Integrative Process Worksheet

LEED v4 IP Credit Integrative Process

For BD+C projects

Identify and document the items found under the following sections:

- Energy-Related Systems
- Water-Related Systems

For ID+C projects

Identify and document the items found under the following sections:

- Energy-Related Systems
- Site Selection

For one additional point, complete Water-Related Systems

Energy-Related Systems

Required for BD+C and ID+C projects

Describe the baseline assumptions for each component.

Site Conditions (BD+C only)	100ft x 100ft semi-shaded square lot with natural land coverings. The lot is relatively flat, allowing for building placement in any location on the lot. The street side of the lot faces south/southwest, and is home to a large tree that provides shade over a significant portion of the site. Adjacent buildings abut the walls delineating the property line. Baseline building requires hardscape area for parking for up to 3 vehicles. Other site areas will contain softscapes for play areas, vegetable gardens, and native flora.
Massing and Orientation (BD+C only)	6000 square foot building needed to meet programatic requirements. Baseline building is a 3 story rectangularly shaped building with long edge of the rectangle facing east/west while the short edge faces north/south, allowing the long edge to capture prevailing winds for natural conditioning/ventilation. Baseline building structure is CMU block as it is most prevalent local building material. Baseline building is placed in the center-rear of the site to allow for vehicle access and separation from neighboring buildings on both sides of the site.
Basic Envelope Attributes	Reinforced concrete masonry structure with window openings designed for airflow throughout the building to accommodate natural ventilation. Larger window openings facing east to capture the prevailing wind and smaller openings on the west side to allow for heat to escape the building. Windows are 100% operable and have shading devices to reduce solar heat gain.

Lighting Levels	The baseline building uses locally standard incandescant lighting, and natural daylight to light the occupied spaces. Walls are light in color to allow for higher reflectance and lower artificial lighting levels.
Thermal Comfort Ranges	The project is in a warm, humid country. The local people are accustomed to warm weather. The baseline project is designed to be naturally ventilated to reduce energy consumption.
Plug and Process Load Needs	The baseline project is designed with standard ASHRAE plugload density. The project has 2 primary functions; residency for infants and young children, and offices for administrative support for the organization. The offices require loads sufficient for up to 15 laptops, a printer, and other basic office needs. Additionally, all water on site will come from a well below the site. The well pumping system is a major process load for this project and is anticipated to be the largest individual energy use on site.
Programmatic and Operational Parameters	The building is occupied 24/7, as it is a residence for small children and their caretakers. A portion of the building is office space and will be occupied during standard business hours. These spaces are designed to be separate in order to allow the children a safe space to play and call home while still allowing for full operational efficiency of the organization. Additionally, the space is designed to be a community resource and shelter in the event of an emergency, providing fresh water and a safe place for the community should a disaster strike.

Describe at least two potential load reduction strategies that were assessed for each aspect through simple box energy modeling before the completion of schematic design.

Site Conditions (BD+C only)	The large tree that provides shade for a significant portion of the site was investigated to see if it can remain on the site to continue to provide shade and reduce solar heat gain in the project building during the day. Additionally, various hardscape elements were analyzed, including pervious and light colored pavers to reduce the heat island effect and keep cooling needs lower.
Massing and Orientation (BD+C only)	Both the original straight line building and a different design involving an L shaped primary building to capture the prevailing wind and allow for natural ventilation and maximum daylighting were considered. The L shaped building will also allow for additional solar exposure on the roof to maximize the potential output for a PV array. Additionally, various locations on the project site were considered, including placing long edge of the primary building on the north side of the site and on the east side of the site.
Basic Envelope Attributes	Various glazing systems and window options were considered to reduce energy loads due to solar heat gains, including fully operable glass windows, and permanent openings with shading devices. Additionally, the building's location and orientation on the site was investigated in order to determine how lighting loads would be affected.
Lighting Levels	As mentioned above, building orientation, wall color and various materials were all considered when designing the project. The source of the lighting was also considered, including investigations into LED and fluourescent technologies that can significantly reduce the energy use of the lighting required on site.

