Version: V02

LEED v4 BD+C: Core and Shell

Building Life-Cycle Impact Reduction

Individual Project# 1000155444 - 420 Rutherford Avenue

--- This form has been substituted from LEED v4.1 BD+C: Core and Shell credit Building Life-Cycle Impact Reduction ---

Select one of the following:

- ○ **Option 1. Building and material reuse (2-6 points)**
- ◉ **Option 2. Whole building life-cycle assessment (1-4 points)**

Option 2. Whole Building Life-Cycle Assessment

All Paths :

Has the project conducted a life cycle assessment of the project's structure & enclosure? ◉ Yes ○ No

Who conducted the LCA study? Include the authors name, company, title and project role.

Lama Bitar, WSP, Consultant II

List the scope of the LCA study: e.g. Basic requirements of the structure- complete building envelope from cladding to interior finish, footings and foundations, etc. and additional materials such as interior finishes (if included).

The WBLCA system boundary included the building's structure and enclosure. Structural elements include frame and floors inclusive of fireproofing and concrete encasement. Enclosure includes all materials from the exterior cladding to the interior sheathing, inclusive of insulation. Roof assemblies include the entire assembly inclusive of membranes, insulation, and vapor barriers.
The system boundary excludes: interior finishes on the walls (e.g. paints), floors, and ceilings; non-structural interior partitions; interior stairs; railings; Mechanical/Electrical/Plumbing (MEP) equipment; site elements (such as the exterior ramps); fire detection systems; elevators; parking lots; site improvements (such as pavements and curbs); and landscaping (such as landscaping and the green roof).

Confirm the following:

- ☑ MEP equipment and controls, fire detection / alarm system fixtures, elevators, conveying systems, excavation, site development, and parking lots have been excluded from the study.

List the System Boundaries of the LCA study and the tool(s) used to conduct the study. Confirm the study is a cradle-to-grave assessment. At a minimum, the study must include modules A1-A3, A4, at least one module from B1-B5, and at least one module from C1-C4.

- The service life of the model will be 60 years to fully account for material replacement.
- Building components that made up less than 5% of the total mass of the scope are not evaluated.
- The baseline and proposed designs are of a comparable size, function, orientation, and operating energy performance as defined in EA prerequisite Minimum Energy Performance;
- The life cycle inventory data sets comply with ISO 14044; and
- The assessment is cradle to grave including modules A1-A, A4, B2-B5, C2-C4, and Module D. The scope excludes module A5 (installation), B1 (use), and B6 (operational energy).

Describe the envelope assembly of the proposed building project (e.g., exterior walls: two layers of reinforced concrete sandwiched over an inner rigid extruded polystyrene insulation core, aluminum curtain wall system with insulating glass units, double glazed; roof: reinforced concrete roof deck with insulated two ply modified bitumen roofing membrane):

The exterior wall enclosure is primarily metal plate rainscreen panel on a subgirt system over 4-inch mineral wool insulation, a self-adhering sheet-applied air barrier, 5/8-inch exterior sheathing, 6-inch metal stud, and 5/8-inch interior sheathing. At the base of the building, there is stone cladding over a subgirt system, 4-inch XPS insulation board, and self-adhering sheet-applied air barrier over the foundation wall. A portion of the foundation wall assembly is architectural concrete instead of stone cladding. In addition, the envelope includes a 4-sided structural silicone glazed (SSG) low-E coated curtain wall system, with intermittent spandrel panels, and metal plate panels between each band of curtain wall.

Describe the structural system of the proposed building project:

The proposed building reflects a design iteration with a different selection of building products from the baseline building. It is the same size as the baseline building at 113,191 square feet. It has the same function and is in the same orientation as the baseline building. The proposed building model used for the whole building life cycle assessment (WBLCA) represents the same design as the proposed building used for the energy model. Changes implemented in the proposed model do not impact the energy model by maintaining the same R-values and fenestration ratios.

The WBLCA covers a complete assessment of the building envelope and structural elements of life cycle stages outlined by the credit requirements over a 60-year service life. For boundary conditions, building components that made up less than 5% of the total mass of the project scope were not evaluated. The impact assessment method used was TRACI 2.1 (Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts), a method developed by the U.S. Environmental Protection Agency. The tool used was Tally, a life cycle assessment plug-in for Autodesk Revit.

