

Guidelines

Embodied Carbon Guidelines

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Background and Context

Vancouver's Climate Emergency Action Plan, approved by City Council in November 2020, sets a goal of reducing embodied carbon in construction by 40% by 2030. In May 2022, City Council approved changes to the Vancouver Building By-law¹ (VBBL) to require designers to calculate, limit, and later reduce, embodied carbon in new Part 3 buildings.

These guidelines are referenced by the by-law to provide guidance on demonstrating compliance with embodied carbon requirements in the VBBL. The guidelines may also be used for requirements in policies or programs to calculate or reduce embodied carbon in construction, such as rezoning policies or owner's project requirements.

The sections in these guidelines are as follows.

1. General:

This section provides general information about these guidelines, including references.

2. Compliance:

This section describes the process for determining compliance with an embodied carbon requirement. It includes two ways to comply: an absolute path and a baseline path.

3. Specifying the Object of Assessment:

This section defines the object of assessment and system boundary, which set the physical and temporal scope of the calculation of embodied carbon. The system boundary is defined by specifying the inclusion and exclusion of life cycle stages, building elements, and lifespan of the building and building elements. Appendix A provide additional information on specifying the object of assessment.

4. Quantifying Embodied Carbon

This section provides guidance on conducting a whole-building life cycle assessment (wbLCA) to estimate embodied carbon emissions. The content of this section applies to both proposed design and baseline embodied carbon assessment. This section covers guidance on establishing a bill of materials, quantifying embodied carbon, and treatment of special topics, including design for disassembly, biogenic carbon, and naturally occurring concrete carbonation.

5. Determining the Baseline:

This section provides guidance on creating a functionally equivalent baseline for compliance through the baseline path, which is one of the two compliance paths described in Section 2.

¹ <https://free.bcpublications.ca/civix/document/id/public/vbbl2019/1173727518>

6. Documentation:

This section describes the documents that must be submitted to the City of Vancouver at the time of rezoning and Building Permit applications.

For further guidance on calculating embodied carbon and whole-building life cycle assessment, refer to the National Research Council of Canada's National Guidelines for Whole-building Life Cycle Assessment² (Referred to as "NRC Guidelines" in this document).

Intent

This document provides guidance on demonstrating compliance with the City of Vancouver's requirements to calculate, limit, or reduce embodied carbon.

The intent of this document is to provide guidance on:

- Embodied carbon calculations used for compliance;
- Identifying embodied carbon limits used for compliance;
- Creating a functionally-equivalent baseline; and,
- Submission requirements used for compliance.

This document does not intend to provide guidance on how to reduce embodied carbon emissions. Various industry and research organizations have provided resources on reducing embodied carbon, including:

- Carbon Leadership Forum (CLF)
 - Embodied Carbon Reduction Checklist³
 - Embodied Carbon Toolkit for Architects⁴
 - MEP 2040 initiative⁵
- Architecture 2030⁶
- Structural Engineering Institute, SE 2050 initiative⁷

Application

These guidelines are developed to be used for compliance with the embodied carbon requirements of the VBBL for Part 3 buildings. They may also be used for assessing and reporting embodied carbon of Part 9 buildings, however, the VBBL does not currently have any embodied carbon requirements for Part 9 buildings.

² See Appendix B.3 (b) for the link to this reference.

³ <https://carbonleadershipforum.org/ec-checklist-template>

⁴ <https://carbonleadershipforum.org/clf-architect-toolkit>

⁵ <https://www.mep2040.org/>

⁶ <https://architecture2030.org/embodied-carbon-actions/>

⁷ <https://se2050.org/>

Definitions and Acronyms

Definitions

Any terms not defined below shall be as defined by the VBBL or the NRC Guidelines.

Biogenic Carbon is carbon stored in biomaterials through natural processes, but not fossilized or derived from fossil resources.

Bill of Materials is a list of individual building materials and products and their quantities that make up a building.

Concrete Carbonation is a naturally occurring reaction in concrete products when atmospheric CO₂ (in the presence of water) reacts with the cement. Carbon is sequestered in the process and the strength of concrete increases. However, it also creates an acidic environment, which can corrode steel reinforcing bars.

Embodied Carbon, Embodied Carbon Impacts, Whole-building Embodied Carbon, and Whole-building Embodied Carbon Impacts refer to the greenhouse gas emissions associated with materials and construction processes throughout the life cycle of a building, except emissions from building energy use. This can include emissions from material extraction, manufacture, transportation, construction, replacement, refurbishment, demolition, removal, and other processes. For the purposes of these guidelines, *embodied carbon* and these related terms are the total global warming potential (GWP) impact calculated in compliance with these guidelines. Embodied carbon is measured in kilograms of carbon dioxide equivalent (kgCO₂e).

Embodied Carbon Baseline, Functionally-equivalent Baseline, and Baseline for the purposes of these guidelines are derived from a single theoretical “typical” design (i.e., an archetype), based on standardized assumptions and the proposed design being assessed for compliance, all as specified and in compliance with these guidelines. Calculating the embodied carbon of the baseline is one way to create an embodied carbon benchmark, for the purpose of demonstrating relative embodied carbon performance.

For the purposes of demonstrating compliance with the embodied carbon requirements of the Vancouver Building By-law (VBBL), any of the pathways for calculating the embodied carbon benchmark included in Section 2 shall be considered equivalent to a functionally-equivalent baseline.

Embodied Carbon Benchmark refer to a reference point against which comparisons can be made, for the purposes of demonstrating relative embodied carbon performance (i.e., a percent improvement). This benchmark can be a baseline or absolute carbon intensity (kgCO₂e/m²).

Embodied Carbon Limit for the purposes of these guidelines is the embodied carbon impacts that shall not be exceeded by the proposed design to comply with an embodied carbon requirement, such as those set in the VBBL. It is the highest embodied carbon impacts, and the minimum performance level, allowed.

Embodied Carbon Requirement refers a requirement to consider embodied carbon during building design or construction and may include a requirement to achieve relative embodied carbon performance (i.e., a percent improvement) over a benchmark.

Environmental Product Declaration (EPD) is a third party-verified document written in conformance with regional or international standards that reports the environmental impacts of a product, including its global warming potential (GWP), commonly known as embodied carbon, based on life cycle assessment (LCA) models.

Gross Floor Area (GFA) for the purposes of these guidelines is as defined in Appendix A of the NRC Guidelines, except that calculation of gross floor area shall exclude any floor area of a parkade (refer to definition of parkade). GFA measures fully-enclosed spaces to the outside face of enclosing walls, without deductions in area for interior walls, columns, and floor openings such as stairwells, elevators, ducts, or other openings.

Life Cycle Assessment (LCA) is the process of evaluating a system, component, product, assembly, or building, from the moment of extraction of raw materials to transportation, processing, manufacturing, use, recyclability, and disposal. Through this methodology the cumulative and ultimate social, environmental, and economic costs, benefits, and impacts are assessed. This is often referred to as a cradle-to-grave or cradle-to-cradle assessment.

Life Cycle Inventory (LCI) is a list of input and output flows for a particular process. The flows are resource use, such as materials, energy, and water, as well as emissions to air, land, and water.

Life Cycle Impact Assessment (LCIA) is a set of characterization factors that are applied to an LCI to arrive at environmental indicator results. These results may estimate “end-point” impacts, such as damage to human health, or “mid-point” impacts, such as global warming potential.

Object of Assessment is a building and building elements included in the embodied carbon assessment, as defined in accordance with Section 3 of these guidelines.

OmniClass is a comprehensive standardized classification system used in the construction industry, developed by the National Institute of Building Sciences (NIBS) in the United States. It is used to categorize and organize information related to building projects, including components, materials, systems, and processes throughout the whole project life cycle.

Parkade for the purposes of these guidelines is a building or part thereof for the storage or parking of motor vehicles and containing no provision for the repair or servicing of such vehicles.

Note: This is the same as the definition of “storage garage” in the Vancouver Building By-law.

Product Environmental Profile (PEP) is an EPD that covers electrical, electronic, and HVAC products (See Environmental Product Declaration (EPD) definition).

Proposed Design is the building design that is assessed for compliance with an embodied carbon requirement, at the time of that assessment. For example, for a building being assessed for compliance with embodied carbon requirements in the VBBL, it is the proposed design reflected in the Building Permit application documents. For preliminary stage assessments such as during rezoning, the proposed design being assessed and submitted may be one of many possible designs and represent one of many pathways

to achieving compliance with an embodied carbon requirement. Where details are not known at the time of assessment, refer to guidance in Section 4 of this document and in Tables 1 and 2.

System Boundary is the physical, geographical, and temporal scope of the assessment, including life cycle stages, building elements, processes, flows, and activities included or excluded from the life cycle assessment.

UniFormat is a widely used elemental classification system produced by the Construction Specifications Institute (CSI) and Construction Specifications Canada (CSC).

User is the individual or company that uses these guidelines to calculate the embodied carbon of a building and demonstrate compliance with embodied carbon requirements.

Whole-building Life Cycle Assessment (wbLCA) is the process of conducting an LCA for a building as opposed to the building products and elements. See the definition for life cycle assessment (LCA).

Acronyms

BIM	Building Information Model
CLF	Carbon Leadership Forum
EPD	Environmental Product Declaration
GFA	Gross Floor Area
GWP	Global Warming Potential
HVAC	Heating, Ventilation, and Air Conditioning
IGU	Insulated Glass Unit
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
LCIA	Life Cycle Impact Assessment
MEP	Mechanical Electrical Plumbing
MURB	Multi-unit Residential Building
NRC	National Research Council of Canada
PEP	Product Environmental Profile
VBBL	Vancouver Building By-law
wbLCA	Whole-building Life Cycle Assessment
XPS	Extruded Polystyrene (insulation)

Embodied Carbon Guidelines

1 General

1.1 References

The normative standards and guidelines referenced in this document are listed in Appendix A.1. The embodied carbon assessment shall comply with the most recent version of these references. Where there are differences between this document and the referenced standards and guidelines, the provisions of this document shall apply.

The most commonly used software tools for building embodied carbon assessment – listed in Appendix A.2 (a) – and the databases within these tools comply with the normative references.

The informative references are listed in Appendix A.2. These references are provided as additional resources but compliance to them is not required.

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2 Compliance

Compliance with an embodied carbon requirement shall be determined by following the steps in this section. To determine compliance:

- 1) Calculate the embodied carbon of the proposed design;
- 2) Calculate the embodied carbon benchmark using one of two pathways;
- 3) Calculate the embodied carbon limit by multiplying the benchmark by a reduction factor; and,
- 4) Compare the embodied carbon limit with the embodied carbon of the proposed design.

Compliance shall then be documented in accordance with Section 6.

2.1 Calculate the embodied carbon of the proposed design

Define the object of assessment according to Sections 3 and calculate the embodied carbon of the proposed design following Section 4.

2.2 Calculate the embodied carbon benchmark

Determine the embodied carbon benchmark using one of the two following pathways:

(a) Absolute Path

Calculate the embodied carbon benchmark from an absolute embodied carbon intensity using the following formula:

$$EC_{BM} = ECI \times GFA_p$$

Where:

EC_{BM} = Embodied Carbon Benchmark (in kgCO₂e)

GFA_p = Gross Floor Area of the Proposed Building (in m²)

(Excluding parkade, see Definitions and Acronyms for guidance on calculating GFA.)

ECI = Absolute Embodied Carbon Intensity (in kgCO₂e/m²)

Note:

For compliance with the Vancouver Building By-law, the following value may be used:

$$ECI = 400 \text{ kgCO}_2\text{e/m}^2$$

The absolute embodied carbon intensity value (400 kgCO₂e/m²) is for the mandatory scope of the object of assessment, as specified in Section 2. This value is based on data collected from embodied carbon submissions for the City of Vancouver rezoning requirements from 2017 to 2023. As more data is collected, the value may be refined to reflect different building types or other important variables in wbLCA.

Example

If the absolute embodied carbon intensity is $400 \text{ kgCO}_2\text{e}/\text{m}^2$, the benchmark for a proposed design with $10,000 \text{ m}^2$ gross floor area can be calculated as follows:

$$EC_{BM} = 400 \times 10,000$$

$$EC_{BM} = 4,000,000 \text{ kgCO}_2\text{e}$$

(b) Baseline Path

Create a functionally-equivalent baseline following Section 5. The baseline shall follow the same guidance as the proposed design for specifying the object of assessment (Section 3) and calculating the embodied carbon (Section 4).

$$EC_{BM} = EC_{BL}$$

Where:

EC_{BM} = Embodied Carbon Benchmark (in kgCO_2e)

EC_{BL} = Embodied Carbon of the Baseline (in kgCO_2e)

2.3 Calculate the embodied carbon limit

Calculate the embodied carbon limit by multiplying the embodied carbon benchmark by a reduction factor.

$$EC_L = EC_{BM} \times f$$

Where:

f = reduction factor to be applied to the benchmark, in accordance with the embodied carbon requirements

Note:

The VBBL requirements effective in 2023 require that embodied carbon impacts not be more than double a functionally-equivalent baseline (i.e. the benchmark, as per the definition of functionally-equivalent baseline), so in this case $f = 2$

Example:

For example, if required to achieve an embodied carbon reduction of 10%, the reduction factor and embodied carbon limit are:

$$f = 0.9.$$

$$EC_L = EC_{BM} \times 0.9$$

2.4 Determine compliance

To comply with an embodied carbon requirement, the embodied carbon of the proposed design shall not exceed the embodied carbon limit.

$$EC_p \leq EC_L$$

Wherein:

EC_p = Embodied Carbon of the Proposed Design (in kgCO_{2e})

EC_L = Embodied Carbon Limit (in kgCO_{2e})

(a) Multiple Buildings

Multiple buildings may be combined in one calculation of embodied carbon, if they share a common parkade, or a common podium, because they use the same below-grade concrete structural design. If the buildings have no common spaces, the embodied carbon calculation and reporting shall be done separately for each building.