Thermal Comfort Ranges	Because the project will be naturally ventilated, strategies for expanding thermal comfort ranges focused primarily on reducing solar heat gain and adding circulation as necessary. Ceiling fans add circulation and help improve overall occupant satisfaction by widening the thermal comfort range, particularly on hot days, but they also add to the energy use on site. Additional materials for the building skin, overhangs, and other architectural elements were investigated to lower solar heat gain.
Plug and Process Load Needs	Load shedding is difficult in the office area of the project, but plug load reductions in sleeping rooms and other areas of the facility were considered during the modeling phase. In the modeling process, loads were reduced to one standard outlet per sleeping room since the young children will not require a lot of electronic devices. Additionally, multiple pump sizes and well filtration options were considered in order to determine the most efficient use of electricity while considering the water needs for the project.
Programmatic and Operational Parameters	The programatic needs of the project have been fairly stable since the initial concept was introduced. However, there were considerations made for the size of the office area as well as the training facility. Various scenarios were also considered for the number of sleeping rooms for the children.

Describe how research and analysis uncovered through discovery influenced the project building program, form, geometry, and/or configuration.

Site Conditions (BD+C only)	The project opted to maintain the large specimen shade tree in order to lower the impact of solar heat gain on the project building. Additionally, the project team elected to use lighter colored pavings and hardscapes to reduce the heat island effect. These steps were likely to occur on the project anyway, but the discovery process did confirm these best practices.
Massing and Orientation (BD+C only)	The discovery process helped determine that a single row of rooms along a corridor in a “C” shape. This shape is pointing eastward to capture the nearly continuous trade winds. The single width of rooms allows all rooms to access the air flow, as well as be completely day lit during daylight hours (near the equator, the shortest day of the year still has 11 hours of daylight, (13 in the summer). The openings into rooms have been shaped to allow the breezes to sweep the room, with openings high, and larger on the windward side. To enhance day lighting and ventilation, the room height is 11’-6”, allowing windows to be higher in the room, and keep heat higher. Floors are hard surface, so that they are cool to the touch.
Basic Envelope Attributes	To keep the building mass from becoming hot, the walls are designed to be a lighter weight infill, and the structure is partially shaded by an outer screen wall of hardwood rods.
Lighting Levels	The analysis confirmed that the lighting system within the residential portion of the building should be high efficacy fixtures such as CFL and LEDs. Additionally, lighting controls such as occupancy sensors and timers are being considered to lower the lighting load for the project.
Thermal Comfort Ranges	The analysis confirmed that due to the moderate tropical climate, heating is not necessary. All rooms will have operable louvered openings, with their openings and arrangement optimized to receive the easterly trade winds which are quite constant.

	In an effort to save energy, mechanical cooling systems were kept to an absolute minimum. The majority of the facility will take advantage of large openings to the exterior, allowing all occupied spaces to qualify under ASHRAE 62.1 as naturally ventilated. Air movement and perceived cooling in these areas will be accommodated by natural breezes and ceiling fan assist.
Plug and Process Load Needs	The analysis for the project allowed the project team to determine that due to an unreliable grid, the project needs to attempt to be net zero. therefore, the loads on the project need to be minimal. The analysis allowed the project team to determine critical and non-critical loads and design the project with 2 electric panels that separate these loads should there be a need to reduce the overall load of the building in an emergency scenario.
Programmatic and Operational Parameters	As mentioned above, most of the programatic elements were determined prior to the project concept phase. The analysis allowed the team to confirm the need for separate facilities for the office and childrens areas. This also influenced the final configuration of the project, leading to the "C" shaped design.

Provide a brief explanation of how the research and analysis uncovered through discovery influenced the project design and/or resulted in system downsizing. If applicable, give reasons for not addressing topics.