The proposed structural model contains the same materials and assemblies as the baseline model, with changes made to reflect modifications and refinements made throughout the design up to the 50% Construction Drawings phase. For the structural model, the steel framing systems and concrete mix designs in the concrete foundations and slabs were modified. For the architectural model, the overall design remained the same from the 50% Design Development up to the 50% Construction Document phases.
Following correspondence with the Architecture and Structural Engineering teams, changes made to the proposed design from the baseline design included:

- Upgrading the strength of the steel columns to a higher strength steel (from 50 ksi to 65 ksi). This reduced the total tonnage of steel at the columns by 30 tons, as calculated by the project Structural Engineer. This changed the total weight of steel resulting from columns from 253.91 tons to 223.91 tons.
- Decreasing the vibration requirements on the floor framing. This reduced the total tonnage of steel beams by 150 tons, as calculated by the project Structural Engineer. This changed the total weight of steel resulting from beams from 767.45 tons to 617.45 tons.

List the service life assumed in the LCA (in years) of the proposed building project:

60

Path 2-4:

Has the project conducted a life cycle assessment of the project's structure & enclosure and compared it against a baseline building and demonstrated reductions? (●) Yes ( ) No

List the service life (in years) of the baseline building:

60

Confirm the following:

- [x] The baseline and proposed buildings are of comparable size and function.

Provide a description of the approach used for defining the baseline building (Early Design, Existing Building, Building Archetype, etc.).

WSP received the 50% Design Development drawings, specifications, and Revit models of 420 Rutherford Avenue. To conduct this comparative assessment, the requirements and parameters of the LEED version 4.1 Materials and Resources Credit, Building Life Cycle Impact Reduction, Option 2 WBLCA were followed, including:

- Reviewing project documents received from the design team, including 50% Design Development architectural and structural drawings and specifications for the design.
- Reviewing 50% Design Development Revit models received from the design team for conformance to the contract documents, including one architectural model and one structural model of the design.
- Holding a conference call with the design team to clarify any questions on the architectural and structural designs.
- Reviewing area take-offs received from the design team for: the GFRC, wood, and roof canopies; GFRC rainscreen panels; curtain wall; stone panel cladding; metal rainscreen panels; and penthouse screens.
- Assigning each construction material within the two Revit models to materials in the Tally database, referencing the architectural and structural drawings, specifications, and submittals as needed.
- Generating output reports via Tally.
- Verifying the results of the reports with a WSP technical reviewer.

- [x] The baseline and proposed buildings are of comparable operating energy performance as defined in EA Prerequisite Minimum Energy Performance.

- [x] The same LCA software / tool and ISO 14044 –compliant data set is used to study both the baseline building and the proposed building. If using a dataset other than one for the specific project location, describe why the data set was selected as a proxy.

Describe the structural system and envelope assembly of the baseline building. Include a description of why the baseline structural and enclosure systems represent typical construction for this project, location, and building type.

The baseline building reflects a design iteration generated once major decisions about the wall, roof, floor, and structural assemblies were made. It is the same size as the proposed building at 113,191 square feet. It has the same function and is in the same orientation as the proposed building. The baseline building model used for the whole building life cycle assessment (WBLCA) represents the same design as the baseline building used for the energy model.

The WBLCA covers a complete assessment of the building envelope and structural elements over life cycle stages outlined by the LEED credit requirements over a 60-year service life. For boundary conditions, building components that made up less than 5% of the total mass of the project scope were not evaluated. The impacts assessment method used was TRACI 2.1 (Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts), a method developed by the U.S. Environmental Protection Agency. The tool used was Tally, an LCA plug-in for Autodesk Revit.

The baseline structural system consists of 4000PSI concrete members with moderate steel reinforcement including a slab-on-grade, composite metal decks, foundations, and columns. In addition, there are steel columns and steel framing members. In the absence of a project-specific concrete design mix during the baseline phase, the Eastern Region concrete mix from the National Ready Mixed Concrete Association (NRCMA) Member and Regional LCA Benchmark (Industry Average Report) – V 3.0 was used.

Architectural materials and assemblies included all materials required for each component's manufacturing such as sealants, adhesives, coatings, and finishes. The roof assemblies include a 60-mil adhered polyvinyl chloride (PVC) roofing membrane over cover board, R-30 polyisocyanurate (PIR) board insulation, and a self-adhering sheet vapor barrier. There is an area of green roof consisting of hot-applied rubberized asphalt membrane roofing system and 8-inch extruded polystyrene (XPS) insulation. There is also an area of roof with 3/4-inch porcelain pavers over the PVC membrane assembly. Areas of canopy consist of the above PVC roof membrane assembly, as well as metal plate panel and wood cladding rainscreen assemblies.

