MILLER HULL

May 23th, 2022

**Re: Milestone Incentive: Innovation - Embodied Carbon Analysis**

Dear: Julie Knorr

The University of Washington Health Science Education Building was analyzed to emit 2,220 tons of carbon in its upfront emissions. The material selection of CLT floors and exterior metal siding reduced upfront emissions by approximately 20% compared to a baseline building of same use, shape, and size.

The majority of these emissions comes from the buildings concrete, steel and insulation. Miller Hull conducted this whole building life cycle (WBLCA) assessment by using software known as Tally. Tally uses industry standard Environmental Product Declarations (EPD's) to calculate the global warming potential of each material shown in our Revit building information models. We leverage these tools during design to spotlight the most impactful materials and find feasible alternatives or compare design iterations to help material selection. At this time, Miller Hull is including substructure, superstructure, envelope, and fixed interior building elements in whole building life cycle assessment studies. These are analyzed in what is knowns as the A1 (raw material supply), A2 (transport) and A3 (manufacturing) product stages.

There are two types of emissions that the building industry is responsible for: operational energy emissions and embodied carbon emissions. The operational emissions result from the energy used by the building to heat and cool and provide electricity for any equipment and lights in the building. Embodied carbon emissions result from the energy used to extract, manufacture and transport building materials and products. Unlike operational emissions that can change over a building's lifetime depending on operation, embodied emissions are set at the time of construction. This means that there is no opportunity to reduce them as with operational emissions when a building can be operated more efficiently over time or receive energy from a cleaner source like an evolving campus utility or a greener regional utility grid. Between now and 2050, embodied emissions will account for almost half of the total climate impact incurred by the new buildings we are designing today. Emissions, like embodied carbon, that are added to the world now are more harmful because they are accumulating at a faster rate and link directly to human health problems and death rates right now. Reducing embodied emissions from our buildings is a critical step to addressing climate change.

The use of mass timber structure has been shown to reduce the embodied carbon of buildings. The majority of embodied emissions from architecture typically stems from a building's primary structural system. Typically, concrete and steel, common materials for building structure, are the highest emitters of embodied carbon emissions. Using a structural system alternative of mass timber like cross laminated timber (CLT), can help to reduce the embodied emissions of a building's structural system. In the UW HSEB project, we have been able to see a reduction in overall embodied carbon emissions because of the use of mass timber. Other benefits include the use of a regionally available, renewable resource and support for smaller economies that harvest and produce timber. The use of exposed CLT also provides an aesthetic benefit and helps to reduce duplicative materials for ceiling finishes. When wood is responsibly harvested, there can be great environmental and economic benefits.

Addressing embodied carbon in every project is a must in order to reach climate targets. Using building materials and products that support reducing these emissions is possible now and projects like the University of Washington's Health Science Education Building exemplify this. By using renewable and regionally-sourced resources like cross

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laminated timber helps the market realize the potential for emissions-reducing buildings. The University of Washington is helping other projects to see the value in wisely choosing building materials. .

Attached you will find two life cycle assessments of embodied environmental impacts that include embodied carbon analysis.

- Attachment A – Project Design is a report prepared to describe the current project basis of design.
- Attachment B – Alternate Baseline Design is a report used to establishing an assumed baseline building where no CLT was used, and the metal panel siding was replaced with glass fiber reinforced concrete panels.

Sincerely,

Bradly Gunn
Project Architect, The Miller Hull Partnership

FIGURE 1 - HSEB Embodied Carbon Analysis

# HEALTH SCIENCES EDUCATION BUILDING DESIGN

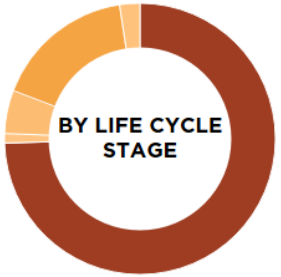
HEALTH SCIENCES EDUCATION BUILDING

LATEST VERSION: **3.1**

3.1

TOTAL GWP: **2,865 tCO2e** *(618.7 passenger vehicles driving for a year*)*
GWP / AREA: **318 kgCO2e/m2**

| | |
|---|---|
| Study date: | May 20, 2022 |
| Tally modeler: | Katherine Martin |
| Tally version: | Null |
| Project area: | 100,000 sf |
| Reference lifespan: | 60 years |
| Notes: | Envelope and Structure |



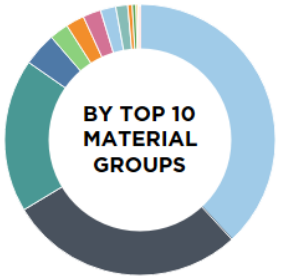

| | |
|---|---|
| [A1-A3] Product | 75% |
| [A4] Transportation | 1% |
| [B2-B5] Maintenan.. | 5% |
| [C2-C4] End of Life | 17% |
| [D] Module D | 2% |

**TOP MATERIALS BY GWP** *(57 materials defined, total)*

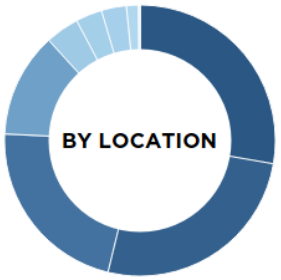
| | | | GWP | Mass Total |
|---|---|---|---|---|
| 1 | Steel, W section (wide flange shape) | 59 | 588,166 | 517,281 *8.4% of total* |
| 2 | Cast-in-place concrete, structural concrete, 5000 p.. | 60 | 484,508 | 2,355,158 *38.1% of total* |
| 3 | Extruded polystyrene (XPS), board | 60 | 416,084 | 5,578 *0.1% of total* |
| 4 | Cast-in-place concrete, structural concrete, 3000 p.. | 60 | 293,318 | 1,350,786 *21.8% of total* |
| 5 | Cast-in-place concrete, structural concrete, 4000 p.. | 60 | 154,025 | 869,023 *14.0% of total* |
| 6 | Polyethelene sheet vapor barrier (HDPE) | 60 | 89,467 | 34,145 *0.6% of total* |
| 7 | Steel, HSS section | 60 | 86,564 | 48,942 *0.8% of total* |
| 8 | Aluminum, sheet | 60 | 85,836 | 21,243 *0.3% of total* |
| 9 | Steel, deck | 60 | 75,352 | 36,306 *0.6% of total* |
| 10 | Mineral wool, board, generic | 60 | 70,684 | 39,858 *0.6% of total* |

-200K 0K 200K 400K 600K 800K 0K 1000K 2000K 3000K

GWP (kgCO2eq) Mass Total (kg)




| | |
|---|---|
| Metal | 39% |
| Concrete | 29% |
| Insulation | 19% |
| Vapor barrier | 4% |
| Glazing | 2% |
| Plaster | 2% |
| Metal Coating | 2% |
| Ceiling tile | 2% |
| Roofing membra.. | 1% |
| Window frame | 1% |
| Coating | 0% |
| Adhesive / Seala.. | 0% |
| Composite | 0% |
| Door | 0% |
| Door frame | 0% |
| Opening hardwar.. | 0% |




| | |
|---|---|
| Structure | 28% |
| Walls | 26% |
| Floors | 22% |
| Roofs | 12% |
| Curtainwall Panels | 4% |
| Ceilings | 3% |
| Curtainwall Mulli.. | 3% |
| Stairs and Railings | 1% |
| Doors | 0% |
| Windows | 0% |

# HEALTH SCIENCES EDUCATION BUILDING

## Full building summary

5/19/2022

## Table of Contents

Report Summary 1

LCA Results

- Results per Life Cycle Stage 2
- Results per Life Cycle Stage, itemized by Division 3
- Results per Division 4
- Results per Division, itemized by Tally Entry 5
- Results per Division, itemized by Material 6
- Results per Revit Category 8
- Results per Revit Category, itemized by Family 9
- Results per Building Element 11

Appendix

- Calculation Methodology - Life Cycle Assessment Methods 12
- Calculation Methodology - Life Cycle Stages 13
- Calculation Methodology - Environmental Impact Categories 14
- LCI Data 15

# Report Summary

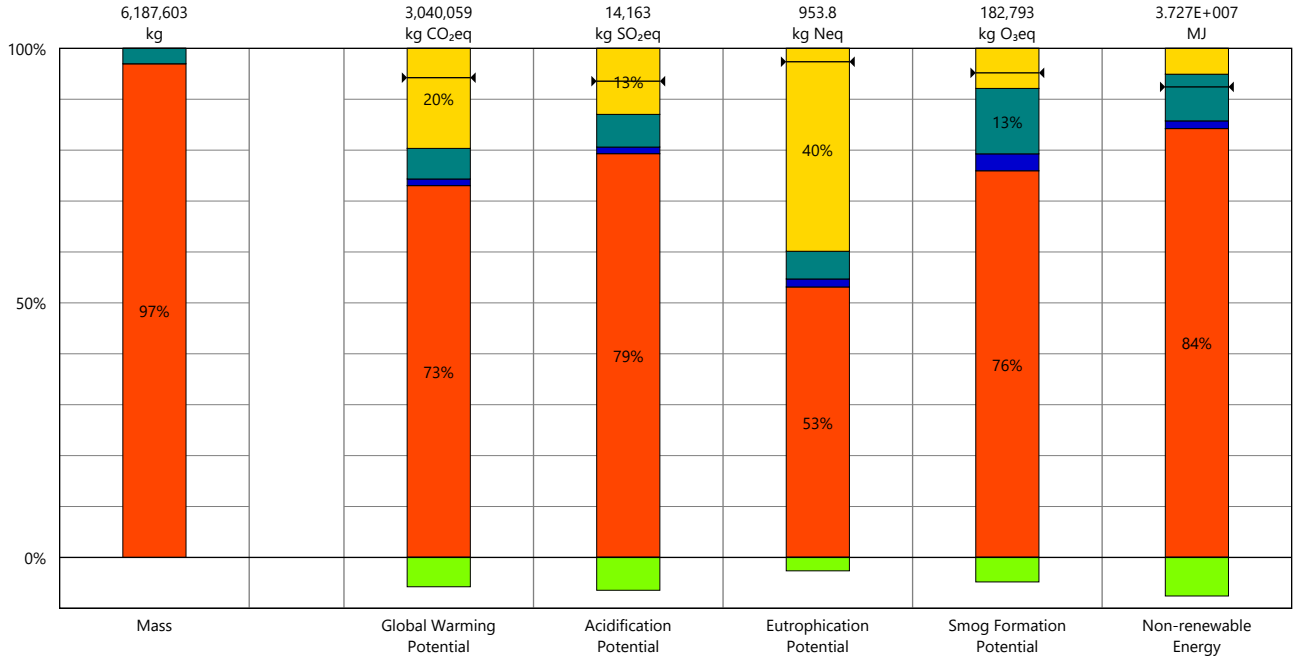
**Created with Tally**
Commercial Version 2022.04.08.01

| | |
|---|---|
| **Author** | Katherine Martin |
| **Company** | The Miller Hull Partnership |
| **Date** | 5/19/2022 |
| **Project** | HEALTH SCIENCES EDUCATION BUILDING |
| **Location** | 1607 NE Pacific Street |
| **Gross Area** | 100,000 $ft^2$ |
| **Building Life** | 60 years |
| **Boundaries** | Cradle to grave, inclusive of biogenic carbon; see appendix for a full list of materials and processes |

**Goal and Scope of Assessment**
Complete building envelope and structural elements, including foundations and footings, structural wall assembly (cladding to interior finish), structural floors and ceilings, and roof assemblies.

| 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 $CO_2$eq) | 2,220,176 | 39,688 | 182,652 | 597,543 | -175,252 |
| Acidification (kg $SO_2$eq) | 11,232 | 183.9 | 909.3 | 1,838 | -914 |
| Eutrophication (kg Neq) | 506.7 | 14.97 | 51.89 | 380.2 | -25.1 |
| Smog Formation (kg $O_3$eq) | 138,829 | 6,077 | 23,492 | 14,396 | -8,801 |
| Ozone Depletion (kg CFC-11eq) | 0.2889 | 1.359E-009 | 3.943E-004 | 4.939E-005 | 9.009E-004 |
| Primary Energy (MJ) | 3.677E+007 | 577,149 | 3,703,493 | 2,025,103 | -3,731,000 |
| Non-renewable Energy (MJ) | 3.139E+007 | 563,338 | 3,416,642 | 1,894,656 | -2,823,543 |
| Renewable Energy (MJ) | 5,369,627 | 13,956 | 288,480 | 132,360 | -910,462 |
| **Environmental Impacts / Area** | | | | | |
| Global Warming (kg $CO_2$eq/$m^2$) | 239.0 | 4.272 | 19.66 | 64.32 | -18.9 |
| Acidification (kg $SO_2$eq/$m^2$) | 1.209 | 0.0198 | 0.09787 | 0.1978 | -0.09838 |
| Eutrophication (kg Neq/$m^2$) | 0.05454 | 0.001612 | 0.005586 | 0.04093 | -0.002705 |
| Smog Formation (kg $O_3$eq/$m^2$) | 14.94 | 0.6541 | 2.529 | 1.550 | -0.9474 |
| Ozone Depletion (kg CFC-11eq/$m^2$) | 3.110E-005 | 1.463E-013 | 4.244E-008 | 5.316E-009 | 9.697E-008 |
| Primary Energy (MJ/$m^2$) | 3,957 | 62.12 | 398.6 | 218.0 | -402 |
| Non-renewable Energy (MJ/$m^2$) | 3,379 | 60.64 | 367.8 | 203.9 | -304 |
| Renewable Energy (MJ/$m^2$) | 578.0 | 1.502 | 31.05 | 14.25 | -98.0 |

## Results per Life Cycle Stage

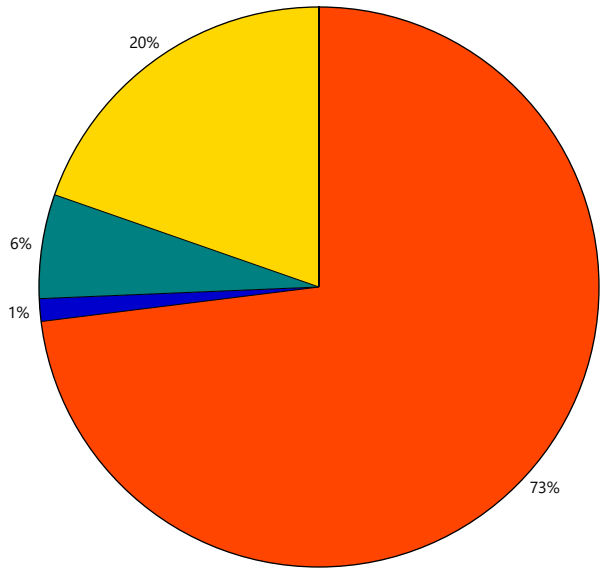



### Legend

Net value (impacts + credits)

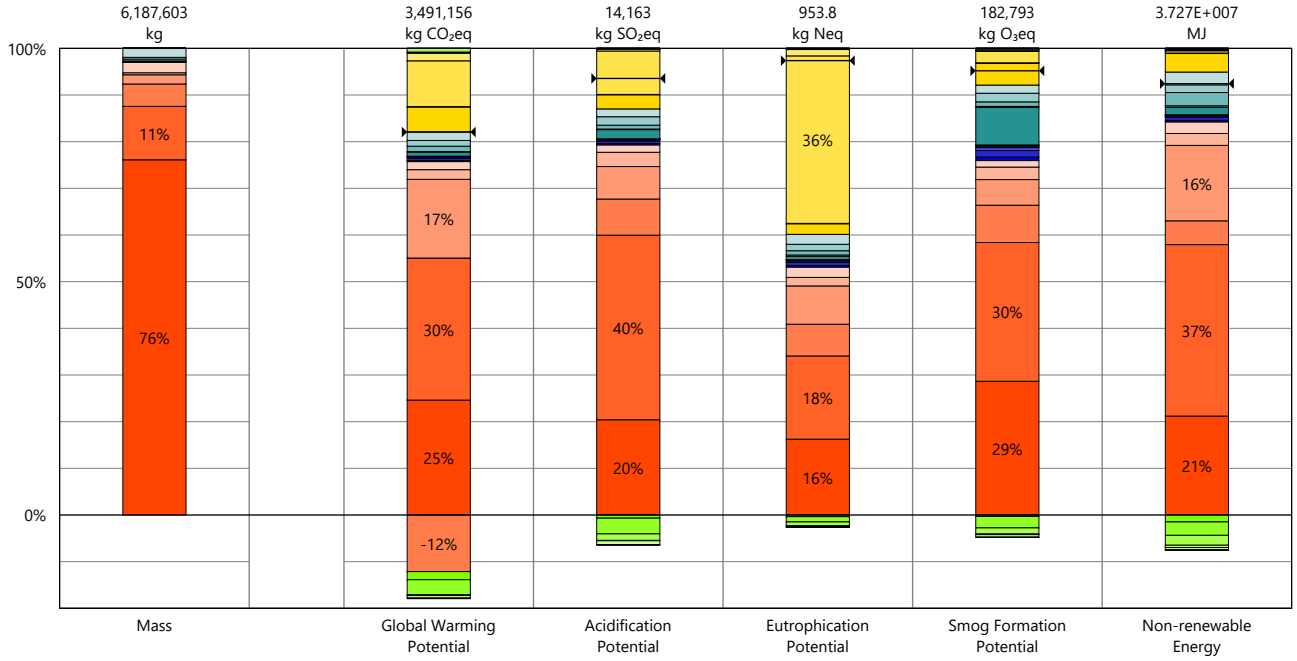
Life Cycle Stages

- 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




### Legend

Net value (impacts + credits)

Product [A1-A3]
- 03 - Concrete
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal and Moisture Protection
- 08 - Openings and Glazing
- 09 - Finishes

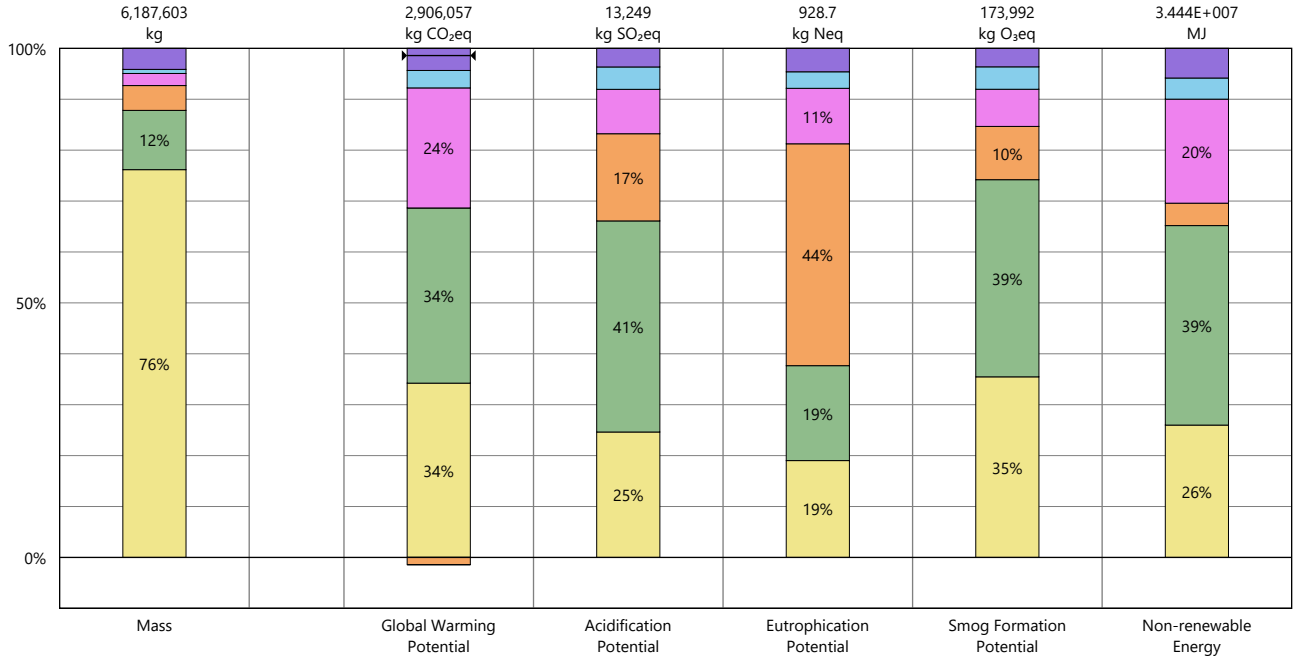
Transportation [A4]
- 03 - Concrete
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal and Moisture Protection
- 08 - Openings and Glazing
- 09 - Finishes

Maintenance and Replacement [B2-B5]
- 03 - Concrete
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal and Moisture Protection
- 08 - Openings and Glazing
- 09 - Finishes

End of Life [C2-C4]
- 03 - Concrete
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal and Moisture Protection
- 08 - Openings and Glazing
- 09 - Finishes

Module D [D]
- 03 - Concrete
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal and Moisture Protection
- 08 - Openings and Glazing
- 09 - Finishes

## Results per Division

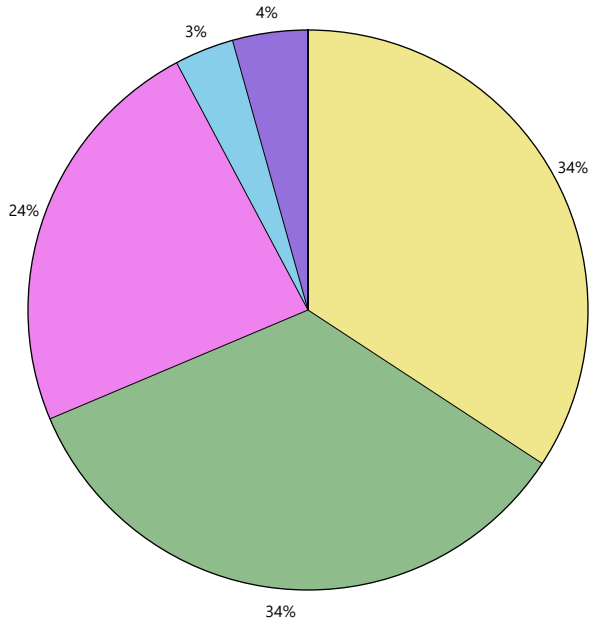



### Legend

Net value (impacts + credits)

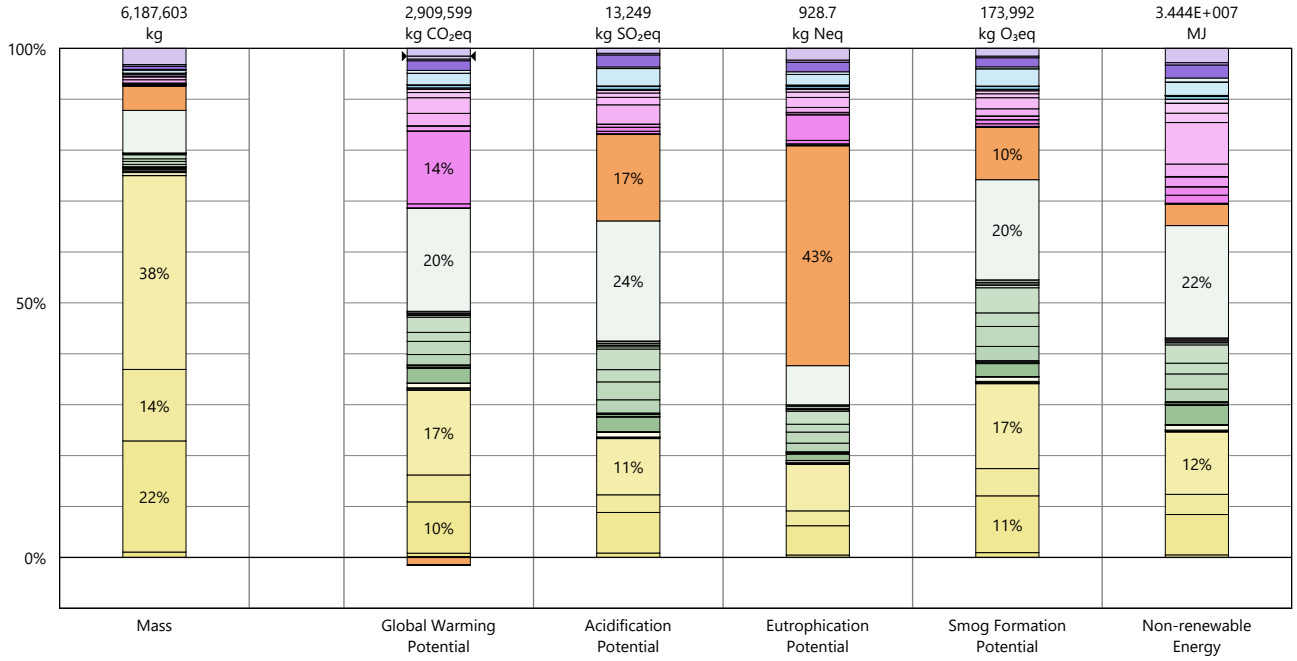
Divisions

- 03 - Concrete
- 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




### Legend

Net value (impacts + credits)

#### 03 - Concrete

- Cast-in-place concrete, lightweight structural concrete, 5000 psi
- Cast-in-place concrete, structural concrete, 3000 psi
- Cast-in-place concrete, structural concrete, 4000 psi
- Cast-in-place concrete, structural concrete, 5000 psi
- Precast concrete column
- Precast concrete nonstructural panel
- Precast concrete paver
- Stair, concrete with metal nosing
- Stair, precast single run (stretcher)
- Steel, reinforcing rod

#### 05 - Metals

- Aluminum, angle
- Aluminum, formed
- Aluminum, sheet
- Stainless Steel, Fasteners
- Steel, angle
- Steel, C channel
- Steel, C-H-stud metal framing
- Steel, C-stud metal framing
- Steel, C-stud metal framing with insulation
- Steel, deck
- Steel, furring channel
- Steel, HSS section
- Steel, plate
- Steel, rectangular bar
- Steel, rod
- Steel, round bar
- Steel, round tubing
- Steel, sheet, stainless
- Steel, W section (wide flange shape)

#### 06 - Wood/Plastics/Composites

- Cross laminated timber (CLT)
- Domestic hardwood
- Phenolic resin solid surface, sheet
- Plywood, interior grade

#### 07 - Thermal and Moisture Protection

- EPDM, roofing membrane
- Extruded polystyrene (XPS), board
- Fiberglass clip system
- Fluid applied synthetic polymer air barrier
- Metal roofing panels, formed
- Mineral wool, board, generic
- Polyethelene sheet vapor barrier (HDPE)
- Polyisocyanurate (PIR), board
- SBS modified bitumen, sheet
- Self adhering membrane
- Self-adhering sheet waterproofing, modified bituminous sheet
- Wood siding

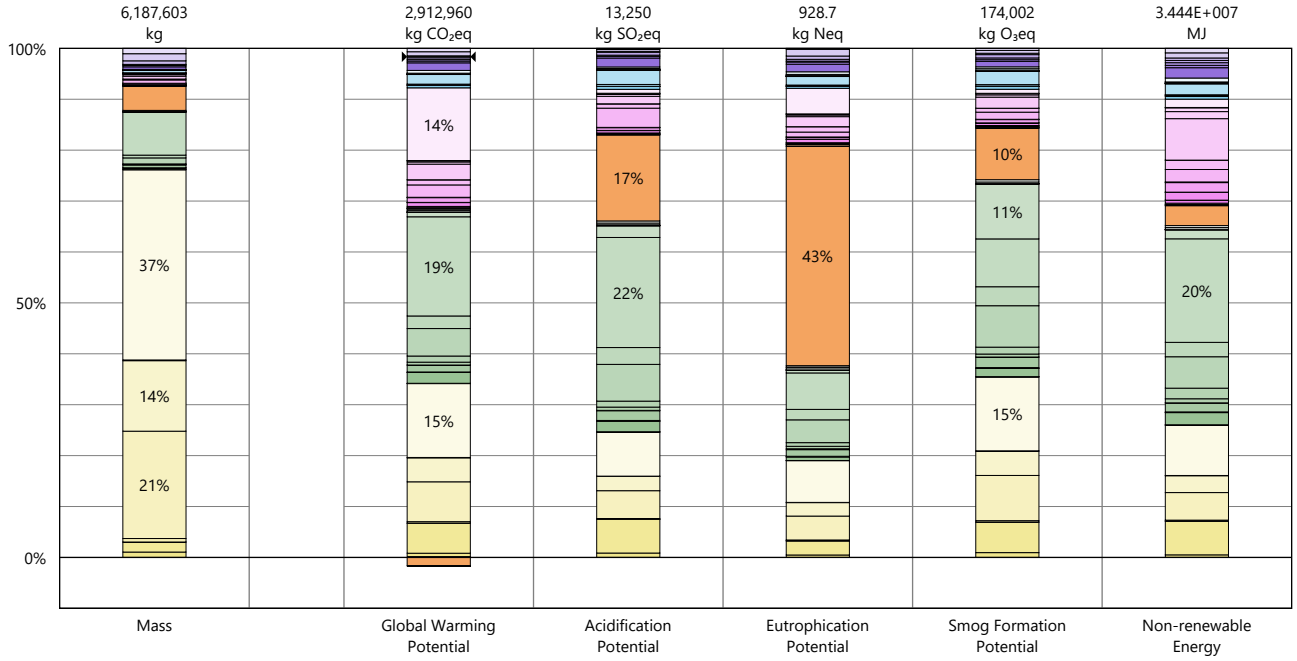
#### 08 - Openings and Glazing

- Aluminum mullion, inclusive of finish
- Door frame, aluminum
- Door frame, steel, galvanized
- Door, exterior, aluminum
- Door, exterior, steel
- Door, interior, steel
- Glazing, custom IGU
- Glazing, monolithic sheet
- Window frame, vinyl

#### 09 - Finishes

- Acoustic ceiling system, mineral fiber board
- Fiberglass mat gypsum sheathing
- Wall board, gypsum

## Results per Division, itemized by Material




### Legend

Net value (impacts + credits)

#### 03 - Concrete

- Lightweight concrete, 5000 psi, Pacific Northwest regional average
- Steel, reinforcing rod
- Steel, sheet
- Structural concrete, 3000 psi, 0% fly ash and slag
- Structural concrete, 3000 psi, Pacific Northwest regional average
- Structural concrete, 4000 psi, 20% fly ash and 30% slag
- Structural concrete, 5000 psi, 0% fly ash and slag
- Structural concrete, 5000 psi, 20% fly ash and 30% slag

#### 05 - Metals

- Aluminum extrusion, painted, AEC - EPD
- Aluminum, formed
- Aluminum, sheet
- Anodized aluminum, sheet
- Coated steel deck, SDI - EPD
- Cold formed structural steel
- Fasteners, stainless steel
- Fiberglass blanket insulation, unfaced
- Fluoropolymer coating, metal stock
- Galvanized steel
- Galvanized steel decking
- Hot rolled structural steel, AISC - EPD
- Paint, enamel, solvent based
- Paint, exterior metal coating, silicone-based
- Paint, exterior metal coating, silicone-based, by area
- Polyurethane coating, metal stock
- Powder coating, metal stock
- Stainless steel sheet, Chromium 18/8
- Stainless steel, extruded, chromium 18/8
- Steel, reinforcing rod
- Steel, sheet

#### 06 - Wood/Plastics/Composites

- CLT (Cross laminated timber)
- Laminated spruce panel board
- Phenolic resin solid surfacing, sheet
- White oak lumber, 1 inch
- Wood stain, water based

#### 07 - Thermal and Moisture Protection

- Adhesive, acrylic
- Domestic softwood, US, AWC - EPD
- EPDM, non-reinforced membrane, 90 mils, SPRI - EPD
- Fasteners, galvanized steel
- Fasteners, stainless steel
- Fluid applied synthetic polymer air barrier
- Fluoropolymer coating, metal stock
- Glass fiber reinforced plastic paneling
- Mineral wool, high density, NAIMA - EPD
- PIR rigid foam insulation, roof, R=20.5, PIMA - EPD
- PIR rigid foam insulation, wall, R=14.6, PIMA - EPD
- Polyethelene sheet vapor barrier (HDPE)
- SBS modified bitumen, assembly (base & cap), ARMA - EPD
- SBS modified bitumen, cap sheet, ARMA - EPD
- Self adhering flashing membrane, 40 mil
- Steel, sheet
- XPS insulation, Foamular average, Owens Corning - EPD

#### 08 - Openings and Glazing

- Aluminum extrusion, anodized, AEC - EPD
- Argon gas for IGU
- Door frame, aluminum, powder-coated, no door
- Door frame, metal, galvanized, no door
- Fasteners, galvanized steel
- Fasteners, stainless steel
- Frit (for glazing)
- Glazing, monolithic sheet, generic
- Glazing, monolithic sheet, safety glass
- Glazing, monolithic sheet, tempered
- Hardware, stainless steel
- Hollow door, exterior, aluminum, anodized
- Hollow door, exterior, aluminum, anodized, large vision panel