Site Conditions (BD+C only)	The existing site conditions and landcover influenced where the main building will be located on the site. By studying the conditions, the team was able to determine the best location for a naturally ventilated, solar powered structure.
Massing and Orientation (BD+C only)	As mentioned above, much of the design was influenced by the study of the wind patterns and the geography of the site itself. The massing of the building is optimized for natural ventilation and capturing the trade winds and as much sun as possible while still limiting solar heat gain and ensuring occupant comfort.
Basic Envelope Attributes	Building envelope features were designed with solar heat gain in mind, based on the initial analysis. There are no windows on the project, all openings are hardwood louvers with bug screen. This allows for maximum airflow and comfort on the project while minimizing the energy required to cool the project.
Lighting Levels	Because light surfaces and maximum daylighting were assumed from the early stages due to the inconsistency of the local grid, the analysis had little impact on lowering overall lighting (lumen) requirements. Changes to lighting type, such as the use of LEDs and CFLs as well as automatic controls are options being considered in the final design of the project that were introduced in the early discussions.
Thermal Comfort Ranges	Initial models demonstrated that the best option for maximizing thermal comfort on the project included using ceiling fans to increase the overall airflow through the project. Therefore, fans were included in the design. In order to ensure that the fans do not draw too much power, sensor technology is bein evaluated to ensure that they are not running when a room is empty.
Plug and Process Load Needs	Overall plug loads were kept to a minimum in the residence area of the project to keep energy use down. The office and kitchen areas required enough energy to operate all essential appliances and therefore additional plugs were added in these areas. The well remains the largest overall process load for the site, as there are very few other energy-

	using systems.
Programmatic and Operational Parameters	A few of the programatic elements involving serving the community were closely examined during this phase to ensure that the goal of providing sevices for the community don't interfere with the energy and water goals of the project. As such, some of the community items were scaled back to ensure that these goals could be met.

Describe how this process informed changes made to the Owner's Project Requirements and Basis of Design.

Site Conditions (BD+C only)	The large specimen shade tree was kept in the project and the parking area was placed farther away from the main building in order to reduce heat island effect of hardscape close to the building. Native plantings were added to the perimeter walls to ensure that the space is green and full of life while still allowing for a play area for the children.
Massing and Orientation (BD+C only)	The project was designed in a C shape and located on the western half of the site in order to maximize capture of the trade winds in order to encourage natural ventilation and conditioning of the space.
Basic Envelope Attributes	Shade devices are included to minimize solar heat gain. Walls and roofs are designed with various insulation factors: • U-Value for un-insulated wall is R-3. • U-Value for insulated wall is R-10 • U-Value for doors is (wooden, solid) U = .5 R = 2 • U-Value for Windows is Metal Frame U = .71 SHGC = .73 • U-Value for the Roof is R-16
Lighting Levels	Light colored finishes are encouraged to enhance overall lighting quality while the lighting system within the building is to be designed per ASHRAE and Illuminating Engineering Society (IES) recommendations. Given that the project is targeting NetZero, it is crucial that the lighting load be minimal, yet still meet the IES recommended foot-candle levels. Lighting control options were added to the BOD.
Thermal Comfort Ranges	Ceiling fans were added to ensure a wider range of comfort for building occupants.
Plug and Process Load Needs	Loads were separated into "essential" and "non-essential" loads allowing for load shedding in the event of an emergency. Other items identified above, including pump sizing and plug location were added to BOD.
Programmatic and Operational Parameters	Programatic and operational parameters were determined prior. Slight adjustments were made in emergency situations to ensure that the building systems can withstand an emergency for a prolonged period of time.

Water-Related Systems

Required for BD+C projects. One additional point for ID+C projects.

Describe the baseline assumptions for each component.

Indoor Water Demand	Baseline indoor water demand assumes 38 full time residents (children and caretakers), 26 non-resident FTEs and up to 20 visitors at a time (on weekends). Additionally, in an emergency scenario, the building is designed to provide sanctuary for up to 60 people for up to 2 weeks. Baseline assumptions include standard LEED baseline assumptions for residential indoor fixture use for the 38 residents (5 daily uses of lavatories and lavatory sinks, 1 daily shower, etc.), 26 FTE (3 daily uses of lavatories, etc.) at LEED baseline water use levels. Visitors are anticipated only on Saturdays and were calculated at the same rate as the 26 FTE employees.
Outdoor Water Demand (BD+C only)	The outdoor water baseline assumed full irrigation for the landscape features on the project, including vegetable gardens, green wall, and rooftop plantings including the green roof.
Process Water Demand	The kitchen is designed to serve the 38 residents with healthy, nutritious meals. All building occupant will use the filtered faucet in the sink to obtain potable drinking water. The baseline assumption is that each occupant will obtain 1 gallon of water per day from the filtered faucet. Additionally, a clothes washer and laundry sink will be used to clean the clothing of the residents at the site.
Supply Sources	The baseline water supply source is the municipal water supply, which may not be accessible at the project site. This water supply is not safe for drinking in most instances, even if it is available at the site. Traditionally, most businesses and buildings in the surrounding area have potable water delivered via a large water tank truck and stored on site in a tank.