For demonstrating compliance at the time of Building Permit, large developments with multiple parcels must provide at least one calculation for each parcel of the development, and results may be averaged, per gross floor area, across a development up to the level of each parcel.

Rezoning applications with two or more buildings are not required to calculate embodied carbon emissions per building. They may calculate embodied carbon per building type and estimate the total embodied carbon by multiplying the estimated embodied carbon intensity by the total gross floor area of each archetype. Refer to Sections 4.2 and 4.3 for guidance on assumption for estimating material quantities and embodied carbon when project-specific data may not be available, including at the rezoning stage.

2.5 Document compliance

See Section 6 for compliance documentation and submittal requirements.

3 Specification of the Object of Assessment

3.1 General

This section specifies the object of assessment and system boundary. These set the scope of the calculation of embodied carbon for compliance with embodied carbon requirements.

3.2 Life Cycle Stages

Figure 2 in Appendix B.1 (a) shows different life cycle stages and modules in a wbLCA. A description of each module is provided in Appendix B.1 (b).

(a) **Required Scope:**

Embodied carbon shall be calculated using a cradle-to-grave life cycle boundary and include modules A1-A5, B1-B5, and C1-C4, wherever data is available.

For further options for end-of-life scenarios, refer to Section 4.3 (c) (vi) for salvaging and reusing and Section 4.3 (c) (vii) for design for disassembly practices.

(b) **Optional Scope:**

Module D shall not be included in the embodied carbon calculations used for compliance. However, embodied carbon from module D may be calculated and reported separately.

3.3 Building Elements

The building elements in this section are organized by Level 1 and 2 of OmniClass⁸ element classification. A detailed list of mandatory and optional elements, with Level 3 and 4 OmniClass breakdown is provided in Table 4 in Appendix B.2.

The mandatory building elements described in Section 3.3 (a) must be included in the embodied carbon reporting and compliance.

Optional elements specified in Section 3.3 (b) may be included in the embodied carbon reporting scope.

Users may include some or all of the optional elements in the scope of assessment when demonstrating compliance in the baseline path (Section 2.2 (b)), although their inclusion is not mandatory. If any optional scopes are included for demonstrating compliance, the scope of the proposed design and the baseline must be the same.

If any optional scopes are included for the compliance purposes, the embodied carbon emissions and percentage reduction achieved shall be reported both with and without the optional scopes.

The inclusion and exclusion of optional elements may be decided at Level 4 OmniClass. This means that if a Level 4 optional sub-element is included in reporting and/or compliance, all materials and

⁸ See Appendix A.2 (c)

products for that sub-element shall be included. See Section 4.3 (b) for more information on completeness requirement to comply with VBBL requirements.

(a) Required Scope

(i) Substructure

- Foundations
- Subgrade Enclosures (including below-grade exterior walls and below-grade floors, columns and beams, shear walls, and stairs)
- Slabs-on-Grade

(ii) Shell

- Superstructure (including above-grade floors, columns and beams, interior shear walls, stairs, balconies, roof structure, and canopies).
- Exterior Vertical Enclosures (above-grade exterior walls, exterior windows and doors)
- Exterior Horizontal Enclosures (including roofing, roof windows, and skylights)

(b) Optional Scope

(i) Interiors

- Interior Construction (including interior non-structural walls, partitions, windows, doors, raised floors, and suspended ceilings)
- Interior Finishes (including wall finishes, flooring, stair finishes, and ceiling finishes)

(ii) Services

- Conveying
- Plumbing
- Heating, Ventilation, and Air Conditioning (HVAC)
- Fire Protection
- Electrical
- Communications
- Electronic Safety and Security
- Integrated Automation

(iii) Equipment and Furnishings

(iv) Special Construction & Demolition

- Including building demolition and selective demolition

(v) Sitework

- Including excavation, parking lots, and landscaping

Note:

The required scope specified in this section and Table 4, Appendix B.2, are subject to availability of data from the project and software tool. The user may specify the required scope that are excluded from reporting with a brief explanation in the Embodied Carbon Design Report (see Section 6.1).

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4 Quantifying Embodied Carbon

4.1 General

All calculations of embodied carbon shall comply with this section, regardless of whether it is for the proposed or baseline design, unless otherwise allowed by these guidelines.

(a) Calculation Methodology

Embodied carbon shall be calculated using a wbLCA methodology in compliance with these guidelines.

4.2 Establishing a Bill of Materials

A bill of material is a list of individual building materials and product and their quantities that make up the physical building. The bill of materials is used to assess the embodied carbon of a building.

(a) Sources

The NRC Guidelines⁹ list three mechanisms for obtaining materials and product quantities, referred to as bill of materials:

- A building information model (BIM)
- A cost estimate
- Takeoffs from drawings

If the bills of materials created from a BIM or cost estimate is missing any of the required elements¹⁰ (e.g., foundations) or quantities of materials or products within a required element (e.g., concrete reinforcement), those quantities shall be added and accounted for in the embodied carbon assessment. These can be manually calculated through takeoffs or by using an early-design wbLCA or embodied carbon assessment software tool. If used at Building Permit stage, these tools must be able to reflect the building geometry, such as Carbon Designer tool of One Click LCA¹¹ and the assembly approach in Athena Impact Estimator¹².

(b) Completeness

Quantification of materials and flows shall correspond to the level of development, timing of the assessment, and availability of information for the proposed design, as well as the relative importance to the embodied carbon results and the purpose of the study (e.g., informing proposed design, meeting requirements, or performance declaration).

The bill of materials shall include all the materials and products greater than 1% of total project mass. The total of materials excluded from any Level 3 OmniClass building element

⁹ See Appendix A.2 (b) (ii).

¹⁰ See Section 2.3 for the list of required elements.

¹¹ <https://www.oneclicklca.com/carbon-designer/>

¹² See Appendix A.2 (a).

category of the required elements shall not be greater than 5% of mass (See Table 4, Appendix B.2 for the required elements). The users may use their professional judgment to identify the cut-off points.

(i) Rezoning Application and Schematic Design Stage

For calculations at the preliminary or schematic design stage, such as those made as part of a rezoning application, there may be limited information available for the proposed design. The purpose of the study at this stage is not to demonstrate compliance, but to inform building design to reduce embodied carbon and prepare for future compliance. For this purpose, very basic quantity estimates – such as an order of magnitude estimate, or a ‘Class D – Indicative Estimate’ according to the KPMB Lab WBLCA Classification System¹³ – for the materials with the most relative importance to embodied carbon may be sufficient to inform design and begin the process of reducing the embodied carbon of the building design.

(ii) Building Permit Application and Construction Documents Stage

As the project progresses and more information about the options for building elements become available, the project team shall create a more accurate embodied carbon model to inform the design. Quantification of materials and flows in embodied carbon calculations used to demonstrate compliance with an embodied carbon requirement, such as a Building Permit application, shall generally conform to the level of detail of a ‘Class B – Design Estimate’ according to the according to the KPMB Lab WBLCA Classification System.

(c) Material and product Types

If certain materials and product types are not specified in project documents, the project team shall use their professional judgement to specify them based on local common practices specific to their building archetype.

Table 1 provide general guidance for common material and product types for local practices in Vancouver. While the project teams can use this table as a guide, they should primarily rely on their professional judgment to identify whether typical materials and assemblies for their building archetype and design requirements vary from the information in this table.

¹³ See Appendix A.2 (b) (ii).

Table 1: Default Common-practice Assemblies and Materials for the Key Building Elements

Building Elements (OmniClass)			Default Material and Product Assumption
Level 1	Level 2	Level 3	
Substructure	Foundations	-	<ul style="list-style-type: none"> Steel-reinforced Concrete*
	Subgrade Enclosures	Walls for Subgrade Enclosures	
Shell	Superstructure	Floor Construction: Vertical (i.e. columns)	<ul style="list-style-type: none"> Steel-reinforced Concrete*
		<ul style="list-style-type: none"> Floor Construction: Horizontal (i.e. beams and floor plates) Roof Construction 	<ul style="list-style-type: none"> Typical Span: Steel-reinforced Concrete* Long Span: Steel Trusses
	Exterior Vertical Enclosure	Exterior Walls**	<ul style="list-style-type: none"> Type: <ul style="list-style-type: none"> Office and Commercial Storefront: Aluminum Curtain Wall Residential (7+ storeys): Aluminum Window Wall Other: SteelFramed Wall Framing: 6" deep steel framing @ 16" on-centre Sheathing: Gypsum Board*** on Both Sides Thermal Insulation (Cavity): Mineral Wool Batt Insulation Thermal Insulation (Continuous): Heavy Density Mineral Board Cladding: Galvanized Steel
		Exterior Windows	<ul style="list-style-type: none"> Window Frame: Aluminum Insulated Glass Unit (IGU): As required to meet the thermal performance Window-to-wall ratio: As required to meet the thermal performance
	Exterior Horizontal Enclosures	Roofing	<ul style="list-style-type: none"> Insulation: <ul style="list-style-type: none"> Conventional Roof: Polyiso Inverted Roof: Extruded Polystyrene (XPS) Interior Sheathing: Gypsum Board*** Membrane: 2-ply Styrene Butadiene Styrene (SBS)
	Interiors	Interior Construction	Interior Partitions
Interior Finishes		Wall Finishes	<ul style="list-style-type: none"> Paint

Building Elements (OmniClass)			Default Material and Product Assumption
Level 1	Level 2	Level 3	
		Floor Finishes	<ul style="list-style-type: none"> • Office Units: Carpet • Residential and Hotel Suites: Vinyl • Retail: Ceramic Tiles • Industrial: Exposed Concrete • Healthcare: Ceramic Tiles • All Building Types: <ul style="list-style-type: none"> ○ Hallways (except for retail): Carpet ○ Below-grade and Service Rooms: Exposed Concrete ○ Bathrooms and Showers: Ceramic Tiles
		Ceiling Finishes	<ul style="list-style-type: none"> • Drop Ceiling: Acoustic Tile • Other: Gypsum Board*** with Skim Coat and Paint

* If no detailed steel reinforcement (rebar) quantities are available, embodied carbon calculations may use One Click LCA's recommended average concrete reinforcement quantities¹⁴ (in kg rebar/m³ concrete) as a guideline for typical ranges in rebar for different building elements. This is suitable in earlier design phases; however, if actual rebar quantities are available in later design stages, it is best to use those quantities instead.

** For mixed-use buildings with multiple enclosure types, the enclosure assembly types in the embodied carbon model shall follow the pattern of enclosure in proposed design (e.g., a mixed-use building that uses window wall enclosure across the residential portions of the building and used curtain wall for the commercial portion). The pattern shall be matched in the baseline modelling for the baseline path (Section 2.2 (b)).

*** Type X gypsum board shall be assumed for fire rated walls.

4.3 Embodied Carbon Quantification

(a) Software Tools

(i) Rezoning Application and Schematic Design Stage

In addition to the wbLCA or embodied carbon assessment software tools specified in the following sub-section, rezoning applications can use early design tools.

Early design tools that allow reflecting geometry and industry-average material EPDs, e.g., Carbon Designer tool of One Click LCA and assembly approach in Athena Impact Estimator, can provide a more accurate estimate. However, if sufficient data on building design is not available, for instance in large master-plan developments, tools that provide high-level embodied carbon estimates based on building type, building size, element types can also be used, e.g., Embodied Carbon Pathfinder¹⁵.

¹⁴ <https://oneclicklca.zendesk.com/hc/en-us/articles/360020943800-Average-Quantities-of-Reinforcement-in-Concrete>

¹⁵ <https://www.buildingpathfinder.com/>

(ii) **Building Permit Application and Construction Documents Stage**

The software tools used for VBBL requirements shall comply with EN 15978:2011¹⁶ or an equivalent regional standard. A list of commonly used tools are provided in Appendix A.2 (a).

While these guidelines require a cradle-to-grave life cycle boundary, use software that are missing modules beyond A1-A3 may still for compliance, by using of the methodology provided in Section 4.3 (c) (viii).

(b) **Data Sources**

Except as required or allowed in this section, scenarios, flow types, data quality of Life Cycle Inventory (LCI) flows, sets of environmental data, data quality of environmental data, and Life Cycle Impact Assessment (LCIA) method used to calculate embodied carbon shall be as built into the software tool.

(i) **Impact Indicators**

The LCIA method used in the software tool shall be TRACI v2.1¹⁷ or newer. The tools listed in Appendix A.2 (a) use TRACI for embodied carbon assessment of buildings in North America.

Calculation of embodied carbon for demonstrating compliance with an embodied carbon standard only require reporting of the Global Warming Potential (GWP) environmental impact category. Other environmental impact category results may be reported separately.

(ii) **Environmental Product Declarations (EPDs)**

The EPDs in the LCA databases of the software tools used for VBBL compliance shall comply with one of the following standards¹⁸.