## Results per Division, itemized by Material (continued)

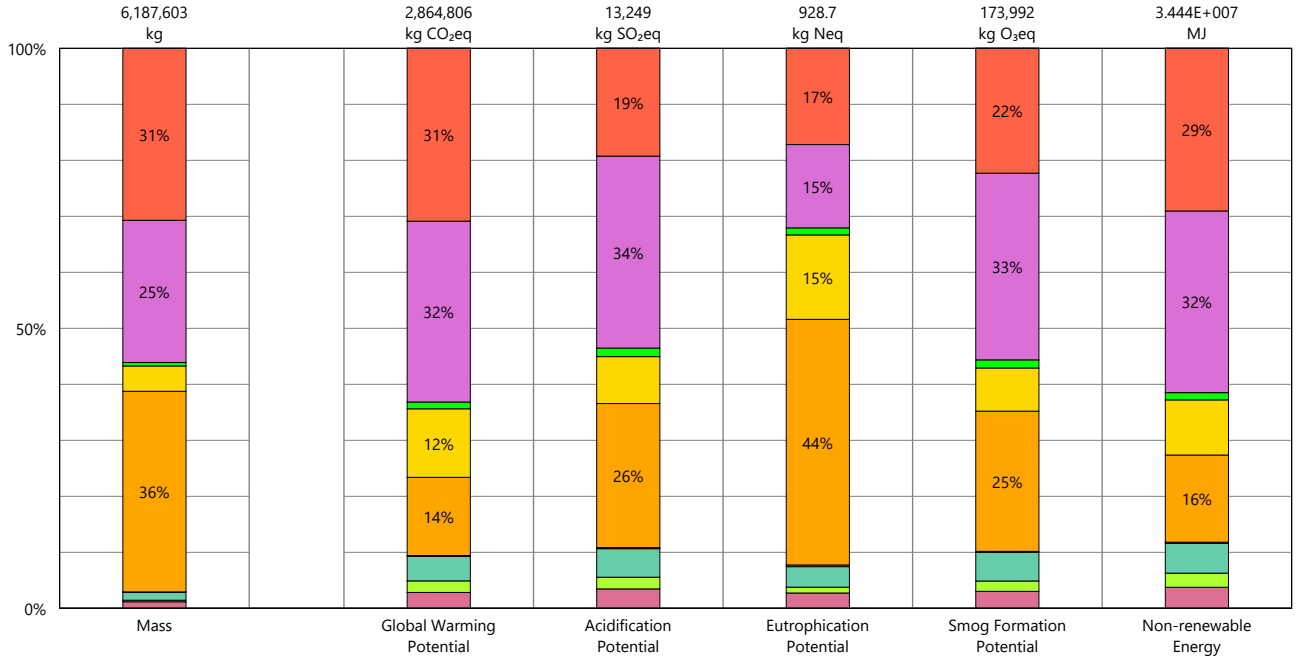
### Legend (continued)

- Hollow door, exterior, steel, galvanized
- Hollow door, interior, steel, fire-rated
- Hollow door, interior, steel, galvanized
- IGU spacer
- Laminating (for glazing)
- Low-e coating (for glazing)
- Overhead door closer, aluminum
- Stainless steel door hinge
- Window frame, vinyl, fixed

09 - Finishes

- Acoustic ceiling tile (ACT), mineral fiber board
- Fiberglass mat gypsum sheathing board
- Paint, interior acrylic latex
- Suspended grid
- Wall board, gypsum, fire-resistant (Type X)
- Wall board, gypsum, moisture- and mold-resistant
- Wall board, gypsum, natural

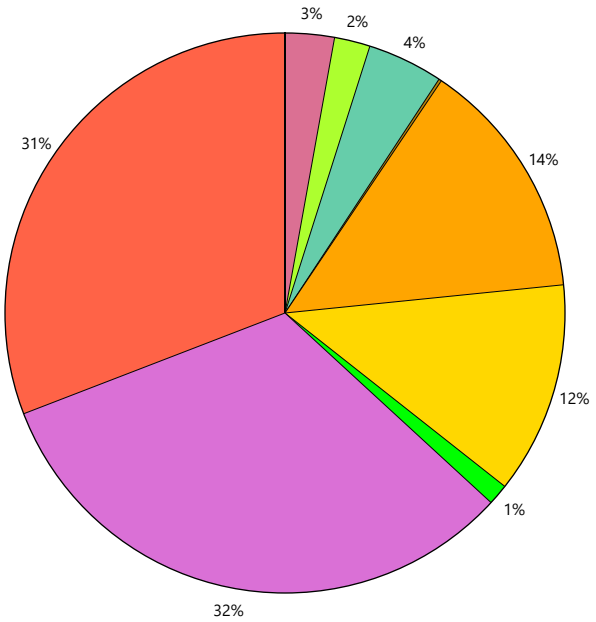
## Results per Revit Category




### Legend

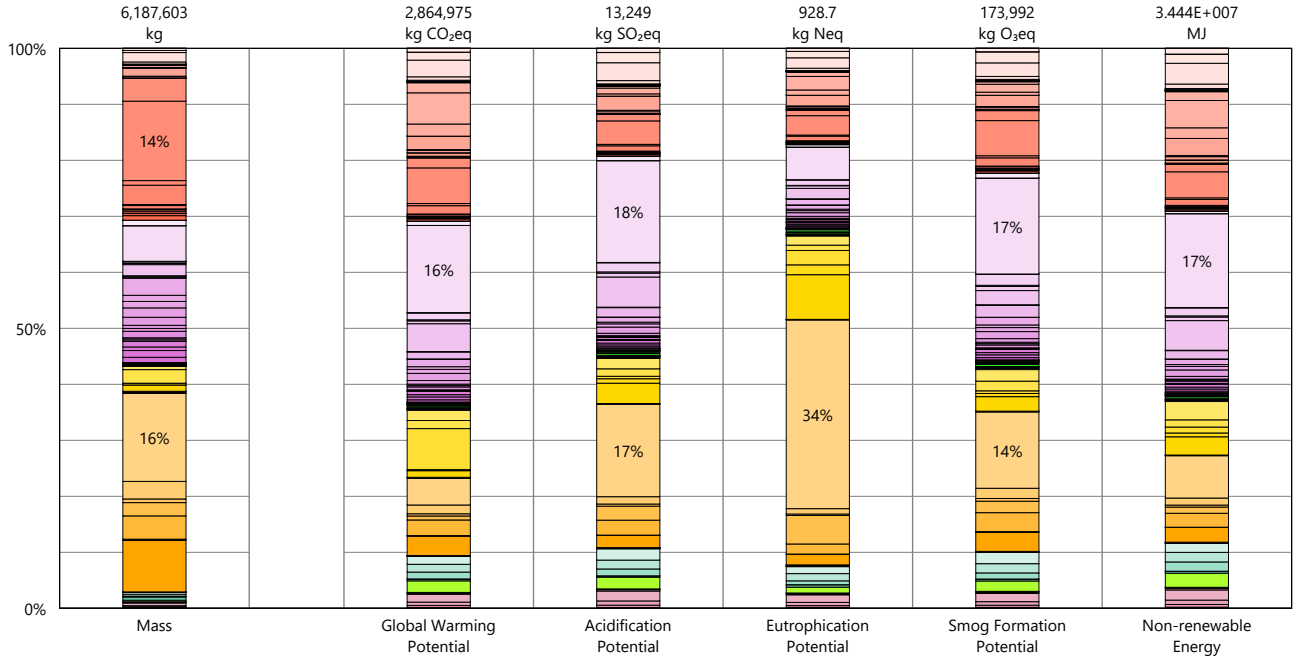
Revit Categories

- 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

### Ceilings

- 1-C2- GWB on Mtl. Stud
- 2-C2- GWB on Mtl. Stud
- ACT 4 AcoustiBuilt Ceiling
- C1 - ACT-1 - 2' x 4'
- C1 - ACT-2 - 2' x 2' HRC
- C1 - ACT-3 - 2' x 2'
- C1 - ACT-5 - 2' x 6'
- C2- GWB on Mtl. Stud
- C7- GWB on Mtl. Stud 2
- Linear Wood Ceiling

### Curtainwall Mullions

- Rectangular Mullion

### Curtainwall Panels

- cp_HSEB - Base Material Panel_vertical
- cp_HSEB - Skin Shingle flashing
- cp_HSEB - Skin Shingle Panel_hoz
- cp_HSEB - Window at Upper Levels
- System Panel

### Doors

- (F1-HMW) dr-SGL-A
- (F2) dr-Double-Flush-with 4 sided jambs
- (FG1-CW) dr-SGL-CW
- (FG2-AL) dr-DBL-A
- (FG2-CW) dr-DBL-CW
- (N1-HMW) dr-SGL-A
- temp-fence

### Floors

- (F1) SLAB ON GRADE
- (F1) SLAB ON GRADE - 6"
- (F1) SLAB ON GRADE - 8"
- (F2) CONCRETE METAL DECK
- (F3) CONCRETE DECK O/ 3 PLY CLT FLOOR N/W DIRECTION
- (F3) CONCRETE METAL DECK (STRUCTURAL ONLY)
- (F3) CONCRETE METAL DECK W/ TOPPING SLAB
- (F4) CONCRETE DECK O/ 3 PLY CLT FLOOR
- 12" Concrete Slab
- 1F5 - 1 HR RATED HORIZONTAL DUCT ENCLOSURE
- 3.5" Light Duty Paving Over Sturcture
- 3/16" Aluminum Plate

### Roofs

- (R1) CLT ROOF
- (R1) CLT ROOF - CLT PATTERN N/S
- (R2) INSULATION O/ ASPHALT MEMBRANE O/ STRUCT
- (R2) STRUCTURAL SLAB LAYER OF ASSEMBLY R2
- (R3) SBS OVER METAL DECK
- (R4) SOUTH VEST ROOF
- (R4) SOUTH VEST ROOF (INTERIOR)
- 1/4" STEEL PLATE
- 3/16" Aluminum Plate

### Stairs and Railings

- Construction Specialties_Crash Rail_6" ECR-60S
- HSEB - Pipe Guardrail - GDR-2
- HSEB - Pipe Guardrail - GDR-2 without handrail
- HSEB - STR-1 _Precast Tread & Riser
- HSEB - STR-2 _Precast Tread Steel Riser 2
- HSEB Guardrail - Cable Rail
- HSEB Guardrail - Cable Rail without handrail
- HSEB Handrail - HNDRL-1
- HSEB Handrail - HNDRL-3
- HSEB PIPE Handrail - HNDRL-2
- HSEB ST-11 (CAST IN PLACE)
- HSEB ST-9 (CAST IN PLACE)
- HSEB Type C - STR-4_Conc filled w/ C channel
- HSEB Type C_STR-10_Conc filled w/ C channel
- HSEB Type C_STR-5_Conc filled w/ C channel 2
- HSEB Type C_STR-6_Conc filled w/ Plate Stringer - Roof Access
- HSEB Type C_STR-8_Conc filled w/ Plate

# Results per Revit Category, itemized by Family (continued)

## Legend (continued)

- HSEB_STR-3_Precast Tread Steel Riser
- HSEB-GDR-4_Canerail

### Structure

- 04.016_LCL FND Slab_Spread Ftg_F10.0 10x10x3.0d
- 04.016_LCL FND Slab_Spread Ftg_F11.0 11x11x3.25d
- 04.016_LCL FND Slab_Spread Ftg_F12.0 12x12x4d
- 04.016_LCL FND Slab_Spread Ftg_F12.0 14x14x4.5d
- 04.016_LCL FND Slab_Spread Ftg_F2.0 2x2x11"d
- 04.016_LCL FND Slab_Spread Ftg_F4.0 4x4x1.5d
- 04.016_LCL FND Slab_Spread Ftg_F8.0 8x8x2.5d
- 04.016_LCL FND Slab_Spread Ftg_F9.0 9x9x2.75d
- 04.016_LCL FND Slab_Spread Ftg_FW6.0 6x8x2.5d
- 04.017_LCL FND Slab_Cont. Ftg FW3.0_36wx18d
- 04.017_LCL FND Slab_Cont. Ftg FW4.0_48wx18d
- 04.017_LCL FND Slab_Cont. Ftg FW4.0_48wx24d
- 04.017_LCL FND Slab_Cont. Ftg FW5.0_60wx18d
- 04.017_LCL FND Slab_Cont. Ftg FW5.0A_60wx30d
- 04.017_LCL FND Slab_Cont. Ftg FW7.0_87wx42d 2
- 04.017_LCL FND Slab_Cont. Ftg FW8.0_96wx48d
- 04.017_LCL FND Slab_Cont. Ftg_24wx12d
- KPFF - SCOL - Concrete - Round
- KPFF - SCOL - Steel - HSS - Rectangular (C) - TC
- KPFF - SCOL - Steel - HSS - Rectangular (C) - TC- 2x
- KPFF - SCOL - Steel - HSS - Round (C) - TC
- KPFF - SCOL - Steel - W - Wide Flange (C) - TC
- KPFF - SFRM - Steel - BRB - Buckling Restrained Brace
- KPFF - SFRM - Steel - C - Channel (C) - TC
- KPFF - SFRM - Steel - HSS - Rectangular (C) - TC
- KPFF - SFRM - Steel - Kicker Brace - L - Angle - TC
- KPFF - SFRM - Steel - L - Angle (C) - TC
- KPFF - SFRM - Steel - W - Wide Flange (C) - TC
- KPFF - SFRM - Steel - WT - Wide Flange Tee - TC
- KPFF - SFRM - Steel - WT - Wide Flange Tee (C) - TC
- LCL_C_Pilaster_Rect_()w()d
- LCL_Embed_2x3-Nelson-Studs_OffSet

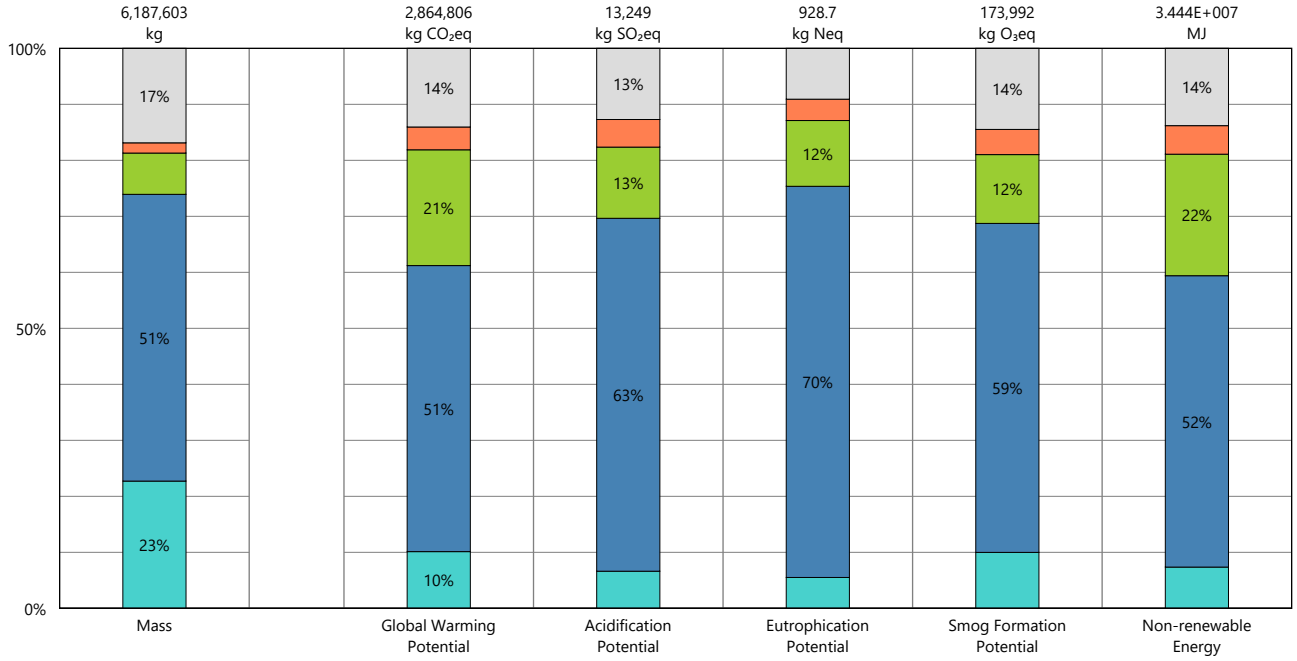
### Walls

- (A1)_Furr Mtl Stud 7/8"_GWB (1-0)
- (A3)_Furr Mtl Stud 3-5/8"_GWB (1-0)
- (B8)_TYP Mtl Stud 8"_GWB Insulation
- 04.215_LCL_C_Slab Transition_Wall(12")
- 04.215_LCL_C_Slab Transition_Wall(15")
- 04.215_LCL_C_Slab Transition_Wall(4")
- 04.215_LCL_C_Slab Transition_Wall(6")
- 04.215_LCL_C_Slab Transition_Wall(8")
- 04.225_LCL_C_CURB_Wall(11")
- 04.225_LCL_C_CURB_Wall(4")
- 04.225_LCL_C_CURB_Wall(6")
- 04.225_LCL_C_CURB_Wall(8")
- 04.300_LCL_C_Foundation_Wall(10")
- 04.310_LCL_C_PIT_Wall(8")
- 04.380_LCL_C_SHOTCRETE_Wall(16")
- 04.380_LCL_C_SHOTCRETE_Wall(19")
- 04.380_LCL_C_SHOTCRETE_Wall(22")
- 04.380_LCL_C_SHOTCRETE_Wall(24")
- 1-B6
- 1-N8 GFRC @ FRAMED WALL STAGGERED STUD
- 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 11"
- 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 16"
- 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 8"
- 1-W05 CONCRETE WALL W/ EXTERIOR INSULATION 22"
- 1-W06 PRE-CAST CONCRETE @ FRAMED WALL
- 1-W06 PRE-CAST CONCRETE @ FRAMED WALL STAGGERED STUD
- 1-W07_METAL STUD LIGHTWEIGHT CLADDING
- 2-A0_Furr Hat Channel 7/8"_GWB (2-0) 2 hour rated
- 2-A0_GWB Type X (2-0) 2 hour rated
- 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_16"
- 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_22"
- 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_24"
- 2-W01 CONCRETE WALL WITHOUT CONC
- 3-W07_METAL STUD LIGHTWEIGHT CLADDING
- 6" Axiom Trim Piece
- A4_Furr Mtl Stud 4"_GWB (1-0)
- Aluminum Plate 1/8"
- Aluminum Plate 3/16"
- B4
- B6
- Concrete 8" - STRUCTURAL
- Corner_1
- Corner_2
- Corner_3
- Corner_4
- P_SOUTH VESTIBULE WALL
- Parapet Cap Coping
- Picture Window Bend Plate
- W06 PRE-CAST CONCRETE @ FRAMED WALL
- W07_METAL STUD LIGHTWEIGHT CLADDING
- W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse)
- W08_METAL STUD LIGHTWEIGHT CLADDING (CW Parapet) no insulation
- W08_METAL STUD LIGHTWEIGHT CLADDING (Parapet)
- W09_SOUTH VESTIBULE WALL

### Windows

- LOUVER-parametric

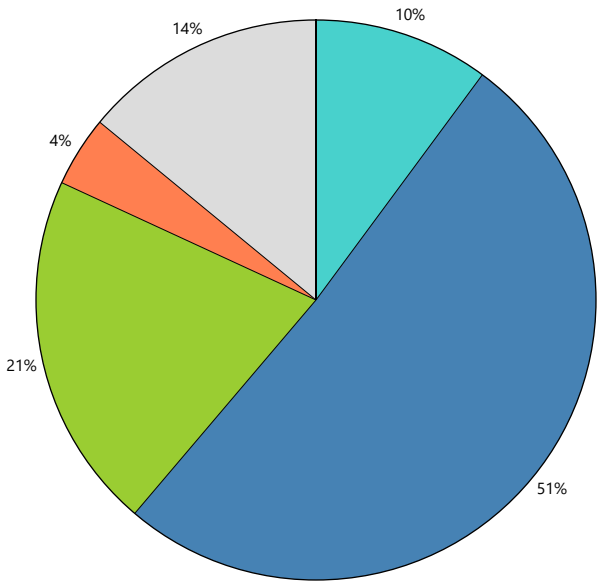
## Results per Building Element




### Legend

Building Elements

- Substructure
- 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 $CO_2$eq).

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 $SO_2$eq

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 $CO_2$eq

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 $O_3$eq

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

**HSEB_ARCH_D_19.rvt**

Worksets
- ARCH_Ceilings
- ARCH_Exterior Walls
- ARCH_Floors & Roof
- ARCH_Vertical Circulation

Phases
- Base Budget
- Enabling Scope
- Existing
- Value Add Scope

**HSEB_STRUCT_DC_19.rvt (Read-only)**

Worksets
- L - 04.220 Equipment Pads
- LCL-SLEEVES-BLOCKOUTS-MISC.
- S - Structural
- S - Structural - Baseline

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.

**Acoustic ceiling tile (ACT), mineral fiber board** **31,086.8 kg**

Used in the following Revit families:

| | |
|---|---|
| C1 - ACT-1 - 2' x 4' | 3,683.4 kg (50 yrs) |
| C1 - ACT-2 - 2' x 2' HRC | 7,515.5 kg (50 yrs) |
| C1 - ACT-3 - 2' x 2' | 17,510.0 kg (50 yrs) |
| C1 - ACT-5 - 2' x 6' | 2,378.0 kg (50 yrs) |

Used in the following Tally entries:
Acoustic ceiling system, mineral fiber board

Description:
Mineral fiber board acoustic ceiling tile, 5/8" thick

Life Cycle Inventory:
100% Mineral fiber board

Product Scope:
Cradle to gate of panel only, excludes suspended grid system and installation hardware

Transportation Distance:
By truck: 172 km

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

LCI Source:
DE: Mineral fibres ceiling boards (EN15804 A1-A3) ts (2017)

**Adhesive, acrylic** **2,477.7 kg**

Used in the following Revit families:

| | |
|---|---|
| (R1) CLT ROOF - CLT PATTERN N/S | 361.1 kg (20 yrs) |
| (R3) SBS OVER METAL DECK | 1,540.8 kg (20 yrs) |
| (R4) SOUTH VEST ROOF | 13.5 kg (20 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (CW Parapet) no insulation | 26.8 kg (20 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (Parapet) | 535.4 kg (20 yrs) |

Used in the following Tally entries:
SBS modified bitumen, sheet

Description:
Generic acrylic construction adhesive

Life Cycle Inventory:
5% Naphtha at refinery
95% Acrylate resin (solvent-systems)
0.5% NMVOC emissions

Product Scope:
Cradle to gate, plus emissions during application

Transportation Distance:
By truck: 840 km

End-of-Life Scope:
99.5% solids to landfill (plastic waste)

# LCI Data (continued)

LCI Source:
US: Naphtha at refinery ts (2014)
DE: Acrylate resin (solvent-systems) ts (2017)

**Aluminum extrusion, anodized, AEC - EPD** **3,507.9 kg**

Used in the following Revit families:
Rectangular Mullion 3,507.9 kg (60 yrs)

Used in the following Tally entries:
Aluminum mullion, inclusive of finish

Description:
Extruded and anodized aluminum part. Data based on 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 34.5% scrap input while remainder is processed and credited as avoided burden

LCI Source:
RNA: Aluminum extrusion, anodized - 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 extrusion, painted, AEC - EPD** **12.0 kg**

Used in the following Revit families:
Picture Window Bend Plate 12.0 kg (60 yrs)

Used in the following Tally entries:
Aluminum, angle

Description:
Painted aluminum extrusions (not thermally-improved). Industry-wide EPD from the Aluminum Extruders Council. 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% Recovered
5% Landfilled (inert material)

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

LCI Source:
EPD (US), American Extruders Council (2016)

EPD Source:
11240237.101.1

EPD Designation Holder:
Aluminum Extruders Council (AEC)

EPD Program Operator:
UL Environment

EPD Expiration:
10/4/2021

**Aluminum, formed** **477.9 kg**

Used in the following Revit families:
Corner_1 265.5 kg (60 yrs)
Corner_2 212.4 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

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)

**Aluminum, sheet** **19,863.4 kg**

Used in the following Revit families:
(R4) SOUTH VEST ROOF 112.5 kg (60 yrs)
1/4" STEEL PLATE 543.3 kg (60 yrs)
3/16" Aluminum Plate 41.7 kg (60 yrs)
Aluminum Plate 1/8" 25.2 kg (60 yrs)
Aluminum Plate 3/16" 221.2 kg (60 yrs)
cp_HSEB - Skin Shingle flashing 14.7 kg (60 yrs)
cp_HSEB - Skin Shingle Panel_hoz 6,681.8 kg (60 yrs)
Parapet Cap Coping 500.6 kg (60 yrs)
Rectangular Mullion 11,722.4 kg (60 yrs)

Used in the following Tally entries:
Aluminum, sheet

Description:
Aluminum sheet, formed and cut. Data based on industry-wide EPD for cold-rolled aluminum from the Aluminum Association (EPD ID 4786092064.101.1).

Life Cycle Inventory:
100% Aluminum

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)

# LCI Data (continued)

RNA: Secondary Aluminum Ingot AA/ts (2010)

**Anodized aluminum, sheet** **56.4 kg**

Used in the following Revit families:

| | |
|---|---|
| 3/16" Aluminum Plate | 56.4 kg (60 yrs) |
| LOUVER-parametric | 0.0 kg (60 yrs) |

Used in the following Tally entries:
Aluminum, sheet

Description:
Anodized aluminum sheet, formed and cut. Data based on industry-wide EPD for anodized aluminum from the Aluminum Extruders Council (EPD ID 11240237.101.1).

Life Cycle Inventory:
100% Anodized aluminum

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)
RNA: Anodization of aluminum extrusion AEC/ts (2015) [EPD]
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) [EPD]
RNA: Secondary Aluminum Ingot AA/ts (2010) [EPD]

**Argon gas for IGU** **58.5 kg**

Used in the following Revit families:

| | |
|---|---|
| (FG2-AL) dr-DBL-A | 1.3 kg (40 yrs) |
| (FG2-CW) dr-DBL-CW | 0.2 kg (40 yrs) |
| cp_HSEB - Window at Upper Levels | 23.2 kg (40 yrs) |
| System Panel | 33.7 kg (40 yrs) |

Used in the following Tally entries:
Glazing, custom IGU

Description:
Argon gas in insulating glass unit

Life Cycle Inventory:
Argon gas

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 940 km

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

LCI Source:
US: Argon (gaseous) ts (2017)

**CLT (Cross laminated timber)** **294,549.2 kg**

Used in the following Revit families:

| | |
|---|---|
| (F3) CONCRETE DECK O/ 3 PLY CLT FLOOR N/W DIRECTION | 31,376.8 kg (60 yrs) |
| (F4) CONCRETE DECK O/ 3 PLY CLT FLOOR | 207,418.0 kg (60 yrs) |
| (R1) CLT ROOF | 45,307.1 kg (60 yrs) |
| (R1) CLT ROOF - CLT PATTERN N/S | 10,447.4 kg (60 yrs) |

Used in the following Tally entries:
Cross laminated timber (CLT)

Description:
Engineered wood panel made of several layers of kiln-dried lumber stacked in alternating directions, bonded with structural adhesives, and pressed to form a solid rectangular panel.

Life Cycle Inventory:
Proxied by Glulam

Product Scope:
Cradle to gate

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: Glue laminated timbers CORRIM (2011)

**Coated steel deck, SDI - EPD** **2,255.5 kg**

Used in the following Revit families:

| | |
|---|---|
| (F3) CONCRETE METAL DECK (STRUCTURAL ONLY) | 2,255.5 kg (60 yrs) |

Used in the following Tally entries:
Steel, deck

Description:
Coated steel roof and floor deck panels, 1 ½" – 3" in depth and manufactured from 22 – 16 gage material. Industry-wide EPD from the Steel Deck Institute.

Life Cycle Inventory:
For information and quantities, see EPD

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 28% scrap input while remainder is processed and credited as avoided burden.

LCI Source:
US: Steel deck - Steel deck institute (SDI) (A1-A3) ts (2012)

EPD Source:
4786052957.101.1

EPD Designation Holder:
Steel Deck Institute

EPD Program Operator:
UL Environment

EPD Expiration:
12/15/2020

**Cold formed structural steel** **36,531.0 kg**

Used in the following Revit families:

| | |
|---|---|
| 1-C2- GWB on Mtl. Stud | 78.7 kg (60 yrs) |
| 1F5 - 1 HR RATED HORIZONTAL DUCT ENCLOSURE | 62.4 kg (60 yrs) |
| 2-C2- GWB on Mtl. Stud | 431.1 kg (60 yrs) |
| C1 - ACT-1 - 2' x 4' | 2,097.7 kg (60 yrs) |
| C1 - ACT-2 - 2' x 2' HRC | 3,757.6 kg (60 yrs) |
| C1 - ACT-3 - 2' x 2' | 8,881.3 kg (60 yrs) |
| C1 - ACT-5 - 2' x 6' | 1,105.7 kg (60 yrs) |
| C2- GWB on Mtl. Stud | 652.6 kg (60 yrs) |
| KPFF - SCOL - Steel - HSS - Rectangular (C) - TC | 6,800.6 kg (60 yrs) |
| KPFF - SFRM - Steel - BRB - Buckling Restrained Brace | 12,601.9 kg (60 yrs) |
| Linear Wood Ceiling | 61.4 kg (60 yrs) |

Used in the following Tally entries:
Steel, C-H-stud metal framing
Steel, C-stud metal framing
Steel, furring channel
Steel, HSS section

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

# LCI Data (continued)

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)

**Domestic softwood, US, AWC - EPD** **1,096.8 kg**

Used in the following Revit families:

| | |
|---|---|
| (R4) SOUTH VEST ROOF | 141.9 kg (30 yrs) |
| (R4) SOUTH VEST ROOF (INTERIOR) | 163.7 kg (30 yrs) |
| Linear Wood Ceiling | 549.3 kg (30 yrs) |
| P_SOUTH VESTIBULE WALL | 135.2 kg (30 yrs) |
| W09_SOUTH VESTIBULE WALL | 106.7 kg (30 yrs) |

Used in the following Tally entries:
Wood siding

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

EPD Designation Holder:
American Wood Council and Canadian Wood Council

EPD Program Operator:
UL Environment

EPD Expiration:
4/16/2019

**Door frame, aluminum, powder-coated, no door** **99.2 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1-HMW) dr-SGL-A | 10.6 kg (50 yrs) |
| (FG1-CW) dr-SGL-CW | 10.6 kg (50 yrs) |
| (FG2-AL) dr-DBL-A | 56.0 kg (50 yrs) |
| (N1-HMW) dr-SGL-A | 10.9 kg (50 yrs) |
| temp-fence | 11.2 kg (50 yrs) |

Used in the following Tally entries:
Door frame, aluminum

Description:
Aluminum door frame

Life Cycle Inventory:
94% Aluminum
6% Powder coat (by weight)

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)

**Door frame, metal, galvanized, no door** **3.1 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1-HMW) dr-SGL-A | 3.1 kg (45 yrs) |

Used in the following Tally entries:
Door frame, steel, galvanized

Description:
Stainless steel, 18 ga door frame

Life Cycle Inventory:
100% Galvanized steel

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

Transportation Distance:
By truck: 568 km

End-of-Life Scope:
98% recovered
2% landfilled (inert material)

Module D Scope:
Product has a 44% scrap input while remainder is processed and credited as avoided burden.

LCI Source:
DE: Aluminium wing frame profile, powder coated (2011)
modified with: US: Metal roll forming MCA (2010)
GLO: Steel sheet stamping and bending (5% loss) ts (2012)
RNA: Steel hot dip galvanized worldsteel (2007)

**EPDM, non-reinforced membrane, 90 mils, SPRI - EPD** **7,049.7 kg**

Used in the following Revit families:

| | |
|---|---|
| (R1) CLT ROOF | 6,989.4 kg (20 yrs) |
| (R4) SOUTH VEST ROOF | 60.3 kg (20 yrs) |

Used in the following Tally entries:
EPDM, roofing membrane

Description:
Non-reinforced ethylene propylene diene terpolymer (EPDM) synthetic rubber roofing membrane, default thickness of 90 mils (2.5 mm) Industry-wide EPD from the Single Ply Roofing Industry.

