LEED v4.1 BD+C: New Construction

Building Life-Cycle Impact Reduction

Unit Type: (•) IP (inch-pound) ( ) SI (International System of Units)

Select one of the following:

- ( ) **Option 1. Historic building reuse (5 points)**
- ( ) **Option 2. Renovation of abandoned or blighted building (5 points)**
- ( ) **Option 3. Building and material reuse (1-4 points)**
- (•) **Option 4. Whole building life-cycle assessment (1-4 points)**

Option 4. Whole Building Life-Cycle Assessment

Path 1:

Has the project conducted a life cycle assessment of the project's structure & enclosure? (•) Yes ( ) No

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

Path 1-4:

Table: Life-cycle assessment impact measures (for all paths)

Complete the table below for all six impact categories for the baseline building and proposed building (as appropriate).

	Baseline Building Value (All Paths)	Proposed Building Value (Path 2-4)	Units	Percent Reduction (%)
Global warming potential GHG	34.544	31.4519	kg CO_2e	8.9512
Stratospheric ozone depletion	0	0	kg CFC-11	0
Acidification of land and water	0.1069	0.0992	( ) moles H (•) kg SO_2	7.203
Eutrophication	0.0065	0.006	(•) kg N ( ) kg PO_4	7.6923
Tropospheric ozone formation	1.9176	1.7491	( ) kg NOx ( ) kg O_3 ( ) kg C_2H_4	8.787
Depletion of non-renewable energy resources	325.9761	308.4349	MJ	5.3811

Number of measures with at least a 10% reduction	0

Notes:

- Project must demonstrate at least a 10% reduction in three categories for 3 points and six categories for exemplary performance. Proposed building values must not exceed baseline building values by 5% in any category.
- Report impacts rounded to the nearest 10^{-4} for all six impact categories.

Paths 1 through 4:

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

Dirk Kestner, Walter P Moore, Director of Sustainable Design, Structural Engineer / LCA Specialist

At what stage(s) of design was the LCA study performed? What members of the design team provided input in the study?

WBLCA was performed throughout the design and construction process. WBLCA was first performed in mid schematic design and was been updated through substantial completion, which is well beyond completion of the elevated concrete construction, which was the assembly optimized as part of this WBLCA. The design team monitored the submittals of concrete mixes used by the general contractor to ensure they followed the assumptions for concrete mix proportions in the WBCLA model. The WBLCA was led by the structural engineering team, with input on enclosure assemblies from the architect. The owner was updated on WBLCA progress during LEED meetings during design and construction.

How did the LCA study inform the final project design?

The initial LCA showed that the concrete in the building was the single largest contributor to impacts of study. The LCA started in mid SD, but many elements of the exterior design were established very early in SD, so there were limited options for design exploration with the exterior envelope. The impact reduction strategy for this project focused on the concrete mix optimization, specifically cement reduction. To maximize the effects of the improved concrete mix designs, we focused our approach on the design elements with the highest volume; In this case, the elevated slabs and the foundations.

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 design team included maximum cement content limitations on the Construction Documents. The WBLCA team checked the submitted concrete mix proportions against these requirements and ensured they met the cement limits. The WBLCA model based on the early Construction Documents for this project demonstrated 5% (or greater) impact reductions in five of the six impact categories, Global Warming Potential, Acidification of Land and Water, Eutrophication, Tropospheric Ozone Formation, Depletion of Non-Renewable Energy Resources. No impact increased.

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).

LCA included superstructure, foundations, and complete envelope.

List the System Boundaries of the LCA study (e.g. A1 Raw Material Supply - A4 Transport, B1 Use -B5 Refurbishment, etc.) and the tool(s) used to conduct the study:

Both the baseline and proposed building LCA's were performed within Tally 2020, which served as the data source for all information except specific concrete mix proportions. The LCA system boundaries for both the baseline and proposed buildings include all appropriate cradle-to-grave impacts as defined in EN 15804-2013 sections A1-A4, B1-B5, and C1-C4 and Module D.

Confirm the following:

- [x] 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 service life assumed in the LCA (in years) of the proposed building project:

60

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 envelope consists of metal panel, vision and spandrel glazing, brick masonry, cast stone, and CMU with the following components.

Metal Panel: insulated aluminum composite metal panel system, non-permeable air barrier, ½" gypsum sheathing, 6" metal stud framing at 16" o.c., 6" batt insulation between studs, 5/8" interior gypsum board Vision/spandrel Glazing: 2"x6" nominal mullion profile (intermediate horizontal and vertical), 1" nominal insulating vision/spandrel glass

Brick masonry: 3 5/8" face brick veneer, air space, 2' rigid insulation (4" at pilasters), non-permeable air barrier, ½" gypsum sheathing, 6" metal stud framing at 16" o.c., 6" batt insulation between studs, 5/8" interior gypsum board Cast stone; cast stone band, air space, 2" rigid insulation (4" at pilasters), no-permeable air barrier, ½" gypsum sheathing, 7/8" metal framing at 16" max CMU: 3 5/8" or 7 5/8" concrete masonry unit, air space, 2" rigid insulation non-permeable air barrier, ½" gypsum sheathing, 6" metal stud framing at 16" o.c., 6" batt insulation between studs, 5/8" interior gypsum board Roof: . The roof is a modified bitumen asphalt membrane with and 6" of PIR insulation and cover board.

Describe the structural system of the proposed building project:

The structural system is a 25" deep cast-in-place wide-module beam and slab system with a 5" thick slab and 20" deep by 66" wide pan forms with concrete girders. The foundation consists of drilled piers. This is the common structural system used for academic buildings in central Texas, and on the campus of UT Austin. The only difference between the baseline and proposed systems is the concrete mix proportions.

Paths 2 through 4 only:

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.).

The WBLCA team used an "Early Design" approach to define the baseline building, but then updated the bill of materials for both the baseline and reference throughout design - the quiantities are identical - the optimization strategy employed was the optimization of concrete mix proportions. The LCA did not incorporate enclosure changes.

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

Provide a description of the functional equivalence between the baseline and the proposed. Include comparisons of the size, function/program, system boundaries, service life and operating energy performance.

Aside from the specific changes to concrete mix proportions all other structural and enclosure elements of the proposed and baseline buildings are identical.

- [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.

Confirmed. The Tally data set was used for both buildings, all materials.

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

60

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

The baseline building envelope is identical to the proposed building, which is identical to the Construction Documents. This envelope meets all LEED, and local energy code requirements for operational energy performance.

The structural system in the baseline building is identical to the proposed building structure. The only differences between it and the proposed are the concrete mix proportions.

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.

N/A

Path 2-4: Design Optimizations

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

Design Element	Summary of Optimization Strategy	GWP Reduction (kg CO_2e)
Above grade structure (superstructure)	Concrete mix optimization / cement reduction	78,300
Foundations	Concrete mix optimization / cement reduction	29,500
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.

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)

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