The exterior wall enclosure is primarily metal plate rainscreen panel on a subgirt system over 4-inch mineral wool insulation, sheet-applied air barrier, 5/8-inch exterior sheathing, 6-inch metal stud, and 5/8-inch interior sheathing. At the base of the building, there is stone cladding over a sub girt system, 4-inch extruded polystyrene (XPS) insulation board, and sheet-applied air barrier over the foundation wall. A portion of the foundation wall assembly is architectural concrete over XPS and sheet-applied air barrier. In addition, the envelope includes a 4-sided SSG low-E coated curtain wall system, with intermittent spandrel panels, and metal plate panels between each band of curtain wall.

At the penthouse, the above noted metal plate rainscreen assembly occurs at the exterior of weathertight building enclosure walls, and insulated metal wall panels occur over galvanized steel supports as a screen where there are no weathertight enclosure walls.

Describe how the project team expects to incorporate findings from the LCA study into the project documents and ensure adherence to the LCA-informed design throughout the design and construction process:

The following changes informed the design documentation and were monitored through the submittal process:

- Using a higher strength steel (from 50 ksi to 65 ksi) for columns. This reduced the total tonnage of steel at the columns by 30 tons.
- Decreasing the vibration requirements on the floor framing. This reduced the total tonnage of steel beams by 150 tons.

Table: Life-cycle assessment impact measures (Complete the table below for all six impact categories for the baseline building and proposed building (as appropriate).

	Baseline Building Value (Path 2-4 only)	Proposed Building Value	Units	Percent Reduction (%)
Global warming potential GHG	5,473,453.05	5,294,749.49	kg CO_2e	3.2649
Stratospheric ozone depletion	0.689	0.689	kg CFC-11e	0
Acidification of land and water	18,133.91	17,231.73	○ moles H+ ● kg SO_2e	4.9751
Eutrophication	891.83	870.89	● kg N ○ kg PO_4	2.348
Tropospheric ozone formation	255,976.98	250,827.88	○ kg NOx ● kg O_3 ○ kg C_2H_4	2.0115
Depletion of non-renewable energy resources	48,345,566.28	46,139,699.86	MJ	4.5627
Number of measures with at least a 5% reduction				0
Number of measures with at least a 10% reduction				0

Notes:

- Proposed building values must not exceed baseline building values by 5% in any category.

- Report impacts per square foot or per square meter rounded to the nearest 10^{-4} for all six impact categories.
- Exemplary Performance: achieve Path 4 and reduce GWP by 40% or more.

Path 4 only:

Describe the structural and/or enclosure system building reuse elements incorporated into the project. Include systems or materials reused in-place, materials reused from other parts of the building, or offsite reuse (salvaged materials) incorporated into the structure and/or enclosure. Describe how the impacts from reuse were included in the LCA study and list the proportion of reduction(s) due to reuse strategies.

Path 2-4: Design Optimizations

List the optimization strategies made to the project design (by design element category) that resulted in reductions to GWP, as applicable.

Design Element	Summary of Optimization Strategy	GWP Reduction (kg CO_2e)
Above grade structure (superstructure)	Increase strength of steel in columns and decrease floor framing vibration reqs.	178,703.56
Foundations		0
Wall assembly		0
Roof assembly		0
Other		0

For all Paths:

Upload the LCA report (PDF, Word, Excel or JPG file) including the summary page from the life-cycle assessment tool stating, at a minimum, the impact category values for both the baseline and proposed buildings: global warming potential GHG (greenhouse gases), stratospheric ozone depletion, acidification of land and water, eutrophication, tropospheric ozone formation, and depletion of non-renewable energy resources.

File	Size	Uploaded on	Uploaded by
20220714_WBLCA Report_420 Rutherford(1).pdf	1.49 MB	14 Jul 2022 05:46 PM	Talia Mamayek

Special Circumstances

Describe the circumstances limiting the project team's ability to provide the submittals required in this form. Be sure to reference what additional documentation has been provided, if any. Non-standard documentation will be considered upon its merits. (Optional)

Upload any additional documentation that supports the claim to special circumstances. (Optional)

Last edited on 14 Jul 2022 05:46 PM by Talia Mamayek