

Executive Summary

The following report discusses a lighting redesign, electrical analysis, structural redesign, daylighting study, and mechanical redesign for The Barnes Foundation in Philadelphia, PA, that was conducted for the Architectural Engineering senior thesis. Five spaces will be focused on for this report; the Site, Light Box, Light Court, Lower Lobby, and Office.

The Barnes Foundation is an art education facility that's goal is to inspire and educate visitors. The building houses galleries, an auditorium, reception areas, office areas, and more. The new lighting designs is based around the concept of "The Barnes in Philly and Philly in The Barnes"; expressing the connection of the facility to the city that it calls home and creating its own identity that will become part of Philadelphia's vibrant history.

The site lighting of The Barnes was designed to create a more open and safe area for visitors and passer-bys. Site walls were then highlighted to aid in way-finding when searching for the entrance of the building. The Light Box, located on the roof, contains linear RGB LEDs that create a subtle, yet dynamic, color-changing display to symbolize the energy and excitement of the city. The Light Court uses the limestone paneling of the walls to emphasize circulation while bollards along the center of the space create gathering areas. The Lower Lobby was primarily lit with recessed linear fixtures that resemble the pattern of the limestone paneling of the Light Court. Public and private scenes were also created in this space. The Office consisted of newly designed skylight wells to increase the amount of natural light in the space and direct/indirect lighting is then used to create the remaining ambient light of the space.

The electrical analysis of the building consisted of three portions: a branch circuit redesign, a short circuit analysis, and photovoltaic array study. The branch circuits were redesigned to ensure the facility can handle the new lighting loads. Short circuit calculations were conducted on one path of the one-line diagram to ensure proper protection of from overcurrents and power outages. A photovoltaic array study found that an additional array above the Office roof could create 31,000 kWh of energy for the facility.

The skylight wells in the Office required a redesign of the roof structural system of that area. The roof was converted from a concreted cambered structure to a steel one and the pre-existing green roof was removed to reduce the total dead load. After testing various beams and girders, a working structure was created that allowed for the desired skylight well design.

The skylight wells were designed to resemble the large roof monitors located in many of the gallery spaces within the facility. The final design was then analyzed with the use of Daysim; the results showed that the skylight design achieved the LEED requirement of 55% spatial daylight autonomy.

Because of these new skylights, a mechanical redesign was required to assess if the current mechanical system was capable of handling the loads caused by the skylight and reduction of the green roof. Using Trane TRACE it was found that the new load was roughly 4 tons while the current system was designed for 6 tons. This resulted in only having to redesign the layout of the mechanical system to avoid the skylight wells and lighting.