- EN 15804+A1 for European products, that their EPDs published prior to July 2022
- EN 15804+A2 for European products, that their EPDs published since July 2022
- ISO 21930:2017 for products from North America and other regions which do not have their regional standards
- Other equivalent EPD standards used in other regions

The EPDs used in the software tools in Appendix A.2 (a) comply with the above standards.

(c) **Assumptions, Data Modifications, and Manual Calculations**

Where the software tool allows it and the user has access to higher quality project-specific or regional data, the user may modify the data within the software tool to reflect the higher quality data.

¹⁶ See Appendix A.1 (a).

¹⁷ See Appendix A.1 (b).

¹⁸ See Appendix A.1 (c).

If there are data limitations in the software tool, the user may utilize manual calculations outside of the software and replace relevant data from the tool.

Any changes to the default software tool data and assumptions shall be described and justified as part of the Embodied Carbon Design Report (see Section 6.1).

The following sub-sections describes the possible assumptions, modifications, and calculations and the life cycle module impacted by them.

(i) **Material type and EPDs (Modules Depend on the Scope of EPDs)**

In software tools that allow selecting EPDs, such as One Click LCA¹⁹, EC3²⁰, and tallyCAT²¹, product-specific EPDs shall be used for the proposed design, when available and when a single product and manufacturer has been specified and no acceptable alternate has been identified in the project documents. Where acceptable alternates with available EPDs have been identified, the alternative with the highest product-specific GWP shall be used. If maximum GWPs have been specified, a product-specific EPD that is closest in GWP to the maximum GWP may be used.

When the specified products do not have product-specific EPDs, or if specific products or GWP maximums have not been specified, industry average EPDs shall be used, when available. If the baseline compliance path is used (Section 2.2 (b)), the baseline shall also use industry-wide EPDs.

The 2023 CLF North American Material Baseline Report²² (CLF Baselines Report) shall be referenced to identify the relevant industry-wide EPDs. Where available, B.C. or Canadian industry-wide EPDs shall be used.

For some material categories, industry-wide EPDs are not available in certain software tools or no industry-wide EPD exist (e.g., XPS insulation and carpet). In these cases, a product-specific EPD that is closest in GWP to the “Typical (Median)” value outlined in the latest version of CLF Baselines Report may be used.

In software tools that do not allow selecting EPDs, such as Athena Impact Estimator and tallyLCA²³, the default GWP values in the tool may be used.

Table 2 provides additional guidance for the default material type and EPD-choice assumptions, including relevant organizations that publish industry-wide EPDs. These may be used when project or product-specific material types and EPDs are not available.

¹⁹ See Appendix A.2 (a).

²⁰ See Appendix A.2 (a).

²¹ See Appendix A.2 (a).

²² See Appendix A.1 (d).

²³ See Appendix A.2 (a).

Table 2: Default Materials and Product Assumptions and EPD Selection

Material/Product	Default Material Type and EPD Assumptions
Concrete	<p>All concrete shall assume baseline mixes specified in the BC provincial industry-wide EPD²⁴, with matching air entrainment and at equivalent strength to the proposed design, unless lower strengths are enabled by structural design efficiencies as allowed in Table 3.</p> <p>If no information is available on the proposed design, consider assuming the following compressive strengths can be used:</p> <ul style="list-style-type: none"> • Foundation, Footings, Slab-on-grade - 25 MPa • Exterior Walls, Interior Walls - 35 MPa • Suspended Floor and Roof Slabs and Beams - 35 MPa • Stairs, Columns, Shear Walls - 40 MPa <p>If no information is available on air entrainment for concrete in the proposed design, air-entrained concrete mixes can be assumed for building elements exposed to exterior conditions (e.g., foundations, parkade slabs, exterior walls, slab-on-grade, etc.) and non-air entrained concrete mixes can be assumed for elements not exposed (e.g., interior concrete elements).</p> <p>Note: Athena Impact Estimator tool currently does not include BC provincial industry-average concrete mixes EPDs in their database. Projects that use this tool can select the “Benchmark” mixes defined within older CRMCA 2017 Canadian Industry-Average EPD that is currently available in the tool. If in future BC-average EPDs become available, BC values shall be used.</p>
Insulation	<p>XPS:</p> <p>The newer generation of XPS that is compliant with Canadian HFC regulation shall be referenced (e.g., Owens Corning FOAMULAR NGX, SOPREMA SOPRA- XPS, KingSpan GreenGuard LG XPS, or DuPont’s ST-100 XPS). The conventional XPS insulation products that use HFC blowing agents shall not be references, as those are banned in Canada due to new regulations that came into effect on Jan. 1, 2021.</p> <p>The CLF Baseline Report averages XPS from both HFC and HFO blowing agent products to derive an average GWP value. Do not use this baseline value.</p> <p>Closed Cell Spray Foam:</p> <p>If the Closed Cell Spray Foam (ccSPF) insulation is proposed, it shall reference the newer generation of low-GWP blowing agents compliant with Canadian HFC regulation. Reference the SPFA Industry-wide EPD (2018) for Spray Foam using HFO blowing agents. The conventional ccSPF insulation products that use HFC blowing agents shall not be referenced, as those are banned in Canada due to new regulations that came into effect on Jan. 1, 2021.</p> <p>The CLF Baseline Report averages ccSPF from both HFC and HFO blowing agent products to derive an average GWP value. Do not use this baseline value.</p>

²⁴ https://pcr-epd.s3.us-east-2.amazonaws.com/810.CRMCA_EP_D_BC.pdf

Material/Product	Default Material Type and EPD Assumptions
Windows and Glazing	<p>If the software tool does not have data specific to the window frame of the proposed design, a different window frame can be a proxy value.</p> <p>If the software tool does not have data specific to the triple-pane windows:</p> <ul style="list-style-type: none"> • If the software tool allows it, window frame and glazing layers can be modelled separately. • If the tool only allows using EPDs that combine window frame and glazing, the emissions can be approximated by referencing a double pane window EPD with appropriate window frame and adding an additional pane of flat glass or processed glass with the same area as the proposed window.
Steel Reinforcement (Rebar)	<p>The fabricated rebar EPD published by Concrete Reinforcing Steel Institute (CRSI) shall be referenced.</p> <p>Note: Post-tensioned slabs reduce rebar quantities in structural concrete. However, post Tension (PT) Tendons typically use much lower recycled content steel and have higher GWP impacts compared to conventional rebar. If no EPD is available for PT tendons, embodied carbon calculations shall approximate the impacts by doubling the PT tendon quantity and map to conventional rebar EPD (CRSI industry-wide EPD).</p>
Steel	<p>For non-rebar steel including Plate Steel, Hollow Structural Section (HSS), Hot-Rolled Sections, Steel Framing, and Open Web Steel Joist, baselines shall reference the relevant industry-wide EPD.</p> <p>Where available in the software tool refer to:</p> <ul style="list-style-type: none"> • Fabricated steel data instead of unfabricated steel • Canadian industry-wide EPDs over US industry-wide EPDs. <p>Examples of organizations that have published industry-wide EPDs are Canadian Institute of Steel Construction (CISC), American Institute of Steel Construction (AISC), American Galvanizers Association (AGA), Steel Framing Industry Association (SFIA), Metal Building Manufacturers Association (MBMA), Steel Joist Institute (SJI), Steel Tube Institute (STI), Steel Deck Institute (SDI), and Metal Construction Association (MCA).</p>
Aluminum	<p>Aluminum products shall reference the relevant industry-wide EPD.</p> <p>Where available, reference Canadian industry-wide EPDs (e.g., AluQuebec) over US industry-wide EPDs. Examples of industry-wide EPDs are:</p> <ul style="list-style-type: none"> • Extruded Aluminum: Aluminum Extruders Council (AEC) • Curtain Wall: AluQuebec • Aluminum Windows: AluQuebec • Aluminum Sheet/Cladding: AluQuebec, Aluminum Association, Ceilings & Interior Systems Construction Association (CISCA), Metal Construction Association (MCA)
Wood	<p>Refer to Section 4.4 (a) on biogenic carbon calculation.</p> <p>Wood products shall reference relevant industry-wide EPDs from the Canadian Wood Council (CWC) or other relevant organizations.</p>

Material/Product	Default Material Type and EPD Assumptions
Services	<p>(Optional)</p> <p>Product-specific EPDs, Product Environmental Profiles²⁵ (PEPs), or industry-average data shall be used.</p> <p>If none of the above data sources are available, the project team can calculate the embodied carbon of building services using guidance from TM65 Embodied Carbon in Building Services: A Calculation Methodology and TM65LA Embodied carbon in building services: Using TM65 outside the UK²⁶.</p> <p>Refrigerant emissions shall not be included in the embodied carbon assessment or compliance²⁷.</p>

Note:

EC3 and tallyCAT both use EC3 database, which by default displays uncertainty-adjusted GWP (uaGWP) values that apply an uncertainty factor on top of the Reported GWP values in EPDs. Users may use the uaGWP results for analysis. However if in the future there is an option to export the project results in "Reported GWP", those values shall be used, instead of the uaGWP values in submissions.

(ii) Transportation to Construction Site (Module A4)

Where the tool allows it, scenarios and data related to the transportation to construction site can be adjusted to reflect project-specific or typical local distances and transportation modes.

(iii) Construction Site Emissions (Module A5)

The construction site emissions shall be per the default scenarios in the software tool.

If the tool allows it, the user can replace the default values with more representative regional data, e.g., from comparable previous projects. Data required from construction sites include electricity, natural gas, and water consumption and the GHG emissions associated with them.

If the proposed design specifies requirements resulting in embodied carbon reduction on construction processes, the proposed design requirements may replace the default values in the tool, if the tool allows it. For instance, the proposed design can specify minimum requirements for construction waste diversion beyond the default scenarios in the software tool or specify using prefabricated assemblies can cut down construction waste generation and increase recycling rate compared to on-site construction.

(iv) Lifespan of Buildings, Elements, and Products (Module B)

²⁵ <http://www.pep-ecopassport.org/create-a-pep/>

²⁶ See Appendix A.2 (d).

²⁷ Reporting and reducing refrigerant GHGs is considered under VBBL operational carbon requirements. <https://council.vancouver.ca/20220517/documents/R1a.pdf#page=15>

Embodied carbon calculations shall assume 60 years for the reference study period and the required service life of the building, regardless of the actual required service life of the building.

The calculations may assume shorter lifespans for products and elements, based on default assumptions in the software tools. Where the tools allow modifying the lifespans, they may be replaced with the lifespan based on the EPDs, warranty documents provided by the product suppliers, or values provided in Table 5 in Appendix C.1.

(v) Waste Management at the End-of-Life (Module C)

Where the tool allows it, default scenarios for waste management at the end of building life can be updated to better reflect a product that may have been specified, the proposed design, or regional waste management practices.

For instance, the default transportation distances specified in module C2 may be modified to reflect the current waste and recovery facility locations in the project jurisdiction.

(vi) Salvaging and Reusing (Modules A-C)

If in the proposed design, a portion or components of the existing building on site are reused or if a salvaged component from another site is reused, the quantity of reused materials and components shall be excluded from all the life cycle stages (A-C) in the embodied carbon assessment. When calculating the floor area of the building for calculating the embodied carbon intensity, the reused portion should be included in the floor area, unless it the area is underground parkade area.

The embodied carbon from the demolition of the portion of the existing building that is removed from the site shall not be included in the embodied carbon calculation.

(vii) Design for Disassembly (Modules C-D)

Design for Disassembly (DfD) enables future reuse and recycling and thus reduces emissions from module C and D. However, currently there is no quantitative approach to measure how DfD solutions may reduce embodied carbon.

To encourage such practices, if a project design incorporates CSA Z782-06 Guideline for Design for Disassembly and Adaptability in Buildings for building structure and/or enclosure they can reduce modules C1-C4 emissions of the mandatory element scope by 50% for each of these building systems.

(viii) Modules Beyond A1-A3 (Modules A4-A5, B, and C)

Where the software tool scope is missing data for modules beyond A1-A3 (for example EC3 and tallyCAT and Builders for Climate Action's BEAM Estimator²⁸), the following methodology may be used²⁹:

- A4-A5 impacts shall be assumed equal to 10% of the A1-A3 impacts;

²⁸ <https://www.buildersforclimateaction.org/beam-estimator.html>

Note that the BEAM Estimator tool is only applicable for Part 9 buildings and cannot be used for compliance with VBBL requirements for Part 3 buildings.

²⁹ These percentages are derived from the relative impacts of life cycle stages from about 60 wBLcAs, using Athena Impact Estimator and One Click LCA tools. This includes the data from *Carbon Footprint Benchmarking of BC Multi-Unit Residential Buildings*, Athena Institute, May 2017. http://www.athenasmi.org/wp-content/uploads/2017/09/BC_MURB_carbon_benchmarking_final_report.pdf.

- B1-B5 impacts shall be assumed equal to 10% of the A1-A3 impacts;
- C1-C4 impacts shall be assumed equal to 5% of the A1-A3 impacts.

4.4 Treatment of Special Topics

(a) Biogenic Carbon

If embodied carbon impacts associated with biogenic carbon are calculated, the results shall be reported separately and shall not be included in demonstration of compliance with the embodied carbon limit.

If biogenic carbon results are calculated, they shall be calculated according to one of the following.