Provide a brief explanation of how the research and analysis uncovered through discovery influenced the project design and/or changes to the design. If applicable, give reasons for not addressing these topics.

Indoor Water Demand	Because water is a precious resource, and water traditionally has to be trucked in, water efficient fixtures, biodigesters, and other water saving measures were considered in order to reduce water demand. The ultimate goal was to reduce indoor water use by up to 50% if possible while still allowing for the basic needs of the project to take place, including daily showers for the residents. Ultimately, low-flow, dual flush, and waterless fixtures were selected to ensure maximum savings while maintaining performance.
Outdoor Water Demand (BD+C only)	In order to reduce outdoor water use, it was determined to use only native and adaptive plants for all landscaping areas and to ensure that there would be no permanent irrigation system. This allows for a dramatic reduction in overall water use.

Process Water Demand	Water efficient fixtures are planned for process water uses, but ultimately the process water was less of a concern than indoor and outdoor water use due to the fact that the need for the laundry and kitchen facilities exists no matter what. By selecting water efficient fixtures, the project team addressed this water use as best as they could, especially considering there are no major process uses such as a cooling tower on this project.
Supply Sources	The investigative process of this project revealed that there is a sufficient water source below the project site, and that a well could be drilled to supply water so the project won't have to rely on water delivery for its water needs. Additionally, all rainwater on site will be captured via a drainage system on the roof of the project building, permeable pavement, an on-site wetland, and other on-site strategies. This water will be filtered and treated on site, allowing it to be mixed with the well water, dramatically reducing the amount of potable water used.

Describe how this process informed changes made to the Owner's Project Requirements and Basis of Design.

Indoor Water Demand	The process had minimal impact on the OPR and BOD documents because water savings were already a stated goal for this project. Indoor water fixtures were always going to be water efficient. If anything, this process encouraged the team to consider additional methods for indoor water use reduction.
Outdoor Water Demand (BD+C only)	The process ultimately led to the team selecting plantings, landscapes and hardscape features that allowed for the outdoor water use to be eliminated outside of the initial establishment period for the native plants used on site.
Process Water Demand	This process forced the team to consider whether certain process water elements were required on site, however, they ultimately are required to operate the project, therefore, no major changes to these fixtures were made since water efficiency was already a priority for this project.
Supply Sources	This process had a major impact on the supply sources discussion for the project. Because of the discovery of a well on site, the entire team worked to determine how to best incorporate the well with the site landscaping and rainwater collection elements.

Explain how one on-site nonpotable water supply source was used to reduce municipal supply or wastewater treatment for the demand components listed below. (For BD+C projects, potable water use must be reduced for at least two demand components.)

Indoor Water Demand	Incorporating rainwater captured onsite, filtering and treating it, and mixing it with the well water allows for a tremendous reduction in the use of the well water. This treated rainwater ultimately becomes potable water but comes from non-traditional sources.
Outdoor Water Demand (BD+C only)	No outdoor water use. Not applicable.

Process Water Demand	Incorporating rainwater captured onsite, filtering and treating it, and mixing it with the well water allows for a tremendous reduction in the use of the well water. This treated rainwater ultimately becomes potable water but comes from non-traditional sources.
Supply Sources	Incorporating rainwater captured onsite, filtering and treating it, and mixing it with the well water allows for a tremendous reduction in the use of the well water. This treated rainwater ultimately becomes potable water but comes from non-traditional sources.

Site Selection

Required for ID+C projects

Describe the project goals related to each component.

Building Site Attributes	
Transportation	
Building Features	
Occupant Well-Being	

Describe the suitability (or lack thereof) of the base building options considered for each site selection component.

Building Site Attributes	
Transportation	
Building Features	
Occupant Well-Being	

Provide a brief explanation of how the analysis informed building site selection.

Building Site Attributes	
Transportation	
Building Features	
Occupant Well-Being	

Provide a brief explanation of how the selected space meets the project goals related to indoor environmental quality and occupant well-being.

Building Site Attributes	
Transportation	
Building Features	
Occupant Well-Being	

Describe how this process informed changes made to the Owner's Project Requirements and Basis of Design.

Building Site Attributes	
Transportation	

Building Features	
Occupant Well-Being	