drinking water. CDM is also responsible for carrying out various other tasks for USAID, such as dealing with frozen pipes in hospitals during what has been a very harsh winter, Selim says. Additionally, CDM is preparing water and sanitation feasibility studies for five cities. The studies, which should be finished by the end of this year, will determine what can be done to quickly bring water to the cities, says Selim.

Working in a war-ravaged country has proved challenging, according to Selim. Locating skilled laborers and proper construction machinery in Afghanistan is difficult. To address the situation, equipment and construction crews are being brought into the country from the Middle East. The pace of the project has also been impeded by the restricted access to certain construction sites, says Selim. As a result of the conflict between Soviet occupation forces and the mujahideen in the 1980s, Afghanistan is rife with land mines. Demining activities can take several months, and surveying and construction cannot proceed until an area has been declared safe by local demining authorities. Despite the setbacks and delays, progress on the 18-month project continues. As Selim puts it, "There are impediments, but the work can be done."

—Jessica Binns

MASS TRANSIT

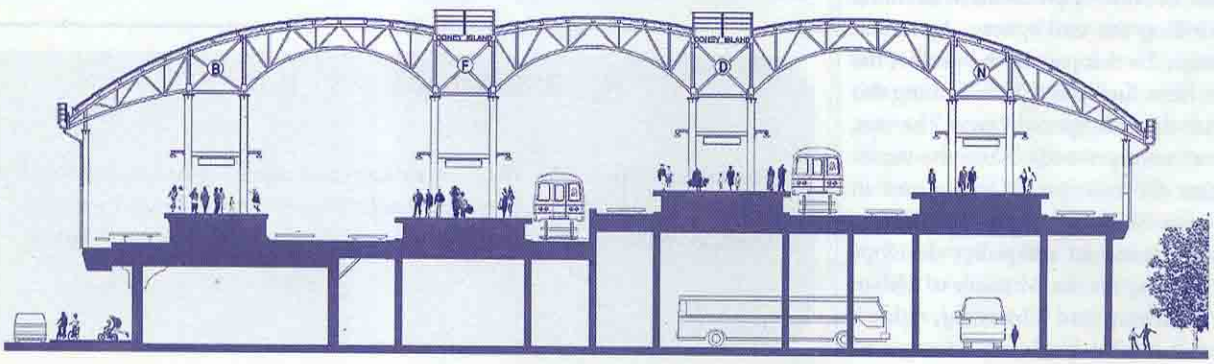
Roof Brings Solar Power to New York Transit Station

The newly rebuilt Stillwell Avenue subway station, in Coney Island, in the southern part of the New York City borough of Brooklyn, features power-generating technology on a scale that will significantly reduce the station's consumption of electricity from the city's power grid. Designed by the architecture firm Kiss + Cathcart, of Brooklyn, and engineered by Jacobs Engineering, of New York City, the station's roof features custom-designed panels of glazed photovoltaic cells. This new roof covers one of the busiest stations in the New York City Transit system and is one of the largest of its kind in the world.

The roof has an area of approximately 76,000 sq ft (7,060 m²)—54,000 sq ft (5,017 m²) of which is photovoltaic glass—and comprises 2,730 identical panels, each 4 by 5 ft (1.2 by 1.5 m). A portion of each panel is layered with photovoltaic sensors and polyvinyl butyral—a strong plastic resin. The panels are arranged so that the portions that do not contain the polyvinyl

Tony Daniels, Kiss + Cathcart, Architects, both

The Stillwell Avenue subway station, in the New York City borough of Brooklyn, features an arched roof integrating 2,730 photovoltaic panels that will generate 250,000 kWh of electricity annually. The roof is supported by arch trusses that span from one platform to the next in neo-Victorian fashion.



or photovoltaic layers align to form skylights that provide natural light to the station's interior. "It would be a shame to have to turn on the lights during the day under a solar generating roof," says Tony Daniels, the project manager for Kiss + Cathcart.

Generating 250,000 kWh annually, the roof could support 40 single-family homes. It will provide a maximum of 65 percent of the station's electricity during sunny summer days and an average of 15 percent over the course of a year. "It may not seem like much, but it is quite a bit of energy for a station that runs day and night," says Daniels.

As daylight filters through the skylights, it encounters a web of steel transverse members connecting the top and bottom chords of arch trusses that span from platform to platform. The trusses span 36 to 39 ft (11 to 12 m) above each set of tracks on the east and west sides of the station, which are separated by a center platform. The truss configuration is reminiscent of that used in 19th-century train stations.

Columns are placed on the platforms in pairs 11 ft (3 m) apart to support the arch trusses and roof. Engineers opted for pairs of columns rather than larger single columns to provide additional space for ramps leading to the entrance beneath the elevated station. In addition to the entrance, the space beneath the tracks is occupied by communications and signaling equipment and by a police station. In fact, the roof design and erection coincided with a larger project by New York City Transit to, with the exception of the foundation piles and pile caps, rebuild the entire station.

Daniels says that because New York City Transit will maintain the roof with its own personnel, engineers had to design a relatively simple way to replace or maintain the panels. The design includes a mobile gantry that will allow maintenance workers to change a panel from above the roof, obviating the need to halt train operations or bring in customized lift equipment.

According to Greg Kiss, a principal of Kiss + Cathcart, among the most challenging aspects of the project was convincing New York City Transit that the solar roof would be feasible and cost effective. Several years were spent educating the organization about the benefits conferred by photovoltaic technology and convincing it that the structure could be built and maintained above an active rail system. "In the end, I think the fact that [New York City Transit] decided to do it speaks to an education dialogue [that] has been much more thorough than what you see during a normal project," says Kiss. "I wish all projects worked this way."

—*Brett Hansen*