- The methodology included within the software tool; or,
- The GWPbio as calculated by the WWF Biogenic Carbon Footprint Calculator for Harvested Wood Products³⁰.

Where assumptions on biogenic carbon vary from the default biogenic carbon modelling by the software tools, these assumptions around shall be explicitly stated.

(b) Concrete Carbonation

Naturally occurring concrete carbonation shall not be included in the embodied carbon calculations used for compliance, although results from concrete carbonation may be calculated and reported separately.

If concrete carbonation results are calculated, they shall be calculated using the default modelling by the software tools and according to the methodology in the guideline 15 in the NRC Guidelines for whole-building life cycle assessment.

Where assumptions on concrete carbonation vary from the default modelling by the software tools, these assumptions shall be explicitly stated.

(c) Land Use Change

The direct and induced land use change impacts shall not be included in the embodied carbon calculation.

³⁰ <https://www.worldwildlife.org/projects/biogenic-carbon-footprint-calculator-for-harvested-wood-products>

5 Creating a Baseline

This section provides guidance on creating a baseline for compliance through the baseline path described in Section 2.2 (b).

5.1 General

(a) Calculation Methodology

Except as allowed by this section, calculation of embodied carbon shall be the same for the baseline and proposed design and in accordance with Sections 3 and 4 of these guidelines.

The software tool used to calculate embodied carbon shall be the same for the proposed and the baseline.

5.2 Functional Equivalency

The baseline shall be functionally equivalent with the proposed design and meet all the VBBL and zoning requirements.

(a) Thermal Equivalence

The proposed design and the baseline shall have functionally-equivalent thermal performance, as determined by the building architect, envelope engineer, mechanical engineer, or energy modeller.

The thermal equivalency may be approximate and as determined by those noted above. As such, approximate equivalency of clear-wall assembly R-value is acceptable for the embodied carbon modeling of the baseline. Detailed calculations of thermal bridging and thermal equivalence are not required.

The glazing ratio and number of panes shall be the same in the baseline and the proposed design.

(b) Structural Equivalence

The proposed design and the baseline shall have functionally-equivalent structural performance, as determined by the building structural engineer or architect.

For more guidance, refer to the “Design Structure for Material Efficiency” section of Table 3. The Whole Building Life Cycle Assessment: Reference Building Structure and Strategies³¹, published by ASCE/SEI, can be referred to for more guidance on creating an equivalent baseline structure.

(c) Geometry Equivalence

Except as allowed in Section 5.4, the proposed design and the baseline shall have functionally-equivalent building geometry and program (i.e., services and function of the

³¹ See Appendix A.2 (f).

spaces, number of residential units and occupancy numbers for multi-unit residential buildings (MURBs), building shape and orientation).

5.3 Approaches to Creating a Baseline

There are two acceptable approaches for creating a baseline: using an early design iteration and using the proposed design.

(a) Using an Early Design Iteration

A useful approach to developing a baseline is to calculate the embodied carbon of an earlier iteration of the proposed design, and then use that as the starting point for creating an improved design with lower embodied carbon.

The early design iteration chosen as the baseline must meet the functional equivalency requirements specified in Section 5.2. Slight variations in the geometry resulting from the design iterations are acceptable if the baseline and proposed design offer the same services and functions.

The material quantities in the baseline that are derived from an early design iteration may be attained from a lower quality data source than the proposed design. If certain materials, product types, and quantities are not specified in the early design, the user shall collaborate with the project team to determine these factors for establishing the baseline.

The project team can utilize data from comparable previous projects as a reference to estimate the quantity of materials in the baseline. As an example, the quantity of structural materials can be estimated based on the amount of those materials per gross floor area obtained from a similar previous project.

Early-design wbLCA or embodied carbon assessment tools can also be used to estimate the missing material quantities.

(b) Using the Proposed Design

The user can modify the proposed design wbLCA to create the baseline to demonstrate compliance.

This approach ensures the baseline is functionally-equivalent to the proposed design, has a similar level of detail, and the user is aware of all sources of difference between the embodied carbon of the proposed design and the baseline (e.g., material substitutions and material efficiencies).

To do so, a copy of the proposed design wbLCA is created. The quantities, types, and EPDs of the materials used in the proposed design to reduce embodied carbon are replaced with the common-practice quantities, types, and EPDs.

Section 5.4 offers further guidance on material and component assumptions for the baseline.

5.4 Default Baseline Assumptions

The project team shall use their professional judgement to specify the baseline materials and assemblies that reflect local common practice specific to the given building archetype. See Section

4.2 (c) for more guidance on identifying the common-practice approaches. See Section 4.3 (c) for guidance on default material type and EPD assumptions.

Table 3 provides additional guidance on calculating the embodied carbon of the baseline, relative to the proposed design. Table 3 is loosely organized by embodied carbon reduction strategies adapted from the Carbon Leadership Forum’s Embodied Carbon Reduction Checklist³². Refer to the resources provided in the Intent Section for ideas and strategies to reduce embodied carbon.

Where baseline assumptions specified by the project team vary from Table 1, Table 2, and Table 3, a description shall be provided alongside the embodied carbon results (see Section 6.2 (d)).

Table 3: Calculating Embodied Carbon of the Baseline Relative to the Proposed Design

Baseline	Proposed Design
1. Build Less, Reuse More	
Reduce Demolition	
(Out of scope) If the proposed design includes partial or complete demolition of any existing structure or building on the site, the baseline shall not include the emissions from the demolition of the existing building.	(Out of scope) See Section 4.3 (c) (vi)
Reuse/Retrofit Existing Buildings	
The baseline shall assume entirely new construction for all building areas, even if some portions of the building will be retained and reused in the proposed design.	See Section 4.3 (c) (vi)
Use Salvaged or Refurbished Materials	
The baseline shall assume entirely new materials for all materials and assemblies, even if salvaged materials are used in the proposed design.	See Section 4.3 (c) (vi)
Design for Disassembly (DfD)	
(Optional) Even if DfD is incorporated in the proposed design, default module C and D assumptions in the software tool shall be used for the baseline. The baseline module C and D data may be modified if the project team can provide more representative project-specific or regional data on these modules.	(Optional) See Section 4.3 (c) (vii)

³² <https://carbonleadershipforum.org/ec-checklist-template>

Baseline	Proposed Design																						
2. Design Lighter and Smarter																							
Reduce Floor Area of Below-Grade Construction																							
<p>The baseline shall assume parkade areas consistent with the minimum parking requirements in the City of Vancouver parking by-law.</p> <p>In areas without a minimum, or where the parking amounts resulting from a minimum are unclear, the following table may be used. In buildings with large footprints, or that are part of larger developments, the values in the table below may be excessive. Users are encouraged to use their professional judgement in creating an appropriate baseline.</p> <table border="1" data-bbox="302 604 1037 1087"> <thead> <tr> <th colspan="2" data-bbox="302 604 1037 642">Baseline Assumptions for Below-Grade Parking Structure</th> </tr> <tr> <th data-bbox="302 642 680 699">Above-Grade Storeys in the Proposed Building</th> <th data-bbox="680 642 1037 699">Below-Grade Storeys</th> </tr> </thead> <tbody> <tr> <td data-bbox="302 699 680 737">1-3</td> <td data-bbox="680 699 1037 737">1</td> </tr> <tr> <td data-bbox="302 737 680 795">4-6</td> <td data-bbox="680 737 1037 795">RR zones: 1 All others: 2</td> </tr> <tr> <td data-bbox="302 795 680 833">7-12</td> <td data-bbox="680 795 1037 833">2</td> </tr> <tr> <td data-bbox="302 833 680 871">13-18</td> <td data-bbox="680 833 1037 871">3</td> </tr> <tr> <td data-bbox="302 871 680 909">19-24</td> <td data-bbox="680 871 1037 909">4</td> </tr> <tr> <td data-bbox="302 909 680 947">25-30</td> <td data-bbox="680 909 1037 947">5</td> </tr> <tr> <td data-bbox="302 947 680 984">31-36</td> <td data-bbox="680 947 1037 984">6</td> </tr> <tr> <td data-bbox="302 984 680 1022">37-42</td> <td data-bbox="680 984 1037 1022">7</td> </tr> <tr> <td data-bbox="302 1022 680 1087">43+</td> <td data-bbox="680 1022 1037 1087">8</td> </tr> </tbody> </table>	Baseline Assumptions for Below-Grade Parking Structure		Above-Grade Storeys in the Proposed Building	Below-Grade Storeys	1-3	1	4-6	RR zones: 1 All others: 2	7-12	2	13-18	3	19-24	4	25-30	5	31-36	6	37-42	7	43+	8	<p>As per the proposed design</p>
Baseline Assumptions for Below-Grade Parking Structure																							
Above-Grade Storeys in the Proposed Building	Below-Grade Storeys																						
1-3	1																						
4-6	RR zones: 1 All others: 2																						
7-12	2																						
13-18	3																						
19-24	4																						
25-30	5																						
31-36	6																						
37-42	7																						
43+	8																						
Design Structure for Material Efficiency																							
<p>The baseline may assume a typical structural design, appropriate to the building and functionally equivalent to the proposed design, as determined by the building structural engineer.</p> <p>Where intentional design choices are made that vary from a typical design and result in embodied carbon reduction, those may be reflected in differences between the baseline and the proposed design. Otherwise, both the baseline and proposed design shall have the same structural design assumptions. Examples of these design choices for the structural elements include:</p> <ul style="list-style-type: none"> Increasing bay sizing, column and beam spacing, and member cross sections; Avoiding cantilevers and transfer slabs; Reducing rebar quantities in structural concrete by using post-tensioned slabs; The knock-on effects of lighter structures, e.g., using void systems, timber structural elements, lighter enclosure and façade systems may result in smaller footings and foundations. Allowing for the preservation of an existing structure; Exposing structural materials where possible to avoid finishing. 	<p>As per the proposed design</p>																						

Baseline	Proposed Design
<p>For more guidance, refer to Table 1 and Table 2 in this document and the Whole Building Life Cycle Assessment: Reference Building Structure and Strategies by ASCE/SEI (See Appendix A.2 (f)).</p> <div data-bbox="285 380 1029 621" style="border: 1px solid black; padding: 10px; margin: 10px 0;"> <p>Note:</p> <p>If an early design iteration is used as the baseline (Section 5.3 (a)), contingency factors assumed in early design (e.g. adding an extra 10% to structural materials quantity) shall be excluded. Embodied carbon reduction from removing the contingency factors cannot be accounted for in compliance.</p> </div>	
Choose Finishes Carefully	
<p>Optional</p> <p>If included in the embodied carbon of the proposed design, the baseline may assume typical interior finishes, appropriate to the building and functionally equivalent to the proposed design, as determined by the building architect.</p> <p>See Table 1 for more guidance on interior material and assembly types.</p>	<p>Optional</p> <p>As per the proposed design</p>
Minimize Construction and Demolition Waste	
<p>As per the default scenarios in the software tools for modules A5 and C1-C4.</p> <p>The baseline data may be modified, if the tool allows it, and if the project team can provide more representative project-specific or regional waste management data.</p>	<p>As per the proposed design</p>
3. Use Low-Carbon Alternatives	
Select Lower-Carbon Structural and Enclosure Materials and Assemblies	
<p>The baseline structure and enclosure assemblies and materials shall reflect local typical practice for the building type and application. The project team should use their professional judgement to specify the local common practice for the building archetype and application.</p> <p>Refer to Table 1 for more guidance on common materials and assemblies in Vancouver local practices.</p>	<p>As per proposed design</p>
Select Carbon-Storing Materials	
<p>(Optional for reporting) (Out of scope for compliance)</p> <p>If reported for the proposed design, the baseline shall also report biogenic carbon. The results shall be reported separately and shall not be included in demonstration of compliance.</p>	<p>(Optional for reporting) (Out of scope for compliance)</p> <p>See Section 4.4 (a)</p>

Baseline	Proposed Design
Select Lower-Carbon Mechanical, Electrical, and Plumbing (MEP) Systems	
<p>(Optional)</p> <p>If included in the proposed design, the baseline shall assume typical MEP design that meets the operational carbon requirements in VBBL, as determined by the building mechanical engineer.</p> <p>Refer to Table 2 for more guidance on calculating embodied carbon of services.</p>	<p>(Optional)</p> <p>As per the proposed design</p>
4. Procure Low-Carbon Products	
Use Zero-carbon Construction	
<p>For construction site emissions, the baseline shall be as per the default scenarios in the software tool for modules A4 and A5. The default values in the tool may be replaced with more comprehensive data that the project team may have from comparable previous projects.</p>	<p>See Section 4.3 (c) (iii)</p>
Specify Lower-carbon Options	
<p>The baseline shall use the most local industry-wide EPD available for a material or product (by order of priority: BC, Canada, and North America).</p> <p>Refer to Section 4.3 (c) (i) for more guidance on choosing the industry-wide EPDs for common materials and products.</p>	<p>See Section 4.3 (c) (i)</p>

6 Documentation

The documents specified in Sections 6.1 and 6.2 shall be submitted at the time of Building Permit application. For rezoning application requirements, refer to the applicable policy and/or bulletin³³.

Resubmission of these documents are not required at Occupancy Permit stage.

The documents and data collected will be utilized for compliance purposes. In addition, anonymized data might be shared with research entities and policy makers for informing future policy and regulatory enhancements.

