge	-0.05	1.24	202.01
Wood stain, water based	0.01	0.00	5.24
Floors	**308.98**	**17.52**	**22,690.92**
Birch lumber, 1 inch	0.36	0.04	-6.50
Cherry lumber, 1 inch	5.01	0.52	-152.48
Domestic softwood, US, AWC - EPD	97.09	7.23	-12,741.32
Exterior grade plywood, US	9.79	0.69	-685.00
Fiber cement structural panel, Eternit, Eterplan - EPD	8.95	0.55	4,223.33
Interior grade plywood, US, AWC - EPD	0.51	0.04	-35.41
Mortar type S	0.00	0.00	0.00
Steel, reinforcing rod	17.04	0.50	3,344.80
Stone slab, limestone	121.06	4.46	8,199.37
Structural concrete, 2500 psi, Great Lakes Midwest regional average	13.51	0.95	5,682.50

Structural concrete, 3000 psi, 0% fly ash and slag	6.19	0.42	2,395.16
Structural concrete, 3000 psi, North Central regional average	0.89	0.06	374.24
Structural concrete, 4000 psi, North Central regional average	28.37	2.05	11,999.21
Wood stain, water based	0.21	0.02	93.02
Roofs	**116.05**	**10.26**	**7,728.52**
Aluminum, formed	6.74	0.17	1,520.58
Cellulose insulation, blown	10.14	4.20	-2,585.11
Domestic softwood, US, AWC - EPD	19.65	1.46	-2,578.45
Exterior grade plywood, US	20.45	1.44	-1,430.88
Fasteners, stainless steel	1.15	0.19	56.13
Paint, exterior metal coating, silicone-based, by area	0.11	0.00	6.71
SBS modified asphalt, strip, ARMA - EPD	57.82	2.80	12,739.56
Stairs and Railings	**1.91**	**0.19**	**285.09**
Ash lumber, 2 inch	1.48	0.16	341.54
Domestic softwood, US, AWC - EPD	0.43	0.03	-56.45
Structure	**2.78**	**0.21**	**-364.63**
Domestic softwood, US, AWC - EPD	2.78	0.21	-364.63
Walls	**274.80**	**23.49**	**29,628.13**
Aluminum extrusion, AEC - EPD	30.05	1.03	5,253.06
Cellulose insulation, blown	10.89	4.51	-2,776.95
Domestic softwood, US, AWC - EPD	36.59	2.72	-4,802.01
ETFE sheet	27.13	1.83	8,389.13
Exterior grade plywood, US	21.85	1.54	-1,528.45
Fasteners, stainless steel	0.86	0.14	42.08
Fiber cement board	25.72	6.37	5,945.80
Fiber cement structural panel, Eternit, Eterplan - EPD	5.64	0.34	2,659.67
Fiberglass mat gypsum sheathing board	17.62	1.63	4,080.91
Glazing, triple, insulated (air)	5.27	0.23	699.17
Mineral wool, high density, NAIMA - EPD	32.39	0.58	4,577.48
Mortar type S	0.00	0.00	0.00
Paint, exterior acrylic latex	3.91	0.29	871.26
Paint, interior acrylic latex	0.66	0.03	175.85
Polyethelene sheet vapor barrier (HDPE)	0.51	0.05	235.38
Steel, reinforcing rod	1.26	0.04	247.92
Stone slab, limestone	49.75	1.83	3,369.13

Structural concrete, 3000 psi, North Central regional average	3.77	0.27	1,591.09
Wall board, gypsum, natural	0.94	0.06	597.63
Windows	**36.85**	**1.70**	**5,105.59**
Domestic softwood, US, AWC - EPD	0.00	0.00	0.00
Glazing, triple, insulated (air)	34.52	1.51	4,577.94
Paint, exterior acrylic latex	0.14	0.01	31.68
Spray polyurethane foam, closed cell (HFO blowing agent), SPFA - EPD	0.00	0.00	0.00
Window frame, aluminum, powder-coated, operable, insulated	1.72	0.13	315.07
Window frame, vinyl, fixed	0.46	0.05	180.91
Grand Total	**832.87**	**61.10**	**65,227.12**