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 (plastic waste)

LCI Source:
US: Non-reinforced EPDM single ply roofing membrane, 90 mils, A1-A3 - SPRI ts (2017)

# LCI Data (continued)

EPD Source:
4786842353.103.1

EPD Designation Holder:
Single Ply Roofing Industry (SPRI)

EPD Program Operator:
UL Environment

EPD Expiration:
2/14/2022

**Fasteners, galvanized steel** **459.9 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1-HMW) dr-SGL-A | 0.2 kg (40 yrs) |
| (R1) CLT ROOF | 455.7 kg (40 yrs) |
| (R4) SOUTH VEST ROOF | 3.9 kg (40 yrs) |

Used in the following Tally entries:
Door frame, steel, galvanized
EPDM, roofing membrane

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 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** **251.1 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1-HMW) dr-SGL-A | 0.2 kg (50 yrs) |
| (FG1-CW) dr-SGL-CW | 0.2 kg (50 yrs) |
| (FG2-AL) dr-DBL-A | 1.2 kg (50 yrs) |
| (N1-HMW) dr-SGL-A | 0.2 kg (50 yrs) |
| (R4) SOUTH VEST ROOF | 0.3 kg (50 yrs) |
| (R4) SOUTH VEST ROOF (INTERIOR) | 0.4 kg (50 yrs) |
| Corner_3 | 7.3 kg (60 yrs) |
| Corner_4 | 7.2 kg (60 yrs) |
| cp_HSEB - Base Material Panel_vertical | 24.7 kg (60 yrs*) |
| cp_HSEB - Skin Shingle Panel_hoz | 189.9 kg (50 yrs) |
| Linear Wood Ceiling | 3.0 kg (50 yrs) |
| P_SOUTH VESTIBULE WALL | 1.6 kg (50-60 yrs) |
| temp-fence | 0.2 kg (50 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse) | 13.3 kg (60 yrs) |
| W09_SOUTH VESTIBULE WALL | 1.3 kg (50-60 yrs) |

Used in the following Tally entries:
Door frame, aluminum
Metal roofing panels, formed
Stainless Steel, Fasteners
Wood siding

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)

**Fiberglass blanket insulation, unfaced** **8,304.9 kg**

Used in the following Revit families:

| | |
|---|---|
| 1-N8 GFRC @ FRAMED WALL STAGGERED STUD | 25.1 kg (60 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL | 463.2 kg (60 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL STAGGERED STUD | 258.1 kg (60 yrs) |
| 1-W07_METAL STUD LIGHTWEIGHT CLADDING | 2,485.9 kg (60 yrs) |
| 3-W07_METAL STUD LIGHTWEIGHT CLADDING | 36.6 kg (60 yrs) |
| P_SOUTH VESTIBULE WALL | 20.0 kg (60 yrs) |
| W06 PRE-CAST CONCRETE @ FRAMED WALL | 786.0 kg (60 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING | 3,342.5 kg (60 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse) | 222.0 kg (60 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (CW Parapet) no insulation | 31.2 kg (60 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (Parapet) | 622.6 kg (60 yrs) |
| W09_SOUTH VESTIBULE WALL | 11.8 kg (60 yrs) |

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

Description:
Fiberglass batt
density varies from 10-14 kg/$m^3$.

Life Cycle Inventory:
100% Fiberglass

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 172 km

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

LCI Source:
US: Fiberglass Batt NAIMA (2007)

**Fiberglass mat gypsum sheathing board** **19,777.6 kg**

Used in the following Revit families:

| | |
|---|---|
| (R1) CLT ROOF | 9,483.4 kg (60 yrs) |
| (R1) CLT ROOF - CLT PATTERN N/S | 2,186.8 kg (60 yrs) |
| (R3) SBS OVER METAL DECK | 7,465.4 kg (60 yrs) |
| (R4) SOUTH VEST ROOF | 166.9 kg (60 yrs) |
| (R4) SOUTH VEST ROOF (INTERIOR) | 192.5 kg (60 yrs) |
| 3-W07_METAL STUD LIGHTWEIGHT CLADDING | 152.6 kg (60 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (CW Parapet) no insulation | 130.1 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 Data (continued)

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

**Fluid applied synthetic polymer air barrier** **16,719.9 kg**

Used in the following Revit families:

| | |
|---|---|
| 1-N8 GFRC @ FRAMED WALL STAGGERED STUD | 59.7 kg (40 yrs) |
| 1-W05 CONCRETE WALL W/ EXTERIOR INSULATION 22" | 193.9 kg (40 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL | 1,929.9 kg (40 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL STAGGERED STUD | 614.5 kg (40 yrs) |
| 1-W07_METAL STUD LIGHTWEIGHT CLADDING | 5,178.9 kg (40 yrs) |
| 3-W07_METAL STUD LIGHTWEIGHT CLADDING | 76.3 kg (40 yrs) |
| W06 PRE-CAST CONCRETE @ FRAMED WALL | 1,637.5 kg (40 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING | 6,963.6 kg (40 yrs) |
| W09_SOUTH VESTIBULE WALL | 65.6 kg (40 yrs) |

Used in the following Tally entries:
Fluid applied synthetic polymer air barrier

Description:
Liquid-applied rubberized membrane

Life Cycle Inventory:
34% Calcium carbonate
30% Polymer blend (SBS)
1% Silica
5% Titanium dioxide
30% Water

Product Scope:
Cradle to gate for materials only, neglects manufacturing requirements

Transportation Distance:
By truck: 555 km

End-of-Life Scope:
70% Landfilled (plastic waste) (excludes water evaporation)

LCI Source:
US: Styrene-butadiene rubber (SBR) ts (2017)
US: Silica sand (flour) ts (2017)
US: Tap water from groundwater ts (2017)
US: Titanium dioxide pigment ts (2017)
US: Limestone flour (5mm) ts (2017)
US: Electricity grid mix ts (2014)

**Fluoropolymer coating, metal stock** **1,989.8 kg**

Used in the following Revit families:

| | |
|---|---|
| 1/4" STEEL PLATE | 27.7 kg (60 yrs) |
| 3/16" Aluminum Plate | 2.1 kg (60 yrs) |
| Aluminum Plate 1/8" | 1.4 kg (60 yrs) |
| Aluminum Plate 3/16" | 12.6 kg (60 yrs) |
| Corner_1 | 19.7 kg (60 yrs) |
| Corner_2 | 15.8 kg (60 yrs) |
| Corner_3 | 16.0 kg (60 yrs) |
| Corner_4 | 15.8 kg (60 yrs) |
| cp_HSEB - Skin Shingle Panel_hoz | 765.5 kg (60 yrs) |
| KPFF - SCOL - Steel - HSS - Rectangular (C) - TC | 48.6 kg (60 yrs) |
| KPFF - SCOL - Steel - W - Wide Flange (C) - TC | 441.2 kg (60 yrs) |
| KPFF - SFRM - Steel - BRB - Buckling Restrained Brace | 0.0 kg (60 yrs) |
| KPFF - SFRM - Steel - HSS - Rectangular (C) - TC | 80.5 kg (60 yrs) |
| KPFF - SFRM - Steel - Kicker Brace - L - Angle - TC | 11.5 kg (60 yrs) |
| KPFF - SFRM - Steel - L - Angle (C) - TC | 1.8 kg (60 yrs) |
| P_SOUTH VESTIBULE WALL | 2.6 kg (60 yrs) |
| Parapet Cap Coping | 74.3 kg (60 yrs) |
| Rectangular Mullion | 421.2 kg (60 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse) | 29.4 kg (60 yrs) |
| W09_SOUTH VESTIBULE WALL | 2.1 kg (60 yrs) |

Used in the following Tally entries:
Aluminum, formed
Aluminum, sheet
Metal roofing panels, formed
Steel, angle
Steel, HSS section
Steel, W section (wide flange shape)

Description:
Standard fluoropolymer coating for metals. This entry is used as a part of the larger MCA EPD for Roll Formed Steel Panels (EPD ID 13CA27321.101.1).

Life Cycle Inventory:
100% Fluoropolymer coating

Product Scope:
Cradle to gate, including application

Transportation Distance:
N/A

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

LCI Source:
US: Coil coating MCA (2010)
US: Electricity grid mix ts (2014)
US: Thermal energy from natural gas ts (2014)

**Frit (for glazing)** **2.1 kg**

Used in the following Revit families:

| | |
|---|---|
| System Panel | 2.1 kg (40 yrs) |

Used in the following Tally entries:
Glazing, custom IGU

Description:
Frit applied at a default density of 0.05 kg/m² gives 100% coverage with 19 micrometers thickness. User to select frit density of 20%, 30%, 40%, 50%, or 60% coverage.

Life Cycle Inventory:
90.9% Glass granulate
9% Butyl acetate
0.1% Nitrocellulose

Product Scope:
Cradle to gate

Transportation Distance:
N/A

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

LCI Source:
US: Electricity grid mix ts (2014)
US: Thermal energy from natural gas ts (2014)
DE: Butyl acetate ts (2017)
DE: Nitrocellulose (cellulose nitrate) ts (2017)
DE: Expanded glass granulate ts (2017)
IT: Flat-screen printing ENEA (2002)
US: Tap water from groundwater ts (2017)

**Galvanized steel** **73,359.3 kg**

Used in the following Revit families:

| | |
|---|---|
| (A1)_Furr Mtl Stud 7/8"_GWB (1-0) | 51.0 kg (60 yrs) |
| (A3)_Furr Mtl Stud 3-5/8"_GWB (1-0) | 72.0 kg (60 yrs) |
| (B8)_TYP Mtl Stud 8"_GWB Insulation | 36.9 kg (60 yrs) |
| (R4) SOUTH VEST ROOF | 131.4 kg (60 yrs) |
| (R4) SOUTH VEST ROOF (INTERIOR) | 1,189.5 kg (60 yrs) |
| 1-B6 | 9.7 kg (60 yrs) |
| 1-N8 GFRC @ FRAMED WALL STAGGERED STUD | 52.1 kg (60 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL | 1,269.2 kg (60 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL STAGGERED STUD | 380.2 kg (60 yrs) |
| 1-W07_METAL STUD LIGHTWEIGHT CLADDING | 5,461.7 kg (60 yrs) |
| 2-A0_Furr Hat Channel 7/8"_GWB (2-0) 2 hour rated | 14.0 kg (60 yrs) |
| 3-W07_METAL STUD LIGHTWEIGHT CLADDING | 124.5 kg (60 yrs) |
| 6" Axiom Trim Piece | 185.6 kg (60 yrs) |
| A4_Furr Mtl Stud 4"_GWB (1-0) | 157.9 kg (60 yrs) |
| ACT 4 AcoustiBuilt Ceiling | 630.0 kg (60 yrs) |
| B4 | 90.4 kg (60 yrs) |
| B6 | 68.7 kg (60 yrs) |
| C7- GWB on Mtl. Stud 2 | 226.3 kg (60 yrs) |
| HSEB - Pipe Guardrail - GDR-2 | 1,171.6 kg (60 yrs) |
| HSEB - Pipe Guardrail - GDR-2 without handrail | 1,048.1 kg (60 yrs) |
| HSEB Guardrail - Cable Rail | 626.0 kg (60 yrs) |
| HSEB Guardrail - Cable Rail without handrail | 1,105.3 kg (60 yrs) |
| HSEB Handrail - HNDRL-1 | 1,445.7 kg (60 yrs) |
| HSEB Handrail - HNDRL-3 | 46.3 kg (60 yrs) |
| HSEB PIPE Handrail - HNDRL-2 | 205.4 kg (60 yrs) |
| HSEB-GDR-4_Canerail | 24.5 kg (60 yrs) |
| KPFF - SCOL - Steel - HSS - Rectangular (C) - TC | 12,562.2 kg (60 yrs) |

# LCI Data (continued)

| | |
|---|---|
| KPFF - SCOL - Steel - HSS - Rectangular (C) - TC- 2x | 567.7 kg (60 yrs) |
| KPFF - SCOL - Steel - HSS - Round (C) - TC | 221.2 kg (60 yrs) |
| KPFF - SFRM - Steel - HSS - Rectangular (C) - TC | 15,577.6 kg (60 yrs) |
| LCL_Embed_2x3-Nelson-Studs_OffSet | 165.4 kg (45 yrs) |
| P_SOUTH VESTIBULE WALL | 62.1 kg (60 yrs) |
| W06 PRE-CAST CONCRETE @ FRAMED WALL | 2,026.0 kg (60 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING | 7,767.5 kg (60 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse) | 16,481.0 kg (60 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (CW Parapet) no insulation | 118.8 kg (60 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (Parapet) | 1,934.1 kg (60 yrs) |
| W09_SOUTH VESTIBULE WALL | 51.6 kg (60 yrs) |

Used in the following Tally entries:
Steel, C-stud metal framing
Steel, C-stud metal framing with insulation
Steel, furring channel
Steel, HSS section
Steel, plate
Steel, rectangular bar
Steel, round tubing

Description:
Hot dipped galvanized steel profile, for use with cladding systems.

Life Cycle Inventory:
100% Steel, hot dip galvanized

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 44% scrap input while remainder is processed and credited as avoided burden

LCI Source:
RNA: Steel hot dip galvanized worldsteel (2007)
GLO: Steel sheet stamping and bending (5% loss) ts (2014)
US: Electricity grid mix ts (2014)
US: Lubricants at refinery ts (2014)
GLO: Compressed air 7 bar (medium power consumption) ts (2014)
US: Metal roll forming M CA (2010)
GLO: Value of scrap worldsteel (2014)

**Galvanized steel decking** **33,605.6 kg**

Used in the following Revit families:

| | |
|---|---|
| (F2) CONCRETE METAL DECK | 12,079.3 kg (60 yrs) |
| (F3) CONCRETE METAL DECK W/ TOPPING SLAB | 3,185.1 kg (60 yrs) |
| (R2) STRUCTURAL SLAB LAYER OF ASSEMBLY R2 | 7,867.3 kg (60 yrs) |
| (R3) SBS OVER METAL DECK | 10,403.8 kg (60 yrs) |
| (R4) SOUTH VEST ROOF (INTERIOR) | 70.0 kg (60 yrs) |

Used in the following Tally entries:
Steel, deck

Description:
Hot dip galvanized steel roof decking, corrugated profile. Default roof decking is galvanized to G90 standards, coated on both sides of 20 gauge steel deck, roll formed and precut.

Life Cycle Inventory:
100% Steel, hot dip galvanized

Product Scope:
Cradle to gate for deck only.

Transportation Distance:
By truck: 431 km

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

Module D Scope:
Product has 44% scrap input while remainder is processed and credited as avoided burden

LCI Source:
RNA: Steel hot dip galvanized worldsteel (2007)
GLO: Steel sheet stamping and bending (5% loss) ts (2014)
US: Electricity grid mix ts (2014)
US: Lubricants at refinery ts (2014)
GLO: Compressed air 7 bar (medium power consumption) ts (2014)
US: Metal roll forming M CA (2010)
GLO: Value of scrap worldsteel (2014)

**Glass fiber reinforced plastic paneling** **318.0 kg**

Used in the following Revit families:

| | |
|---|---|
| 1-N8 GFRC @ FRAMED WALL STAGGERED STUD | 3.1 kg (60 yrs*) |
| 1-W05 CONCRETE WALL W/ EXTERIOR INSULATION 22" | 10.2 kg (60 yrs*) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL | 101.0 kg (60 yrs*) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL STAGGERED STUD | 32.2 kg (60 yrs*) |
| W06 PRE-CAST CONCRETE @ FRAMED WALL | 171.5 kg (60 yrs*) |

Used in the following Tally entries:
Fiberglass clip system

Description:
Glass fibers with polyester resin formed into solid sheet stock

Life Cycle Inventory:
50% Glass fibers
50% Polyester resin

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 172 km

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

LCI Source:
DE: Polyester Resin unsaturated (UP) ts (2017)
US: Glass fibres ts (2017)
GLO: Plastic extrusion profile (unspecific) ts (2017)
US: Electricity grid mix ts (2014)
US: Thermal energy from natural gas ts (2014)
US: Lubricants at refinery ts (2014)
GLO: Compressed air 7 bar (medium power consumption) ts (2014)

**Glazing, monolithic sheet, generic** **4,667.0 kg**

Used in the following Revit families:

| | |
|---|---|
| cp_HSEB - Window at Upper Levels | 3,859.1 kg (40 yrs) |
| System Panel | 807.9 kg (40 yrs) |

Used in the following Tally entries:
Glazing, custom IGU

Description:
Standard float glass, uncoated. Note: this entry is appropriate for clear or tinted glass. Default thickness is 3 mm.

Life Cycle Inventory:
Glazing

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 940 km

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

LCI Source:
DE: Window glass simple (EN15804 A1-A3) ts (2017)

**Glazing, monolithic sheet, safety glass** **68.3 kg**

Used in the following Revit families:

| | |
|---|---|
| (N1-HMW) dr-SGL-A | 68.3 kg (30 yrs) |

Used in the following Tally entries:
Glazing, monolithic sheet

Description:
Standard safety glass, default thickness is 3mm. Note: this entry is appropriate for clear or tinted glass.

# LCI Data (continued)

Life Cycle Inventory:
Sodium sulphate
Soda (Na2CO3)
Silica sand
Calcium hydroxide
Lime
Tin
Dolomite

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 940 km

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

LCI Source:
DE: Window glass simple (EN15804 A1-A3) ts (2017)

**Glazing, monolithic sheet, tempered** **34,096.8 kg**

Used in the following Revit families:

| | |
|---|---|
| (FG1-CW) dr-SGL-CW | 61.9 kg (40 yrs) |
| (FG2-AL) dr-DBL-A | 862.9 kg (40 yrs) |
| (FG2-CW) dr-DBL-CW | 208.5 kg (40 yrs) |
| cp_HSEB - Window at Upper Levels | 10,856.3 kg (40 yrs) |
| System Panel | 22,107.2 kg (40 yrs) |

Used in the following Tally entries:
Glazing, custom IGU

Description:
Tempered float glass. Note: this entry is appropriate for clear or tinted glass. Default thickness is 3 mm.

Life Cycle Inventory:
Tempered glazing

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 940 km

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

LCI Source:
DE: Window glass simple (EN15804 A1-A3) ts (2017)
US: Electricity grid mix ts (2014)
US: Thermal energy from natural gas ts (2014)

**Hardware, stainless steel** **45.2 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1-HMW) dr-SGL-A | 7.0 kg (60 yrs) |
| (F2) dr-Double-Flush-with 4 sided jambs | 7.5 kg (60 yrs) |
| (FG2-AL) dr-DBL-A | 10.3 kg (60 yrs) |
| (FG2-CW) dr-DBL-CW | 10.3 kg (60 yrs) |
| (N1-HMW) dr-SGL-A | 5.3 kg (60 yrs) |
| temp-fence | 4.7 kg (60 yrs) |

Used in the following Tally entries:
Door, exterior, aluminum
Door, exterior, steel
Door, interior, steel

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)

**Hollow door, exterior, aluminum, anodized** **86.2 kg**

Used in the following Revit families:

| | |
|---|---|
| (F2) dr-Double-Flush-with 4 sided jambs | 86.2 kg (30 yrs) |

Used in the following Tally entries:
Door, exterior, aluminum

Description:
Anodized aluminum, exterior, with interior steel supports and polyurethane foam insulation

Life Cycle Inventory:
3% Steel
71% Anodized aluminum
25% Polyurethane foam

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

Transportation Distance:
By truck: 568 km

End-of-Life Scope:
70% Steel recovered
30% Steel landfilled (inert material)
95% Aluminum recovered (includes processing and avoided burden credit)
5% Aluminum is landfilled (inert material)
100% Insulation landfilled (plastic material)

Module D Scope:
Product has 50% aluminum scrap input and 1% steel scrap input while remainder is processed and credited as avoided burden.

LCI Source:
DE: Polyurethane foam (PUR) ts (2017)
RNA: Anodization of aluminium (EN15804 A1-A3) ts (2015)
RNA: Cold Rolled Aluminum AA/ts (2010)
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: Steel hot dip galvanized worldsteel (2007)
RNA: Secondary Aluminum Ingot AA/ts (2010)
RNA: Primary Aluminum Ingot AA/ts (2010)

**Hollow door, exterior, aluminum, anodized, large vision panel** **236.9 kg**

Used in the following Revit families:

| | |
|---|---|
| (FG2-AL) dr-DBL-A | 118.4 kg (30 yrs) |
| (FG2-CW) dr-DBL-CW | 118.4 kg (30 yrs) |

Used in the following Tally entries:
Door, exterior, aluminum

Description:
Hollow, anodized aluminum exterior door inclusive of large vision panel (>50% door area), polyurethane foam insulation, no frame

Life Cycle Inventory:
47% Glass
3% Steel
37% Anodized aluminum
13% Polyurethane foam

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

Transportation Distance:
By truck: 568 km

End-of-Life Scope:
70% Steel recovered
30% Steel landfilled (inert material)
95% Aluminum recovered (includes processing and avoided burden credit)
5% Aluminum is landfilled (inert material)

# LCI Data (continued)

100% Insulation landfilled (plastic material)
100% Glass landfilled (inert material)

Module D Scope:
Product has 26% aluminum scrap input and 1% steel scrap input while remainder is processed and credited as avoided burden.

LCI Source:
DE: Polyurethane foam (PUR) ts (2017)
RNA: Anodization of aluminium (EN15804 A1-A3) ts (2015)
RNA: Cold Rolled Aluminum AA/ts (2010)
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: Steel hot dip galvanized worldsteel (2007)
RNA: Secondary Aluminum Ingot AA/ts (2010)
RNA: Primary Aluminum Ingot AA/ts (2010)
DE: Window glass simple (EN15804) ts (2017)

**Hollow door, exterior, steel, galvanized** **96.7 kg**

Used in the following Revit families:
(N1-HMW) dr-SGL-A 96.7 kg (30 yrs)

Used in the following Tally entries:
Door, exterior, steel

Description:
Hollow door, exterior, steel, 18 ga. inclusive of EPS insulation, no frame

Life Cycle Inventory:
5% Extruded polystyrene
95% Galvanized steel

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

Transportation Distance:
By truck: 568 km

End-of-Life Scope:
70% Steel recovered
30% Steel landfilled (inert material)
100% Core landfilled (biodegradable material)

Module D Scope:
Product has 44% scrap input while remainder is processed and credited as avoided burden.

LCI Source:
DE: Expanded Polystyrene (PS 25) (EN15804 A1-A3) ts (2017)
GLO: Steel sheet stamping and bending (5% loss) ts (2017)
GLO: Value of scrap worldsteel (2014)
US: Electricity grid mix ts (2014)
US: Lubricants at refinery ts (2014)
GLO: Compressed air 7 bar (medium power consumption) ts (2014)
RNA: Steel hot dip galvanized worldsteel (2007)

**Hollow door, interior, steel, fire-rated** **81.8 kg**

Used in the following Revit families:
(F1-HMW) dr-SGL-A 81.8 kg (50 yrs)

Used in the following Tally entries:
Door, interior, steel

Description:
Fire-rated door, interior, steel, inclusive of mineral fiber insulation, no frame

Life Cycle Inventory:
72% Steel
28% Mineral wool

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

Transportation Distance:
By truck: 568 km

End-of-Life Scope:
70% Steel recovered
30% Steel landfilled (inert material)
100% Insulation landfilled (plastic material)

Module D Scope:
Product has 12% scrap input while remainder is processed and credited as avoided burden.

LCI Source:
DE: Expanded Polystyrene (PS 30) (EN15804 A1-A3) ts (2017)
GLO: Steel sheet stamping and bending (5% loss) ts (2017)
GLO: Value of scrap worldsteel (2014)
US: Electricity grid mix ts (2014)
US: Lubricants at refinery ts (2014)
GLO: Compressed air 7 bar (medium power consumption) ts (2014)
RNA: Steel finsihed cold rolled coil worldsteel (2007)
DE: Mineral fibres ceiling boards (EN15804 A1-A3) ts (2017)

**Hollow door, interior, steel, galvanized** **157.1 kg**

Used in the following Revit families:
(F1-HMW) dr-SGL-A 67.3 kg (50 yrs)
temp-fence 89.7 kg (50 yrs)

Used in the following Tally entries:
Door, interior, steel

Description:
Hollow, galvanized steel interior door inclusive of honeycomb kraft paper, no frame

Life Cycle Inventory:
12% Kraft core
88% Galvanized steel

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

Transportation Distance:
By truck: 568 km

End-of-Life Scope:
70% Steel recovered
30% Steel landfilled (inert material)
100% Core landfilled (biodegradable material)

Module D Scope:
Product has 41% scrap input while remainder is processed and credited as avoided burden.

LCI Source:
DE: Kraft paper ts (2017)
GLO: Steel sheet stamping and bending (5% loss) ts (2017)
GLO: Value of scrap worldsteel (2014)
US: Electricity grid mix ts (2014)
US: Lubricants at refinery ts (2014)
GLO: Compressed air 7 bar (medium power consumption) ts (2014)
RNA: Steel hot dip galvanized worldsteel (2007)

**Hot rolled structural steel, AISC - EPD** **518,506.5 kg**

Used in the following Revit families:

| | |
|---|---|
| HSEB Type C - STR-4_Conc filled w/ C channel | 1,158.0 kg (60 yrs) |
| HSEB Type C_STR-10_Conc filled w/ C channel | 332.8 kg (60 yrs) |
| HSEB Type C_STR-5_Conc filled w/ C channel 2 | 3,047.8 kg (60 yrs) |
| KPFF - SCOL - Steel - W - Wide Flange (C) - TC | 122,740.2 kg (60 yrs) |
| KPFF - SFRM - Steel - C - Channel (C) - TC | 4,966.2 kg (60 yrs) |
| KPFF - SFRM - Steel - Kicker Brace - L - Angle - TC | 976.4 kg (60 yrs) |
| KPFF - SFRM - Steel - L - Angle (C) - TC | 264.1 kg (60 yrs) |
| KPFF - SFRM - Steel - W - Wide Flange (C) - TC | 384,876.4 kg (60 yrs) |
| KPFF - SFRM - Steel - WT - Wide Flange Tee - TC | 40.7 kg (60 yrs) |
| KPFF - SFRM - Steel - WT - Wide Flange Tee (C) - TC | 104.0 kg (60 yrs) |

Used in the following Tally entries:
Steel, angle
Steel, C channel
Steel, W section (wide flange shape)

Description:
Hot rolled structural steel. Industry-wide EPD from the American Institute of Steel Construction.

Life Cycle Inventory:
For information and quantities, see EPD

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 431 km

# LCI Data (continued)

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

Module D Scope:
Product has 100% scrap input, burden reflects difference between recovered material and scrap input

LCI Source:
RNA: Hot rolled structural steel sections AISC (2010)

EPD Source:
4786979051.102.1

EPD Designation Holder:
American Institute of Steel Construction

EPD Program Operator:
UL Environment

EPD Expiration:
3/31/2021

**IGU spacer** **283.4 kg**

Used in the following Revit families:

| | |
|---|---|
| (FG2-AL) dr-DBL-A | 6.3 kg (40 yrs) |
| (FG2-CW) dr-DBL-CW | 1.2 kg (40 yrs) |
| cp_HSEB - Window at Upper Levels | 112.7 kg (40 yrs) |
| System Panel | 163.2 kg (40 yrs) |

Used in the following Tally entries:
Glazing, custom IGU

Description:
Insulating glass unit (IGU) spacer and gasket used to separate two or more plies of glass. Density value assumes a 1/2" (13/2 mm) spacer.

Life Cycle Inventory:
70% Polybutadiene rubber spacer
30% Nitrile rubber spacer

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 940 km

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

LCI Source:
DE: Polybutadiene rubber ts (2017)
DE: Nitrile butadiene rubber, incl. MMA (NBR-speciality) ts (2017)

**Laminated spruce panel board** **278.9 kg**

Used in the following Revit families:

| | |
|---|---|
| C7- GWB on Mtl. Stud 2 | 278.9 kg (30 yrs) |

Used in the following Tally entries:
Plywood, interior grade

Description:
Laminated spruce woodboard (Duo-/Trio boards) consists of layers of spruce bonded with phenolic resin-based adhesive. Laminated woodboards in comparison to laminated timber are thicker (45mm). Appropriate for use in interior applications.

Life Cycle Inventory:
100% Laminated wood board

Product Scope:
Cradle to gate, excludes finishes
laminate as proxy for glue and adhesives during installation

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:
DE: Laminated wood panel board ts (2017)

**Laminating (for glazing)** **58.5 kg**

Used in the following Revit families:

| | |
|---|---|
| System Panel | 58.5 kg (40 yrs) |

Used in the following Tally entries:
Glazing, custom IGU

Description:
Glazing lamination using PVB film

Life Cycle Inventory:
3% PVB film (30% adipic acid
70% PVB)
97% Glass

Product Scope:
Cradle to gate

Transportation Distance:
N/A

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

LCI Source:
DE: Adipic acid from cyclohexane ts (2017)
DE: Polyvinyl Butyral Granulate (PVB) 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)

**Lightweight concrete, 5000 psi, Pacific Northwest regional average** **65,224.5 kg**

Used in the following Revit families:

| | |
|---|---|
| HSEB Type C - STR-4_Conc filled w/ C channel | 1,437.3 kg (60 yrs) |
| HSEB Type C_STR-10_Conc filled w/ C channel | 552.8 kg (60 yrs) |
| HSEB Type C_STR-5_Conc filled w/ C channel 2 | 2,234.5 kg (60 yrs) |
| HSEB Type C_STR-6_Conc filled w/ Plate Stringer - Roof Access | 413.5 kg (60 yrs) |
| HSEB Type C_STR-8_Conc filled w/ Plate | 318.4 kg (60 yrs) |
| KPFF - SCOL - Concrete - Round | 1,268.3 kg (60 yrs) |
| LCL_C_Pilaster_Rect_()w()d | 58,999.5 kg (60 yrs) |

Used in the following Tally entries:
Cast-in-place concrete, lightweight structural concrete, 5000 psi

Description:
Lightweight concrete, 5000 psi, Pacific Northwest regional average. Mix design matches National Ready-Mix Concrete Association (NRMCA) Industry-wide EPD.

Life Cycle Inventory:
Expanded shale: 34%, Sand: 32%, Portland cement PCA - EPD: 19%, Water: 10%, Fly ash: 5%, 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

# LCI Data (continued)

30% utane) ts (2014)
US: Light fuel oil at refinery ts (2014)

**Low-e coating (for glazing)** **312.7 kg**

Used in the following Revit families:

| | |
|---|---|
| (FG2-AL) dr-DBL-A | 7.1 kg (40 yrs) |
| (FG2-CW) dr-DBL-CW | 1.3 kg (40 yrs) |
| cp_HSEB - Window at Upper Levels | 126.8 kg (40 yrs) |
| System Panel | 177.5 kg (40 yrs) |

Used in the following Tally entries:
Glazing, custom IGU

Description:
Low-e coating for application to glazing lite

Life Cycle Inventory:
Ferro chrome mix
Nickel mix
Tin
Silver mix

Product Scope:
Cradle to gate

Transportation Distance:
N/A

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

LCI Source:
Low-e coating from DE: Double glazing unit (EN15804 A1-A3) ts (2017)

**Mineral wool, high density, NAIMA - EPD** **39,858.1 kg**

Used in the following Revit families:

| | |
|---|---|
| 1-N8 GFRC @ FRAMED WALL STAGGERED STUD | 38.2 kg (60 yrs) |
| 1-W05 CONCRETE WALL W/ EXTERIOR INSULATION 22" | 248.2 kg (60 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL | 1,235.2 kg (60 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL STAGGERED STUD | 393.3 kg (60 yrs) |
| 1-W07_METAL STUD LIGHTWEIGHT CLADDING | 13,257.9 kg (60 yrs) |
| 3-W07_METAL STUD LIGHTWEIGHT CLADDING | 195.3 kg (60 yrs) |
| W06 PRE-CAST CONCRETE @ FRAMED WALL | 2,096.0 kg (60 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING | 17,826.7 kg (60 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse) | 1,184.1 kg (60 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (Parapet) | 3,320.3 kg (60 yrs) |
| W09_SOUTH VESTIBULE WALL | 63.0 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

**Overhead door closer, aluminum** **26.1 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1-HMW) dr-SGL-A | 4.7 kg (30 yrs) |
| (FG2-AL) dr-DBL-A | 10.7 kg (30 yrs) |
| (FG2-CW) dr-DBL-CW | 10.7 kg (30 yrs) |

Used in the following Tally entries:
Door, exterior, aluminum
Door, interior, steel

Description:
Aluminum overhead door closer. Data based on product-specific EPD from FV S+B.