6.1 Embodied Carbon Design Report

Compliance with embodied carbon requirements in the VBBL shall be demonstrated by submitting the Embodied Carbon Design Report³⁴.

Where, as allowed by these guidelines, manual changes to the software tool have been made, or alternates to the default assumptions specified in these guidelines used, a summary and justification shall be submitted in the spaces provided in the Embodied Carbon Design Report.

Projects with multiple buildings shall follow the guidance provided in Section 2.4 (a) to decide whether the embodied carbon compliance of the buildings should be reported separately or together. If reported separately, one Embodied Carbon Design Report shall be submitted per building.

6.2 Other Submittal Requirements

In addition to the Embodied Carbon Design Report, projects shall provide a compressed file containing all of the following³⁵.

(a) **Embodied Carbon Emissions**

The embodied carbon emissions breakdown or an equivalent output of all the raw data from the software tool.

(b) **Bill of Materials**

The bill of materials or an equivalent output of all the raw data from the software tool.

(c) **EPDs**

Where the proposed design requires specific products, or requires an equivalent embodied carbon intensity, and the EPD for the specified product is not available in the software tool used, the product-specific EPD shall be submitted.

³³ <https://vancouver.ca/green-vancouver/zero-emissions-buildings.aspx#bylaws-policies-guidelines>

³⁴ [The link to the Design Report will be added here once available]

³⁵ See the following link for guidance on preparing and submitting raw data outputs from each software tool:
<https://tinyurl.com/COV-ECDR>.

Appendices

Embodied Carbon Guidelines

DRAFT

Appendix A: References

A.1 Normative References

(a) Quantifying Whole-building Embodied Carbon

- (i) EN 15978:2011 Sustainability of Construction Works – Assessment of environmental performance of buildings – Calculation method³⁶, 2011

(b) Life cycle Inventory (LCIA)

- (i) Tool for Reduction and Assessment of Chemicals and Other Environmental Impacts (TRACI) v2.1³⁷, 2012

(c) Environmental Product Declarations (EPDs)

- (i) ISO 21930:2017 Sustainability in Buildings and Civil Engineering Works – Core Rules for Environmental Product Declarations of Construction Products and Services³⁸, 2017
- (ii) EN 15804+A1 or EN 15804+A2 Sustainability of Construction Works – Environmental Product Declarations – Core Rules for the Product Category of Construction Products³⁹, 2014 and 2019

(d) Industry Average Embodied Carbon Intensities

- (i) 2023 CLF North American Material Baselines Report⁴⁰, 2023 (referred to as CLF Baseline Report in this document)

A.2 Informative References

(a) Common wbLCA and Embodied Carbon Assessment Software Tools

The following are the most common software tools used in North America for embodied carbon assessment of Part 3 buildings. These tools follow the normative standards specified in the above (a)-(c) sub-sections. These tools are acceptable for compliance with VBBL.

³⁶ The current version of the NRC Guidelines (2022) references EN 15978:2011, instead of the international standard equivalents, ISO 21931-1:2010. This is because the available version of the ISO standard at the time did not provide much detail on conducting wbLCA. However, the new version, ISO 21931-1:2022, is available now. If NRC Guidelines replaced the EN 15978:2011 reference with ISO 21931-1:2022, the wbLCA for compliance shall also comply with ISO 21931-1:2022.

³⁷ <https://www.epa.gov/chemical-research/tool-reduction-and-assessment-chemicals-and-other-environmental-impacts-traci>

³⁸ ISO 21930 is an international standard that provides principles, specifications and requirements for building product EPDs. ISO 21930 is the standard used in North America for building products.
<https://www.iso.org/standard/61694.html#:~:text=ISO%2021930%3A2017%20provides%20the,any%20type%20of%20construction%20works>.

³⁹ EN 15804 is a European standard that European building product EPDs had to comply with before July 2022.

<https://www.en-standard.eu/une-en-15804-2012-a1-2014-sustainability-of-construction-works-environmental-product-declarations-core-rules-for-the-product-category-of-construction-products/>

In 2019, a major addendum was added to EN 15804, which became mandatory in July 2022.

<https://www.en-standard.eu/csn-en-15804-a2-sustainability-of-construction-works-environmental-product-declarations-core-rules-for-the-product-category-of-construction-products/>

⁴⁰ At the time of publishing these guidelines, 2023 is the latest version of the CLF Baseline Report, which is available here:

<https://carbonleadershipforum.org/clf-material-baselines-2023/>

If other tools are used, the user must check with the tool providers to ensure the tool and the databases used within the tool comply with standards specified in Appendix A.1 (a)-(c).

If the user modifies the default embodied carbon results from the software tool used to incorporate EPDs that are not available in, they user ensure the EPD used comply with one of the standards specified in sub-section (c).

- (i) Athena Impact Estimator⁴¹
 - (ii) TallyLCA⁴²
 - (iii) TallyCAT⁴³
 - (iv) Embodied Carbon in Construction calculator (EC3)⁴⁴
 - (v) One Click LCA⁴⁵
- (b) **Whole-building Embodied Carbon Assessment**
- (i) NRC National Guidelines for Whole-Building Life Cycle Assessment⁴⁶, 2022 (referred to as NRC Guidelines in this document)
 - (ii) KPMB Lab WBLCA Classification System⁴⁷, 2022
 - (iii) BSR/ASHRAE/ICC Standard 240P, Evaluating Greenhouse Gas (GHG) and Carbon Emissions in Building Design, Construction and Operation, Advisory Public Review Draft⁴⁸, 2023 (referred to as ASHRAE/ICC 240p in this document)
- (c) **Building Element Classification**
- (i) OmniClass⁴⁹, Table 21 - Elements⁵⁰, 2012
- (d) **Building Services Embodied Carbon Assessment (Optional)**
- (i) TM65 Embodied Carbon in Building Services: A Calculation Methodology⁵¹, 2021
 - (ii) TM65LA Embodied carbon in building services: Using TM65 outside the UK⁵², 2022

⁴¹ <https://calculatelca.com/software/impact-estimator/>

⁴² <https://www.buildingtransparency.org/tally/tally-lca/>

⁴³ <https://www.buildingtransparency.org/tally/tallycat/>

⁴⁴ <https://carbonleadershipforum.org/ec3-tool/>

⁴⁵ <https://www.oneclicklca.com/construction/life-cycle-assessment-software/>

⁴⁶ <https://nrc-publications.canada.ca/eng/view/object?id=f7bd265d-cc3d-4848-a666-8eeb1fbde910>

⁴⁷ <http://kpmb.com/wp-content/uploads/2022/09/WBLCA-Classification-System.pdf>

⁴⁸ This reference is a draft standard and is subject to change. However, the content provided valuable resource for these guidelines. An advisory public review was open for the draft standard in April-May 2023. See the following link for more information:

<https://www.ashrae.org/about/news/2023/ashrae-and-the-international-code-council-seeking-comments-on-greenhouse-gas-emissions-evaluation-standard>

⁴⁹ <https://www.csiresources.org/standards/omniclass>

⁵⁰ OmniClass consists of 15 tables for classifying the entire built environment throughout the full project life cycle. Table 21 (Elements) provides a hierarchical taxonomy for classifying and identifying elements within a facility.

⁵¹ Developed by the UK Chartered Institution of Building Services Engineers (CIBSE), TM65 provides guidance on how to use EPDs to assess the embodied carbon of building services equipment, and where EPDs are not available, it provides guidance on how to estimate the embodied carbon.

<https://www.cibse.org/knowledge-research/knowledge-portal/embodied-carbon-in-building-services-a-calculation-methodology-tm65>

⁵² <https://www.cibse.org/knowledge-research/knowledge-portal/tm65la-using-the-tm65-methodology-outside-the-uk-pdf-2022>

(e) **Design for Disassembly (Optional)**

- (i) CSA Z782-06 Guideline for Design for Disassembly and Adaptability in Buildings⁵³, 2006

(f) **Determining the Baseline**

- (i) ASCE/SEI Whole Building Life Cycle Assessment: Reference Building Structure and Strategies⁵⁴, 2018

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⁵³ This guideline by Canadian Standard Association provides a framework for reducing the negative environmental impact of building construction and waste through design for disassembly and adaptability

<https://www.csagroup.org/store/product/Z782-06/>
⁵⁴ <https://ascelibrary.org/doi/book/10.1061/9780784415054>

Appendix B: Additional Information on the Specification of the Object of Assessment

B.1 Life Cycle Stages

(a) Life Cycle Stages and the System Boundary for Compliance

The following graph shows the life cycle stages and the system boundary for a wbLCA to comply with these guidelines.

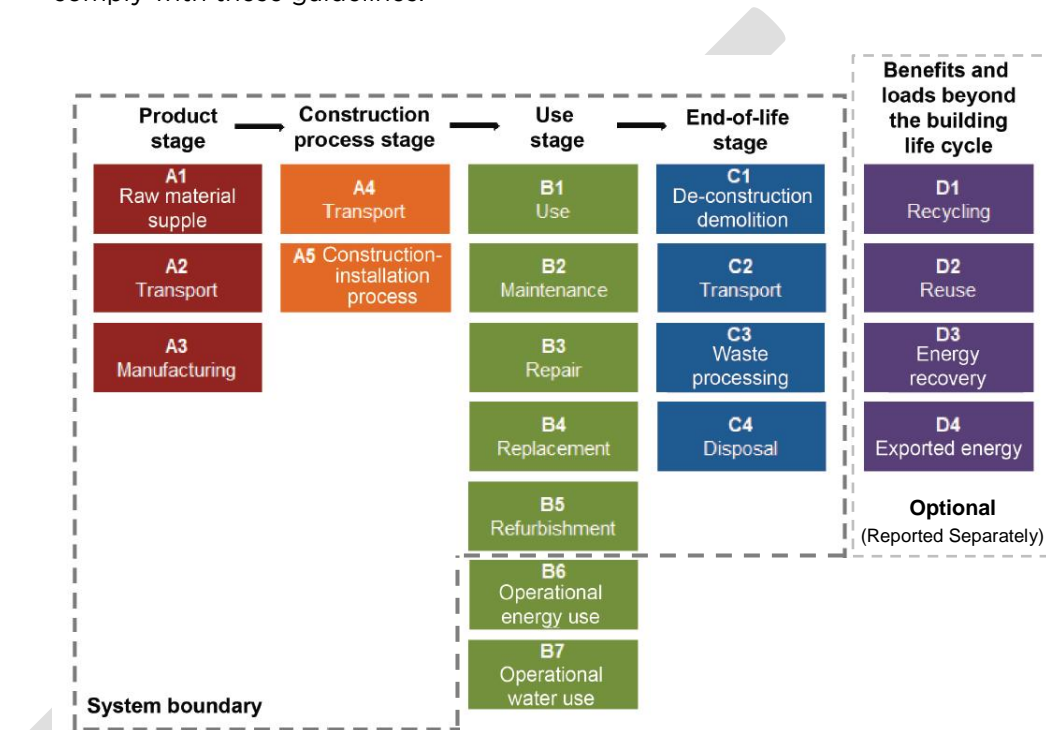


Figure 2: Life Cycle Stages and the System Boundary
(Source: Figure 4, NRC Guidelines, Modified)

(b) Description of Life Cycle Stages

The following definitions for the life cycle stages are from ASHRAE/ICC 240p.

(i) Product Stage (Modules A1-A3)

- **Raw material supply (Module A1):**

The raw material supply module includes all processes and materials associated with harvesting, extraction, collection, and further production of raw materials.

- **Raw material transport (Module A2):**

The raw material transport module includes the transport of raw materials to a product manufacturing facility or to multiple manufacturing facilities.

- **Manufacturing (Module A3):**

The manufacturing module includes the processes and materials required for the fabrication and production of a product. These typically occur within a manufacturing facility.

(ii) **Construction stage (Modules A4-A5)**

- **Transportation to the construction site (Module A4):**

The transportation to the construction site module includes the delivery of all materials and products included in the bill of materials to the construction site.

- **Construction (Module A5):**

The construction module assessment includes processes and materials required for the assembly of the project on a site.

(iii) **Use stage (Modules B1 – B7)**

- **In-use emissions (Module B1):**

The in-use emissions module captures the non-energy related emissions that occur during the life of the building associated with normal conditions of use of the products and components installed in the project. This module also includes emissions from materials such as off-gassing or blowing agents in insulation, processes such as carbonation, and fugitive emissions of refrigerants.

- **Maintenance (Module B2):**

The maintenance module includes all processes and materials used for planned maintenance required to sustain the functions of the building and building systems, including the production, transportation, and end-of-life treatment of materials used in the maintenance processes.

- **Repair (Module B3):**

The repair module assessment includes all processes and materials required to sustain the functions of the building outside of regularly planned maintenance, including production and transport of materials and components, waste management and end-of-life treatment of materials and components removed from the building, and production, transport and disposal of ancillary materials used during the repair.

- **Replacement (Module B4):**

The replacement module assessment includes all processes, materials, and components used in replacing components in their entirety at the end of their service life, including production and transportation of new materials and components, waste management and end-of-life treatment of materials and components removed from the building, and production, transport and disposal of ancillary materials used during the replacement.

- **Refurbishment (Module B5):**

The refurbishment module assessment includes all processes, materials, and components used during refurbishment or retrofit processes within the larger project, including production and transportation of new materials and components, waste management and end-of-life treatment of materials and components removed from

the building, and production, transport and disposal of ancillary materials used during the refurbishment activity.