Sum of Ozone Depletion Potential Total (CFC-11eq)	Sum of Smog Formation Potential Total (kgO3eq)	Sum of Primary Energy Demand Total (MJ)	Sum of Non-renewable Energy Demand Total (MJ)	Sum of Renewable Energy Demand Total (MJ)	Sum of Mass Total (kg)
6.22E-06	**683.73**	**189,921.38**	**55,392.89**	**134,757.63**	**19,356.80**
5.94E-06	14.29	2,622.81	2,403.60	223.87	145.25
8.17E-08	461.68	127,791.18	10,781.14	117,260.61	12,480.70
1.99E-07	65.30	18,426.52	3,721.86	14,679.03	1,287.97
3.95E-10	87.17	16,454.93	14,785.71	1,654.88	365.96
1.77E-10	55.28	24,625.93	23,700.57	939.24	5,076.92
1.06E-08	**60.10**	**16,634.47**	**1,403.37**	**15,263.72**	**1,624.60**
1.06E-08	60.10	16,634.47	1,403.37	15,263.72	1,624.60
2.18E-06	**228.12**	**56,842.21**	**57,243.72**	**-447.00**	**1,152.44**
2.18E-06	228.12	56,842.21	57,243.72	-447.00	1,152.44
5.89E-05	**55.64**	**23,281.61**	**11,900.56**	**11,349.73**	**816.43**
2.37E-10	19.42	6,372.11	3,806.16	2,578.23	64.72
9.73E-08	35.19	9,153.49	1,873.98	7,254.23	628.77
-4.22E-09	0.13	43.13	38.33	4.86	1.11
9.41E-06	2.25	1,114.66	872.93	240.69	34.93
4.60E-11	6.22	2,052.19	1,855.68	196.54	34.11
4.94E-05	-7.90	4,409.69	3,319.78	1,072.41	48.61
7.53E-11	0.33	136.34	133.70	2.76	4.18
-9.51E-06	**5,024.22**	**769,980.63**	**414,094.39**	**356,761.25**	**174,226.11**
-1.23E-10	6.92	1,988.46	510.35	1,471.71	106.68
-1.75E-09	97.78	30,287.17	6,625.73	23,722.01	1,511.40
1.90E-07	1,073.42	297,114.96	25,066.19	272,631.34	29,017.68
3.41E-07	111.87	31,567.31	6,376.09	25,147.30	2,206.49
1.51E-06	191.69	57,942.35	53,240.47	4,772.30	2,291.07
1.76E-08	5.78	1,632.04	329.65	1,300.12	114.08
0.00E+00	0.00	0.00	0.00	0.00	0.00
-1.16E-05	202.66	47,140.34	44,380.50	2,830.99	2,372.65
5.15E-09	2,207.46	124,585.13	110,993.15	13,746.62	24,150.08
8.49E-10	310.60	50,280.30	47,229.77	3,047.50	36,508.96

3.77E-10	138.16	20,082.99	18,753.61	1,326.40	12,221.91
5.61E-11	20.42	3,253.08	3,051.99	200.92	2,166.25
1.83E-09	651.61	101,684.27	95,161.57	6,514.96	61,484.57
1.34E-09	5.85	2,422.22	2,375.32	49.08	74.30
1.02E-05	**1,490.00**	**652,164.10**	**491,837.25**	**160,630.65**	**20,015.44**
1.89E-07	68.85	25,077.52	20,325.06	4,752.52	489.18
1.07E-09	72.14	40,563.08	6,000.06	34,703.21	2,279.22
3.85E-08	217.23	60,126.94	5,072.63	55,172.21	5,872.29
7.12E-07	233.69	65,940.49	13,318.91	52,529.82	4,609.10
8.26E-06	2.09	1,117.57	891.63	228.67	24.77
3.89E-12	0.60	131.94	111.37	20.31	5.33
1.04E-06	895.41	459,206.57	446,117.59	13,223.92	6,735.55
2.43E-10	**26.32**	**6,633.41**	**1,761.56**	**4,879.52**	**382.07**
-5.99E-10	21.57	5,316.96	1,650.50	3,671.54	253.50
8.42E-10	4.76	1,316.46	111.06	1,207.97	128.57
5.44E-09	**30.72**	**8,502.82**	**717.34**	**7,802.15**	**830.43**
5.44E-09	30.72	8,502.82	717.34	7,802.15	830.43
6.60E-04	**3,594.78**	**854,567.10**	**586,019.37**	**268,479.14**	**66,313.93**
1.26E-06	421.12	82,209.74	72,523.98	8,757.36	1,857.25
1.15E-09	77.49	43,573.14	6,445.30	37,278.42	2,448.36
7.16E-08	404.55	111,978.03	9,447.06	102,750.53	10,936.31
3.74E-04	291.46	171,199.84	153,626.58	17,802.47	761.61
7.61E-07	249.63	70,436.91	14,227.12	56,111.79	4,923.39
6.20E-06	1.57	837.81	668.42	171.43	18.57
5.12E-09	415.27	86,674.40	66,588.44	20,094.60	10,869.81
9.51E-07	120.72	36,489.57	33,528.53	3,005.38	1,442.81
1.56E-04	231.83	74,629.07	64,859.65	9,855.93	8,058.80
2.80E-10	68.06	10,269.16	9,777.65	502.65	508.37
1.22E-04	157.37	57,020.16	54,562.17	2,612.18	2,581.20
0.00E+00	0.00	0.00	0.00	0.00	0.00
4.63E-10	102.28	19,307.13	17,348.58	1,941.73	429.39
9.38E-11	12.68	4,183.24	3,782.66	400.64	69.53
6.71E-11	9.97	7,494.37	7,379.50	109.67	89.83
-8.58E-07	15.02	3,494.04	3,289.48	209.83	175.86
2.11E-09	907.05	51,192.20	45,607.24	5,648.51	9,923.30

2.39E-10	86.82	13,830.73	12,975.74	854.25	9,209.95
7.00E-11	21.88	9,747.55	9,381.27	371.78	2,009.57
5.73E-08	**476.34**	**76,154.21**	**71,939.78**	**4,257.76**	**3,484.31**
0.00E+00	0.00	0.00	0.00	0.00	0.00
1.83E-09	445.66	67,239.38	64,021.07	3,291.17	3,328.62
1.68E-11	3.72	701.94	630.73	70.59	15.61
0.00E+00	0.00	0.00	0.00	0.00	0.00
5.05E-08	19.70	4,903.17	4,272.51	601.03	74.08
4.96E-09	7.26	3,309.72	3,015.47	294.97	66.00
7.28E-04	**11,669.97**	**2,654,681.95**	**1,692,310.25**	**963,734.55**	**288,202.57**