Life Cycle Inventory:
See EPD

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 1001 km

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

Module D Scope:
Product has 0% scrap input, burden reflects difference between recovered material and scrap input

LCI Source:
DE: Overhead door closer aluminum - FV S+B PE-EPD (2009)
RNA: Secondary Aluminum Ingot AA/ts (2010)
RNA: Primary Aluminium Ingot AA/ts (2010)

EPD Source:
EPD-ARG-20160183-IBG1-EN

EPD Designation Holder:
European Federation of Associations of Lock and Builders Hardware Manufacturers (ARGE)

EPD Program Operator:
Institut Bauen and Umwelt (IBU)

EPD Expiration:
9/13/2021

**Paint, enamel, solvent based** **9,648.7 kg**

Used in the following Revit families:

| | |
|---|---|
| 3/16" Aluminum Plate | 5.0 kg (15 yrs) |
| KPFF - SCOL - Steel - HSS - Rectangular (C) - TC | 255.3 kg (15 yrs) |
| KPFF - SCOL - Steel - HSS - Rectangular (C) - TC- 2x | 23.1 kg (15 yrs) |
| KPFF - SCOL - Steel - HSS - Round (C) - TC | 10.3 kg (15 yrs) |
| KPFF - SFRM - Steel - C - Channel (C) - TC | 94.7 kg (15 yrs) |
| KPFF - SFRM - Steel - HSS - Rectangular (C) - TC | 182.2 kg (15 yrs) |
| KPFF - SFRM - Steel - W - Wide Flange (C) - TC | 9,069.8 kg (15 yrs) |
| KPFF - SFRM - Steel - WT - Wide Flange Tee - TC | 1.9 kg (15 yrs) |
| KPFF - SFRM - Steel - WT - Wide Flange Tee (C) - TC | 6.4 kg (15 yrs) |

Used in the following Tally entries:
Aluminum, sheet
Steel, C channel
Steel, HSS section
Steel, W section (wide flange shape)

Description:
Solvent-based enamel paint, appropriate for use on metals

Life Cycle Inventory:
17% Binding agent
16% Pigments and fillers
67% Solvent

Product Scope:
Cradle to gate, including emissions during application

Transportation Distance:
By truck: 642 km

End-of-Life Scope:
33% Solids landfilled (plastic waste)

LCI Source:
DE: Solvent paint white (EN15804 A1-A3) ts (2017)

# LCI Data (continued)

**Paint, exterior metal coating, silicone-based** **493.4 kg**

Used in the following Revit families:

| | |
|---|---|
| (F3) CONCRETE METAL DECK (STRUCTURAL ONLY) | 60.0 kg (30 yrs) |
| (R2) STRUCTURAL SLAB LAYER OF ASSEMBLY R2 | 165.6 kg (30 yrs) |
| (R3) SBS OVER METAL DECK | 219.0 kg (30 yrs) |
| (R4) SOUTH VEST ROOF | 1.2 kg (30 yrs) |
| cp_HSEB - Skin Shingle flashing | 1.3 kg (30 yrs) |
| HSEB - STR-2 _Precast Tread Steel Riser 2 | 10.2 kg (30 yrs) |
| HSEB Type C - STR-4_Conc filled w/ C channel | 5.1 kg (30 yrs) |
| HSEB Type C_STR-10_Conc filled w/ C channel | 1.9 kg (30 yrs) |
| HSEB Type C_STR-5_Conc filled w/ C channel 2 | 11.2 kg (30 yrs) |
| HSEB Type C_STR-6_Conc filled w/ Plate Stringer - Roof Access | 3.8 kg (30 yrs) |
| HSEB Type C_STR-8_Conc filled w/ Plate | 0.8 kg (30 yrs) |
| HSEB_STR-3_Precast Tread Steel Riser | 2.5 kg (30 yrs) |
| LOUVER-parametric | 11.1 kg (30 yrs) |

Used in the following Tally entries:
Aluminum, sheet
Steel, deck
Steel, plate

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, exterior metal coating, silicone-based, by area** **18.2 kg**

Used in the following Revit families:

| | |
|---|---|
| HSEB Type C - STR-4_Conc filled w/ C channel | 5.1 kg (30 yrs) |
| HSEB Type C_STR-10_Conc filled w/ C channel | 1.9 kg (30 yrs) |
| HSEB Type C_STR-5_Conc filled w/ C channel 2 | 11.2 kg (30 yrs) |

Used in the following Tally entries:
Steel, C channel

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** **3,325.8 kg**

Used in the following Revit families:

| | |
|---|---|
| 1-C2- GWB on Mtl. Stud | 14.1 kg (7 yrs) |
| 1-W07_METAL STUD LIGHTWEIGHT CLADDING | 1,791.9 kg (7 yrs) |
| 2-A0_Furr Hat Channel 7/8"_GWB (2-0) 2 hour rated | 4.1 kg (7 yrs) |
| 2-C2- GWB on Mtl. Stud | 96.7 kg (7 yrs) |
| 3-W07_METAL STUD LIGHTWEIGHT CLADDING | 26.4 kg (7 yrs) |
| A4_Furr Mtl Stud 4"_GWB (1-0) | 60.8 kg (7 yrs) |
| ACT 4 AcoustiBuilt Ceiling | 74.6 kg (7 yrs) |
| C1 - ACT-1 - 2' x 4' | 614.3 kg (7 yrs) |
| C2- GWB on Mtl. Stud | 456.2 kg (7 yrs) |
| C7- GWB on Mtl. Stud 2 | 26.8 kg (7 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse) | 160.0 kg (7 yrs) |

Used in the following Tally entries:
Acoustic ceiling system, mineral fiber board
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)

**Phenolic resin solid surfacing, sheet** **2,684.0 kg**

Used in the following Revit families:

| | |
|---|---|
| cp_HSEB - Base Material Panel_vertical | 2,684.0 kg (20 yrs) |

Used in the following Tally entries:
Phenolic resin solid surface, sheet

Description:
Phenolic resin saturated kraft paper formed into solid sheet stock

Life Cycle Inventory:
85% Kraft paper
15% Phenolic resin

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 640 km

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

LCI Source:
US: Phenolic resin (45% concentration) ts (2017)
GLO: Plastic extrusion profile (unspecific) ts (2017)
US: Electricity grid mix ts (2014)
US: Thermal energy from natural gas ts (2014)
US: Lubricants at refinery ts (2014)
GLO: Compressed air 7 bar (medium power consumption) ts (2014)
EU-28: Kraft paper ts (2017)

**PIR rigid foam insulation, roof, R=20.5, PIMA - EPD** **11,174.7 kg**

Used in the following Revit families:

| | |
|---|---|
| (R1) CLT ROOF | 4,739.8 kg (60 yrs) |
| (R1) CLT ROOF - CLT PATTERN N/S | 1,093.0 kg (60 yrs) |
| (R3) SBS OVER METAL DECK | 5,330.3 kg (60 yrs) |
| (R4) SOUTH VEST ROOF | 11.7 kg (60 yrs) |

Used in the following Tally entries:
Polyisocyanurate (PIR), board

Description:
Polyisocyanurate rigid foam roof insulation with glass-fiber reinforced facers, R-value of 20.5, 3.5" thickness (89 mm). Industry-wide EPD from the Polyisocyanurate Insulation Manufacturers Association.

Life Cycle Inventory:
For information and quantities, see EPD

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 250 km

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

# LCI Data (continued)

LCI Source:
RNA: Polyisocyanurate rigid foam board roof insulaton, R=20.5 (A1-A3) ts-EPD (2013)

EPD Source:
EPD10043

EPD Designation Holder:
Polyisocyanurate Insulation Manufacturers Association

EPD Program Operator:
NSF International

EPD Expiration:
2/6/2020

**PIR rigid foam insulation, wall, R=14.6, PIMA - EPD** **9.8 kg**

Used in the following Revit families:

| | |
|---|---|
| cp_HSEB - Skin Shingle flashing | 9.8 kg (60 yrs) |

Used in the following Tally entries:
Polyisocyanurate (PIR), board

Description:
Polyisocyanurate rigid foam wall insulation with aluminum foil over kraft paper facers, R-value of 14.6, 2.25" thickness (57.2 mm). Industry-wide EPD from the Polyisocyanurate Insulation Manufacturers Association.

Life Cycle Inventory:
For information and quantities, see EPD

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 250 km

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

LCI Source:
RNA: Polyisocyanurate rigid foam board wall insulation, R=14.6 (A1-A3) ts-EPD (2013)

EPD Source:
EPD10042

EPD Designation Holder:
Polyisocyanurate Insulation Manufacturers Association

EPD Program Operator:
NSF International

EPD Expiration:
2/6/2020

**Polyethelene sheet vapor barrier (HDPE)** **34,144.9 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1) SLAB ON GRADE | 570.6 kg (60 yrs) |
| (F1) SLAB ON GRADE - 6" | 0.4 kg (60 yrs) |
| (F1) SLAB ON GRADE - 8" | 5.3 kg (60 yrs) |
| (R1) CLT ROOF | 421.6 kg (60 yrs) |
| (R1) CLT ROOF - CLT PATTERN N/S | 97.2 kg (60 yrs) |
| (R2) INSULATION O/ ASPHALT MEMBRANE O/ STRUCT | 143.4 kg (60 yrs) |
| (R3) SBS OVER METAL DECK | 414.9 kg (60 yrs) |
| (R4) SOUTH VEST ROOF | 3.6 kg (60 yrs) |
| (R4) SOUTH VEST ROOF (INTERIOR) | 4.2 kg (60 yrs) |
| 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 11" | 590.2 kg (60 yrs) |
| 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 16" | 193.7 kg (60 yrs) |
| 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 8" | 1,865.2 kg (60 yrs) |
| 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_16" | 6,745.6 kg (60 yrs) |
| 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_22" | 17,358.2 kg (60 yrs) |
| 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_24" | 5,580.5 kg (60 yrs) |
| 2-W01 CONCRETE WALL WITHOUT CONC | 150.2 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)

**Polyurethane coating, metal stock** **10.7 kg**

Used in the following Revit families:

| | |
|---|---|
| KPFF - SCOL - Steel - HSS - Rectangular (C) - TC | 10.7 kg (50 yrs) |

Used in the following Tally entries:
Steel, HSS section

Description:
Polyurethane coating, for metal stock

Life Cycle Inventory:
100% Polyurethane coating

Product Scope:
Cradle to gate, includes installation

Transportation Distance:
N/A

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

LCI Source:
DE: Application base coat (automobile) ts (2017)
DE: Polyurethane (copolymer-component) (estimation from TPU adhesive) ts (2017)

**Powder coating, metal stock** **1.7 kg**

Used in the following Revit families:

| | |
|---|---|
| Picture Window Bend Plate | 1.7 kg (50 yrs) |

Used in the following Tally entries:
Aluminum, angle

Description:
Powder coating, for metal stock

Life Cycle Inventory:
100% Powder coating

Product Scope:
Cradle to gate, including application

Transportation Distance:
N/A

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

LCI Source:
DE: Application top coat powder (aluminium) ts (2017)
DE: Coating powder (industry, outside, red) ts (2017)

**SBS modified bitumen, assembly (base & cap), ARMA - EPD** **18,668.2 kg**

Used in the following Revit families:

| | |
|---|---|
| (R1) CLT ROOF - CLT PATTERN N/S | 2,720.6 kg (40 yrs) |
| (R3) SBS OVER METAL DECK | 11,609.5 kg (40 yrs) |
| (R4) SOUTH VEST ROOF | 101.8 kg (40 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (CW Parapet) no insulation | 202.3 kg (40 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (Parapet) | 4,034.0 kg (40 yrs) |

Used in the following Tally entries:
SBS modified bitumen, sheet

Description:
Styrene-butadiene-styrene (SBS)-modified bituminous roofing consisting of a base sheet and cap sheet. Industry-wide EPD from the Asphalt Roofing Manufacturers Association.

# LCI Data (continued)

Life Cycle Inventory:
For information and quantities, see EPD

Product Scope:
Cradle to gate, accounts for product overlap when installing

Transportation Distance:
By truck: 172 km

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

LCI Source:
RNA: Atactic-polypropylene (APP)-modified bitumen (asphalt) roofing base sheet - ARMA (A1-A3) (2012)
RNA: Atactic-polypropylene (APP)-modified bitumen (asphalt) roofing cap sheet - ARMA (A1-A3) (2012)

EPD Source:
4787168709.105.1

EPD Designation Holder:
Asphalt Roofing Manufacturers Association (ARMA)

EPD Program Operator:
UL Environment

EPD Expiration:
10/28/2021

**SBS modified bitumen, cap sheet, ARMA - EPD** **8,400.9 kg**

Used in the following Revit families:

| | |
|---|---|
| (R2) INSULATION O/ ASPHALT MEMBRANE O/ STRUCT | 2,285.1 kg (60 yrs) |
| 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 11" | 111.1 kg (60 yrs) |
| 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 16" | 36.5 kg (60 yrs) |
| 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 8" | 351.2 kg (60 yrs) |
| 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_16" | 1,270.0 kg (60 yrs) |
| 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_22" | 3,268.1 kg (60 yrs) |
| 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_24" | 1,050.7 kg (60 yrs) |
| 2-W01 CONCRETE WALL WITHOUT CONC | 28.3 kg (60 yrs) |

Used in the following Tally entries:
Self-adhering sheet waterproofing, modified bituminous sheet

Description:
Styrene-butadiene-styrene (SBS)-modified bituminous cap sheet. Industry-wide EPD from the Asphalt Roofing 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 (plastic waste)

LCI Source:
RNA: Atactic-polypropylene (APP)-modified bitumen (asphalt) roofing cap sheet - ARMA (A1-A3) (2012)

EPD Source:
4787168709.105.1

EPD Designation Holder:
Asphalt Roofing Manufacturers Association (ARMA)

EPD Program Operator:
UL Environment

EPD Expiration:
10/28/2021

**Self adhering flashing membrane, 40 mil** **13.1 kg**

Used in the following Revit families:

| | |
|---|---|
| (R4) SOUTH VEST ROOF | 13.1 kg (40 yrs) |

Used in the following Tally entries:
Self adhering membrane

Description:
40 mil (1 mm) Asphalt rubber sheet inclusive of polyethelyne backing

Life Cycle Inventory:
82% Rubberized asphalt (25% SBS)
18% Polyethylene HD

Product Scope:
Cradle to gate for materials only, neglects manufacturing requirements

Transportation Distance:
By truck: 172 km

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

LCI Source:
US: Styrene-butadiene rubber (SBR) ts (2017)
DE: Bitumen cold adhesive (EN15804 A1-A3) ts (2017)
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)

**Stainless steel door hinge** **52.5 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1-HMW) dr-SGL-A | 9.8 kg (30 yrs) |
| (F2) dr-Double-Flush-with 4 sided jambs | 8.1 kg (30 yrs) |
| (FG2-AL) dr-DBL-A | 11.2 kg (30 yrs) |
| (FG2-CW) dr-DBL-CW | 11.2 kg (30 yrs) |
| (N1-HMW) dr-SGL-A | 5.7 kg (30 yrs) |
| temp-fence | 6.5 kg (30 yrs) |

Used in the following Tally entries:
Door, exterior, aluminum
Door, exterior, steel
Door, interior, steel

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

**Stainless steel sheet, Chromium 18/8** **43.4 kg**

Used in the following Revit families:

| | |
|---|---|
| Construction Specialties_Crash Rail_6" ECR-60S | 43.4 kg (45 yrs) |

Used in the following Tally entries:
Steel, sheet, stainless

Description:
Stainless steel sheet, Type 304 (Chromium 18/8)

Life Cycle Inventory:
100% Stainless steel plate

# LCI Data (continued)

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 418 km

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

Module D Scope:
Product has 52% scrap input while remainder is processed and credited as avoided burden

LCI Source:
RER: Stainless steel cold rolled coil (304) Eurofer (2010)
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)
RER: Stainless steel flat product (304) - value of scrap Eurofer (2010)

**Stainless steel, extruded, chromium 18/8** **690.3 kg**

Used in the following Revit families:

| | |
|---|---|
| HSEB Guardrail - Cable Rail | 176.3 kg (60 yrs) |
| HSEB Guardrail - Cable Rail without handrail | 514.0 kg (60 yrs) |

Used in the following Tally entries:
Steel, round bar

Description:
Stainless steel, extruded, Type 304 (Chromium 18/8)

Life Cycle Inventory:
100% Stainless 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 52% scrap input while remainder is processed and credited as avoided burden

LCI Source:
RER: Stainless steel cold rolled coil (304) Eurofer (2010)
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)
RER: Stainless steel flat product (304) - value of scrap Eurofer (2010)

**Steel, reinforcing rod** **128,247.9 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1) SLAB ON GRADE | 5,757.9 kg (60 yrs) |
| (F1) SLAB ON GRADE - 6" | 4.0 kg (60 yrs) |
| (F1) SLAB ON GRADE - 8" | 53.4 kg (60 yrs) |
| (F2) CONCRETE METAL DECK | 8,992.2 kg (60 yrs) |
| (F3) CONCRETE DECK O/ 3 PLY CLT FLOOR N/W DIRECTION | 4,255.8 kg (60 yrs) |
| (F3) CONCRETE METAL DECK (STRUCTURAL ONLY) | 1,397.0 kg (60 yrs) |
| (F3) CONCRETE METAL DECK W/ TOPPING SLAB | 3,921.8 kg (60 yrs) |
| (F4) CONCRETE DECK O/ 3 PLY CLT FLOOR | 27,656.3 kg (60 yrs) |
| (R2) STRUCTURAL SLAB LAYER OF ASSEMBLY R2 | 1,384.9 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F10.0 10x10x3.0d | 705.8 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F11.0 11x11x3.25d | 828.1 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F12.0 12x12x4d | 3,444.6 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F12.0 14x14x4.5d | 4,666.0 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F2.0 2x2x11"d | 76.8 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F4.0 4x4x1.5d | 19.8 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F8.0 8x8x2.5d | 202.9 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F9.0 9x9x2.75d | 197.6 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_FW6.0 6x8x2.5d | 1,525.9 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW3.0_36wx18d | 828.3 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW4.0_48wx18d | 945.8 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW4.0_48wx24d | 1,920.7 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW5.0_60wx18d | 14,137.7 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW5.0A_60wx30d | 6,269.2 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW7.0_87wx42d 2 | 987.7 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW8.0_96wx48d | 3,053.2 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg_24wx12d | 135.9 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(12") | 1,889.4 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(15") | 882.7 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(4") | 111.7 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(6") | 58.6 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(8") | 831.3 kg (60 yrs) |
| 04.225_LCL_C_CURB_Wall(11") | 640.6 kg (60 yrs) |
| 04.225_LCL_C_CURB_Wall(4") | 8.9 kg (60 yrs) |
| 04.225_LCL_C_CURB_Wall(6") | 272.4 kg (60 yrs) |
| 04.225_LCL_C_CURB_Wall(8") | 21.6 kg (60 yrs) |
| 04.300_LCL_C_Foundation_Wall(10") | 803.5 kg (60 yrs) |
| 04.310_LCL_C_PIT_Wall(8") | 174.5 kg (60 yrs) |
| 04.380_LCL_C_SHOTCRETE_Wall(16") | 2,833.9 kg (60 yrs) |
| 04.380_LCL_C_SHOTCRETE_Wall(19") | 1,384.2 kg (60 yrs) |
| 04.380_LCL_C_SHOTCRETE_Wall(22") | 17,844.2 kg (60 yrs) |
| 04.380_LCL_C_SHOTCRETE_Wall(24") | 4,729.3 kg (60 yrs) |
| 12" Concrete Slab | 60.7 kg (60 yrs) |
| Concrete 8" - STRUCTURAL | 566.3 kg (60 yrs) |
| HSEB - STR-1 _Precast Tread & Riser | 175.4 kg (60 yrs) |
| HSEB - STR-2 _Precast Tread Steel Riser 2 | 892.2 kg (60 yrs) |
| HSEB ST-11 (CAST IN PLACE) | 38.4 kg (60 yrs) |
| HSEB ST-9 (CAST IN PLACE) | 112.6 kg (60 yrs) |
| HSEB_STR-3_Precast Tread Steel Riser | 216.9 kg (60 yrs) |
| KPFF - SCOL - Concrete - Round | 0.0 kg (60 yrs) |
| KPFF - SFRM - Steel - BRB - Buckling Restrained Brace | 329.3 kg (60 yrs) |
| LCL_C_Pilaster_Rect_()w()d | 0.0 kg (60 yrs) |

Used in the following Tally entries:
Cast-in-place concrete, lightweight structural concrete, 5000 psi
Cast-in-place concrete, structural concrete, 3000 psi
Cast-in-place concrete, structural concrete, 4000 psi
Cast-in-place concrete, structural concrete, 5000 psi
Precast concrete column
Stair, concrete with metal nosing
Stair, precast single run (stretcher)
Steel, reinforcing rod
Steel, rod

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)

**Steel, sheet** **9,279.6 kg**

Used in the following Revit families:

| | |
|---|---|
| Corner_3 | 188.4 kg (60 yrs) |
| Corner_4 | 239.6 kg (60 yrs) |
| HSEB - STR-2 _Precast Tread Steel Riser 2 | 5,384.4 kg (45-60 yrs) |
| HSEB Type C - STR-4_Conc filled w/ C channel | 623.5 kg (45 yrs) |
| HSEB Type C_STR-10_Conc filled w/ C channel | 242.9 kg (45 yrs) |
| HSEB Type C_STR-5_Conc filled w/ C channel 2 | 994.2 kg (45 yrs) |
| HSEB Type C_STR-6_Conc filled w/ Plate Stringer - Roof Access | 170.0 kg (45 yrs) |
| HSEB Type C_STR-8_Conc filled w/ Plate | 133.4 kg (45 yrs) |
| HSEB_STR-3_Precast Tread Steel Riser | 852.8 kg (45-60 yrs) |
| P_SOUTH VESTIBULE WALL | 58.4 kg (60 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse) | 346.1 kg (60 yrs) |
| W09_SOUTH VESTIBULE WALL | 46.0 kg (60 yrs) |

Used in the following Tally entries:
Metal roofing panels, formed

# LCI Data (continued)

Stair, concrete with metal nosing
Steel, plate

Description:
Steel sheet

Life Cycle Inventory:
100% Steel sheet

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 418 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)

**Structural concrete, 3000 psi, 0% fly ash and slag** **42,359.1 kg**

Used in the following Revit families:

| | |
|---|---|
| 3.5" Light Duty Paving Over Sturcture | 7,088.3 kg (30 yrs) |
| cp_HSEB - Base Material Panel_vertical | 35,270.7 kg (60 yrs) |

Used in the following Tally entries:
Precast concrete nonstructural panel
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, Pacific Northwest regional average** **1,304,562.7 kg**

Used in the following Revit families:

| | |
|---|---|
| (F2) CONCRETE METAL DECK | 236,435.8 kg (60 yrs) |
| (F3) CONCRETE DECK O/ 3 PLY CLT FLOOR N/W DIRECTION | 110,972.3 kg (60 yrs) |
| (F3) CONCRETE METAL DECK (STRUCTURAL ONLY) | 36,533.6 kg (60 yrs) |
| (F3) CONCRETE METAL DECK W/ TOPPING SLAB | 187,033.1 kg (60 yrs) |
| (F4) CONCRETE DECK O/ 3 PLY CLT FLOOR | 733,587.9 kg (60 yrs) |

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

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

Life Cycle Inventory:
Coarse aggregate: 45%, Sand: 35%, Portland cement PCA - EPD: 10%, Water: 8%, Fly ash: 3%, 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, 4000 psi, 20% fly ash and 30% slag** **856,960.1 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1) SLAB ON GRADE | 567,361.6 kg (60 yrs) |
| (F1) SLAB ON GRADE - 6" | 468.0 kg (60 yrs) |
| (F1) SLAB ON GRADE - 8" | 8,422.4 kg (60 yrs) |
| (R2) STRUCTURAL SLAB LAYER OF ASSEMBLY R2 | 140,358.3 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F2.0 2x2x11"d | 3,728.8 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(12") | 48,061.4 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(15") | 22,454.6 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(4") | 2,842.4 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(6") | 1,489.9 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(8") | 21,146.0 kg (60 yrs) |
| 04.225_LCL_C_CURB_Wall(11") | 16,294.9 kg (60 yrs) |
| 04.225_LCL_C_CURB_Wall(4") | 227.3 kg (60 yrs) |
| 04.225_LCL_C_CURB_Wall(6") | 6,929.8 kg (60 yrs) |
| 04.225_LCL_C_CURB_Wall(8") | 549.0 kg (60 yrs) |
| 12" Concrete Slab | 16,414.9 kg (60 yrs) |
| HSEB ST-11 (CAST IN PLACE) | 210.9 kg (60 yrs) |

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

Description:
Structural concrete, 4000 psi, 20% fly ash and 30% slag. Mix design matches National Ready-Mix Concrete Association (NRMCA) Industry-wide EPD.

Life Cycle Inventory:
Coarse aggregate: 45%, Sand: 31%, Portland cement PCA - EPD: 9%, Water: 7%, Expanded slag: 5%, Fly ash: 3%, Admixture: <1%

# LCI Data (continued)

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, 5000 psi, 0% fly ash and slag** **8,728.6 kg**

Used in the following Revit families:

| | |
|---|---|
| HSEB - STR-1 _Precast Tread & Riser | 2,539.4 kg (60 yrs) |
| HSEB - STR-2 _Precast Tread Steel Riser 2 | 4,844.9 kg (60 yrs) |
| HSEB_STR-3_Precast Tread Steel Riser | 1,344.3 kg (60 yrs) |

Used in the following Tally entries:
Stair, concrete with metal nosing
Stair, precast single run (stretcher)

Description:
Structural concrete, 5000 psi, 0% fly ash and slag. Mix design matches National Ready-Mix Concrete Association (NRMCA) Industry-wide EPD.

Life Cycle Inventory:
Coarse aggregate: 40%, Sand: 33%, Portland cement PCA - EPD: 20%, 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, 5000 psi, 20% fly ash and 30% slag** **2,312,934.3 kg**

Used in the following Revit families:

| | |
|---|---|
| 04.016_LCL FND Slab_Spread Ftg_F10.0 10x10x3.0d | 56,528.9 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F11.0 11x11x3.25d | 74,100.0 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F12.0 12x12x4d | 36,178.5 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F12.0 14x14x4.5d | 55,398.3 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F4.0 4x4x1.5d | 3,014.9 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F8.0 8x8x2.5d | 20,099.2 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F9.0 9x9x2.75d | 13,990.9 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_FW6.0 6x8x2.5d | 69,640.5 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW3.0_36wx18d | 31,217.6 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW4.0_48wx18d | 33,450.2 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW4.0_48wx24d | 86,718.6 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW5.0_60wx18d | 89,913.9 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW5.0A_60wx30d | 64,658.2 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW7.0_87wx42d 2 | 66,939.6 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW8.0_96wx48d | 188,932.2 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg_24wx12d | 1,847.0 kg (60 yrs) |
| 04.300_LCL_C_Foundation_Wall(10") | 36,007.1 kg (60 yrs) |
| 04.310_LCL_C_PIT_Wall(8") | 11,479.1 kg (60 yrs) |
| 04.380_LCL_C_SHOTCRETE_Wall(16") | 210,675.0 kg (60 yrs) |
| 04.380_LCL_C_SHOTCRETE_Wall(19") | 49,101.7 kg (60 yrs) |
| 04.380_LCL_C_SHOTCRETE_Wall(22") | 859,916.8 kg (60 yrs) |
| 04.380_LCL_C_SHOTCRETE_Wall(24") | 247,805.7 kg (60 yrs) |
| HSEB ST-11 (CAST IN PLACE) | 752.2 kg (60 yrs) |
| HSEB ST-9 (CAST IN PLACE) | 2,812.3 kg (60 yrs) |
| KPFF - SFRM - Steel - BRB - Buckling Restrained Brace | 1,755.9 kg (60 yrs) |

Used in the following Tally entries:
Cast-in-place concrete, structural concrete, 5000 psi
Precast concrete column

Description:
Structural concrete, 5000 psi, 20% fly ash and 30% slag. Mix design matches National Ready-Mix Concrete Association (NRMCA) Industry-wide EPD.

Life Cycle Inventory:
Coarse aggregate: 41%, Sand: 30%, Portland cement PCA - EPD: 11%, Water: 7%, Expanded slag: 6%, Fly ash: 4%, 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)

**Suspended grid** **6,606.7 kg**

Used in the following Revit families:

| | |
|---|---|
| C1 - ACT-1 - 2' x 4' | 782.8 kg (50 yrs) |
| C1 - ACT-2 - 2' x 2' HRC | 1,597.2 kg (50 yrs) |
| C1 - ACT-3 - 2' x 2' | 3,721.3 kg (50 yrs) |
| C1 - ACT-5 - 2' x 6' | 505.4 kg (50 yrs) |

Used in the following Tally entries:
Acoustic ceiling system, mineral fiber board

Description:
Cold-rolled galvanized steel for lightweight ceiling grid

Life Cycle Inventory:
100% HDG 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 44% scrap input while remainder is processed and credited as avoided burden

LCI Source:
RNA: Steel hot dip galvanized worldsteel (2007)
US: Metal roll forming (MCA) (2010)
US: Electricity grid mix ts (2014)
US: Thermal energy from natural gas ts (2014)
GLO: Value of scrap worldsteel (2014)

**Wall board, gypsum, fire-resistant (Type X)** **43,127.3 kg**

Used in the following Revit families:

| | |
|---|---|
| 1-C2- GWB on Mtl. Stud | 444.9 kg (30 yrs) |
| 1F5 - 1 HR RATED HORIZONTAL DUCT ENCLOSURE | 761.0 kg (30 yrs) |
| 1-W07_METAL STUD LIGHTWEIGHT CLADDING | 35,345.8 kg (30 yrs) |
| 2-C2- GWB on Mtl. Stud | 4,958.8 kg (30 yrs) |
| 3-W07_METAL STUD LIGHTWEIGHT CLADDING | 416.5 kg (30 yrs) |
| A4_Furr Mtl Stud 4"_GWB (1-0) | 1,200.2 kg (30 yrs) |

Used in the following Tally entries:
Wall board, gypsum

Description:
Fire-resistant gypsum board

Life Cycle Inventory:
100% Fire-resistant gypsum wallboard (Gypsum, Boric acid, Cement, Sodium lignin sulfonate, Glass fibres, 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 plaster board (Fire protection) (EN15804 A1-A3)PE (2017)

**Wall board, gypsum, moisture- and mold-resistant** **86,468.2 kg**

Used in the following Revit families:

| | |
|---|---|
| (R4) SOUTH VEST ROOF | 123.7 kg (30 yrs) |
| 1-N8 GFRC @ FRAMED WALL STAGGERED STUD | 141.1 kg (30 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL | 4,559.5 kg (30 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL STAGGERED STUD | 1,451.9 kg (30 yrs) |
| 1-W07_METAL STUD LIGHTWEIGHT CLADDING | 24,470.2 kg (30 yrs) |
| 3-W07_METAL STUD LIGHTWEIGHT CLADDING | 288.3 kg (30 yrs) |
| P_SOUTH VESTIBULE WALL | 196.5 kg (30 yrs) |
| W06 PRE-CAST CONCRETE @ FRAMED WALL | 7,737.1 kg (30 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING | 32,902.8 kg (30 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse) | 2,185.4 kg (30 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (Parapet) | 12,256.7 kg (30 yrs) |
| W09_SOUTH VESTIBULE WALL | 155.0 kg (30 yrs) |

Used in the following Tally entries:
Wall board, gypsum

Description:
Moisture- and mold-resistant gypsum board

Life Cycle Inventory:
100% Moisture-resistant gypsum wallboard (Gypsum, Boric acid, Cement, Sodium lignin sulfonate, Glass fibres, 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 plaster board (Moisture resistant) (EN15804 A1-A3) ts (2017)

**Wall board, gypsum, natural** **65,417.5 kg**

Used in the following Revit families:

| | |
|---|---|
| (A1)_Furr Mtl Stud 7/8"_GWB (1-0) | 353.7 kg (30 yrs) |
| (A3)_Furr Mtl Stud 3-5/8"_GWB (1-0) | 395.3 kg (30 yrs) |
| (B8)_TYP Mtl Stud 8"_GWB Insulation | 156.0 kg (30 yrs) |
| 1-B6 | 37.8 kg (30 yrs) |
| 1-C2- GWB on Mtl. Stud | 203.7 kg (30 yrs) |
| 1-N8 GFRC @ FRAMED WALL STAGGERED STUD | 149.4 kg (30 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL | 4,824.8 kg (30 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL STAGGERED STUD | 1,536.4 kg (30 yrs) |
| 2-A0_Furr Hat Channel 7/8"_GWB (2-0) 2 hour rated | 118.0 kg (30 yrs) |
| 2-A0_GWB Type X (2-0) 2 hour rated | 169.4 kg (30 yrs) |
| 2-C2- GWB on Mtl. Stud | 1,397.2 kg (30 yrs) |
| 3-W07_METAL STUD LIGHTWEIGHT CLADDING | 915.4 kg (30 yrs) |
| ACT 4 AcoustiBuilt Ceiling | 1,078.1 kg (30 yrs) |
| B4 | 924.8 kg (30 yrs) |
| B6 | 488.7 kg (30 yrs) |
| C2- GWB on Mtl. Stud | 6,591.9 kg (30 yrs) |
| C7- GWB on Mtl. Stud 2 | 387.3 kg (30 yrs) |
| P_SOUTH VESTIBULE WALL | 207.9 kg (30 yrs) |
| W06 PRE-CAST CONCRETE @ FRAMED WALL | 8,187.4 kg (30 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING | 34,817.8 kg (30 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse) | 2,312.6 kg (30 yrs) |
| W09_SOUTH VESTIBULE WALL | 164.0 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)

**White oak lumber, 1 inch** **1,400.5 kg**

Used in the following Revit families:

| | |
|---|---|
| (R4) SOUTH VEST ROOF | 188.8 kg (50 yrs) |
| (R4) SOUTH VEST ROOF (INTERIOR) | 217.7 kg (50 yrs) |
| Rectangular Mullion | 993.9 kg (50 yrs) |

Used in the following Tally entries:
Domestic hardwood

Description:

# LCI Data (continued)

Kiln-dried American White Oak hardwood lumber of 1" nominal thickness as produced in the eastern United States, focusing on the main production technologies and region-specific characteristics. White oak is frequently used for mouldings, flooring, furniture, doors, 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.