- **Operational energy use (Module B6):**

The operational energy use module includes energy use within the project during the service life of the building, including regulated, non-regulated, and other energy use associated with building user activities (e.g., plug loads and fuel-based process loads).

- **Operational water use (Module B7):**

The operational water use module includes water use and its treatment during the service life of the building, including drinking water used by building-integrated systems and appliance use. Excludes water systems and equipment.

(iv) **Deconstruction and end-of-life (Modules C1-4)**

- **Deconstruction (Module C1):**

The deconstruction module includes all on-site and off-site processes and inputs for the decommissioning, dismantling, deconstructing, and/or demolishing the project.

- **End-of-life transportation (Module C2):**

The end-of-life transportation module includes all transportation between the site and the final sorting, disposal, or end-of-waste location, including transportation to and from intermediate storage or waste processing locations.

- **Processing for reuse, recovery, or recycling (Module C3):**

The processing for reuse, recovery, or recycling module includes all processes and material flows required for recycling, reusing, or recovering construction products, materials, construction elements, and debris to reach their end-of-waste state as recovered material re-entering the market.

- **Disposal (Module C4):**

The disposal module includes all processes and material flows required for waste disposal and treatment, including neutralization, incineration, landfilling, and management of the disposal site.

- Disposal management shall include on-site transport and energy and water use related to waste processing at the disposal location.
- For end-of-life processes with long-term emissions, such as landfilling, a period of 100 years shall be used to calculate relevant emissions.
- Environmental loads from energy recovery process shall be included in the disposal stage assessment.

(v) **Benefits and loads beyond the system boundary (Modules D1-D2)**

- **Future substitution of resources (Module D1):**

The future substitution of resources module includes all environmental loads and benefits from reused products, recycled materials, secondary fuels, and recovered energy leaving a project for use in a subsequent product system as material.

- **Exported energy (Module D2):**

The exported energy module includes all environmental loads and benefits for recovered and exported energy used to meet the energy demand outside of the project.

B.2 Building Elements, Required and Optional Scope for Compliance

Table 4 expands upon the element list provided in Table 9 in NRC Guidelines, Building Model Scope Definition. Table 9 of the NRC Guidelines offer a Level 3, UniFormat⁵⁵ Level 3 OmniClass element list⁵⁶. To provide further clarity on the element scope for VBBL compliance, Table 4 includes Level 4 OmniClass element titles. The last column of Table 4 specifies whether each element is required, optional, or out of scope for VBBL compliance.

Note:

The required scope specified in Table 4 are subject to availability of data from the project and software tool. The user shall specify the required scope that are excluded from reporting with a brief explanation in the Embodied Carbon Design Report (see Section 6.2 (d)).

⁵⁵ <https://www.csiresources.org/standards/uniformat>

⁵⁶ See Appendix A.2 (c)

Table 4: Mandatory and Optional Element Scope for Compliance with VBBL

(Adapted from Table 9, NRC Guidelines)

Legend:

Required	Optional	Exclude
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UniFormat	OmniClass			Inclusion in Scope	
Level 3	Level 3		Level 4		
A	01 00 00	Substructure			
A10	01 10	Foundations			
A 1010	01 10 10	Standard Foundations	01 10 10 10	Wall Foundations	Required
			01 10 10 30	Column Foundations	
			01 10 10 90	Standard Foundation Supplementary Components	Optional
A1020	01 10 20	Special Foundations	01 10 20 10	Driven Piles	Required
			01 10 20 15	Bored Piles	
			01 10 20 20	Caissons	
			01 10 20 30	Special Foundation Walls	Optional
			01 10 20 40	Foundation Anchors	
			01 10 20 50	Underpinning	
			01 10 20 60	Raft Foundations	
		01 10 20 70	Pile Caps	Required	
		01 10 20 80	Grade Beams		
A20	01 20	Subgrade Enclosures			
A2010	01 20 10	Walls for Subgrade Enclosures	01 20 10 10	Subgrade Enclosure Wall Construction	Required
			01 20 10 20	Subgrade Enclosure Wall Interior Skin	
			01 20 10 90	Subgrade Enclosure Wall Supplementary Components	Optional
A40	01 40	Slabs-on-Grade			
A4010	01 40 10	Standard Slabs-on-Grade	-	-	Required
A4030	01 40 20	Structural Slabs-on-Grade	-	-	Required
A4040	01 40 30	Slab Trenches	-	-	Optional
A4040	01 40 40	Pits and Bases	-	-	Optional
A4090	01 40 90	Slab-On-Grade Supplementary Components	01 40 90 10	Perimeter Insulation	Required
			01 40 90 20	Vapor Retarder	
			01 40 90 30	Waterproofing	
			01 40 90 60	Subbase Layer	
			01 40 90 50	Mud Slab	Optional
A60	01 60	Water and Gas Mitigation			
A6010	01 60 10	Building Sub-drainage	01 60 10 10	Foundation Drainage	Optional
			01 60 10 20	Under-slab Drainage	
A6020	01 60 20	Off-Gassing Mitigation	01 60 20 10	Radon Mitigation	Exclude
			01 60 20 50	Methane Mitigation	
A90	01 90	Substructure Related Activities			
A9010	01 90 10	Substructure Excavation	01 90 10 10	Backfill and Compaction	Optional
A9020	01 90 20	Construction Dewatering	-	-	Exclude
A9030	01 90 30	Excavation Support	01 90 30 10	Anchor Tiebacks	Exclude
			01 90 30 20	Cofferdams	
			01 90 30 40	Cribbing and Walers	
			01 90 30 60	Ground Freezing	
			01 90 30 70	Slurry Walls	
A9040	01 90 40	Soil Treatment	-	-	Exclude

UniFormat	OmniClass			Inclusion in Scope	
Level 3	Level 3	Level 4			
B	02 00 00	Shell			
B10	02 10	Superstructure			
B1010	02 10 10	Floor Construction	02 10 10 10	Floor Structural Frame <i>(Includes Columns, Beams, Shear Walls)</i>	Required
			02 10 10 20	Floor Decks, Slabs, and Toppings <i>(Includes Fireproofing and Acoustic)</i>	
			02 10 10 30	Balcony Floor Construction	
			02 10 10 40	Mezzanine Floor Construction	
			02 10 10 50	Ramps	
			02 10 10 90	Floor Construction Supplementary Components	Optional
B1020	02 10 20	Roof Construction	02 10 20 10	Roof Structural Frame	Required
			02 10 20 20	Roof Decks, Slabs, and Sheathing	
			02 10 20 30	Canopy Construction	
			02 10 20 90	Roof Construction Supplementary Components	Optional
B1080	02 10 80	Stairs	02 10 80 10	Stair Construction	Required
			02 10 80 30	Stair Soffits	
			02 10 80 50	Stair Railings	
			02 10 80 60	Fire Escapes	Optional
			02 10 80 70	Metal Walkways	
			02 10 80 80	Ladders	
B20	02 20	Exterior Vertical Enclosures			
B2010	02 20 10	Exterior Walls	02 20 10 10	Exterior Wall Veneer	Required
			02 20 10 20	Exterior Wall Construction	
			02 20 10 30	Exterior Wall Interior Skin	
			02 20 10 40	Fabricated Exterior Wall Assemblies	
			02 20 10 50	Parapets	
			02 20 10 60	Equipment Screens	Optional
			02 20 10 80	Exterior Wall Supplementary Components	
02 20 10 90	Exterior Wall Opening Supplementary Components				
B2020	02 20 20	Exterior Windows	02 20 20 10	Exterior Operating Windows	Required
			02 20 20 20	Exterior Fixed Windows	
			02 20 20 30	Exterior Window Wall	
			02 20 20 40	Exterior Special Function Windows	
B2050	02 20 50	Exterior Doors and Grilles	02 20 50 10	Exterior Entrance Doors	Required
			02 20 50 20	Exterior Utility Doors	
			02 20 50 30	Exterior Oversize Doors	
			02 20 50 40	Exterior Special Function Doors	Optional
			02 20 50 60	Exterior Grilles	
			02 20 50 70	Exterior Gates	
B2070	02 20 70	Exterior Louvers and Vents	02 20 70 10	Exterior Louvers	Optional
			02 20 70 50	Exterior Vents	
B2080	02 20 80	Exterior Wall Appurtenances	02 20 80 10	Exterior Fixed Grilles and Screens	Optional
			02 20 80 30	Exterior Opening Protection Devices	
			02 20 80 50	Exterior Balcony Walls and Railings	
			02 20 80 70	Exterior Fabrications	
			02 20 80 80	Bird Control Devices	
B2090	02 20 90	Exterior Wall Specialties	-	-	Optional

UniFormat	OmniClass			Inclusion in Scope
Level 3	Level 3	Level 4		
B30	02 30	Exterior Horizontal Enclosures		
B3010	02 30 10	Roofing	02 30 10 10 Steep Slope Roofing	Required
			02 30 10 50 Low-Slope Roofing	
			02 30 10 70 Canopy Roofing	
			02 30 10 90 Roofing Supplementary Components	
B3020	02 30 20	Roof Appurtenances	02 30 20 10 Roof Accessories	Optional
			02 30 20 30 Roof Specialties	
			02 30 20 70 Rainwater Management	
B3040	02 30 40	Traffic Bearing Horizontal Enclosures	02 30 40 10 Traffic Bearing Coatings	Optional
			02 30 40 30 Horizontal Waterproofing Membrane	
			02 30 40 50 Wear Surfaces	
			02 30 40 90 Horizontal Enclosure Supplementary Components	
B3060	02 30 60	Horizontal Openings	02 30 60 10 Roof Windows and Skylights	Required
			02 30 60 50 Vents and Hatches	Optional
			02 30 60 90 Horizontal Opening Supplementary Components	
B3080	02 30 80	Overhead Exterior Enclosures	02 30 80 10 Exterior Ceilings	Optional
			02 30 80 20 Exterior Soffits	
			02 30 80 30 Exterior Bulkheads	
C	03 00 00	Interiors		
C10	03 10	Interior Construction		
C1010	03 10 10	Interior Partitions	03 10 10 10 Interior Fixed Partitions	Optional
			03 10 10 20 Interior Glazed Partitions	
			03 10 10 40 Interior Demountable Partitions	
			03 10 10 50 Interior Operable Partitions	
			03 10 10 70 Interior Screens	
			03 10 10 90 Interior Partition Supplementary Components	
C1020	03 10 20	Interior Windows	03 10 20 10 Interior Operating Windows	Optional
			03 10 20 20 Interior Fixed Windows	
			03 10 20 50 Interior Special Function Windows	
			03 10 20 90 Interior Window Supplementary Components	
C1030	03 10 30	Interior Doors	03 10 30 10 Interior Swinging Doors	Optional
			03 10 30 20 Interior Entrance Doors	
			03 10 30 25 Interior Sliding Doors	
			03 10 30 30 Interior Folding Doors	
			03 10 30 40 Interior Coiling Doors	
			03 10 30 50 Interior Panel Doors	
			03 10 30 70 Interior Special Function Doors	
			03 10 30 80 Interior Access Doors and Panels	
			03 10 30 90 Interior Door Supplementary Components	
C1040	03 10 40	Interior Grilles and Gates	03 10 40 10 Interior Grilles	Optional
			03 10 40 50 Interior Gates	
C1060	03 10 60	Raised Floor Construction	03 10 60 10 Access Flooring	Optional
			03 10 60 10 Platform/Stage Floors	
C1070	03 10 70	Suspended Ceiling Construction	03 10 70 10 Acoustical Suspended Ceilings	Optional
			03 10 70 20 Suspended Plaster and Gypsum Board Ceilings	
			03 10 70 50 Specialty Suspended Ceilings	
			03 10 70 70 Special Function Suspended Ceilings	
			03 10 70 90 Ceiling Suspension Components	

UniFormat	OmniClass		Level 4		Inclusion in Scope
Level 3	Level 3				
C1090	03 10 90	Interior Specialties	03 10 90 10	Interior Railings and Handrails	Optional
			03 10 90 15	Interior Lovers	
			03 10 90 20	Information Specialties	Exclude
			03 10 90 25	Compartments and Cubicles	
			03 10 90 30	Service Walls	
			03 10 90 35	Wall and Door Protection	
			03 10 90 40	Toilet, Bath, and Laundry Accessories	
			03 10 90 45	Interior Gas Lighting	
			03 10 90 50	Fireplaces and Stoves	
			03 10 90 60	Safety Specialties	
			03 10 90 70	Storage Specialties	
03 10 90 90	Other Interior Specialties				
C10	03 20	Interior Finishes			
C2010	03 20 10	Wall Finishes	03 20 10 10	Tile Wall Finish	Optional
			03 20 10 20	Wall Paneling	
			03 20 10 30	Wall Coverings	
			03 20 10 35	Wall Carpeting	
			03 20 10 50	Stone Facing	
			03 20 10 60	Special Wall Surfacing	
			03 20 10 70	Wall Painting and Coating	
			03 20 10 80	Acoustical Wall Treatment	
			03 20 10 90	Wall Finish Supplementary Components	
C2020	03 20 20	Interior Fabrications	-	-	Optional
C2030	03 20 30	Flooring	03 20 30 10	Flooring Treatment	Optional
			03 20 30 20	Tile Flooring	
			03 20 30 30	Specialty Flooring	
			03 20 30 40	Masonry Flooring	
			03 20 30 50	Wood Flooring	
			03 20 30 60	Resilient Flooring	
			03 20 30 70	Terrazzo Flooring	
			03 20 30 75	Fluid-Applied Flooring	
			03 20 30 80	Carpeting, Athletic Flooring	
			03 20 30 85	Entrance Flooring	
			03 20 30 90	Flooring Supplementary Components	
C2040	03 20 40	Stair Finishes	03 20 40 20	Tile Stair Finish	Optional
			03 20 40 40	Masonry Stair Finish	
			03 20 40 45	Wood Stair Finish	
			03 20 40 50	Resilient Stair Finish	
			03 20 40 60	Terrazzo Stair Finish	
			03 20 40 75	Carpeted Stair Finish	
C2050	03 20 50	Ceiling Finishes	03 20 50 10	Plaster and Gypsum Board Finish	Optional
			03 20 50 20	Ceiling Paneling	
			03 20 50 70	Ceiling Painting and Coating	
			03 20 50 80	Acoustical Ceiling Treatment	
			03 20 50 90	Ceiling Finish Supplementary Components	
D	04 00 00	Services			
D10	04 10	Conveying			
D1010	04 10 10	Vertical Conveying Systems	04 10 10 10	Elevators	Optional
			04 10 10 20	Lifts	
			04 10 10 30	Escalators	
			04 10 10 50	Dumbwaiters	
			04 10 10 60	Moving Ramps	

UniFormat	OmniClass			Inclusion in Scope	
Level 3	Level 3	Level 4			
D1030	04 10 30	Horizontal Conveying	04 10 30 10	Moving Walks	Optional
			04 10 30 30	Turntables	
			04 10 30 50	Passenger Loading Bridges	
			04 10 30 70	People Movers	Exclude
D1050	04 10 50	Material Handling	04 10 50 10	Cranes	Exclude
			04 10 50 20	Hoists	
			04 10 50 30	Derricks	
			04 10 50 40	Conveyors	
			04 10 50 50	Baggage Handling Equipment	
			04 10 50 60	Chutes	
			04 10 50 70	Pneumatic Tube Systems	
D1080	04 10 80	Operable Access Systems	04 10 80 10	Suspended Scaffolding	Exclude
			04 10 80 20	Rope Climbers	
			04 10 80 30	Elevating Platforms	
			04 10 80 40	Powered Scaffolding	
			04 10 80 50	Building Envelope Access	
D20	04 20	Plumbing			
D2010	04 20 10	Domestic Water Distribution	04 20 10 10	Facility Potable-Water Storage Tanks	Optional
			04 20 10 20	Domestic Water Equipment	
			04 20 10 40	Domestic Water Piping	
			04 20 10 60	Plumbing Fixtures	
D2020	04 20 20	Sanitary Drainage	04 20 20 10	Sanitary Sewerage Equipment	Optional
			04 20 20 30	Sanitary Sewerage Piping	
			04 20 20 90	Sanitary Drainage Supplementary Components	
			04 20 30 10	Stormwater Drainage Equipment	
D2030	04 20 30	Building Support Plumbing Systems	04 20 30 20	Stormwater Drainage Piping	Optional
			04 20 30 30	Facility Stormwater Drains	
			04 20 30 60	Gray Water Systems	
			04 20 30 90	Building Support Plumbing System Supplementary Components	
D2050	04 20 50	General Service Compressed-Air	-	-	Optional
D2060	04 20 60	Process Support Plumbing Systems	04 20 60 10	Compressed-Air Systems	Optional
			04 20 60 20	Vacuum Systems	
			04 20 60 30	Gas Systems	
			04 20 60 40	Chemical-Waste Systems	
			04 20 60 50	Processed Water Systems	
			04 20 60 90	Process Support Plumbing System Supplementary Components	
D30	04 30	Heating, Ventilation, and Air Conditioning (HVAC)			
D3010	04 30 10	Facility Fuel Systems	04 30 10 10	Fuel Piping	Optional
			04 30 10 30	Fuel Pumps	
			04 30 10 50	Fuel Storage Tanks	
D3020	04 30 20	Heating Systems	04 30 20 10	Heat Generation	Optional
			04 30 20 30	Thermal Heat Storage	
			04 30 20 70	Decentralized Heating Equipment	
			04 30 20 90	Heating System Supplementary Components	

UniFormat	OmniClass		Level 4		Inclusion in Scope
Level 3	Level 3		Level 4		
D3030	04 30 30	Cooling Systems	04 30 30 10	Central Cooling	Optional
			04 30 30 30	Evaporative Air-Cooling	
			04 30 30 50	Thermal Cooling Storage	
			04 30 30 70	Decentralized Cooling	
D3050	04 30 50	Facility HVAC Distribution Systems	04 30 50 10	Facility Hydronic Distribution	Optional
			04 30 50 30	Facility Steam Distribution	
			04 30 50 50	HVAC Air Distribution	
			04 30 50 90	Facility Distribution Systems Supplementary Components	
D3060	04 30 60	Ventilation	04 30 60 10	Supply Air	Optional
			04 30 60 20	Return Air	
			04 30 60 30	Exhaust Air	
			04 30 60 40	Outside Air	
			04 30 60 60	Air-to-Air Energy Recovery	
			04 30 60 70	HVAC Air Cleaning	
D3070	04 30 70	Special Purpose HVAC Systems	04 30 70 10	Snow Melting	Optional
D40	04 40	Fire Protection			
D4010	04 40 10	Fire Suppression	04 40 10 10	Water-Based Fire-Suppression	Optional
			04 40 10 50	Fire-Extinguishing	
			04 40 10 90	Fire Suppression Supplementary Components	
D4030	04 40 30	Fire Protection Specialties	04 40 30 10	Fire Protection Cabinets	Optional
			04 40 30 30	Fire Extinguishers	
			04 40 30 50	Breathing Air Replenishment Systems	
			04 40 30 70	Fire Extinguisher Accessories	
D50	04 50	Electrical			
D5010	04 50 10	Facility Power Generation	04 50 10 10	Packaged Generator Assemblies	Optional
			04 50 10 20	Battery Equipment	
			04 50 10 30	Photovoltaic Collectors	
			04 50 10 40	Fuel Cells	
			04 50 10 60	Power Filtering and Conditioning	
			04 50 10 70	Transfer Switches	
			04 50 10 90	Facility Power Generation Supplementary Components	
D5020	04 50 20	Electrical Service and Distribution	04 50 20 10	Electrical Service	Optional
			04 50 20 30	Power Distribution	
			04 50 20 70	Facility Grounding	
			04 50 20 90	Electrical Service and Distribution Supplementary Components	
D5030	04 50 30	General Purpose Electrical Power	04 50 30 10	Branch Wiring System	Optional
			04 50 30 50	Wiring Devices	
			04 50 30 90	General Purpose Electrical Power Supplementary Components	
D5040	04 50 40	Lighting	04 50 40 10	Lighting Control	Optional
			04 50 40 20	Branch Wiring for Lighting	
			04 50 40 50	Lighting Fixtures	
			04 50 40 90	Lighting Supplementary Components	

UniFormat	OmniClass			Inclusion in Scope	
Level 3	Level 3		Level 4		
D5080	04 50 80	Miscellaneous Electrical Systems	04 50 80 10	Lightning Protection	Optional
			04 50 80 10	Cathodic Protection	
			04 50 80 10	Transient Voltage Suppression	
			04 50 80 10	Miscellaneous Electrical Systems Supplementary Components	
D60	04 60	Communications			
D6010	04 60 10	Data Communications	04 60 10 10	Data Communications Network Equipment	Optional
			04 60 10 20	Data Communications Hardware	
			04 60 10 30	Data Communications Peripheral Data Equipment	
			04 60 10 50	Data Communications Software	Exclude
			04 60 10 60	Data Communication Program and Integration Services	
D6020	04 60 20	Voice Communications	04 60 20 10	Voice Communications Switching and Routing Equipment	Optional
			04 60 20 20	Voice Communications Terminal Equipment	
			04 60 20 30	Voice Communications Messaging	Exclude
			04 60 20 40	Call Accounting	
			04 60 20 50	Call Management	
D6030	04 60 30	Audio-Video Communication	04 60 30 10	Audio-Video Systems	Optional
			04 60 30 50	Electronic Digital Systems	
D6060	04 60 60	Distributed Communications and Monitoring	04 60 60 10	Distributed Audio-Video Communications Systems	Exclude
			04 60 60 30	Healthcare Communications and Monitoring	
			04 60 60 50	Distributed Systems	
D6090	04 60 90	Communications Supplementary Components	04 60 90 10	Supplementary Components	Exclude
D70	04 70	Electronic Safety and Security			
D7010	04 70 10	Access Control and Intrusion Detection	04 70 10 10	Access Control	Exclude
			04 70 10 50	Intrusion Detection	
D7030	04 70 30	Electronic Surveillance	04 70 30 10	Video Surveillance	Exclude
			04 70 30 50	Electronic Personal Protection	
D7050	04 70 50	Detection and Alarm	04 70 50 10	Fire Detection and Alarm	Exclude
			04 70 50 20	Radiation Detection and Alarm	
			04 70 50 30	Fuel-Gas Detection and Alarm	
			04 70 50 40	Fuel-Oil Detection and Alarm	
			04 70 50 50	Refrigeration Detection and Alarm	
			04 70 50 60	Water Intrusion Detection and Alarm	
D7070	04 70 70	Electronic Monitoring and Control	04 70 70 10	Electronic Detention Monitoring and Control	Exclude
D7090	04 70 90	Electronic Safety and Security Supplementary Components	04 70 90 10	Supplementary Components	Exclude

UniFormat	OmniClass			Inclusion	
Level 3	Level 3	Level 4		in Scope	
D80	04 80	Integrated Automation			
D8010	04 80 10	Integrated Automation Facility Controls	04 80 10 10	Integrated Automation Control of Equipment	Exclude
			04 80 10 20	Integrated Automation Control of Conveying Equipment	
			04 80 10 30	Integrated Automation Control of Fire-Suppression Systems	
			04 80 10 40	Integrated Automation Control of Plumbing Systems	
			04 80 10 50	Integrated Automation Control of HVAC Systems	
			04 80 10 60	Integrated Automation Control of Electrical Systems	
			04 80 10 70	Integrated Automation Control of Communication Systems	
			04 80 10 80	Integrated Automation Control of Electronic Safety and Security Systems	
E	05 00 00	Equipment and Furnishings			
E10	05 10	Equipment			
E1010	05 10 10	Vehicle and Pedestrian Equipment	05 10 10 10	Vehicle Servicing Equipment	Exclude
			05 10 10 30	Interior Parking Control Equipment	
			05 10 10 50	Loading Dock Equipment	
			05 10 10 70	Interior Pedestrian Control Equipment	
E1030	05 10 30	Commercial Equipment	05 10 30 10	Mercantile and Service Equipment	Exclude
			05 10 30 20	Vault Equipment	
			05 10 30 25	Teller and Service Equipment	
			05 10 30 30	Refrigerated Display Equipment	
			05 10 30 35	Commercial Laundry and Dry Cleaning Equipment	
			05 10 30 40	Maintenance Equipment	
			05 10 30 50	Hospitality Equipment	
			05 10 30 55	Unit Kitchens	
			05 10 30 60	Photographic Processing Equipment	
			05 10 30 70	Postal, Packaging, and Shipping Equipment	
		05 10 30 75	Office Equipment		
		05 10 30 80	Foodservice Equipment		
E1040	05 10 40	Institutional Equipment	05 10 40 10	Educational and Scientific Equipment	Exclude
			05 10 40 20	Healthcare Equipment	
			05 10 40 40	Religious Equipment	
			05 10 40 60	Security Equipment	
			05 10 40 70	Detention Equipment	
E1060	05 10 60	Residential Equipment	05 10 60 10	Residential Appliances	Exclude
			05 10 60 50	Retractable Stairs	
			05 10 60 70	Residential Ceiling Fans	
E1070	05 10 70	Entertainment and Recreational Equipment	05 10 70 10	Theater and Stage Equipment	Exclude
			05 10 70 20	Musical Equipment	
			05 10 70 50	Athletic Equipment	
			05 10 70 60	Recreational Equipment	
E1090	05 10 90	Other Equipment	05 10 90 10	Solid Waste Handling Equipment	Exclude
			05 10 90 30	Agricultural Equipment	
			05 10 90 40	Horticultural Equipment	
			05 10 90 60	Decontamination Equipment	