Life Cycle Inventory:
100% White Oak

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: White Oak lumber, 1 inch (769 kg/m$^3$), kiln-dried ts/AHEC (2017)

EPD Source:
Information

EPD Designation Holder:
American Hardwood Export Council (AHEC)

**Window frame, vinyl, fixed** **5,801.7 kg**

Used in the following Revit families:

| | |
|---|---|
| cp_HSEB - Window at Upper Levels | 5,801.7 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** **2,753.0 kg**

Used in the following Revit families:

| | |
|---|---|
| (F4) CONCRETE DECK O/ 3 PLY CLT FLOOR | 2,676.2 kg (10 yrs) |
| (R4) SOUTH VEST ROOF | 4.3 kg (10 yrs) |
| (R4) SOUTH VEST ROOF (INTERIOR) | 4.9 kg (10 yrs) |
| Rectangular Mullion | 67.6 kg (10 yrs) |

Used in the following Tally entries:
Cross laminated timber (CLT)
Domestic hardwood

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

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)

**XPS insulation, Foamular average, Owens Corning - EPD** **5,577.8 kg**

Used in the following Revit families:

| | |
|---|---|
| (R2) INSULATION O/ ASPHALT MEMBRANE O/ STRUCT | 2,783.8 kg (60 yrs) |
| 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 11" | 50.8 kg (60 yrs) |
| 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 16" | 16.7 kg (60 yrs) |
| 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 8" | 160.4 kg (60 yrs) |
| 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_16" | 580.2 kg (60 yrs) |
| 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_22" | 1,493.0 kg (60 yrs) |
| 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_24" | 480.0 kg (60 yrs) |
| 2-W01 CONCRETE WALL WITHOUT CONC | 12.9 kg (60 yrs) |

Used in the following Tally entries:
Extruded polystyrene (XPS), board

Description:
FOAMULAR XPS (polystyrene) insulation board, HFC foaming agent. EPD representative of US manufacturing condition. FOAMULAR insulation board is available with a variety of R-values and compressive strengths. The default value is based on a thermal resistance of RSI 1 and a compressive strength of 30 psi. If the intended R-value and compressive strength of the assembly is known, use the drop-down menu to designate a specific product.

Note: This temporary entry is sourced directly from third-party verified EPD data and replaces a Tally entry that is undergoing a quality assurance review. This entry developed using data from ecoinvent and modeled in SimaPro but adheres to

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

Product Scope:
Cradle to gate.
Note: Product stage expanded to include blowing agent emissions during distribution and installation, and diffusion from product over service life (B1). As these impacts make a significant contribution to GWP they have been included in the product stage.

Transportation Distance:
By truck: 1190 km

End-of-Life Scope:
100% Landfilled (plastic waste), includes blowing agent emissions released during disposal

LCI Source:
US: Extruded polystyrene (XPS) insulation board, FOAMULAR - Owens Corning EPD (2018), modeled with Simapro 8, source for secondary data is ecoinvent 3.4

EPD Source:
4788721182.101.1

EPD Designation Holder:
Owens Corning

EPD Program Operator:
UL Environment

EPD Expiration:
1/1/2024

# HEALTH SCIENCES EDUCATION BUILDING

## Full building summary

5/19/2022

## Table of Contents

Report Summary 1

LCA Results

- Results per Life Cycle Stage 2
- Results per Life Cycle Stage, itemized by Division 3
- Results per Division 4
- Results per Division, itemized by Tally Entry 5
- Results per Division, itemized by Material 6
- Results per Revit Category 8
- Results per Revit Category, itemized by Family 9
- Results per Building Element 11

Appendix

- Calculation Methodology - Life Cycle Assessment Methods 12
- Calculation Methodology - Life Cycle Stages 13
- Calculation Methodology - Environmental Impact Categories 14
- LCI Data 15

# Report Summary

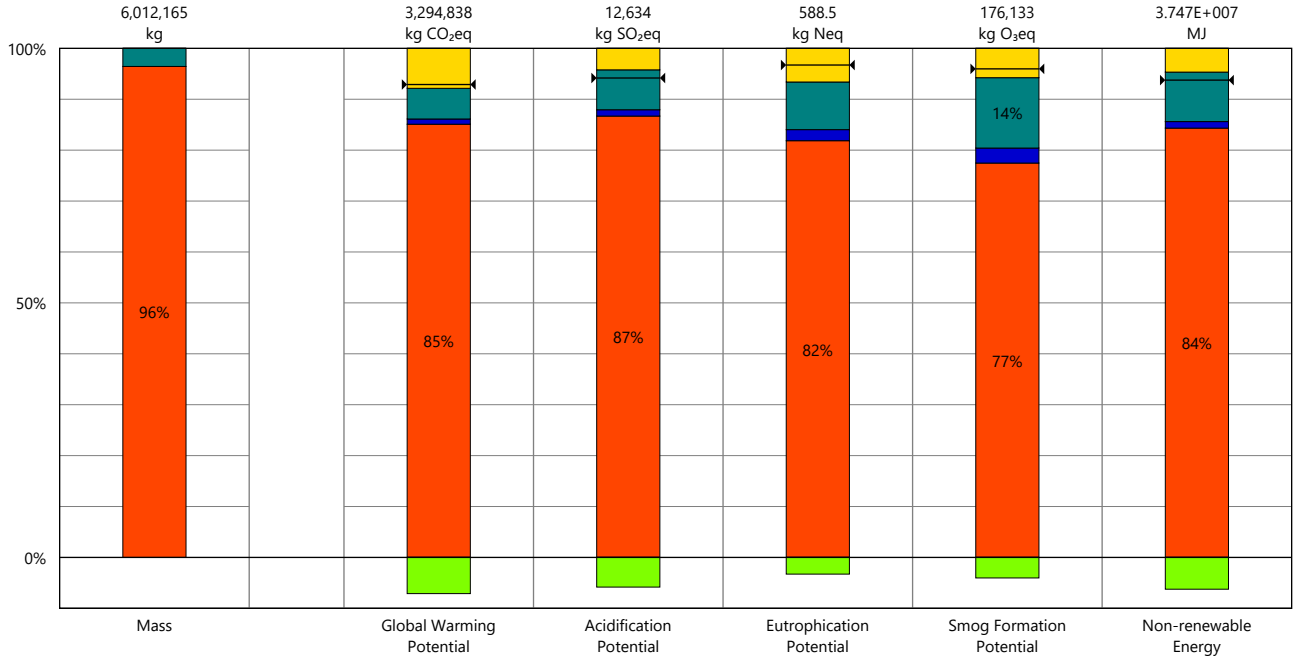
**Created with Tally**
Commercial Version 2022.04.08.01

| | |
|---|---|
| **Author** | Katherine Martin |
| **Company** | The Miller Hull Partnership |
| **Date** | 5/19/2022 |
| **Project** | HEALTH SCIENCES EDUCATION BUILDING |
| **Location** | 1607 NE Pacific Street |
| **Gross Area** | 100,000 ft$^2$ |
| **Building Life** | 60 years |
| **Boundaries** | Cradle to grave, inclusive of biogenic carbon; see appendix for a full list of materials and processes |

**Goal and Scope of Assessment**
Complete building envelope and structural elements, including foundations and footings, structural wall assembly (cladding to interior finish), structural floors and ceilings, and roof assemblies.

| 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 $CO_2$eq) | 2,803,595 | 33,934 | 198,521 | 258,788 | -234,238 |
| Acidification (kg $SO_2$eq) | 10,952 | 157.2 | 989.9 | 534.3 | -736 |
| Eutrophication (kg Neq) | 481.7 | 12.80 | 55.05 | 38.92 | -19.3 |
| Smog Formation (kg $O_3$eq) | 136,435 | 5,196 | 24,342 | 10,160 | -7,105 |
| Ozone Depletion (kg CFC-11eq) | 0.2672 | 1.162E-009 | 4.665E-004 | 4.938E-005 | 0.001196 |
| Primary Energy (MJ) | 3.348E+007 | 493,475 | 3,968,178 | 1,871,516 | -2,608,063 |
| Non-renewable Energy (MJ) | 3.160E+007 | 481,667 | 3,641,479 | 1,750,090 | -2,340,270 |
| Renewable Energy (MJ) | 1,880,759 | 11,933 | 328,624 | 123,439 | -267,817 |
| **Environmental Impacts / Area** | | | | | |
| Global Warming (kg $CO_2$eq/m$^2$) | 301.8 | 3.653 | 21.37 | 27.86 | -25.2 |
| Acidification (kg $SO_2$eq/m$^2$) | 1.179 | 0.01693 | 0.1066 | 0.05751 | -0.07927 |
| Eutrophication (kg Neq/m$^2$) | 0.05185 | 0.001378 | 0.005926 | 0.004189 | -0.002078 |
| Smog Formation (kg $O_3$eq/m$^2$) | 14.69 | 0.5593 | 2.620 | 1.094 | -0.7648 |
| Ozone Depletion (kg CFC-11eq/m$^2$) | 2.876E-005 | 1.251E-013 | 5.021E-008 | 5.316E-009 | 1.287E-007 |
| Primary Energy (MJ/m$^2$) | 3,604 | 53.12 | 427.1 | 201.4 | -281 |
| Non-renewable Energy (MJ/m$^2$) | 3,401 | 51.85 | 392.0 | 188.4 | -252 |
| Renewable Energy (MJ/m$^2$) | 202.4 | 1.284 | 35.37 | 13.29 | -28.8 |

## Results per Life Cycle Stage

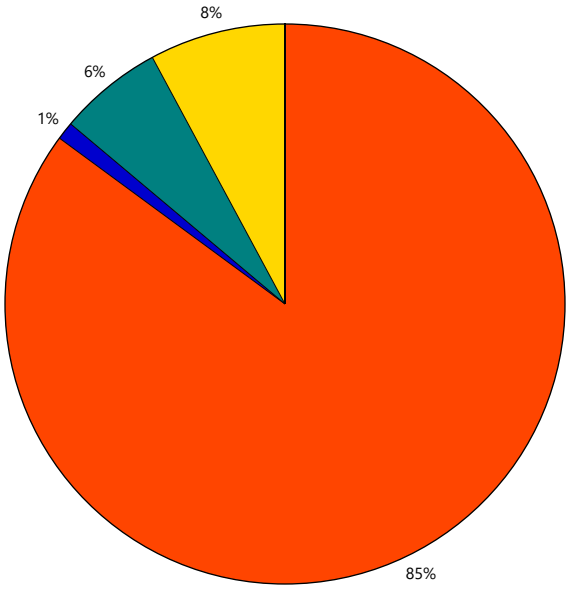



### Legend

Net value (impacts + credits)

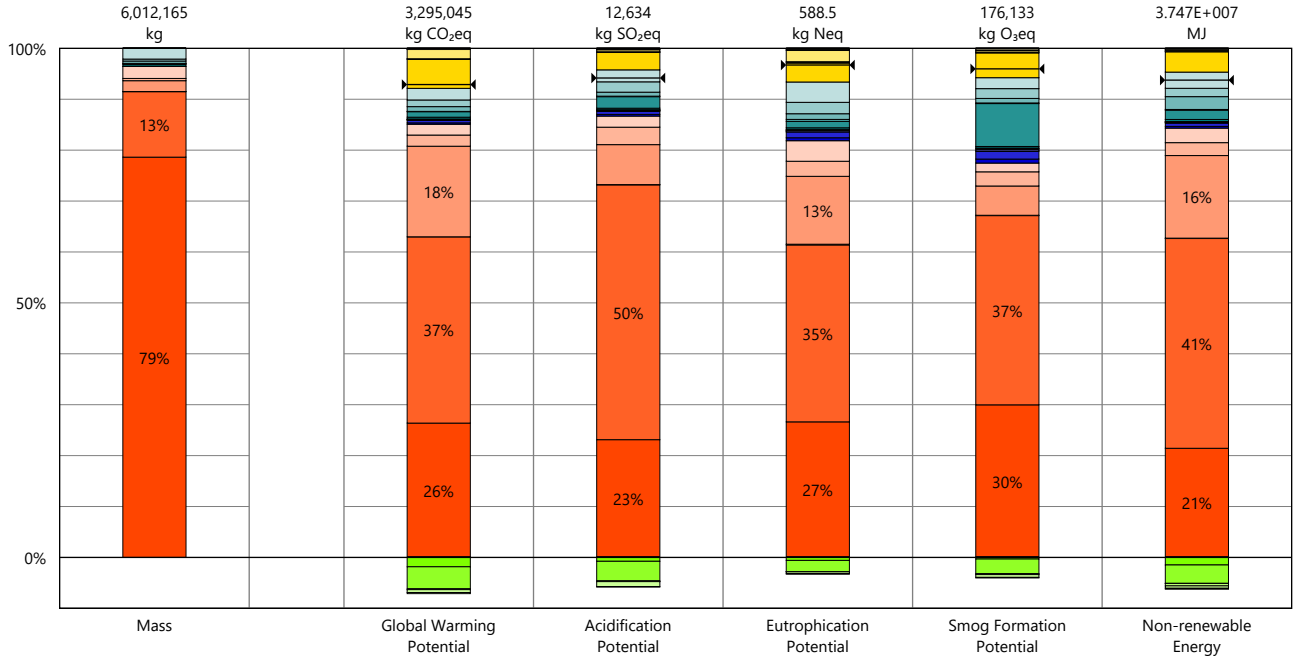
Life Cycle Stages

- 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




### Legend

Net value (impacts + credits)

**Product [A1-A3]**
- 03 - Concrete
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal and Moisture Protection
- 08 - Openings and Glazing
- 09 - Finishes

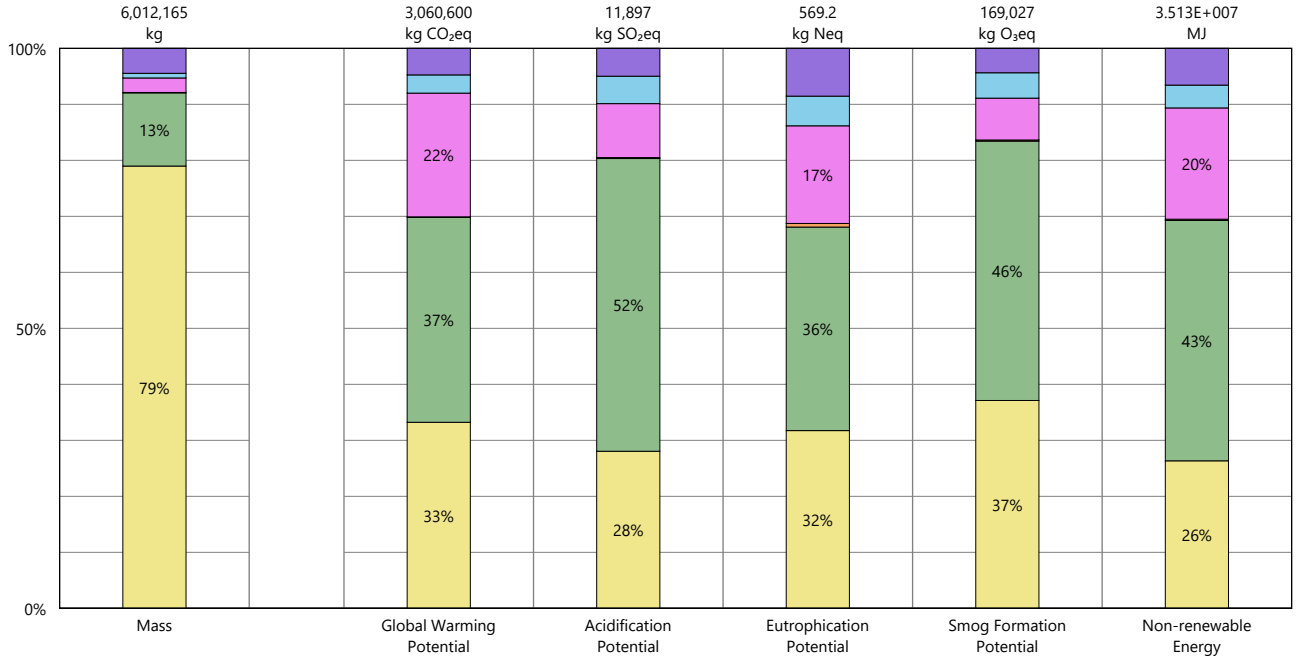
**Transportation [A4]**
- 03 - Concrete
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal and Moisture Protection
- 08 - Openings and Glazing
- 09 - Finishes

**Maintenance and Replacement [B2-B5]**
- 03 - Concrete
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal and Moisture Protection
- 08 - Openings and Glazing
- 09 - Finishes

**End of Life [C2-C4]**
- 03 - Concrete
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal and Moisture Protection
- 08 - Openings and Glazing
- 09 - Finishes

**Module D [D]**
- 03 - Concrete
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal and Moisture Protection
- 08 - Openings and Glazing
- 09 - Finishes

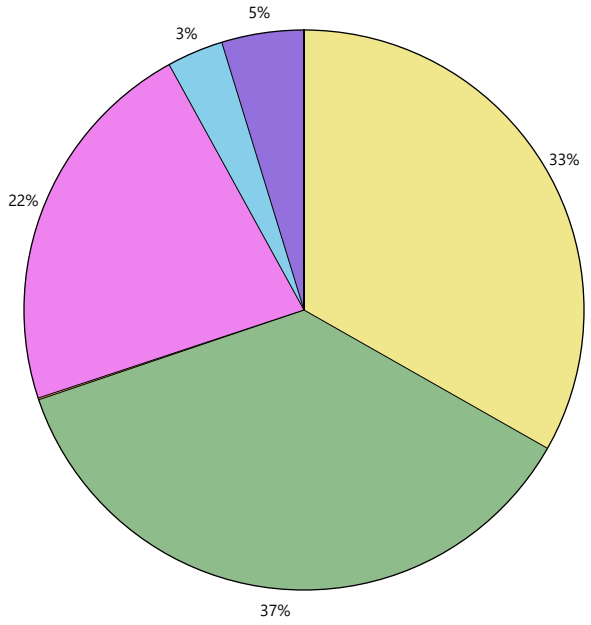
## Results per Division




### Legend

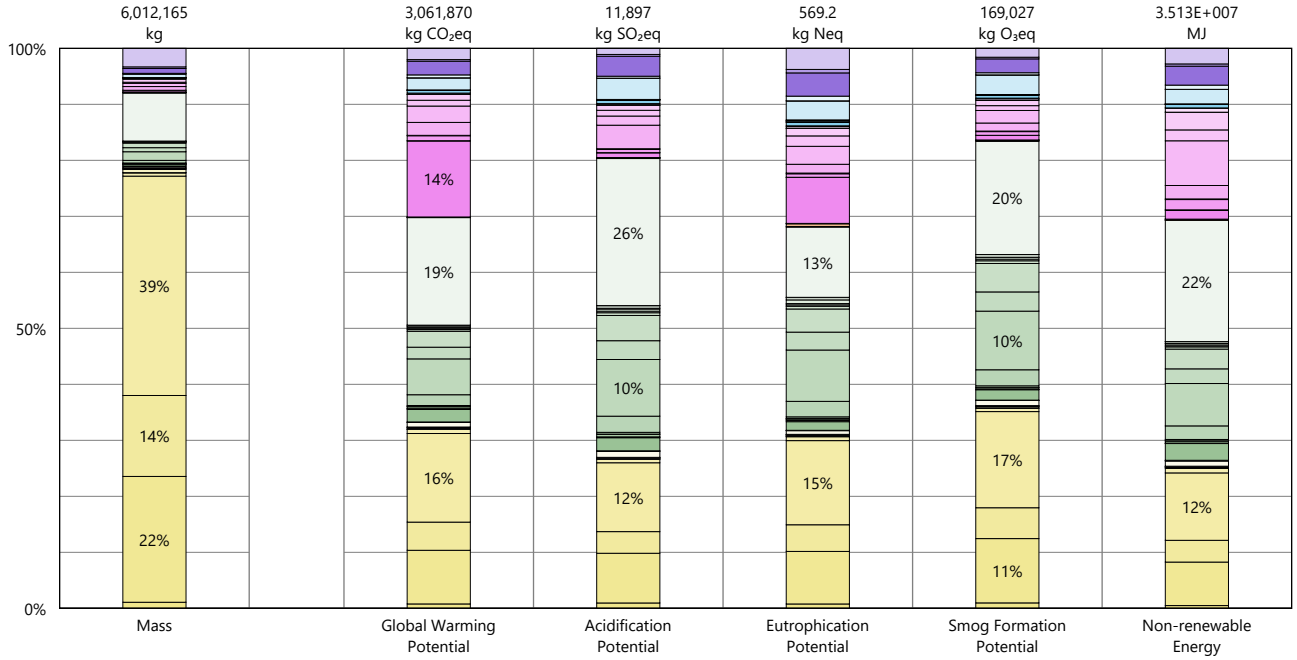
Divisions

- 03 - Concrete
- 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




## Legend

### 03 - Concrete

- Cast-in-place concrete, lightweight structural concrete, 5000 psi
- Cast-in-place concrete, structural concrete, 3000 psi
- Cast-in-place concrete, structural concrete, 4000 psi
- Cast-in-place concrete, structural concrete, 5000 psi
- Glass fiber reinforced concrete, spray coating
- Precast concrete column
- Precast concrete nonstructural panel
- Precast concrete paver
- Stair, concrete with metal nosing
- Stair, precast single run (stretcher)
- Steel, reinforcing rod

### 05 - Metals

- Aluminum, angle
- Aluminum, formed
- Aluminum, sheet
- Stainless Steel, Fasteners
- Steel, angle
- Steel, C channel
- Steel, C-H-stud metal framing
- Steel, C-stud metal framing
- Steel, C-stud metal framing with insulation
- Steel, deck
- Steel, furring channel
- Steel, HSS section
- Steel, plate
- Steel, rectangular bar
- Steel, rod
- Steel, round bar
- Steel, round tubing
- Steel, sheet, stainless
- Steel, W section (wide flange shape)

### 06 - Wood/Plastics/Composites

- Domestic hardwood
- Phenolic resin solid surface, sheet
- Plywood, interior grade

### 07 - Thermal and Moisture Protection

- EPDM, roofing membrane
- Extruded polystyrene (XPS), board
- Fiberglass clip system
- Fluid applied synthetic polymer air barrier
- Metal roofing panels, formed
- Mineral wool, board, generic
- Polyethelene sheet vapor barrier (HDPE)
- Polyisocyanurate (PIR), board
- SBS modified bitumen, sheet
- Self adhering membrane
- Self-adhering sheet waterproofing, modified bituminous sheet
- Wood siding

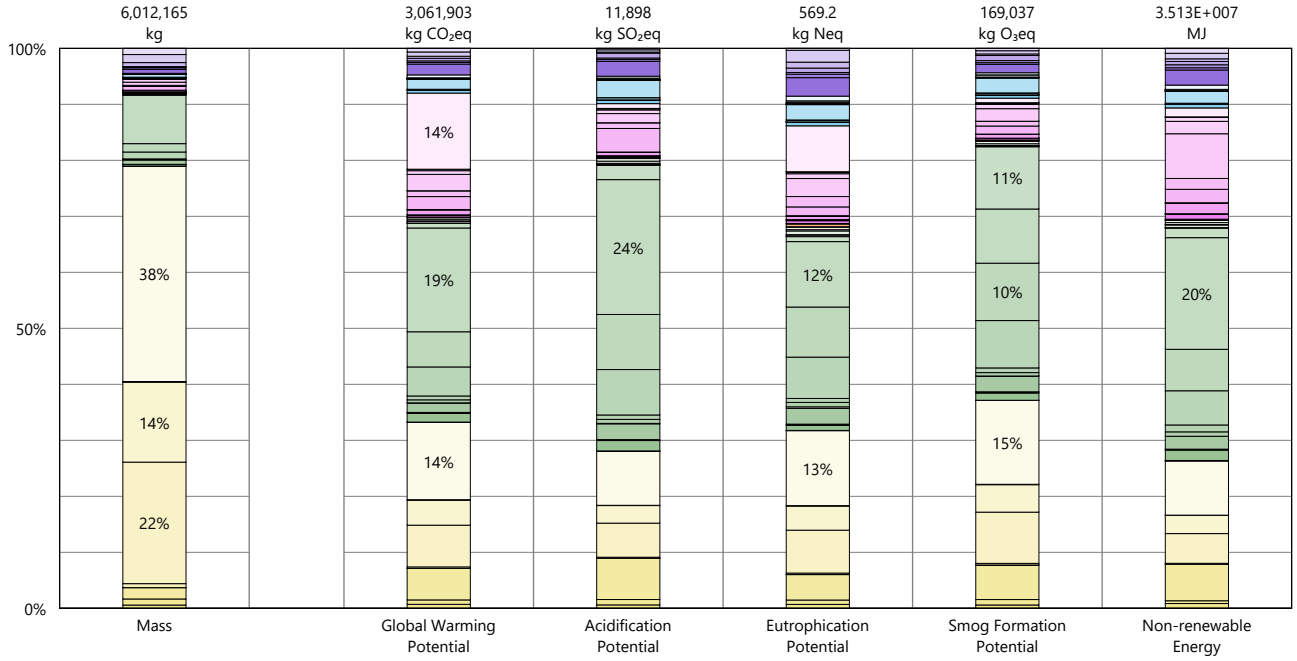
### 08 - Openings and Glazing

- Aluminum mullion, inclusive of finish
- Door frame, aluminum
- Door frame, steel, galvanized
- Door, exterior, aluminum
- Door, exterior, steel
- Door, interior, steel
- Glazing, custom IGU
- Glazing, monolithic sheet
- Window frame, vinyl

### 09 - Finishes

- Acoustic ceiling system, mineral fiber board
- Fiberglass mat gypsum sheathing
- Wall board, gypsum

## Results per Division, itemized by Material




## Legend

### 03 - Concrete

- GFRC, spray coating
- Lightweight concrete, 5000 psi, Pacific Northwest regional average
- Steel, reinforcing rod
- Steel, sheet
- Structural concrete, 3000 psi, 0% fly ash and slag
- Structural concrete, 3000 psi, Pacific Northwest regional average
- Structural concrete, 4000 psi, 20% fly ash and 30% slag
- Structural concrete, 5000 psi, 0% fly ash and slag
- Structural concrete, 5000 psi, 20% fly ash and 30% slag

### 05 - Metals

- Aluminum extrusion, painted, AEC - EPD
- Aluminum, formed
- Aluminum, sheet
- Anodized aluminum, sheet
- Coated steel deck, SDI - EPD
- Cold formed structural steel
- Fasteners, stainless steel
- Fiberglass blanket insulation, unfaced
- Fluoropolymer coating, metal stock
- Galvanized steel
- Galvanized steel decking
- Hot rolled structural steel, AISC - EPD
- Paint, enamel, solvent based
- Paint, exterior metal coating, silicone-based
- Paint, exterior metal coating, silicone-based, by area
- Polyurethane coating, metal stock
- Powder coating, metal stock
- Stainless steel sheet, Chromium 18/8
- Stainless steel, extruded, chromium 18/8
- Steel, reinforcing rod
- Steel, sheet

### 06 - Wood/Plastics/Composites

- Laminated spruce panel board
- Phenolic resin solid surfacing, sheet
- White oak lumber, 1 inch
- Wood stain, water based

### 07 - Thermal and Moisture Protection

- Adhesive, acrylic
- Domestic softwood, US, AWC - EPD
- EPDM, non-reinforced membrane, 90 mils, SPRI - EPD
- Fasteners, galvanized steel
- Fasteners, stainless steel
- Fluid applied synthetic polymer air barrier
- Fluoropolymer coating, metal stock
- Glass fiber reinforced plastic paneling
- Mineral wool, high density, NAIMA - EPD
- PIR rigid foam insulation, roof, R=20.5, PIMA - EPD
- PIR rigid foam insulation, wall, R=14.6, PIMA - EPD
- Polyethelene sheet vapor barrier (HDPE)
- SBS modified bitumen, assembly (base & cap), ARMA - EPD
- SBS modified bitumen, cap sheet, ARMA - EPD
- Self adhering flashing membrane, 40 mil
- Steel, sheet
- XPS insulation, Foamular average, Owens Corning - EPD

### 08 - Openings and Glazing

- Aluminum extrusion, anodized, AEC - EPD
- Argon gas for IGU
- Door frame, aluminum, powder-coated, no door
- Door frame, metal, galvanized, no door
- Fasteners, galvanized steel
- Fasteners, stainless steel
- Frit (for glazing)
- Glazing, monolithic sheet, generic
- Glazing, monolithic sheet, safety glass
- Glazing, monolithic sheet, tempered
- Hardware, stainless steel
- Hollow door, exterior, aluminum, anodized
- Hollow door, exterior, aluminum, anodized, large vision panel
- Hollow door, exterior, steel, galvanized

## Results per Division, itemized by Material (continued)

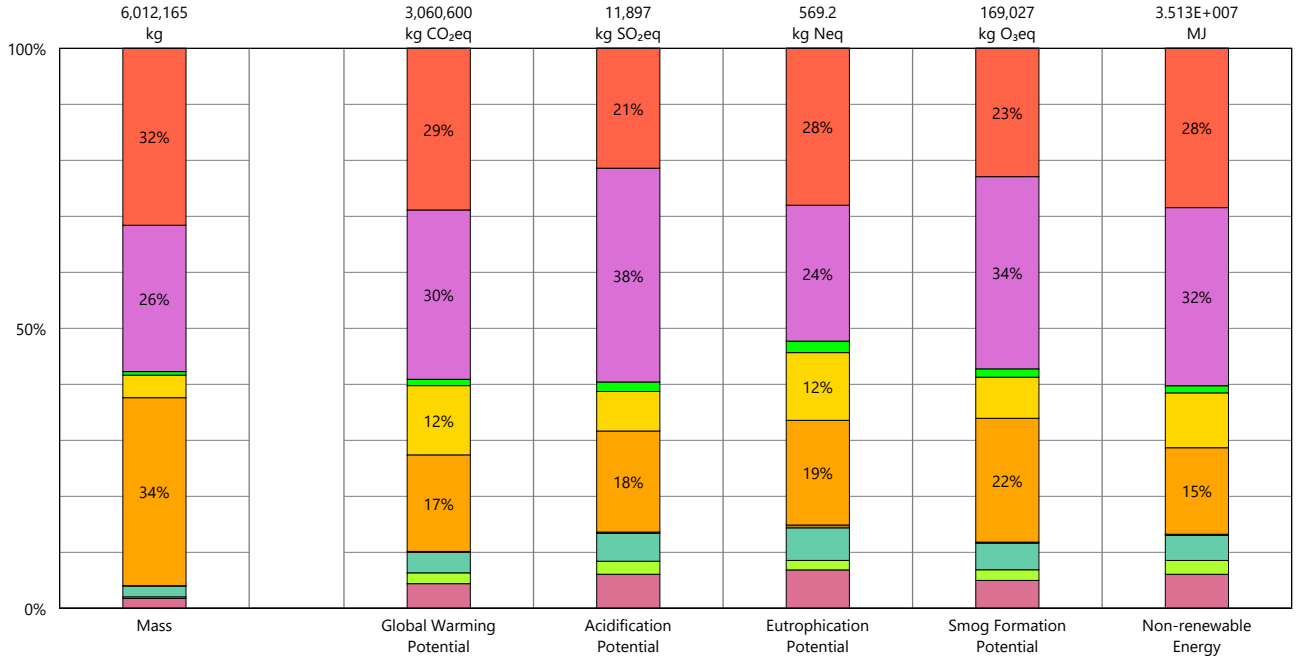
### Legend (continued)