UniFormat	OmniClass			Inclusion in Scope	
Level 3	Level 3	Level 4			
E20	05 20	Furnishings			
E2010	05 20 10	Fixed Furnishings	05 20 10 10	Fixed Art	Exclude
			05 20 10 20	Window Treatments	Optional
			05 20 10 30	Casework	
			05 20 10 70	Fixed Multiple Seating	
			05 20 10 90	Other Fixed Furnishings	
E2050	05 20 50	Movable Furnishings	05 20 50 10	Movable Art	Exclude
			05 20 50 30	Furniture	
			05 20 50 40	Accessories	
			05 20 50 60	Movable Multiple Seating	
			05 20 50 90	Other Movable Furnishings	
F	06 00 00	Special Construction and Demolition			
F10	06 10	Special Construction			
F1010	06 10 10	Integrated Construction	06 10 10 10	Building Modules	Required
			06 10 10 50	Manufactured/Fabricated Rooms	
			06 10 10 70	Modular Mezzanines	
F1020	06 10 20	Special Structures	06 10 20 10	Fabric Structures	Required
			06 10 20 20	Space Frames	
			06 10 20 30	Geodesic Structures	
			06 10 20 40	Manufacturer-Engineered Structures	
			06 10 20 60	Manufactured Canopies	
			06 10 20 65	Rammed Earth Construction	
			06 10 20 70	Towers	
F1030	06 10 30	Special Function Construction	06 10 30 10	Sound and Vibration Control	Required
			06 10 30 30	Seismic Control	
			06 10 30 50	Radiation Protection	
F1050	06 10 50	Special Facility Components	06 10 50 10	Pools	Optional
			06 10 50 20	Interior Fountains	Exclude
			06 10 50 30	Interior Water Features	
			06 10 50 40	Aquariums	
			06 10 50 50	Amusement Park Structures and Equipment	
			06 10 50 60	Ice Rinks	
			06 10 50 70	Animal Containment	
F1060	06 10 60	Athletic and Recreational Special Construction	06 10 60 10	Indoor Soccer Boards	Exclude
			06 10 60 20	Safety Netting	
			06 10 60 30	Arena Football Boards	
			06 10 60 40	Floor Sockets	
			06 10 60 50	Athletic and Recreational Court Walls	
			06 10 60 60	Demountable Athletic Surfaces	
F1080	06 10 80	Special Instrumentation	06 10 80 10	Stress Instrumentation	Exclude
			06 10 80 20	Seismic Instrumentation	
			06 10 80 40	Meteorological Instrumentation	
			06 10 80 60	Earth Movement Monitoring	
F20	06 20	Facility Remediation			
F2010	06 20 10	Hazardous Materials Remediation	06 20 10 10	Transportation and Disposal of Hazardous Materials	Exclude
			06 20 10 20	Asbestos Remediation	
			06 20 10 30	Lead Remediation	
			06 20 10 40	Polychlorinate Biphenyl Remediation	
			06 20 10 50	Mold Remediation	
F30	06 30	Demolition			
F3010	06 30 10	Structure Demolition	06 30 10 10	Building Demolition	Exclude
			06 30 10 30	Tower Demolition	
			06 30 10 50	Bridge Demolition	
			06 30 10 70	Dam Demolition	

UniFormat	OmniClass				Inclusion in Scope
Level 3	Level 3		Level 4		
F3030	06 30 30	Selective Demolition	06 30 30 10	Selective Building Demolition	Exclude
			06 30 30 30	Selective Interior Demolition	
			06 30 30 50	Selective Bridge Demolition	
			06 30 30 70	Selective Historic Demolition	
F3050	06 30 50	Structure Moving	06 30 50 10	Structure Relocation	Exclude
			06 30 50 30	Structure Raising	
G	07 00 00	Sitework			
G10	07 10	Site Preparation			
G1010	07 10 10	Site Clearing	07 10 10 10	Clearing and Grubbing	Exclude
			07 10 10 30	Tree and Shrub Removal and Trimming	
			07 10 10 50	Earth Stripping and Stockpiling	
G1020	07 10 20	Site Elements Demolition	07 10 20 10	Utility Demolition	Exclude
			07 10 20 30	Infrastructure Demolition	
			07 10 20 50	Selective Site Demolition	
G1030	07 10 30	Site Element Relocations	07 10 30 10	Utility Relocation	Exclude
G1050	07 10 50	Site Remediation	07 10 50 10	Physical Decontamination	Exclude
			07 10 50 15	Chemical Decontamination	
			07 10 50 20	Thermal Decontamination	
			07 10 50 25	Biological Decontamination	
			07 10 50 30	Remediation Soil Stabilization	
			07 10 50 40	Site Containment	
			07 10 50 45	Sinkhole Remediation	
			07 10 50 50	Hazardous Waste Drum Handling	
			07 10 50 60	Contaminated Site Material Removal	
G1070	07 10 70	Site Earthwork	07 10 70 10	Grading	Exclude
			07 10 70 20	Excavation and Fill	
			07 10 70 30	Soil Reinforcement	
			07 10 70 35	Slope Protection	
			07 10 70 40	Gabions	
			07 10 70 45	Riprap	
			07 10 70 50	Embankments	
			07 10 70 55	Erosion and Sedimentation Controls	
			07 10 70 60	Soil Stabilization	
			07 10 70 65	Rock Stabilization	
			07 10 70 70	Wetlands	
G20	07 20	Site Improvements			
G2010	07 20 10	Roadways	07 20 10 10	Roadway Pavement	Exclude
			07 20 10 20	Roadway Curbs and Gutters	
			07 20 10 40	Roadway Appurtenances	
			07 20 10 70	Roadway Lighting	
			07 20 10 80	Vehicle Fare Collection	
G2020	07 20 20	Parking Lots	07 20 20 10	Parking Lot Pavement	Exclude
			07 20 20 20	Parking Lot Curbs and Gutters	
			07 20 20 40	Parking Lot Appurtenances	
			07 20 20 70	Parking Lot Lighting	
			07 20 20 80	Exterior Parking Control Equipment	

UniFormat	OmniClass				Inclusion in Scope
Level 3	Level 3		Level 4		
G2030	07 20 30	Pedestrian Plazas and Walkways	07 20 30 10	Pedestrian Pavement	Exclude
			07 20 30 20	Pedestrian Pavement Curbs and Gutters	
			07 20 30 30	Exterior Steps and Ramps	
			07 20 30 40	Pedestrian Pavement Appurtenances	
			07 20 30 70	Plaza and Walkway Lighting	
			07 20 30 80	Exterior Pedestrian Control Equipment	
G2040	07 20 40	Airfields	07 20 40 10	Aviation Pavement	Exclude
			07 20 40 20	Aviation Pavement Curbs and Gutters	
			07 20 40 40	Aviation Pavement Appurtenances	
			07 20 40 70	Airfield Lighting	
			07 20 40 80	Airfield Signaling and Control Equipment	
G2050	07 20 50	Athletic, Recreational, and Playfield Areas	07 20 50 10	Athletic Areas	Exclude
			07 20 50 30	Recreational Areas	
			07 20 50 50	Playfield Areas	
G2060	07 20 60	Site Development	07 20 60 10	Exterior Fountains	Exclude
			07 20 60 20	Fences and Gates	
			07 20 60 25	Site Furnishings	
			07 20 60 30	Exterior Signage	
			07 20 60 35	Flagpoles	
			07 20 60 40	Covers and Shelters	
			07 20 60 45	Exterior Gas Lighting	
			07 20 60 50	Site Equipment	
			07 20 60 60	Retaining Walls	
			07 20 60 70	Site Bridges	
			07 20 60 80	Site Screening Devices	
			07 20 60 85	Site Specialties	
G2080	07 20 80	Landscaping	07 20 80 10	Planting Irrigation	Exclude
			07 20 80 20	Turf and Grasses	Optional ⁵⁷
			07 20 80 30	Plants	
			07 20 80 50	Planting Accessories	Exclude
			07 20 80 70	Landscape Lighting	
			07 20 80 80	Landscaping Activities	
G30	07 30	Liquid and Gas Site Utilities			
G3010	07 30 10	Water Utilities	07 30 10 10	Site Domestic Water Distribution	Exclude
			07 30 10 30	Site Fire Protection Water Distribution	
			07 30 10 50	Site Irrigation Water Distribution	
G3020	07 30 20	Sanitary Sewerage Utilities	07 30 20 10	Sanitary Sewerage Utility Connection	Exclude
			07 30 20 20	Sanitary Sewerage Piping	
			07 30 20 40	Utility Septic Tanks	
			07 30 20 50	Sanitary Sewerage Structures	
			07 30 20 60	Sanitary Sewerage Lagoons	

⁵⁷ Include these only when they are within the building boundary (e.g. on the green roof).

UniFormat	OmniClass				Inclusion in Scope
Level 3	Level 3		Level 4		
G3030	07 30 30	Storm Drainage Utilities	07 30 30 10	Storm Drainage Utility Connection	Exclude
			07 30 30 20	Storm Drainage Piping	
			07 30 30 30	Culverts	
			07 30 30 40	Site Storm Water Drains	
			07 30 30 50	Storm Drainage Pumps	
			07 30 30 60	Site Sub-drainage	
			07 30 30 70	Storm Drainage Ponds and Reservoirs	
G3050	07 30 50	Site Energy Distribution	07 30 50 10	Site Hydronic Heating Distribution	Exclude
			07 30 50 20	Site Steam Energy Distribution	
			07 30 50 40	Site Hydronic Cooling Distribution	
G3060	07 30 60	Site Fuel Distribution	07 30 60 10	Site Gas Distribution	Exclude
			07 30 60 20	Site Fuel-Oil Distribution	
			07 30 60 30	Site Gasoline Distribution	
			07 30 60 40	Site Diesel Fuel Distribution	
			07 30 60 60	Site Aviation Fuel Distribution	
G3090	07 30 90	Liquid and Gas Site Utilities Supplementary Components	07 30 90 10	Supplementary Components	Exclude
G40	07 40	Electrical Site Improvements			
G4010	07 40 10	Site Electric Distribution Systems	07 40 10 10	Electrical Utility Services	Exclude
			07 40 10 20	Electric Transmission and Distribution	
			07 40 10 30	Electrical Substations	
			07 40 10 40	Electrical Transformers	
			07 40 10 50	Electrical Switchgear and Protection Devices	
			07 40 10 70	Site Grounding	
			07 40 10 90	Electrical Distribution System Instrumentation and Controls	
G4010	07 40 50	Site Lighting	07 40 50 10	Area Lighting	Exclude
			07 40 50 20	Flood Lighting	
			07 40 50 50	Building Illumination	
			07 40 50 90	Exterior Lighting Supplementary Components	
G50	07 50	Site Communications			
G5010	07 50 10	Site Communications Systems	07 50 10 10	Site Communications Structures	Exclude
			07 50 10 30	Site Communications Distribution	
			07 50 10 50	Wireless Communications Distribution	
G90	07 90	Miscellaneous Site Construction			
G9010	07 90 10	Tunnels	07 90 10 10	Vehicular Tunnels	Exclude
			07 90 10 20	Pedestrian Tunnels	
			07 90 10 40	Service Tunnels	
			07 90 10 90	Tunnel Construction Related Activities	

Appendix C: Additional Information on Quantifying Embodied Carbon

C.1 Lifespan of Elements and Products

Table 5: Average lifespans for Elements and Products

(Sources: *Recommended Guidelines for Building Component Lifespans in Whole Building Life Cycle Assessment*⁵⁸, Carbon Leadership Forum, 2018; *Instructions for Performing a Multifamily Property Condition Assessment*⁵⁹, Fannie Mae, 2019; *Preventive Maintenance Guidebook: Best Practices to Maintain Efficient and Sustainable Buildings*⁶⁰, BOMA, 2010)

Building Element	Sub-element / Product	Service Life (Years)*
Structure	-	Life of the Building
Roof	Roof Coverings	30
Internal Non-load-bearing Walls	Partitioning and Gypsum Board	30
Interior Wall Finishes	Vinyl	10
	Wallpaper	4
	Epoxy	15
	Fabric	5
	Wood	15
	Paint	10
Floor Finishes	Carpet	5
	Vinyl	12
	Wood (Parquet and Strip)	30
	Stone and Ceramic	50
	Epoxy Coating (for concrete and wood flooring)	10
Ceiling Finishes	Paint	10
	Acoustic tile (Drop Ceiling)	10
	Plaster or Gypsum Board with Skim Coat	30
	Metal	25
	Wood	30
	Epoxy Coating (for concrete and wood ceiling)	10
Furniture, Fixtures & Equipment	-	10

⁵⁸ https://www.carbonleadershipforum.org/wp-content/uploads/2018/07/CLF_Recommendations_BuildingComponentLifespans_07-06-2018.pdf

⁵⁹ <https://multifamily.fanniemae.com/media/6701/display>

⁶⁰ <https://icap.sustainability.illinois.edu/files/projectupdate/2289/Project%20Lifespan%20Estimates.pdf>

Building Element	Sub-element / Product	Service Life (Years)*
Exterior Cladding	Paint	5-10
	Wood shingle, clapboard, stucco, and composite wood	20
	Exterior Insulation Finishing Systems (EIFS)	20
	Vinyl siding	25
	Glazed and Metal Curtain Wall	35
	Precast Concrete Panel	35
	Aluminum Siding	40
	Brick, Block, and Stone	50
	Stone Veneer	50
	Stucco	50
Exterior Windows and Doors	-	30
Mechanical, Electrical, and Plumbing and Services	Water Heating Source	20
	Space Heating and Air Treatment	20
	Ductwork	20
	Electrical Installations	30
	Lighting Fittings	15
	Communications Installations and Controls	15
	Plumbing	25
	Lifts and Conveyors	20

* More detailed breakdown of elements service life for multi-unit residential buildings can be found in Instructions for Performing a Multifamily Property Condition Assessment , Fannie Mae, 2019 and for commercial buildings in Preventive Maintenance Guidebook: Best Practices to Maintain Efficient and Sustainable Buildings , BOMA, 2010.