- Hollow door, interior, steel, fire-rated
- Hollow door, interior, steel, galvanized
- IGU spacer
- Laminating (for glazing)
- Low-e coating (for glazing)
- Overhead door closer, aluminum
- Stainless steel door hinge
- Window frame, vinyl, fixed

09 - Finishes

- Acoustic ceiling tile (ACT), mineral fiber board
- Fiberglass mat gypsum sheathing board
- Paint, interior acrylic latex
- Suspended grid
- Wall board, gypsum, fire-resistant (Type X)
- Wall board, gypsum, moisture- and mold-resistant
- Wall board, gypsum, natural

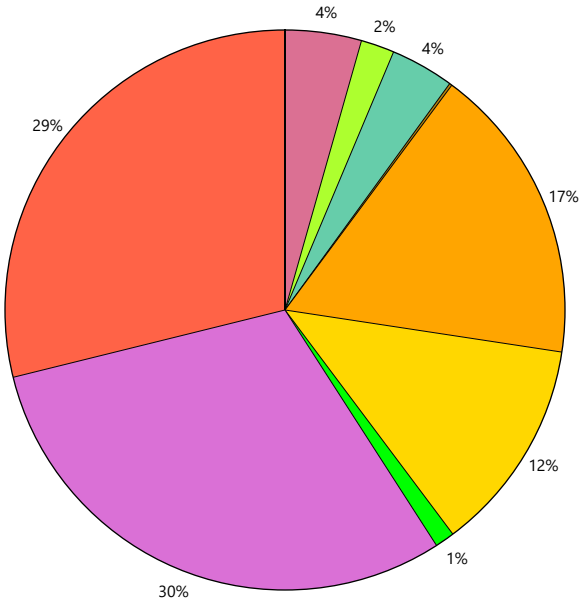
## Results per Revit Category




### Legend

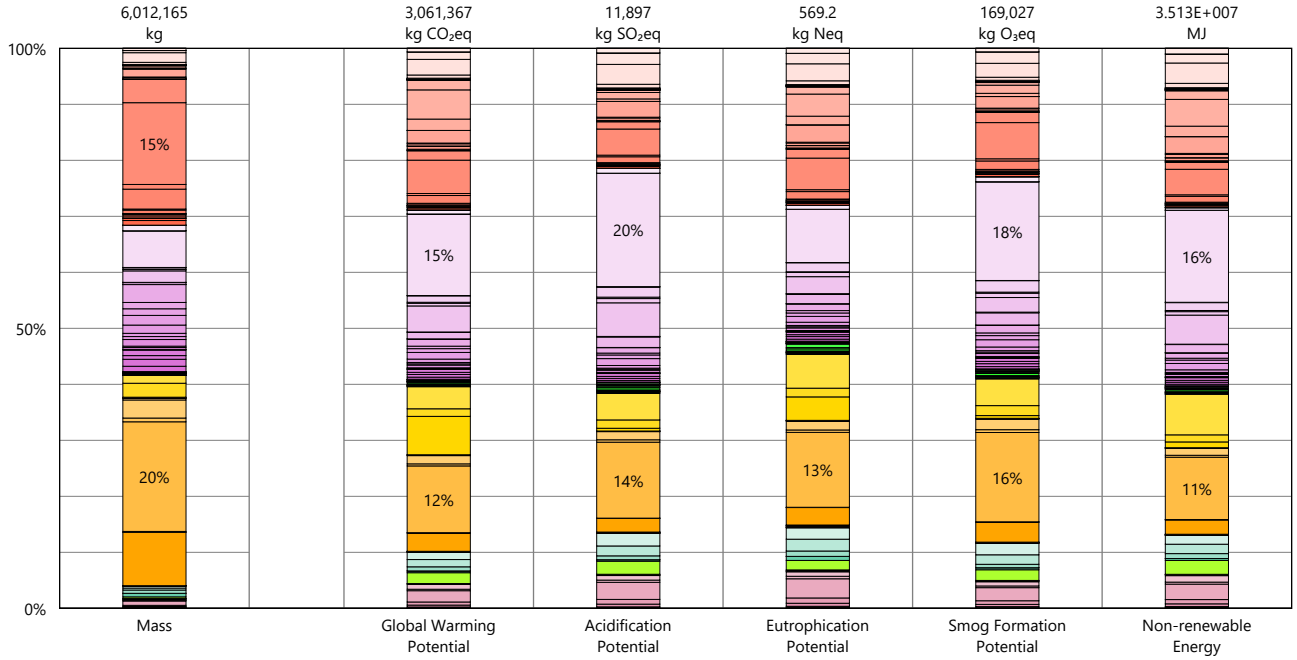
Revit Categories

- 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

### Ceilings

- 1-C2- GWB on Mtl. Stud
- 2-C2- GWB on Mtl. Stud
- ACT 4 AcoustiBuilt Ceiling
- C1 - ACT-1 - 2' x 4'
- C1 - ACT-2 - 2' x 2' HRC
- C1 - ACT-3 - 2' x 2'
- C1 - ACT-5 - 2' x 6'
- C1 - Perf Metal Grid - 2'x6'
- C2- GWB on Mtl. Stud
- C7- GWB on Mtl. Stud 2
- Linear Wood Ceiling

### Curtainwall Mullions

- Rectangular Mullion

### Curtainwall Panels

- cp_HSEB - Base Material Panel_vertical
- cp_HSEB - Skin Shingle flashing
- cp_HSEB - Skin Shingle Panel_hoz
- cp_HSEB - Window at Upper Levels
- System Panel

### Doors

- (F1-HMW) dr-SGL-A
- (F2) dr-Double-Flush-with 4 sided jambs
- (FG1-CW) dr-SGL-CW
- (FG2-AL) dr-DBL-A
- (FG2-CW) dr-DBL-CW
- (N1-HMW) dr-SGL-A
- temp-fence

### Floors

- (F1) SLAB ON GRADE
- (F1) SLAB ON GRADE - 6"
- (F1) SLAB ON GRADE - 8"
- (F2) CONCRETE METAL DECK
- (F3) CONCRETE METAL DECK (STRUCTURAL ONLY)
- (F3) CONCRETE METAL DECK W/ TOPPING SLAB
- 12" Concrete Slab
- 1F5 - 1 HR RATED HORIZONTAL DUCT ENCLOSURE
- 3.5" Light Duty Paving Over Sturcture
- 3/16" Aluminum Plate

### Roofs

- (R2) INSULATION O/ ASPHALT MEMBRANE O/ STRUCT
- (R2) STRUCTURAL SLAB LAYER OF ASSEMBLY R2
- (R3) SBS OVER METAL DECK
- (R4) SOUTH VEST ROOF
- (R4) SOUTH VEST ROOF (INTERIOR)
- 1/4" STEEL PLATE
- 3/16" Aluminum Plate

### Stairs and Railings

- Construction Specialties_Crash Rail_6" ECR-60S
- HSEB - Pipe Guardrail - GDR-2
- HSEB - Pipe Guardrail - GDR-2 without handrail
- HSEB - STR-1 _Precast Tread & Riser
- HSEB - STR-2 _Precast Tread Steel Riser 2
- HSEB Guardrail - Cable Rail
- HSEB Guardrail - Cable Rail without handrail
- HSEB Handrail - HNDRL-1
- HSEB Handrail - HNDRL-3
- HSEB PIPE Handrail - HNDRL-2
- HSEB ST-11 (CAST IN PLACE)
- HSEB ST-9 (CAST IN PLACE)
- HSEB Type C - STR-4_Conc filled w/ C channel
- HSEB Type C_STR-10_Conc filled w/ C channel
- HSEB Type C_STR-5_Conc filled w/ C channel 2
- HSEB Type C_STR-6_Conc filled w/ Plate Stringer - Roof Access
- HSEB Type C_STR-8_Conc filled w/ Plate
- HSEB_STR-3_Precast Tread Steel Riser
- HSEB-GDR-4_Canerail

# Results per Revit Category, itemized by Family (continued)

## Legend (continued)

### Structure

- 04.016_LCL FND Slab_Spread Ftg_F10.0 10x10x3.0d
- 04.016_LCL FND Slab_Spread Ftg_F11.0 11x11x3.25d
- 04.016_LCL FND Slab_Spread Ftg_F12.0 12x12x4d
- 04.016_LCL FND Slab_Spread Ftg_F12.0 14x14x4.5d
- 04.016_LCL FND Slab_Spread Ftg_F2.0 2x2x11"d
- 04.016_LCL FND Slab_Spread Ftg_F4.0 4x4x1.5d
- 04.016_LCL FND Slab_Spread Ftg_F8.0 8x8x2.5d
- 04.016_LCL FND Slab_Spread Ftg_F9.0 9x9x2.75d
- 04.016_LCL FND Slab_Spread Ftg_FW6.0 6x8x2.5d
- 04.017_LCL FND Slab_Cont. Ftg FW3.0_36wx18d
- 04.017_LCL FND Slab_Cont. Ftg FW4.0_48wx18d
- 04.017_LCL FND Slab_Cont. Ftg FW4.0_48wx24d
- 04.017_LCL FND Slab_Cont. Ftg FW5.0_60wx18d
- 04.017_LCL FND Slab_Cont. Ftg FW5.0A_60wx30d
- 04.017_LCL FND Slab_Cont. Ftg FW7.0_87wx42d 2
- 04.017_LCL FND Slab_Cont. Ftg FW8.0_96wx48d
- 04.017_LCL FND Slab_Cont. Ftg_24wx12d
- KPFF - SCOL - Concrete - Round
- KPFF - SCOL - Steel - HSS - Rectangular (C) - TC
- KPFF - SCOL - Steel - HSS - Rectangular (C) - TC- 2x
- KPFF - SCOL - Steel - HSS - Round (C) - TC
- KPFF - SCOL - Steel - W - Wide Flange (C) - TC
- KPFF - SFRM - Steel - BRB - Buckling Restrained Brace
- KPFF - SFRM - Steel - C - Channel (C) - TC
- KPFF - SFRM - Steel - HSS - Rectangular (C) - TC
- KPFF - SFRM - Steel - Kicker Brace - L - Angle - TC
- KPFF - SFRM - Steel - L - Angle (C) - TC
- KPFF - SFRM - Steel - W - Wide Flange (C) - TC
- KPFF - SFRM - Steel - WT - Wide Flange Tee - TC
- KPFF - SFRM - Steel - WT - Wide Flange Tee (C) - TC
- LCL_C_Pilaster_Rect_()w()d
- LCL_Embed_2x3-Nelson-Studs_OffSet

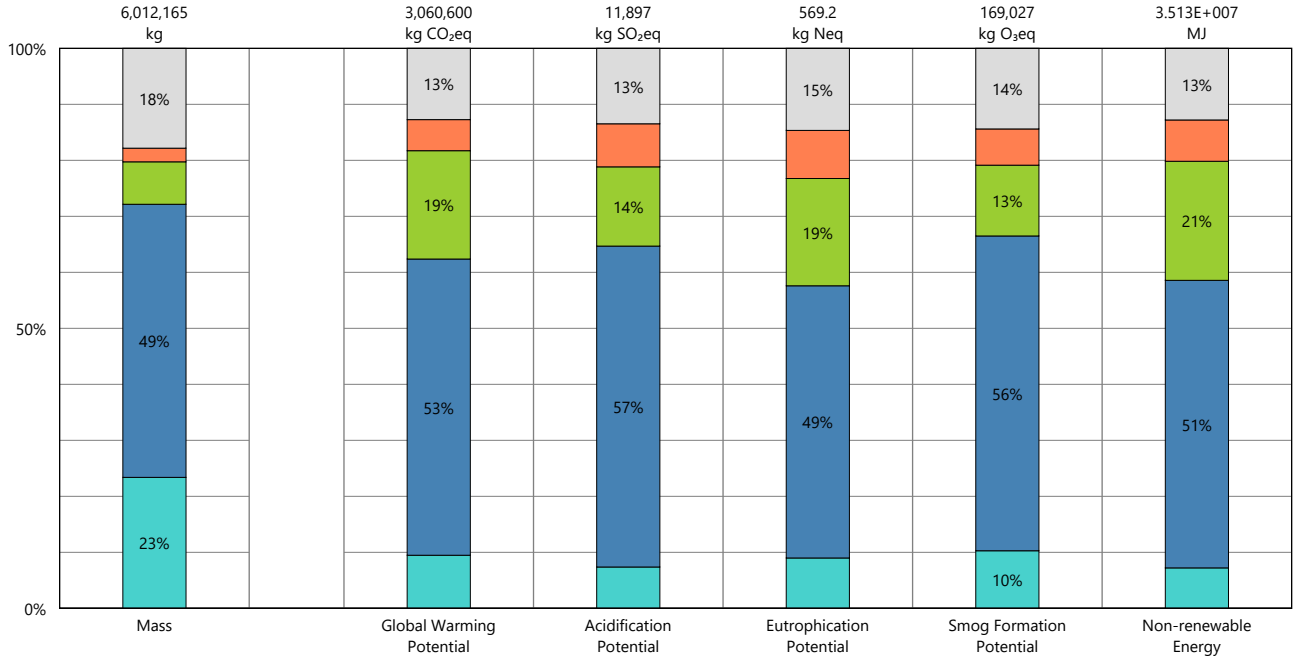
### Walls

- (A3)_Furr Mtl Stud 3-5/8"_GWB (1-0)
- (B8)_TYP Mtl Stud 8"_GWB Insulation
- 04.215_LCL_C_Slab Transition_Wall(12")
- 04.215_LCL_C_Slab Transition_Wall(15")
- 04.215_LCL_C_Slab Transition_Wall(4")
- 04.215_LCL_C_Slab Transition_Wall(6")
- 04.215_LCL_C_Slab Transition_Wall(8")
- 04.225_LCL_C_CURB_Wall(11")
- 04.225_LCL_C_CURB_Wall(4")
- 04.225_LCL_C_CURB_Wall(6")
- 04.225_LCL_C_CURB_Wall(8")
- 04.300_LCL_C_Foundation_Wall(10")
- 04.310_LCL_C_PIT_Wall(8")
- 04.380_LCL_C_SHOTCRETE_Wall(16")
- 04.380_LCL_C_SHOTCRETE_Wall(19")
- 04.380_LCL_C_SHOTCRETE_Wall(22")
- 04.380_LCL_C_SHOTCRETE_Wall(24")
- 1-B6
- 1-N8 GFRC @ FRAMED WALL STAGGERED STUD
- 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 11"
- 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 16"
- 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 8"
- 1-W05 CONCRETE WALL W/ EXTERIOR INSULATION 22"
- 1-W06 PRE-CAST CONCRETE @ FRAMED WALL
- 1-W06 PRE-CAST CONCRETE @ FRAMED WALL STAGGERED STUD
- 1-W07_METAL STUD LIGHTWEIGHT CLADDING
- 2-A0_Furr Hat Channel 7/8"_GWB (2-0) 2 hour rated
- 2-A0_GWB Type X (2-0) 2 hour rated
- 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_16"
- 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_22"
- 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_24"
- 2-W01 CONCRETE WALL WITHOUT CONC
- 3-W07_METAL STUD LIGHTWEIGHT CLADDING
- A4_Furr Mtl Stud 4"_GWB (1-0)
- Aluminum Plate 1/8"
- Aluminum Plate 3/16"
- B4
- B6
- Concrete 8" - STRUCTURAL
- Corner_1
- Corner_2
- Corner_3
- Corner_4
- P_SOUTH VESTIBULE WALL
- Parapet Cap Coping
- Picture Window Bend Plate
- W06 PRE-CAST CONCRETE @ FRAMED WALL
- W07_METAL STUD LIGHTWEIGHT CLADDING
- W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse)
- W08_METAL STUD LIGHTWEIGHT CLADDING (CW Parapet) no insulation
- W08_METAL STUD LIGHTWEIGHT CLADDING (Parapet)
- W09_SOUTH VESTIBULE WALL

### Windows

- LOUVER-parametric

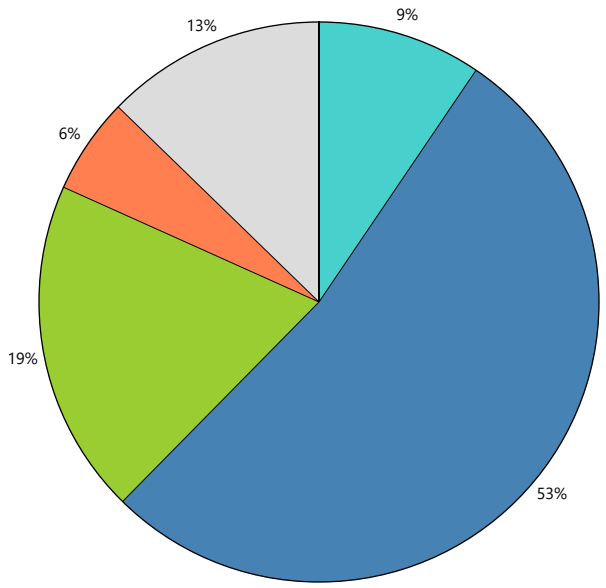
## Results per Building Element




### Legend

Building Elements

- Substructure
- 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 $CO_2$eq).

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 $SO_2$eq

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 $CO_2$eq

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 $O_3$eq

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

**HSEB_ARCH_D_19_Baseline_with ceilings.rvt**

Worksets
- ARCH_Ceilings
- ARCH_Exterior Walls
- ARCH_Floors & Roof
- ARCH_Vertical Circulation

Phases
- Base Budget
- Enabling Scope
- Existing
- Value Add Scope

**HSEB_STRUCT_DC_19.rvt (Read-only)**

Worksets
- L - 04.220 Equipment Pads
- LCL-SLEEVES-BLOCKOUTS-MISC.
- S - Structural
- S - Structural - Baseline

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.

**Acoustic ceiling tile (ACT), mineral fiber board** **42,299.4 kg**

Used in the following Revit families:

| | |
|---|---|
| C1 - ACT-1 - 2' x 4' | 3,770.1 kg (50 yrs) |
| C1 - ACT-2 - 2' x 2' HRC | 7,515.5 kg (50 yrs) |
| C1 - ACT-3 - 2' x 2' | 27,390.4 kg (50 yrs) |
| C1 - ACT-5 - 2' x 6' | 3,623.4 kg (50 yrs) |

Used in the following Tally entries:
Acoustic ceiling system, mineral fiber board

Description:
Mineral fiber board acoustic ceiling tile, 5/8" thick

Life Cycle Inventory:
100% Mineral fiber board

Product Scope:
Cradle to gate of panel only, excludes suspended grid system and installation hardware

Transportation Distance:
By truck: 172 km

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

LCI Source:
DE: Mineral fibres ceiling boards (EN15804 A1-A3) ts (2017)

**Adhesive, acrylic** **4,043.6 kg**

Used in the following Revit families:

| | |
|---|---|
| (R3) SBS OVER METAL DECK | 3,467.8 kg (20 yrs) |
| (R4) SOUTH VEST ROOF | 13.5 kg (20 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (CW Parapet) no insulation | 26.8 kg (20 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (Parapet) | 535.4 kg (20 yrs) |

Used in the following Tally entries:
SBS modified bitumen, sheet

Description:
Generic acrylic construction adhesive

Life Cycle Inventory:
5% Naphtha at refinery
95% Acrylate resin (solvent-systems)
0.5% NMVOC emissions

Product Scope:
Cradle to gate, plus emissions during application

Transportation Distance:
By truck: 840 km

End-of-Life Scope:
99.5% solids to landfill (plastic waste)

LCI Source:
US: Naphtha at refinery ts (2014)

# LCI Data (continued)

DE: Acrylate resin (solvent-systems) ts (2017)

**Aluminum extrusion, anodized, AEC - EPD** **3,507.9 kg**

Used in the following Revit families:
- Rectangular Mullion 3,507.9 kg (60 yrs)

Used in the following Tally entries:
Aluminum mullion, inclusive of finish

Description:
Extruded and anodized aluminum part. Data based on 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 34.5% scrap input while remainder is processed and credited as avoided burden

LCI Source:
RNA: Aluminum extrusion, anodized - 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 extrusion, painted, AEC - EPD** **12.0 kg**

Used in the following Revit families:
- Picture Window Bend Plate 12.0 kg (60 yrs)

Used in the following Tally entries:
Aluminum, angle

Description:
Painted aluminum extrusions (not thermally-improved). Industry-wide EPD from the Aluminum Extruders Council. 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% Recovered
5% Landfilled (inert material)

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

LCI Source:
EPD (US), American Extruders Council (2016)

EPD Source:
11240237.101.1

EPD Designation Holder:
Aluminum Extruders Council (AEC)

EPD Program Operator:
UL Environment

EPD Expiration:
10/4/2021

**Aluminum, formed** **477.9 kg**

Used in the following Revit families:
- Corner_1 265.5 kg (60 yrs)
- Corner_2 212.4 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

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)

**Aluminum, sheet** **16,028.6 kg**

Used in the following Revit families:
- (R4) SOUTH VEST ROOF 112.5 kg (60 yrs)
- 1/4" STEEL PLATE 543.3 kg (60 yrs)
- 3/16" Aluminum Plate 41.7 kg (60 yrs)
- Aluminum Plate 1/8" 25.2 kg (60 yrs)
- Aluminum Plate 3/16" 221.2 kg (60 yrs)
- C1 - Perf Metal Grid - 2'x6' 2,847.0 kg (60 yrs)
- cp_HSEB - Skin Shingle flashing 14.7 kg (60 yrs)
- Parapet Cap Coping 500.6 kg (60 yrs)
- Rectangular Mullion 11,722.4 kg (60 yrs)

Used in the following Tally entries:
Aluminum, sheet

Description:
Aluminum sheet, formed and cut. Data based on industry-wide EPD for cold-rolled aluminum from the Aluminum Association (EPD ID 4786092064.101.1).

Life Cycle Inventory:
100% Aluminum

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)

# LCI Data (continued)

**Anodized aluminum, sheet** **56.4 kg**

Used in the following Revit families:

| | |
|---|---|
| 3/16" Aluminum Plate | 56.4 kg (60 yrs) |
| LOUVER-parametric | 0.0 kg (60 yrs) |

Used in the following Tally entries:
Aluminum, sheet

Description:
Anodized aluminum sheet, formed and cut. Data based on industry-wide EPD for anodized aluminum from the Aluminum Extruders Council (EPD ID 11240237.101.1).

Life Cycle Inventory:
100% Anodized aluminum

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)
RNA: Anodization of aluminum extrusion AEC/ts (2015) [EPD]
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) [EPD]
RNA: Secondary Aluminum Ingot AA/ts (2010) [EPD]

**Argon gas for IGU** **58.5 kg**

Used in the following Revit families:

| | |
|---|---|
| (FG2-AL) dr-DBL-A | 1.3 kg (40 yrs) |
| (FG2-CW) dr-DBL-CW | 0.2 kg (40 yrs) |
| cp_HSEB - Window at Upper Levels | 23.2 kg (40 yrs) |
| System Panel | 33.7 kg (40 yrs) |

Used in the following Tally entries:
Glazing, custom IGU

Description:
Argon gas in insulating glass unit

Life Cycle Inventory:
Argon gas

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 940 km

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

LCI Source:
US: Argon (gaseous) ts (2017)

**Coated steel deck, SDI - EPD** **2,255.5 kg**

Used in the following Revit families:

| | |
|---|---|
| (F3) CONCRETE METAL DECK (STRUCTURAL ONLY) | 2,255.5 kg (60 yrs) |

Used in the following Tally entries:
Steel, deck

Description:
Coated steel roof and floor deck panels, 1 ½" – 3" in depth and manufactured from 22 – 16 gage material. Industry-wide EPD from the Steel Deck Institute.

Life Cycle Inventory:
For information and quantities, see EPD

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 28% scrap input while remainder is processed and credited as avoided burden.

LCI Source:
US: Steel deck - Steel deck institute (SDI) (A1-A3) ts (2012)

EPD Source:
4786052957.101.1

EPD Designation Holder:
Steel Deck Institute

EPD Program Operator:
UL Environment

EPD Expiration:
12/15/2020

**Cold formed structural steel** **48,358.5 kg**

Used in the following Revit families:

| | |
|---|---|
| 1-C2- GWB on Mtl. Stud | 78.7 kg (60 yrs) |
| 1F5 - 1 HR RATED HORIZONTAL DUCT ENCLOSURE | 62.4 kg (60 yrs) |
| 2-C2- GWB on Mtl. Stud | 431.1 kg (60 yrs) |
| C1 - ACT-1 - 2' x 4' | 2,136.8 kg (60 yrs) |
| C1 - ACT-2 - 2' x 2' HRC | 3,757.6 kg (60 yrs) |
| C1 - ACT-3 - 2' x 2' | 13,343.2 kg (60 yrs) |
| C1 - ACT-5 - 2' x 6' | 1,655.2 kg (60 yrs) |
| C1 - Perf Metal Grid - 2'x6' | 6,591.0 kg (60 yrs) |
| C2- GWB on Mtl. Stud | 652.6 kg (60 yrs) |
| KPFF - SCOL - Steel - HSS - Rectangular (C) - TC | 6,800.6 kg (60 yrs) |
| KPFF - SFRM - Steel - BRB - Buckling Restrained Brace | 12,601.9 kg (60 yrs) |
| Linear Wood Ceiling | 247.5 kg (60 yrs) |

Used in the following Tally entries:
Steel, C-H-stud metal framing
Steel, C-stud metal framing
Steel, furring channel
Steel, HSS section

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)

**Domestic softwood, US, AWC - EPD** **2,968.3 kg**

Used in the following Revit families:

| | |
|---|---|
| (R4) SOUTH VEST ROOF | 141.9 kg (30 yrs) |
| (R4) SOUTH VEST ROOF (INTERIOR) | 163.7 kg (30 yrs) |
| Linear Wood Ceiling | 2,420.8 kg (30 yrs) |
| P_SOUTH VESTIBULE WALL | 135.2 kg (30 yrs) |
| W09_SOUTH VESTIBULE WALL | 106.7 kg (30 yrs) |

Used in the following Tally entries:
Wood siding

# LCI Data (continued)

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

EPD Designation Holder:
American Wood Council and Canadian Wood Council

EPD Program Operator:
UL Environment

EPD Expiration:
4/16/2019

**Door frame, aluminum, powder-coated, no door** **99.2 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1-HMW) dr-SGL-A | 10.6 kg (50 yrs) |
| (FG1-CW) dr-SGL-CW | 10.6 kg (50 yrs) |
| (FG2-AL) dr-DBL-A | 56.0 kg (50 yrs) |
| (N1-HMW) dr-SGL-A | 10.9 kg (50 yrs) |
| temp-fence | 11.2 kg (50 yrs) |

Used in the following Tally entries:
Door frame, aluminum

Description:
Aluminum door frame

Life Cycle Inventory:
94% Aluminum
6% Powder coat (by weight)

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)

**Door frame, metal, galvanized, no door** **3.1 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1-HMW) dr-SGL-A | 3.1 kg (45 yrs) |

Used in the following Tally entries:
Door frame, steel, galvanized

Description:
Stainless steel, 18 ga door frame

Life Cycle Inventory:
100% Galvanized steel

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

Transportation Distance:
By truck: 568 km

End-of-Life Scope:
98% recovered
2% landfilled (inert material)

Module D Scope:
Product has a 44% scrap input while remainder is processed and credited as avoided burden.

LCI Source:
DE: Aluminium wing frame profile, powder coated (2011)
modified with: US: Metal roll forming MCA (2010)
GLO: Steel sheet stamping and bending (5% loss) ts (2012)
RNA: Steel hot dip galvanized worldsteel (2007)

**EPDM, non-reinforced membrane, 90 mils, SPRI - EPD** **60.3 kg**

Used in the following Revit families:

| | |
|---|---|
| (R4) SOUTH VEST ROOF | 60.3 kg (20 yrs) |

Used in the following Tally entries:
EPDM, roofing membrane

Description:
Non-reinforced ethylene propylene diene terpolymer (EPDM) synthetic rubber roofing membrane, default thickness of 90 mils (2.5 mm) Industry-wide EPD from the Single Ply Roofing Industry.

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 (plastic waste)

LCI Source:
US: Non-reinforced EPDM single ply roofing membrane, 90 mils, A1-A3 - SPRI ts (2017)

EPD Source:
4786842353.103.1

EPD Designation Holder:
Single Ply Roofing Industry (SPRI)

EPD Program Operator:
UL Environment

EPD Expiration:
2/14/2022

**Fasteners, galvanized steel** **4.2 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1-HMW) dr-SGL-A | 0.2 kg (40 yrs) |
| (R4) SOUTH VEST ROOF | 3.9 kg (40 yrs) |

Used in the following Tally entries:
Door frame, steel, galvanized
EPDM, roofing membrane

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)

# LCI Data (continued)

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

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** **261.2 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1-HMW) dr-SGL-A | 0.2 kg (50 yrs) |
| (FG1-CW) dr-SGL-CW | 0.2 kg (50 yrs) |
| (FG2-AL) dr-DBL-A | 1.2 kg (50 yrs) |
| (N1-HMW) dr-SGL-A | 0.2 kg (50 yrs) |
| (R4) SOUTH VEST ROOF | 0.3 kg (50 yrs) |
| (R4) SOUTH VEST ROOF (INTERIOR) | 0.4 kg (50 yrs) |
| Corner_3 | 7.3 kg (60 yrs) |
| Corner_4 | 7.2 kg (60 yrs) |
| cp_HSEB - Base Material Panel_vertical | 24.7 kg (60 yrs*) |
| cp_HSEB - Skin Shingle Panel_hoz | 189.9 kg (50 yrs) |
| Linear Wood Ceiling | 13.1 kg (50 yrs) |
| P_SOUTH VESTIBULE WALL | 1.6 kg (50-60 yrs) |
| temp-fence | 0.2 kg (50 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse) | 13.3 kg (60 yrs) |
| W09_SOUTH VESTIBULE WALL | 1.3 kg (50-60 yrs) |

Used in the following Tally entries:
Door frame, aluminum
Metal roofing panels, formed
Stainless Steel, Fasteners
Wood siding

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)

**Fiberglass blanket insulation, unfaced** **8,304.9 kg**

Used in the following Revit families:

| | |
|---|---|
| 1-N8 GFRC @ FRAMED WALL STAGGERED STUD | 25.1 kg (60 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL | 463.2 kg (60 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL STAGGERED STUD | 258.1 kg (60 yrs) |
| 1-W07_METAL STUD LIGHTWEIGHT CLADDING | 2,485.9 kg (60 yrs) |
| 3-W07_METAL STUD LIGHTWEIGHT CLADDING | 36.6 kg (60 yrs) |
| P_SOUTH VESTIBULE WALL | 20.0 kg (60 yrs) |
| W06 PRE-CAST CONCRETE @ FRAMED WALL | 786.0 kg (60 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING | 3,342.5 kg (60 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse) | 222.0 kg (60 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (CW Parapet) no insulation | 31.2 kg (60 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (Parapet) | 622.6 kg (60 yrs) |
| W09_SOUTH VESTIBULE WALL | 11.8 kg (60 yrs) |

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

Description:
Fiberglass batt
density varies from 10-14 kg/$m^3$.

Life Cycle Inventory:
100% Fiberglass

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 172 km

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

LCI Source:
US: Fiberglass Batt NAIMA (2007)

**Fiberglass mat gypsum sheathing board** **17,443.5 kg**

Used in the following Revit families:

| | |
|---|---|
| (R3) SBS OVER METAL DECK | 16,801.5 kg (60 yrs) |
| (R4) SOUTH VEST ROOF | 166.9 kg (60 yrs) |
| (R4) SOUTH VEST ROOF (INTERIOR) | 192.5 kg (60 yrs) |
| 3-W07_METAL STUD LIGHTWEIGHT CLADDING | 152.6 kg (60 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (CW Parapet) no insulation | 130.1 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)

**Fluid applied synthetic polymer air barrier** **16,719.9 kg**

Used in the following Revit families:

| | |
|---|---|
| 1-N8 GFRC @ FRAMED WALL STAGGERED STUD | 59.7 kg (40 yrs) |
| 1-W05 CONCRETE WALL W/ EXTERIOR INSULATION 22" | 193.9 kg (40 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL | 1,929.9 kg (40 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL STAGGERED STUD | 614.5 kg (40 yrs) |
| 1-W07_METAL STUD LIGHTWEIGHT CLADDING | 5,178.9 kg (40 yrs) |
| 3-W07_METAL STUD LIGHTWEIGHT CLADDING | 76.3 kg (40 yrs) |
| W06 PRE-CAST CONCRETE @ FRAMED WALL | 1,637.5 kg (40 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING | 6,963.6 kg (40 yrs) |
| W09_SOUTH VESTIBULE WALL | 65.6 kg (40 yrs) |

Used in the following Tally entries:
Fluid applied synthetic polymer air barrier

Description:
Liquid-applied rubberized membrane

Life Cycle Inventory:
34% Calcium carbonate
30% Polymer blend (SBS)
1% Silica
5% Titanium dioxide
30% Water

Product Scope:
Cradle to gate for materials only, neglects manufacturing requirements

Transportation Distance:
By truck: 555 km

End-of-Life Scope:
70% Landfilled (plastic waste) (excludes water evaporation)

# LCI Data (continued)

LCI Source:
US: Styrene-butadiene rubber (SBR) ts (2017)
US: Silica sand (flour) ts (2017)
US: Tap water from groundwater ts (2017)
US: Titanium dioxide pigment ts (2017)
US: Limestone flour (5mm) ts (2017)
US: Electricity grid mix ts (2014)

**Fluoropolymer coating, metal stock** **1,224.3 kg**

Used in the following Revit families:

| | |
|---|---|
| 1/4" STEEL PLATE | 27.7 kg (60 yrs) |
| 3/16" Aluminum Plate | 2.1 kg (60 yrs) |
| Aluminum Plate 1/8" | 1.4 kg (60 yrs) |
| Aluminum Plate 3/16" | 12.6 kg (60 yrs) |
| Corner_1 | 19.7 kg (60 yrs) |
| Corner_2 | 15.8 kg (60 yrs) |
| Corner_3 | 16.0 kg (60 yrs) |
| Corner_4 | 15.8 kg (60 yrs) |
| KPFF - SCOL - Steel - HSS - Rectangular (C) - TC | 48.6 kg (60 yrs) |
| KPFF - SCOL - Steel - W - Wide Flange (C) - TC | 441.2 kg (60 yrs) |
| KPFF - SFRM - Steel - BRB - Buckling Restrained Brace | 0.0 kg (60 yrs) |
| KPFF - SFRM - Steel - HSS - Rectangular (C) - TC | 80.5 kg (60 yrs) |
| KPFF - SFRM - Steel - Kicker Brace - L - Angle - TC | 11.5 kg (60 yrs) |
| KPFF - SFRM - Steel - L - Angle (C) - TC | 1.8 kg (60 yrs) |
| P_SOUTH VESTIBULE WALL | 2.6 kg (60 yrs) |
| Parapet Cap Coping | 74.3 kg (60 yrs) |
| Rectangular Mullion | 421.2 kg (60 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse) | 29.4 kg (60 yrs) |
| W09_SOUTH VESTIBULE WALL | 2.1 kg (60 yrs) |

Used in the following Tally entries:
Aluminum, formed
Aluminum, sheet
Metal roofing panels, formed
Steel, angle
Steel, HSS section
Steel, W section (wide flange shape)

Description:
Standard fluoropolymer coating for metals. This entry is used as a part of the larger MCA EPD for Roll Formed Steel Panels (EPD ID 13CA27321.101.1).

Life Cycle Inventory:
100% Fluoropolymer coating

Product Scope:
Cradle to gate, including application

Transportation Distance:
N/A

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

LCI Source:
US: Coil coating MCA (2010)
US: Electricity grid mix ts (2014)
US: Thermal energy from natural gas ts (2014)

**Frit (for glazing)** **2.1 kg**

Used in the following Revit families:

| | |
|---|---|
| System Panel | 2.1 kg (40 yrs) |

Used in the following Tally entries:
Glazing, custom IGU

Description:
Frit applied at a default density of 0.05 kg/m² gives 100% coverage with 19 micrometers thickness. User to select frit density of 20%, 30%, 40%, 50%, or 60% coverage.

Life Cycle Inventory:
90.9% Glass granulate
9% Butyl acetate
0.1% Nitrocellulose

Product Scope:
Cradle to gate

Transportation Distance:
N/A

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

LCI Source:
US: Electricity grid mix ts (2014)
US: Thermal energy from natural gas ts (2014)
DE: Butyl acetate ts (2017)
DE: Nitrocellulose (cellulose nitrate) ts (2017)
DE: Expanded glass granulate ts (2017)
IT: Flat-screen printing ENEA (2002)
US: Tap water from groundwater ts (2017)

**Galvanized steel** **74,032.5 kg**

Used in the following Revit families:

| | |
|---|---|
| (A3)_Furr Mtl Stud 3-5/8"_GWB (1-0) | 72.0 kg (60 yrs) |
| (B8)_TYP Mtl Stud 8"_GWB Insulation | 36.9 kg (60 yrs) |
| (R4) SOUTH VEST ROOF | 131.4 kg (60 yrs) |
| (R4) SOUTH VEST ROOF (INTERIOR) | 1,189.5 kg (60 yrs) |
| 1-B6 | 9.7 kg (60 yrs) |
| 1-N8 GFRC @ FRAMED WALL STAGGERED STUD | 52.1 kg (60 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL | 1,269.2 kg (60 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL STAGGERED STUD | 380.2 kg (60 yrs) |
| 1-W07_METAL STUD LIGHTWEIGHT CLADDING | 5,461.7 kg (60 yrs) |
| 2-A0_Furr Hat Channel 7/8"_GWB (2-0) 2 hour rated | 14.0 kg (60 yrs) |
| 3-W07_METAL STUD LIGHTWEIGHT CLADDING | 124.5 kg (60 yrs) |
| A4_Furr Mtl Stud 4"_GWB (1-0) | 157.9 kg (60 yrs) |
| ACT 4 AcoustiBuilt Ceiling | 1,539.8 kg (60 yrs) |
| B4 | 90.4 kg (60 yrs) |
| B6 | 68.7 kg (60 yrs) |
| C7- GWB on Mtl. Stud 2 | 226.3 kg (60 yrs) |
| HSEB - Pipe Guardrail - GDR-2 | 1,171.6 kg (60 yrs) |
| HSEB - Pipe Guardrail - GDR-2 without handrail | 1,048.1 kg (60 yrs) |
| HSEB Guardrail - Cable Rail | 626.0 kg (60 yrs) |
| HSEB Guardrail - Cable Rail without handrail | 1,105.3 kg (60 yrs) |
| HSEB Handrail - HNDRL-1 | 1,445.7 kg (60 yrs) |
| HSEB Handrail - HNDRL-3 | 46.3 kg (60 yrs) |
| HSEB PIPE Handrail - HNDRL-2 | 205.4 kg (60 yrs) |
| HSEB-GDR-4_Canerail | 24.5 kg (60 yrs) |
| KPFF - SCOL - Steel - HSS - Rectangular (C) - TC | 12,562.2 kg (60 yrs) |
| KPFF - SCOL - Steel - HSS - Rectangular (C) - TC- 2x | 567.7 kg (60 yrs) |
| KPFF - SCOL - Steel - HSS - Round (C) - TC | 221.2 kg (60 yrs) |
| KPFF - SFRM - Steel - HSS - Rectangular (C) - TC | 15,577.6 kg (60 yrs) |
| LCL_Embed_2x3-Nelson-Studs_OffSet | 165.4 kg (45 yrs) |
| P_SOUTH VESTIBULE WALL | 62.1 kg (60 yrs) |
| W06 PRE-CAST CONCRETE @ FRAMED WALL | 2,026.0 kg (60 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING | 7,767.5 kg (60 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse) | 16,481.0 kg (60 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (CW Parapet) no insulation | 118.8 kg (60 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (Parapet) | 1,934.1 kg (60 yrs) |
| W09_SOUTH VESTIBULE WALL | 51.6 kg (60 yrs) |

Used in the following Tally entries:
Steel, C-stud metal framing
Steel, C-stud metal framing with insulation
Steel, furring channel
Steel, HSS section
Steel, plate
Steel, rectangular bar
Steel, round tubing

Description:
Hot dipped galvanized steel profile, for use with cladding systems.

Life Cycle Inventory:
100% Steel, hot dip galvanized

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 44% scrap input while remainder is processed and credited as avoided burden

# LCI Data (continued)

LCI Source:
RNA: Steel hot dip galvanized worldsteel (2007)
GLO: Steel sheet stamping and bending (5% loss) ts (2014)
US: Electricity grid mix ts (2014)
US: Lubricants at refinery ts (2014)
GLO: Compressed air 7 bar (medium power consumption) ts (2014)
US: Metal roll forming M CA (2010)
GLO: Value of scrap worldsteel (2014)

**Galvanized steel decking** **89,764.5 kg**

Used in the following Revit families:

| | |
|---|---|
| (F2) CONCRETE METAL DECK | 55,227.3 kg (60 yrs) |
| (F3) CONCRETE METAL DECK W/ TOPPING SLAB | 3,185.1 kg (60 yrs) |
| (R2) STRUCTURAL SLAB LAYER OF ASSEMBLY R2 | 7,867.3 kg (60 yrs) |
| (R3) SBS OVER METAL DECK | 23,414.7 kg (60 yrs) |
| (R4) SOUTH VEST ROOF (INTERIOR) | 70.0 kg (60 yrs) |

Used in the following Tally entries:
Steel, deck

Description:
Hot dip galvanized steel roof decking, corrugated profile. Default roof decking is galvanized to G90 standards, coated on both sides of 20 gauge steel deck, roll formed and precut.

Life Cycle Inventory:
100% Steel, hot dip galvanized

Product Scope:
Cradle to gate for deck only.

Transportation Distance:
By truck: 431 km

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

Module D Scope:
Product has 44% scrap input while remainder is processed and credited as avoided burden

LCI Source:
RNA: Steel hot dip galvanized worldsteel (2007)
GLO: Steel sheet stamping and bending (5% loss) ts (2014)
US: Electricity grid mix ts (2014)
US: Lubricants at refinery ts (2014)
GLO: Compressed air 7 bar (medium power consumption) ts (2014)
US: Metal roll forming M CA (2010)
GLO: Value of scrap worldsteel (2014)

**GFRC, spray coating** **35,240.5 kg**

Used in the following Revit families:

| | |
|---|---|
| cp_HSEB - Skin Shingle Panel_hoz | 35,240.5 kg (50 yrs) |

Used in the following Tally entries:
Glass fiber reinforced concrete, spray coating

Description:
Glass fiber reinforced concrete (GFRC) used in spray-up process, inclusive of propulsion agent.

Life Cycle Inventory:
21% Cement
63% Sand
16% Water
3% Acrylate resin

Product Scope:
Cradle to gate, includes propulsion agent, excludes all other installation impacts

Transportation Distance:
By truck: 172 km

End-of-Life Scope:
100% Landfilled

LCI Source:
US: Portland cement PCA/ts (2014)
US: Tap water from groundwater ts (2017)
US: Silica sand (Excavation and processing) ts (2017)
US: Glass fibres ts (2017)
DE: Acrylate resin (epoxy-functional) ts (2017)

**Glass fiber reinforced plastic paneling** **318.0 kg**

Used in the following Revit families:

| | |
|---|---|
| 1-N8 GFRC @ FRAMED WALL STAGGERED STUD | 3.1 kg (60 yrs*) |
| 1-W05 CONCRETE WALL W/ EXTERIOR INSULATION 22" | 10.2 kg (60 yrs*) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL | 101.0 kg (60 yrs*) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL STAGGERED STUD | 32.2 kg (60 yrs*) |
| W06 PRE-CAST CONCRETE @ FRAMED WALL | 171.5 kg (60 yrs*) |

Used in the following Tally entries:
Fiberglass clip system

Description:
Glass fibers with polyester resin formed into solid sheet stock

Life Cycle Inventory:
50% Glass fibers
50% Polyester resin

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 172 km

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

LCI Source:
DE: Polyester Resin unsaturated (UP) ts (2017)
US: Glass fibres ts (2017)
GLO: Plastic extrusion profile (unspecific) ts (2017)
US: Electricity grid mix ts (2014)
US: Thermal energy from natural gas ts (2014)
US: Lubricants at refinery ts (2014)
GLO: Compressed air 7 bar (medium power consumption) ts (2014)

**Glazing, monolithic sheet, generic** **4,667.0 kg**

Used in the following Revit families:

| | |
|---|---|
| cp_HSEB - Window at Upper Levels | 3,859.1 kg (40 yrs) |
| System Panel | 807.9 kg (40 yrs) |

Used in the following Tally entries:
Glazing, custom IGU

Description:
Standard float glass, uncoated. Note: this entry is appropriate for clear or tinted glass. Default thickness is 3 mm.

Life Cycle Inventory:
Glazing

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 940 km

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

LCI Source:
DE: Window glass simple (EN15804 A1-A3) ts (2017)

**Glazing, monolithic sheet, safety glass** **68.3 kg**

Used in the following Revit families:

| | |
|---|---|
| (N1-HMW) dr-SGL-A | 68.3 kg (30 yrs) |

Used in the following Tally entries:
Glazing, monolithic sheet

Description:
Standard safety glass, default thickness is 3mm. Note: this entry is appropriate for clear or tinted glass.

Life Cycle Inventory:
Sodium sulphate
Soda (Na2CO3)
Silica sand
Calcium hydroxide
Lime
Tin
Dolomite

Product Scope:
Cradle to gate

# LCI Data (continued)

Transportation Distance:
By truck: 940 km

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

LCI Source:
DE: Window glass simple (EN15804 A1-A3) ts (2017)

**Glazing, monolithic sheet, tempered** **34,096.8 kg**

Used in the following Revit families:

| | |
|---|---|
| (FG1-CW) dr-SGL-CW | 61.9 kg (40 yrs) |
| (FG2-AL) dr-DBL-A | 862.9 kg (40 yrs) |
| (FG2-CW) dr-DBL-CW | 208.5 kg (40 yrs) |
| cp_HSEB - Window at Upper Levels | 10,856.3 kg (40 yrs) |
| System Panel | 22,107.2 kg (40 yrs) |

Used in the following Tally entries:
Glazing, custom IGU

Description:
Tempered float glass. Note: this entry is appropriate for clear or tinted glass. Default thickness is 3 mm.

Life Cycle Inventory:
Tempered glazing

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 940 km

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

LCI Source:
DE: Window glass simple (EN15804 A1-A3) ts (2017)
US: Electricity grid mix ts (2014)
US: Thermal energy from natural gas ts (2014)

**Hardware, stainless steel** **45.2 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1-HMW) dr-SGL-A | 7.0 kg (60 yrs) |
| (F2) dr-Double-Flush-with 4 sided jambs | 7.5 kg (60 yrs) |
| (FG2-AL) dr-DBL-A | 10.3 kg (60 yrs) |
| (FG2-CW) dr-DBL-CW | 10.3 kg (60 yrs) |
| (N1-HMW) dr-SGL-A | 5.3 kg (60 yrs) |
| temp-fence | 4.7 kg (60 yrs) |

Used in the following Tally entries:
Door, exterior, aluminum
Door, exterior, steel
Door, interior, steel

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)

**Hollow door, exterior, aluminum, anodized** **86.2 kg**

Used in the following Revit families:

| | |
|---|---|
| (F2) dr-Double-Flush-with 4 sided jambs | 86.2 kg (30 yrs) |

Used in the following Tally entries:
Door, exterior, aluminum

Description:
Anodized aluminum, exterior, with interior steel supports and polyurethane foam insulation

Life Cycle Inventory:
3% Steel
71% Anodized aluminum
25% Polyurethane foam

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

Transportation Distance:
By truck: 568 km

End-of-Life Scope:
70% Steel recovered
30% Steel landfilled (inert material)
95% Aluminum recovered (includes processing and avoided burden credit)
5% Aluminum is landfilled (inert material)
100% Insulation landfilled (plastic material)

Module D Scope:
Product has 50% aluminum scrap input and 1% steel scrap input while remainder is processed and credited as avoided burden.

LCI Source:
DE: Polyurethane foam (PUR) ts (2017)
RNA: Anodization of aluminium (EN15804 A1-A3) ts (2015)
RNA: Cold Rolled Aluminum AA/ts (2010)
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: Steel hot dip galvanized worldsteel (2007)
RNA: Secondary Aluminum Ingot AA/ts (2010)
RNA: Primary Aluminum Ingot AA/ts (2010)

**Hollow door, exterior, aluminum, anodized, large vision panel** **236.9 kg**

Used in the following Revit families:

| | |
|---|---|
| (FG2-AL) dr-DBL-A | 118.4 kg (30 yrs) |
| (FG2-CW) dr-DBL-CW | 118.4 kg (30 yrs) |

Used in the following Tally entries:
Door, exterior, aluminum

Description:
Hollow, anodized aluminum exterior door inclusive of large vision panel (>50% door area), polyurethane foam insulation, no frame

Life Cycle Inventory:
47% Glass
3% Steel
37% Anodized aluminum
13% Polyurethane foam

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

Transportation Distance:
By truck: 568 km

End-of-Life Scope:
70% Steel recovered
30% Steel landfilled (inert material)
95% Aluminum recovered (includes processing and avoided burden credit)
5% Aluminum is landfilled (inert material)
100% Insulation landfilled (plastic material)
100% Glass landfilled (inert material)

Module D Scope:
Product has 26% aluminum scrap input and 1% steel scrap input while remainder is processed and credited as avoided burden.

LCI Source:
DE: Polyurethane foam (PUR) ts (2017)
RNA: Anodization of aluminium (EN15804 A1-A3) ts (2015)

# LCI Data (continued)

RNA: Cold Rolled Aluminum AA/ts (2010)
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: Steel hot dip galvanized worldsteel (2007)
RNA: Secondary Aluminum Ingot AA/ts (2010)
RNA: Primary Aluminum Ingot AA/ts (2010)
DE: Window glass simple (EN15804) ts (2017)

**Hollow door, exterior, steel, galvanized** **96.7 kg**

Used in the following Revit families:
(N1-HMW) dr-SGL-A 96.7 kg (30 yrs)

Used in the following Tally entries:
Door, exterior, steel

Description:
Hollow door, exterior, steel, 18 ga. inclusive of EPS insulation, no frame

Life Cycle Inventory:
5% Extruded polystyrene
95% Galvanized steel

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

Transportation Distance:
By truck: 568 km

End-of-Life Scope:
70% Steel recovered
30% Steel landfilled (inert material)
100% Core landfilled (biodegradable material)

Module D Scope:
Product has 44% scrap input while remainder is processed and credited as avoided burden.

LCI Source:
DE: Expanded Polystyrene (PS 25) (EN15804 A1-A3) ts (2017)
GLO: Steel sheet stamping and bending (5% loss) ts (2017)
GLO: Value of scrap worldsteel (2014)
US: Electricity grid mix ts (2014)
US: Lubricants at refinery ts (2014)
GLO: Compressed air 7 bar (medium power consumption) ts (2014)
RNA: Steel hot dip galvanized worldsteel (2007)

**Hollow door, interior, steel, fire-rated** **81.8 kg**

Used in the following Revit families:
(F1-HMW) dr-SGL-A 81.8 kg (50 yrs)

Used in the following Tally entries:
Door, interior, steel

Description:
Fire-rated door, interior, steel, inclusive of mineral fiber insulation, no frame

Life Cycle Inventory:
72% Steel
28% Mineral wool

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

Transportation Distance:
By truck: 568 km

End-of-Life Scope:
70% Steel recovered
30% Steel landfilled (inert material)
100% Insulation landfilled (plastic material)

Module D Scope:
Product has 12% scrap input while remainder is processed and credited as avoided burden.

LCI Source:
DE: Expanded Polystyrene (PS 30) (EN15804 A1-A3) ts (2017)
GLO: Steel sheet stamping and bending (5% loss) ts (2017)
GLO: Value of scrap worldsteel (2014)
US: Electricity grid mix ts (2014)
US: Lubricants at refinery ts (2014)
GLO: Compressed air 7 bar (medium power consumption) ts (2014)
RNA: Steel finsihed cold rolled coil worldsteel (2007)
DE: Mineral fibres ceiling boards (EN15804 A1-A3) ts (2017)

**Hollow door, interior, steel, galvanized** **157.1 kg**

Used in the following Revit families:
(F1-HMW) dr-SGL-A 67.3 kg (50 yrs)
temp-fence 89.7 kg (50 yrs)

Used in the following Tally entries:
Door, interior, steel

Description:
Hollow, galvanized steel interior door inclusive of honeycomb kraft paper, no frame

Life Cycle Inventory:
12% Kraft core
88% Galvanized steel

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

Transportation Distance:
By truck: 568 km

End-of-Life Scope:
70% Steel recovered
30% Steel landfilled (inert material)
100% Core landfilled (biodegradable material)

Module D Scope:
Product has 41% scrap input while remainder is processed and credited as avoided burden.

LCI Source:
DE: Kraft paper ts (2017)
GLO: Steel sheet stamping and bending (5% loss) ts (2017)
GLO: Value of scrap worldsteel (2014)
US: Electricity grid mix ts (2014)
US: Lubricants at refinery ts (2014)
GLO: Compressed air 7 bar (medium power consumption) ts (2014)
RNA: Steel hot dip galvanized worldsteel (2007)

**Hot rolled structural steel, AISC - EPD** **518,506.5 kg**

Used in the following Revit families:

| | |
|---|---|
| HSEB Type C - STR-4_Conc filled w/ C channel | 1,158.0 kg (60 yrs) |
| HSEB Type C_STR-10_Conc filled w/ C channel | 332.8 kg (60 yrs) |
| HSEB Type C_STR-5_Conc filled w/ C channel 2 | 3,047.8 kg (60 yrs) |
| KPFF - SCOL - Steel - W - Wide Flange (C) - TC | 122,740.2 kg (60 yrs) |
| KPFF - SFRM - Steel - C - Channel (C) - TC | 4,966.2 kg (60 yrs) |
| KPFF - SFRM - Steel - Kicker Brace - L - Angle - TC | 976.4 kg (60 yrs) |
| KPFF - SFRM - Steel - L - Angle (C) - TC | 264.1 kg (60 yrs) |
| KPFF - SFRM - Steel - W - Wide Flange (C) - TC | 384,876.4 kg (60 yrs) |
| KPFF - SFRM - Steel - WT - Wide Flange Tee - TC | 40.7 kg (60 yrs) |
| KPFF - SFRM - Steel - WT - Wide Flange Tee (C) - TC | 104.0 kg (60 yrs) |

Used in the following Tally entries:
Steel, angle
Steel, C channel
Steel, W section (wide flange shape)

Description:
Hot rolled structural steel. Industry-wide EPD from the American Institute of Steel Construction.

Life Cycle Inventory:
For information and quantities, see EPD

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 100% scrap input, burden reflects difference between recovered material and scrap input

LCI Source:
RNA: Hot rolled structural steel sections AISC (2010)

# LCI Data (continued)

EPD Source:
4786979051.102.1

EPD Designation Holder:
American Institute of Steel Construction

EPD Program Operator:
UL Environment

EPD Expiration:
3/31/2021

**IGU spacer** **283.4 kg**

Used in the following Revit families:

| | |
|---|---|
| (FG2-AL) dr-DBL-A | 6.3 kg (40 yrs) |
| (FG2-CW) dr-DBL-CW | 1.2 kg (40 yrs) |
| cp_HSEB - Window at Upper Levels | 112.7 kg (40 yrs) |
| System Panel | 163.2 kg (40 yrs) |

Used in the following Tally entries:
Glazing, custom IGU

Description:
Insulating glass unit (IGU) spacer and gasket used to separate two or more plies of glass. Density value assumes a 1/2" (13/2 mm) spacer.

Life Cycle Inventory:
70% Polybutadiene rubber spacer
30% Nitrile rubber spacer

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 940 km

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

LCI Source:
DE: Polybutadiene rubber ts (2017)
DE: Nitrile butadiene rubber, incl. MMA (NBR-speciality) ts (2017)

**Laminated spruce panel board** **278.9 kg**

Used in the following Revit families:

| | |
|---|---|
| C7- GWB on Mtl. Stud 2 | 278.9 kg (30 yrs) |

Used in the following Tally entries:
Plywood, interior grade

Description:
Laminated spruce woodboard (Duo-/Trio boards) consists of layers of spruce bonded with phenolic resin-based adhesive. Laminated woodboards in comparison to laminated timber are thicker (45mm). Appropriate for use in interior applications.

Life Cycle Inventory:
100% Laminated wood board

Product Scope:
Cradle to gate, excludes finishes
laminate as proxy for glue and adhesives during installation

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:
DE: Laminated wood panel board ts (2017)

**Laminating (for glazing)** **58.5 kg**

Used in the following Revit families:

| | |
|---|---|
| System Panel | 58.5 kg (40 yrs) |

Used in the following Tally entries:
Glazing, custom IGU

Description:
Glazing lamination using PVB film

Life Cycle Inventory:
3% PVB film (30% adipic acid
70% PVB)
97% Glass

Product Scope:
Cradle to gate

Transportation Distance:
N/A

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

LCI Source:
DE: Adipic acid from cyclohexane ts (2017)
DE: Polyvinyl Butyral Granulate (PVB) 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)

**Lightweight concrete, 5000 psi, Pacific Northwest regional average** **65,224.5 kg**

Used in the following Revit families:

| | |
|---|---|
| HSEB Type C - STR-4_Conc filled w/ C channel | 1,437.3 kg (60 yrs) |
| HSEB Type C_STR-10_Conc filled w/ C channel | 552.8 kg (60 yrs) |
| HSEB Type C_STR-5_Conc filled w/ C channel 2 | 2,234.5 kg (60 yrs) |
| HSEB Type C_STR-6_Conc filled w/ Plate Stringer - Roof Access | 413.5 kg (60 yrs) |
| HSEB Type C_STR-8_Conc filled w/ Plate | 318.4 kg (60 yrs) |
| KPFF - SCOL - Concrete - Round | 1,268.3 kg (60 yrs) |
| LCL_C_Pilaster_Rect_()w()d | 58,999.5 kg (60 yrs) |

Used in the following Tally entries:
Cast-in-place concrete, lightweight structural concrete, 5000 psi

Description:
Lightweight concrete, 5000 psi, Pacific Northwest regional average. Mix design matches National Ready-Mix Concrete Association (NRMCA) Industry-wide EPD.

Life Cycle Inventory:
Expanded shale: 34%, Sand: 32%, Portland cement PCA - EPD: 19%, Water: 10%, Fly ash: 5%, 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)

**Low-e coating (for glazing)** **312.7 kg**

Used in the following Revit families:

| | |
|---|---|
| (FG2-AL) dr-DBL-A | 7.1 kg (40 yrs) |
| (FG2-CW) dr-DBL-CW | 1.3 kg (40 yrs) |
| cp_HSEB - Window at Upper Levels | 126.8 kg (40 yrs) |
| System Panel | 177.5 kg (40 yrs) |

Used in the following Tally entries:
Glazing, custom IGU

Description:
Low-e coating for application to glazing lite

Life Cycle Inventory:
Ferro chrome mix
Nickel mix
Tin
Silver mix

Product Scope:
Cradle to gate

Transportation Distance:
N/A

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

LCI Source:
Low-e coating from DE: Double glazing unit (EN15804 A1-A3) ts (2017)

**Mineral wool, high density, NAIMA - EPD** **39,858.1 kg**

Used in the following Revit families:

| | |
|---|---|
| 1-N8 GFRC @ FRAMED WALL STAGGERED STUD | 38.2 kg (60 yrs) |
| 1-W05 CONCRETE WALL W/ EXTERIOR INSULATION 22" | 248.2 kg (60 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL | 1,235.2 kg (60 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL STAGGERED STUD | 393.3 kg (60 yrs) |
| 1-W07_METAL STUD LIGHTWEIGHT CLADDING | 13,257.9 kg (60 yrs) |
| 3-W07_METAL STUD LIGHTWEIGHT CLADDING | 195.3 kg (60 yrs) |
| W06 PRE-CAST CONCRETE @ FRAMED WALL | 2,096.0 kg (60 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING | 17,826.7 kg (60 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse) | 1,184.1 kg (60 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (Parapet) | 3,320.3 kg (60 yrs) |
| W09_SOUTH VESTIBULE WALL | 63.0 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

**Overhead door closer, aluminum** **26.1 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1-HMW) dr-SGL-A | 4.7 kg (30 yrs) |
| (FG2-AL) dr-DBL-A | 10.7 kg (30 yrs) |
| (FG2-CW) dr-DBL-CW | 10.7 kg (30 yrs) |

Used in the following Tally entries:
Door, exterior, aluminum
Door, interior, steel

Description:
Aluminum overhead door closer. Data based on product-specific EPD from FV S+B.

Life Cycle Inventory:
See EPD

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 1001 km

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

Module D Scope:
Product has 0% scrap input, burden reflects difference between recovered material and scrap input

LCI Source:
DE: Overhead door closer aluminum - FV S+B PE-EPD (2009)
RNA: Secondary Aluminum Ingot AA/ts (2010)
RNA: Primary Aluminium Ingot AA/ts (2010)

EPD Source:
EPD-ARG-20160183-IBG1-EN

EPD Designation Holder:
European Federation of Associations of Lock and Builders Hardware Manufacturers (ARGE)

EPD Program Operator:
Institut Bauen and Umwelt (IBU)

EPD Expiration:
9/13/2021

**Paint, enamel, solvent based** **9,648.7 kg**

Used in the following Revit families:

| | |
|---|---|
| 3/16" Aluminum Plate | 5.0 kg (15 yrs) |
| KPFF - SCOL - Steel - HSS - Rectangular (C) - TC | 255.3 kg (15 yrs) |
| KPFF - SCOL - Steel - HSS - Rectangular (C) - TC- 2x | 23.1 kg (15 yrs) |
| KPFF - SCOL - Steel - HSS - Round (C) - TC | 10.3 kg (15 yrs) |
| KPFF - SFRM - Steel - C - Channel (C) - TC | 94.7 kg (15 yrs) |
| KPFF - SFRM - Steel - HSS - Rectangular (C) - TC | 182.2 kg (15 yrs) |
| KPFF - SFRM - Steel - W - Wide Flange (C) - TC | 9,069.8 kg (15 yrs) |
| KPFF - SFRM - Steel - WT - Wide Flange Tee - TC | 1.9 kg (15 yrs) |
| KPFF - SFRM - Steel - WT - Wide Flange Tee (C) - TC | 6.4 kg (15 yrs) |

Used in the following Tally entries:
Aluminum, sheet
Steel, C channel
Steel, HSS section
Steel, W section (wide flange shape)

Description:
Solvent-based enamel paint, appropriate for use on metals

Life Cycle Inventory:
17% Binding agent
16% Pigments and fillers
67% Solvent

Product Scope:
Cradle to gate, including emissions during application

Transportation Distance:
By truck: 642 km

End-of-Life Scope:
33% Solids landfilled (plastic waste)

LCI Source:
DE: Solvent paint white (EN15804 A1-A3) ts (2017)

# LCI Data (continued)

**Paint, exterior metal coating, silicone-based** **767.3 kg**

Used in the following Revit families:

| | |
|---|---|
| (F3) CONCRETE METAL DECK (STRUCTURAL ONLY) | 60.0 kg (30 yrs) |
| (R2) STRUCTURAL SLAB LAYER OF ASSEMBLY R2 | 165.6 kg (30 yrs) |
| (R3) SBS OVER METAL DECK | 492.8 kg (30 yrs) |
| (R4) SOUTH VEST ROOF | 1.2 kg (30 yrs) |
| cp_HSEB - Skin Shingle flashing | 1.3 kg (30 yrs) |
| HSEB - STR-2 _Precast Tread Steel Riser 2 | 10.2 kg (30 yrs) |
| HSEB Type C - STR-4_Conc filled w/ C channel | 5.1 kg (30 yrs) |
| HSEB Type C_STR-10_Conc filled w/ C channel | 1.9 kg (30 yrs) |
| HSEB Type C_STR-5_Conc filled w/ C channel 2 | 11.2 kg (30 yrs) |
| HSEB Type C_STR-6_Conc filled w/ Plate Stringer - Roof Access | 3.8 kg (30 yrs) |
| HSEB Type C_STR-8_Conc filled w/ Plate | 0.8 kg (30 yrs) |
| HSEB_STR-3_Precast Tread Steel Riser | 2.5 kg (30 yrs) |
| LOUVER-parametric | 11.1 kg (30 yrs) |

Used in the following Tally entries:
Aluminum, sheet
Steel, deck
Steel, plate

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, exterior metal coating, silicone-based, by area** **18.2 kg**

Used in the following Revit families:

| | |
|---|---|
| HSEB Type C - STR-4_Conc filled w/ C channel | 5.1 kg (30 yrs) |
| HSEB Type C_STR-10_Conc filled w/ C channel | 1.9 kg (30 yrs) |
| HSEB Type C_STR-5_Conc filled w/ C channel 2 | 11.2 kg (30 yrs) |

Used in the following Tally entries:
Steel, C channel

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** **3,448.0 kg**

Used in the following Revit families:

| | |
|---|---|
| 1-C2- GWB on Mtl. Stud | 14.1 kg (7 yrs) |
| 1-W07_METAL STUD LIGHTWEIGHT CLADDING | 1,791.9 kg (7 yrs) |
| 2-A0_Furr Hat Channel 7/8"_GWB (2-0) 2 hour rated | 4.1 kg (7 yrs) |
| 2-C2- GWB on Mtl. Stud | 96.7 kg (7 yrs) |
| 3-W07_METAL STUD LIGHTWEIGHT CLADDING | 26.4 kg (7 yrs) |
| A4_Furr Mtl Stud 4"_GWB (1-0) | 60.8 kg (7 yrs) |
| ACT 4 AcoustiBuilt Ceiling | 182.3 kg (7 yrs) |
| C1 - ACT-1 - 2' x 4' | 628.7 kg (7 yrs) |
| C2- GWB on Mtl. Stud | 456.2 kg (7 yrs) |
| C7- GWB on Mtl. Stud 2 | 26.8 kg (7 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse) | 160.0 kg (7 yrs) |

Used in the following Tally entries:
Acoustic ceiling system, mineral fiber board
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)

**Phenolic resin solid surfacing, sheet** **2,684.0 kg**

Used in the following Revit families:

| | |
|---|---|
| cp_HSEB - Base Material Panel_vertical | 2,684.0 kg (20 yrs) |

Used in the following Tally entries:
Phenolic resin solid surface, sheet

Description:
Phenolic resin saturated kraft paper formed into solid sheet stock

Life Cycle Inventory:
85% Kraft paper
15% Phenolic resin

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 640 km

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

LCI Source:
US: Phenolic resin (45% concentration) ts (2017)
GLO: Plastic extrusion profile (unspecific) ts (2017)
US: Electricity grid mix ts (2014)
US: Thermal energy from natural gas ts (2014)
US: Lubricants at refinery ts (2014)
GLO: Compressed air 7 bar (medium power consumption) ts (2014)
EU-28: Kraft paper ts (2017)

**PIR rigid foam insulation, roof, R=20.5, PIMA - EPD** **12,008.0 kg**

Used in the following Revit families:

| | |
|---|---|
| (R3) SBS OVER METAL DECK | 11,996.3 kg (60 yrs) |
| (R4) SOUTH VEST ROOF | 11.7 kg (60 yrs) |

Used in the following Tally entries:
Polyisocyanurate (PIR), board

Description:
Polyisocyanurate rigid foam roof insulation with glass-fiber reinforced facers, R-value of 20.5, 3.5" thickness (89 mm). Industry-wide EPD from the Polyisocyanurate Insulation Manufacturers Association.

Life Cycle Inventory:
For information and quantities, see EPD

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 250 km

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

# LCI Data (continued)

LCI Source:
RNA: Polyisocyanurate rigid foam board roof insulaton, R=20.5 (A1-A3) ts-EPD (2013)

EPD Source:
EPD10043

EPD Designation Holder:
Polyisocyanurate Insulation Manufacturers Association

EPD Program Operator:
NSF International

EPD Expiration:
2/6/2020

**PIR rigid foam insulation, wall, R=14.6, PIMA - EPD** **9.8 kg**

Used in the following Revit families:

| | |
|---|---|
| cp_HSEB - Skin Shingle flashing | 9.8 kg (60 yrs) |

Used in the following Tally entries:
Polyisocyanurate (PIR), board

Description:
Polyisocyanurate rigid foam wall insulation with aluminum foil over kraft paper facers, R-value of 14.6, 2.25" thickness (57.2 mm). Industry-wide EPD from the Polyisocyanurate Insulation Manufacturers Association.

Life Cycle Inventory:
For information and quantities, see EPD

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 250 km

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

LCI Source:
RNA: Polyisocyanurate rigid foam board wall insulation, R=14.6 (A1-A3) ts-EPD (2013)

EPD Source:
EPD10042

EPD Designation Holder:
Polyisocyanurate Insulation Manufacturers Association

EPD Program Operator:
NSF International

EPD Expiration:
2/6/2020

**Polyethelene sheet vapor barrier (HDPE)** **34,144.9 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1) SLAB ON GRADE | 570.6 kg (60 yrs) |
| (F1) SLAB ON GRADE - 6" | 0.4 kg (60 yrs) |
| (F1) SLAB ON GRADE - 8" | 5.3 kg (60 yrs) |
| (R2) INSULATION O/ ASPHALT MEMBRANE O/ STRUCT | 143.4 kg (60 yrs) |
| (R3) SBS OVER METAL DECK | 933.7 kg (60 yrs) |
| (R4) SOUTH VEST ROOF | 3.6 kg (60 yrs) |
| (R4) SOUTH VEST ROOF (INTERIOR) | 4.2 kg (60 yrs) |
| 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 11" | 590.2 kg (60 yrs) |
| 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 16" | 193.7 kg (60 yrs) |
| 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 8" | 1,865.2 kg (60 yrs) |
| 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_16" | 6,745.6 kg (60 yrs) |
| 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_22" | 17,358.2 kg (60 yrs) |
| 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_24" | 5,580.5 kg (60 yrs) |
| 2-W01 CONCRETE WALL WITHOUT CONC | 150.2 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)

**Polyurethane coating, metal stock** **10.7 kg**

Used in the following Revit families:

| | |
|---|---|
| KPFF - SCOL - Steel - HSS - Rectangular (C) - TC | 10.7 kg (50 yrs) |

Used in the following Tally entries:
Steel, HSS section

Description:
Polyurethane coating, for metal stock

Life Cycle Inventory:
100% Polyurethane coating

Product Scope:
Cradle to gate, includes installation

Transportation Distance:
N/A

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

LCI Source:
DE: Application base coat (automobile) ts (2017)
DE: Polyurethane (copolymer-component) (estimation from TPU adhesive) ts (2017)

**Powder coating, metal stock** **995.2 kg**

Used in the following Revit families:

| | |
|---|---|
| C1 - Perf Metal Grid - 2'x6' | 993.5 kg (50 yrs) |
| Picture Window Bend Plate | 1.7 kg (50 yrs) |

Used in the following Tally entries:
Aluminum, angle
Aluminum, sheet

Description:
Powder coating, for metal stock

Life Cycle Inventory:
100% Powder coating

Product Scope:
Cradle to gate, including application

Transportation Distance:
N/A

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

LCI Source:
DE: Application top coat powder (aluminium) ts (2017)
DE: Coating powder (industry, outside, red) ts (2017)

**SBS modified bitumen, assembly (base & cap), ARMA - EPD** **30,466.4 kg**

Used in the following Revit families:

| | |
|---|---|
| (R3) SBS OVER METAL DECK | 26,128.4 kg (40 yrs) |
| (R4) SOUTH VEST ROOF | 101.8 kg (40 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (CW Parapet) no insulation | 202.3 kg (40 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (Parapet) | 4,034.0 kg (40 yrs) |

Used in the following Tally entries:
SBS modified bitumen, sheet

Description:
Styrene-butadiene-styrene (SBS)-modified bituminous roofing consisting of a base sheet and cap sheet. 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, accounts for product overlap when installing

Transportation Distance:
By truck: 172 km

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

LCI Source:
RNA: Atactic-polypropylene (APP)-modified bitumen (asphalt) roofing base sheet - ARMA (A1-A3) (2012)
RNA: Atactic-polypropylene (APP)-modified bitumen (asphalt) roofing cap sheet - ARMA (A1-A3) (2012)

EPD Source:
4787168709.105.1

EPD Designation Holder:
Asphalt Roofing Manufacturers Association (ARMA)

EPD Program Operator:
UL Environment

EPD Expiration:
10/28/2021

**SBS modified bitumen, cap sheet, ARMA - EPD** **8,400.9 kg**

Used in the following Revit families:

| | |
|---|---|
| (R2) INSULATION O/ ASPHALT MEMBRANE O/ STRUCT | 2,285.1 kg (60 yrs) |
| 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 11" | 111.1 kg (60 yrs) |
| 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 16" | 36.5 kg (60 yrs) |
| 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 8" | 351.2 kg (60 yrs) |
| 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_16" | 1,270.0 kg (60 yrs) |
| 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_22" | 3,268.1 kg (60 yrs) |
| 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_24" | 1,050.7 kg (60 yrs) |
| 2-W01 CONCRETE WALL WITHOUT CONC | 28.3 kg (60 yrs) |

Used in the following Tally entries:
Self-adhering sheet waterproofing, modified bituminous sheet

Description:
Styrene-butadiene-styrene (SBS)-modified bituminous cap sheet. Industry-wide EPD from the Asphalt Roofing 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 (plastic waste)

LCI Source:
RNA: Atactic-polypropylene (APP)-modified bitumen (asphalt) roofing cap sheet - ARMA (A1-A3) (2012)

EPD Source:
4787168709.105.1

EPD Designation Holder:
Asphalt Roofing Manufacturers Association (ARMA)

EPD Program Operator:
UL Environment

EPD Expiration:
10/28/2021

**Self adhering flashing membrane, 40 mil** **13.1 kg**

Used in the following Revit families:

| | |
|---|---|
| (R4) SOUTH VEST ROOF | 13.1 kg (40 yrs) |

Used in the following Tally entries:
Self adhering membrane

Description:
40 mil (1 mm) Asphalt rubber sheet inclusive of polyethelyne backing

Life Cycle Inventory:
82% Rubberized asphalt (25% SBS)
18% Polyethylene HD

Product Scope:
Cradle to gate for materials only, neglects manufacturing requirements

Transportation Distance:
By truck: 172 km

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

LCI Source:
US: Styrene-butadiene rubber (SBR) ts (2017)
DE: Bitumen cold adhesive (EN15804 A1-A3) ts (2017)
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)

**Stainless steel door hinge** **52.5 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1-HMW) dr-SGL-A | 9.8 kg (30 yrs) |
| (F2) dr-Double-Flush-with 4 sided jambs | 8.1 kg (30 yrs) |
| (FG2-AL) dr-DBL-A | 11.2 kg (30 yrs) |
| (FG2-CW) dr-DBL-CW | 11.2 kg (30 yrs) |
| (N1-HMW) dr-SGL-A | 5.7 kg (30 yrs) |
| temp-fence | 6.5 kg (30 yrs) |

Used in the following Tally entries:
Door, exterior, aluminum
Door, exterior, steel
Door, interior, steel

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

**Stainless steel sheet, Chromium 18/8** **43.4 kg**

Used in the following Revit families:

| | |
|---|---|
| Construction Specialties_Crash Rail_6" ECR-60S | 43.4 kg (45 yrs) |

Used in the following Tally entries:
Steel, sheet, stainless

Description:
Stainless steel sheet, Type 304 (Chromium 18/8)

Life Cycle Inventory:
100% Stainless steel plate

Product Scope:
Cradle to gate

# LCI Data (continued)

Transportation Distance:
By truck: 418 km

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

Module D Scope:
Product has 52% scrap input while remainder is processed and credited as avoided burden

LCI Source:
RER: Stainless steel cold rolled coil (304) Eurofer (2010)
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)
RER: Stainless steel flat product (304) - value of scrap Eurofer (2010)

**Stainless steel, extruded, chromium 18/8** **690.3 kg**

Used in the following Revit families:

| | |
|---|---|
| HSEB Guardrail - Cable Rail | 176.3 kg (60 yrs) |
| HSEB Guardrail - Cable Rail without handrail | 514.0 kg (60 yrs) |

Used in the following Tally entries:
Steel, round bar

Description:
Stainless steel, extruded, Type 304 (Chromium 18/8)

Life Cycle Inventory:
100% Stainless 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 52% scrap input while remainder is processed and credited as avoided burden

LCI Source:
RER: Stainless steel cold rolled coil (304) Eurofer (2010)
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)
RER: Stainless steel flat product (304) - value of scrap Eurofer (2010)

**Steel, reinforcing rod** **128,247.9 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1) SLAB ON GRADE | 5,757.9 kg (60 yrs) |
| (F1) SLAB ON GRADE - 6" | 4.0 kg (60 yrs) |
| (F1) SLAB ON GRADE - 8" | 53.4 kg (60 yrs) |
| (F2) CONCRETE METAL DECK | 40,904.3 kg (60 yrs) |
| (F3) CONCRETE METAL DECK (STRUCTURAL ONLY) | 1,397.0 kg (60 yrs) |
| (F3) CONCRETE METAL DECK W/ TOPPING SLAB | 3,921.8 kg (60 yrs) |
| (R2) STRUCTURAL SLAB LAYER OF ASSEMBLY R2 | 1,384.9 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F10.0 10x10x3.0d | 705.8 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F11.0 11x11x3.25d | 828.1 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F12.0 12x12x4d | 3,444.6 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F12.0 14x14x4.5d | 4,666.0 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F2.0 2x2x11"d | 76.8 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F4.0 4x4x1.5d | 19.8 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F8.0 8x8x2.5d | 202.9 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F9.0 9x9x2.75d | 197.6 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_FW6.0 6x8x2.5d | 1,525.9 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW3.0_36wx18d | 828.3 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW4.0_48wx18d | 945.8 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW4.0_48wx24d | 1,920.7 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW5.0_60wx18d | 14,137.7 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW5.0A_60wx30d | 6,269.2 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW7.0_87wx42d 2 | 987.7 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW8.0_96wx48d | 3,053.2 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg_24wx12d | 135.9 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(12") | 1,889.4 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(15") | 882.7 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(4") | 111.7 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(6") | 58.6 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(8") | 831.3 kg (60 yrs) |
| 04.225_LCL_C_CURB_Wall(11") | 640.6 kg (60 yrs) |
| 04.225_LCL_C_CURB_Wall(4") | 8.9 kg (60 yrs) |
| 04.225_LCL_C_CURB_Wall(6") | 272.4 kg (60 yrs) |
| 04.225_LCL_C_CURB_Wall(8") | 21.6 kg (60 yrs) |
| 04.300_LCL_C_Foundation_Wall(10") | 803.5 kg (60 yrs) |
| 04.310_LCL_C_PIT_Wall(8") | 174.5 kg (60 yrs) |
| 04.380_LCL_C_SHOTCRETE_Wall(16") | 2,833.9 kg (60 yrs) |
| 04.380_LCL_C_SHOTCRETE_Wall(19") | 1,384.2 kg (60 yrs) |
| 04.380_LCL_C_SHOTCRETE_Wall(22") | 17,844.2 kg (60 yrs) |
| 04.380_LCL_C_SHOTCRETE_Wall(24") | 4,729.3 kg (60 yrs) |
| 12" Concrete Slab | 60.7 kg (60 yrs) |
| Concrete 8" - STRUCTURAL | 566.3 kg (60 yrs) |
| HSEB - STR-1 _Precast Tread & Riser | 175.4 kg (60 yrs) |
| HSEB - STR-2 _Precast Tread Steel Riser 2 | 892.2 kg (60 yrs) |
| HSEB ST-11 (CAST IN PLACE) | 38.4 kg (60 yrs) |
| HSEB ST-9 (CAST IN PLACE) | 112.6 kg (60 yrs) |
| HSEB_STR-3_Precast Tread Steel Riser | 216.9 kg (60 yrs) |
| KPFF - SCOL - Concrete - Round | 0.0 kg (60 yrs) |
| KPFF - SFRM - Steel - BRB - Buckling Restrained Brace | 329.3 kg (60 yrs) |
| LCL_C_Pilaster_Rect_()w()d | 0.0 kg (60 yrs) |

Used in the following Tally entries:
Cast-in-place concrete, lightweight structural concrete, 5000 psi
Cast-in-place concrete, structural concrete, 3000 psi
Cast-in-place concrete, structural concrete, 4000 psi
Cast-in-place concrete, structural concrete, 5000 psi
Precast concrete column
Stair, concrete with metal nosing
Stair, precast single run (stretcher)
Steel, reinforcing rod
Steel, rod

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)

**Steel, sheet** **9,279.6 kg**

Used in the following Revit families:

| | |
|---|---|
| Corner_3 | 188.4 kg (60 yrs) |
| Corner_4 | 239.6 kg (60 yrs) |
| HSEB - STR-2 _Precast Tread Steel Riser 2 | 5,384.4 kg (45-60 yrs) |
| HSEB Type C - STR-4_Conc filled w/ C channel | 623.5 kg (45 yrs) |
| HSEB Type C_STR-10_Conc filled w/ C channel | 242.9 kg (45 yrs) |
| HSEB Type C_STR-5_Conc filled w/ C channel 2 | 994.2 kg (45 yrs) |
| HSEB Type C_STR-6_Conc filled w/ Plate Stringer - Roof Access | 170.0 kg (45 yrs) |
| HSEB Type C_STR-8_Conc filled w/ Plate | 133.4 kg (45 yrs) |
| HSEB_STR-3_Precast Tread Steel Riser | 852.8 kg (45-60 yrs) |
| P_SOUTH VESTIBULE WALL | 58.4 kg (60 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse) | 346.1 kg (60 yrs) |
| W09_SOUTH VESTIBULE WALL | 46.0 kg (60 yrs) |

Used in the following Tally entries:
Metal roofing panels, formed
Stair, concrete with metal nosing
Steel, plate

# LCI Data (continued)

Description:
Steel sheet

Life Cycle Inventory:
100% Steel sheet

Product Scope:
Cradle to gate

Transportation Distance:
By truck: 418 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)

**Structural concrete, 3000 psi, 0% fly ash and slag** **42,359.1 kg**

Used in the following Revit families:

| | |
|---|---|
| 3.5" Light Duty Paving Over Sturcture | 7,088.3 kg (30 yrs) |
| cp_HSEB - Base Material Panel_vertical | 35,270.7 kg (60 yrs) |

Used in the following Tally entries:
Precast concrete nonstructural panel
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, Pacific Northwest regional average** **1,304,562.7 kg**

Used in the following Revit families:

| | |
|---|---|
| (F2) CONCRETE METAL DECK | 1,080,996.0 kg (60 yrs) |
| (F3) CONCRETE METAL DECK (STRUCTURAL ONLY) | 36,533.6 kg (60 yrs) |
| (F3) CONCRETE METAL DECK W/ TOPPING SLAB | 187,033.1 kg (60 yrs) |

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

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

Life Cycle Inventory:
Coarse aggregate: 45%, Sand: 35%, Portland cement PCA - EPD: 10%, Water: 8%, Fly ash: 3%, 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, 4000 psi, 20% fly ash and 30% slag** **856,960.1 kg**

Used in the following Revit families:

| | |
|---|---|
| (F1) SLAB ON GRADE | 567,361.6 kg (60 yrs) |
| (F1) SLAB ON GRADE - 6" | 468.0 kg (60 yrs) |
| (F1) SLAB ON GRADE - 8" | 8,422.4 kg (60 yrs) |
| (R2) STRUCTURAL SLAB LAYER OF ASSEMBLY R2 | 140,358.3 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F2.0 2x2x11"d | 3,728.8 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(12") | 48,061.4 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(15") | 22,454.6 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(4") | 2,842.4 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(6") | 1,489.9 kg (60 yrs) |
| 04.215_LCL_C_Slab Transition_Wall(8") | 21,146.0 kg (60 yrs) |
| 04.225_LCL_C_CURB_Wall(11") | 16,294.9 kg (60 yrs) |
| 04.225_LCL_C_CURB_Wall(4") | 227.3 kg (60 yrs) |
| 04.225_LCL_C_CURB_Wall(6") | 6,929.8 kg (60 yrs) |
| 04.225_LCL_C_CURB_Wall(8") | 549.0 kg (60 yrs) |
| 12" Concrete Slab | 16,414.9 kg (60 yrs) |
| HSEB ST-11 (CAST IN PLACE) | 210.9 kg (60 yrs) |

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

Description:
Structural concrete, 4000 psi, 20% fly ash and 30% slag. Mix design matches National Ready-Mix Concrete Association (NRMCA) Industry-wide EPD.

Life Cycle Inventory:
Coarse aggregate: 45%, Sand: 31%, Portland cement PCA - EPD: 9%, Water: 7%, Expanded slag: 5%, Fly ash: 3%, Admixture: <1%

# LCI Data (continued)

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, 5000 psi, 0% fly ash and slag** **8,728.6 kg**

Used in the following Revit families:

| | |
|---|---|
| HSEB - STR-1 _Precast Tread & Riser | 2,539.4 kg (60 yrs) |
| HSEB - STR-2 _Precast Tread Steel Riser 2 | 4,844.9 kg (60 yrs) |
| HSEB_STR-3_Precast Tread Steel Riser | 1,344.3 kg (60 yrs) |

Used in the following Tally entries:
Stair, concrete with metal nosing
Stair, precast single run (stretcher)

Description:
Structural concrete, 5000 psi, 0% fly ash and slag. Mix design matches National Ready-Mix Concrete Association (NRMCA) Industry-wide EPD.

Life Cycle Inventory:
Coarse aggregate: 40%, Sand: 33%, Portland cement PCA - EPD: 20%, 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, 5000 psi, 20% fly ash and 30% slag** **2,312,934.3 kg**

Used in the following Revit families:

| | |
|---|---|
| 04.016_LCL FND Slab_Spread Ftg_F10.0 10x10x3.0d | 56,528.9 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F11.0 11x11x3.25d | 74,100.0 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F12.0 12x12x4d | 36,178.5 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F12.0 14x14x4.5d | 55,398.3 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F4.0 4x4x1.5d | 3,014.9 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F8.0 8x8x2.5d | 20,099.2 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_F9.0 9x9x2.75d | 13,990.9 kg (60 yrs) |
| 04.016_LCL FND Slab_Spread Ftg_FW6.0 6x8x2.5d | 69,640.5 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW3.0_36wx18d | 31,217.6 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW4.0_48wx18d | 33,450.2 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW4.0_48wx24d | 86,718.6 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW5.0_60wx18d | 89,913.9 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW5.0A_60wx30d | 64,658.2 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW7.0_87wx42d 2 | 66,939.6 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg FW8.0_96wx48d | 188,932.2 kg (60 yrs) |
| 04.017_LCL FND Slab_Cont. Ftg_24wx12d | 1,847.0 kg (60 yrs) |
| 04.300_LCL_C_Foundation_Wall(10") | 36,007.1 kg (60 yrs) |
| 04.310_LCL_C_PIT_Wall(8") | 11,479.1 kg (60 yrs) |
| 04.380_LCL_C_SHOTCRETE_Wall(16") | 210,675.0 kg (60 yrs) |
| 04.380_LCL_C_SHOTCRETE_Wall(19") | 49,101.7 kg (60 yrs) |
| 04.380_LCL_C_SHOTCRETE_Wall(22") | 859,916.8 kg (60 yrs) |
| 04.380_LCL_C_SHOTCRETE_Wall(24") | 247,805.7 kg (60 yrs) |
| HSEB ST-11 (CAST IN PLACE) | 752.2 kg (60 yrs) |
| HSEB ST-9 (CAST IN PLACE) | 2,812.3 kg (60 yrs) |
| KPFF - SFRM - Steel - BRB - Buckling Restrained Brace | 1,755.9 kg (60 yrs) |

Used in the following Tally entries:
Cast-in-place concrete, structural concrete, 5000 psi
Precast concrete column

Description:
Structural concrete, 5000 psi, 20% fly ash and 30% slag. Mix design matches National Ready-Mix Concrete Association (NRMCA) Industry-wide EPD.

Life Cycle Inventory:
Coarse aggregate: 41%, Sand: 30%, Portland cement PCA - EPD: 11%, Water: 7%, Expanded slag: 6%, Fly ash: 4%, 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)

**Suspended grid** **8,989.6 kg**

Used in the following Revit families:

| | |
|---|---|
| C1 - ACT-1 - 2' x 4' | 801.2 kg (50 yrs) |
| C1 - ACT-2 - 2' x 2' HRC | 1,597.2 kg (50 yrs) |
| C1 - ACT-3 - 2' x 2' | 5,821.1 kg (50 yrs) |
| C1 - ACT-5 - 2' x 6' | 770.1 kg (50 yrs) |

Used in the following Tally entries:
Acoustic ceiling system, mineral fiber board

Description:
Cold-rolled galvanized steel for lightweight ceiling grid

Life Cycle Inventory:
100% HDG 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 44% scrap input while remainder is processed and credited as avoided burden

LCI Source:
RNA: Steel hot dip galvanized worldsteel (2007)
US: Metal roll forming (MCA) (2010)
US: Electricity grid mix ts (2014)
US: Thermal energy from natural gas ts (2014)
GLO: Value of scrap worldsteel (2014)

**Wall board, gypsum, fire-resistant (Type X)** **43,127.3 kg**

Used in the following Revit families:

| | |
|---|---|
| 1-C2- GWB on Mtl. Stud | 444.9 kg (30 yrs) |
| 1F5 - 1 HR RATED HORIZONTAL DUCT ENCLOSURE | 761.0 kg (30 yrs) |
| 1-W07_METAL STUD LIGHTWEIGHT CLADDING | 35,345.8 kg (30 yrs) |
| 2-C2- GWB on Mtl. Stud | 4,958.8 kg (30 yrs) |
| 3-W07_METAL STUD LIGHTWEIGHT CLADDING | 416.5 kg (30 yrs) |
| A4_Furr Mtl Stud 4"_GWB (1-0) | 1,200.2 kg (30 yrs) |

Used in the following Tally entries:
Wall board, gypsum

Description:
Fire-resistant gypsum board

Life Cycle Inventory:
100% Fire-resistant gypsum wallboard (Gypsum, Boric acid, Cement, Sodium lignin sulfonate, Glass fibres, 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 plaster board (Fire protection) (EN15804 A1-A3)PE (2017)

**Wall board, gypsum, moisture- and mold-resistant** **86,468.2 kg**

Used in the following Revit families:

| | |
|---|---|
| (R4) SOUTH VEST ROOF | 123.7 kg (30 yrs) |
| 1-N8 GFRC @ FRAMED WALL STAGGERED STUD | 141.1 kg (30 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL | 4,559.5 kg (30 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL STAGGERED STUD | 1,451.9 kg (30 yrs) |
| 1-W07_METAL STUD LIGHTWEIGHT CLADDING | 24,470.2 kg (30 yrs) |
| 3-W07_METAL STUD LIGHTWEIGHT CLADDING | 288.3 kg (30 yrs) |
| P_SOUTH VESTIBULE WALL | 196.5 kg (30 yrs) |
| W06 PRE-CAST CONCRETE @ FRAMED WALL | 7,737.1 kg (30 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING | 32,902.8 kg (30 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse) | 2,185.4 kg (30 yrs) |
| W08_METAL STUD LIGHTWEIGHT CLADDING (Parapet) | 12,256.7 kg (30 yrs) |
| W09_SOUTH VESTIBULE WALL | 155.0 kg (30 yrs) |

Used in the following Tally entries:
Wall board, gypsum

Description:
Moisture- and mold-resistant gypsum board

Life Cycle Inventory:
100% Moisture-resistant gypsum wallboard (Gypsum, Boric acid, Cement, Sodium lignin sulfonate, Glass fibres, 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 plaster board (Moisture resistant) (EN15804 A1-A3) ts (2017)

**Wall board, gypsum, natural** **66,620.6 kg**

Used in the following Revit families:

| | |
|---|---|
| (A3)_Furr Mtl Stud 3-5/8"_GWB (1-0) | 395.1 kg (30 yrs) |
| (B8)_TYP Mtl Stud 8"_GWB Insulation | 156.0 kg (30 yrs) |
| 1-B6 | 37.8 kg (30 yrs) |
| 1-C2- GWB on Mtl. Stud | 203.7 kg (30 yrs) |
| 1-N8 GFRC @ FRAMED WALL STAGGERED STUD | 149.4 kg (30 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL | 4,824.8 kg (30 yrs) |
| 1-W06 PRE-CAST CONCRETE @ FRAMED WALL STAGGERED STUD | 1,536.4 kg (30 yrs) |
| 2-A0_Furr Hat Channel 7/8"_GWB (2-0) 2 hour rated | 118.0 kg (30 yrs) |
| 2-A0_GWB Type X (2-0) 2 hour rated | 169.4 kg (30 yrs) |
| 2-C2- GWB on Mtl. Stud | 1,397.2 kg (30 yrs) |
| 3-W07_METAL STUD LIGHTWEIGHT CLADDING | 915.4 kg (30 yrs) |
| ACT 4 AcoustiBuilt Ceiling | 2,635.1 kg (30 yrs) |
| B4 | 924.8 kg (30 yrs) |
| B6 | 488.7 kg (30 yrs) |
| C2- GWB on Mtl. Stud | 6,591.9 kg (30 yrs) |
| C7- GWB on Mtl. Stud 2 | 387.3 kg (30 yrs) |
| P_SOUTH VESTIBULE WALL | 207.9 kg (30 yrs) |
| W06 PRE-CAST CONCRETE @ FRAMED WALL | 8,187.4 kg (30 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING | 34,817.8 kg (30 yrs) |
| W07_METAL STUD LIGHTWEIGHT CLADDING (Penthouse) | 2,312.6 kg (30 yrs) |
| W09_SOUTH VESTIBULE WALL | 164.0 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)

**White oak lumber, 1 inch** **1,400.5 kg**

Used in the following Revit families:

| | |
|---|---|
| (R4) SOUTH VEST ROOF | 188.8 kg (50 yrs) |
| (R4) SOUTH VEST ROOF (INTERIOR) | 217.7 kg (50 yrs) |
| Rectangular Mullion | 993.9 kg (50 yrs) |

Used in the following Tally entries:
Domestic hardwood

Description:
Kiln-dried American White Oak hardwood lumber of 1" nominal thickness as produced in the eastern United States, focusing on the main production technologies and region-specific characteristics. White oak is frequently used for mouldings, flooring, furniture, doors, and millwork. Link for interactive LCA data tool is provided at the link listed as "EPD Information"

# LCI Data (continued)

full LCA report is available at http://naturespackaging.org/wp-content/uploads/2016/02/LifeCycleAssessment-Lumber.pdf.

Life Cycle Inventory:
100% White Oak

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: White Oak lumber, 1 inch (769 kg/m³), kiln-dried ts/AHEC (2017)

EPD Source:
Information

EPD Designation Holder:
American Hardwood Export Council (AHEC)

**Window frame, vinyl, fixed** **5,801.7 kg**

Used in the following Revit families:

| | |
|---|---|
| cp_HSEB - Window at Upper Levels | 5,801.7 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** **76.8 kg**

Used in the following Revit families:

| | |
|---|---|
| (R4) SOUTH VEST ROOF | 4.3 kg (10 yrs) |
| (R4) SOUTH VEST ROOF (INTERIOR) | 4.9 kg (10 yrs) |
| Rectangular Mullion | 67.6 kg (10 yrs) |

Used in the following Tally entries:
Domestic hardwood

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

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)

**XPS insulation, Foamular average, Owens Corning - EPD** **5,577.8 kg**

Used in the following Revit families:

| | |
|---|---|
| (R2) INSULATION O/ ASPHALT MEMBRANE O/ STRUCT | 2,783.8 kg (60 yrs) |
| 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 11" | 50.8 kg (60 yrs) |
| 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 16" | 16.7 kg (60 yrs) |
| 1-W01 CONCRETE WALL W/ EXTERIOR INSULATION 8" | 160.4 kg (60 yrs) |
| 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_16" | 580.2 kg (60 yrs) |
| 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_22" | 1,493.0 kg (60 yrs) |
| 2-W01 CONCRETE WALL W/ EXTERIOR INSULATION_24" | 480.0 kg (60 yrs) |
| 2-W01 CONCRETE WALL WITHOUT CONC | 12.9 kg (60 yrs) |

Used in the following Tally entries:
Extruded polystyrene (XPS), board

Description:
FOAMULAR XPS (polystyrene) insulation board, HFC foaming agent. EPD representative of US manufacturing condition. FOAMULAR insulation board is available with a variety of R-values and compressive strengths. The default value is based on a thermal resistance of RSI 1 and a compressive strength of 30 psi. If the intended R-value and compressive strength of the assembly is known, use the drop-down menu to designate a specific product.

Note: This temporary entry is sourced directly from third-party verified EPD data and replaces a Tally entry that is undergoing a quality assurance review. This entry developed using data from ecoinvent and modeled in SimaPro but adheres to

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

Product Scope:
Cradle to gate.
Note: Product stage expanded to include blowing agent emissions during distribution and installation, and diffusion from product over service life (B1). As these impacts make a significant contribution to GWP they have been included in the product stage.

Transportation Distance:
By truck: 1190 km

End-of-Life Scope:
100% Landfilled (plastic waste), includes blowing agent emissions released during disposal

LCI Source:
US: Extruded polystyrene (XPS) insulation board, FOAMULAR - Owens Corning EPD (2018), modeled with Simapro 8, source for secondary data is ecoinvent 3.4

EPD Source:
4788721182.101.1

EPD Designation Holder:
Owens Corning

EPD Program Operator:
UL Environment

EPD Expiration:
1/1/2024