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Vol. 14 No.11 November 1997

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A GRAND OL' TIME

Having served millions of people in its more than 80 years of operation, New York City's Grand Central Terminal is now in the midst of a $150 million renovation, which includes providing cool air to the platforms for the first time.

BY JOANNA R. TURPIN

New York City's Grand Central Terminal will soon be restored to a better-than-original state, thanks to an aggressive restoration project currently underway. The renovation of the landmark building, which was constructed in 1913, is scheduled to be completed by mid-1998.

The 10-year, $150 million renovation will include completely new mechanical and electrical systems, at a cost of approximately $65 million. And for the first time ever, hot and sticky passengers will receive cool air as they wait for trains to arrive and depart.

Charles C. Copeland, P.E., of Goldman, Copeland Associates, New York City, has been involved with the restoration from the beginning. His firm, which has a long history of working on historical buildings, completed the design to build a new chiller plant and upgrade all the facilities in the terminal.

Copeland notes that their original conceptual design for the facility is now being implemented with few changes — "a very unusual event."

COOL RELIEF

While some areas of Grand Terminal (restaurants and retail spaces) have added air conditioning over time, passengers have had to swelter in the main terminal, which sees about 500,000 people on any given day. In addition to the crush of people and the humid climate, air conditioned trains dump heat onto the platforms where passengers wait.

Not surprisingly, then, air conditioning was near the top of the list when it came time to renovate. However, cooling was mainly desired in order to attract additional retailers to the more than 150,000 sq ft of new and renovated retail space. Passenger comfort, while a consideration, was not the first concern.

Part of the renovation included restoring the terminal's famous ceiling, which depicts a celestial scene. *(All photos courtesy of Danille A. Swick.)*

In order to provide the much-needed cooling to all retail and passenger areas, it became necessary to build a new chiller plant. Copeland's designs called for the demolition of the old 43rd St. plant (see accompanying article, page 62). In its place, a 3,000-ton chiller plant was constructed, with 25,000 ft of chilled-water piping.

Six two-stage steam absorption chillers, manufactured by The Trane Company, were used for the new plant, with each providing a little more than 500 tons of cooling. Two-stage chillers were chosen because they were the most economical for the New York City area, says Copeland. Also, "At the time, the utility company was giving huge rebates for using steam chillers, so they saved a lot of capital cost."

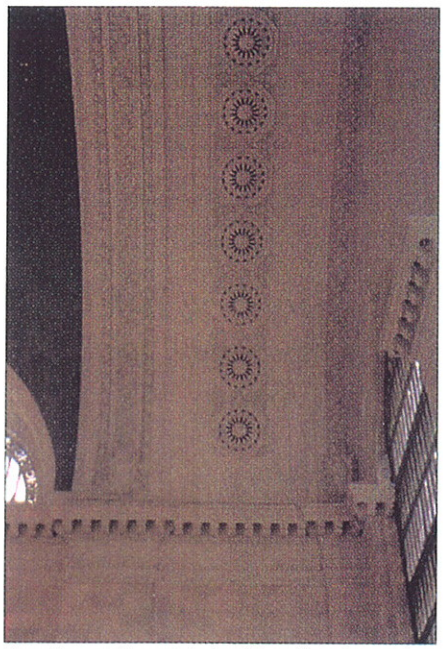
Accompanying the chillers are five cooling towers, which were carefully orchestrated to fit into place on the terminal's roof. "It's a roof with skylights and other equipment, and each tower had to fit in between the skylights," explains Copeland.

"We were lucky. The terminal was originally designed to have an office building on top of it. All of the steel stubbed up above the roof, and we were able to connect into it and support our cooling towers from it."

Retailers' fancoil units will tap into a chilled-water pipe network that runs through all the tenant spaces. Plate-and-frame heat exchangers will be used for winter cooling of the chilled water. "By running the cooling towers in the winter, we can drop the temperature and transfer the energy to the plate-and-frame heat exchangers, distributing it without having to run the chillers."

AIR — WHAT A CONCEPT

The original engineers had a design concept, and 84 years later, Copeland intended to follow their wishes.



Rosettes on the original ceiling allow for smoke exhaust.

"On each side of the main concourse there are very large, hollow columns. We looked at the original drawings and discovered that they intended to use these columns to supply air," he says. "So, we decided to duplicate the way they were originally intended to function."

Copeland's office designed the ductwork to run above the famous ceiling with the heavens painted on it, then connect to the hollow columns. Air flows out of the columns at about 20 ft above the floor.

The distance from floor to ceiling is about 150 ft. "We tried to stratify the cold air so that we're not cooling the air up at the top of the ceiling," explains Copeland. "The air is kept low by having the returns at floor level."

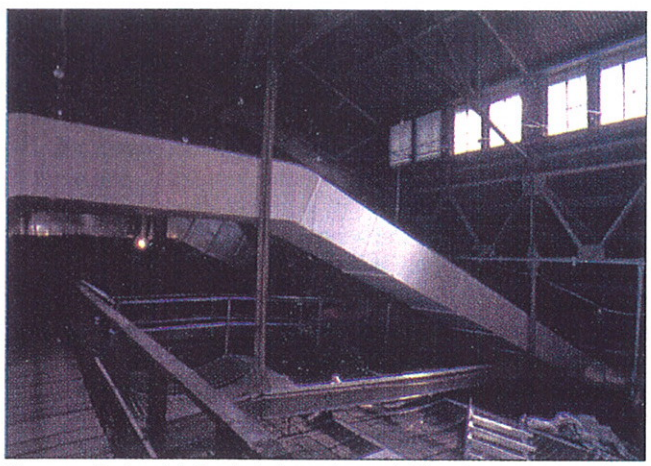
The problem with such a huge space between floor and ceiling is, of course, stack effect. During cold weather, enormous quantities of air are pulled into the terminal and out the upper-story windows. That is a major concern, "so we're pressurizing the space as much as we can by introducing large quantities of fresh air. Then we will minimize the air leaking in."

Copeland adds that the terminal staff will have to do a better job of closing train doors, etc., when everything is finished.

"I like the way it looks and the way it came out. There aren't too many projects that an engineer can participate in like Grand Central Terminal."

— Charles C. Copeland, P.E. Goldman, Copeland Associates.

The 1913 design of the main concourse called for ventilation, but according to Copeland, the idea was "value engineered out." It wasn't a big problem, because as an open public space, air was always coming in and going out, or passengers were dressed for the weather. Temperatures would fluctuate throughout the seasons, though.

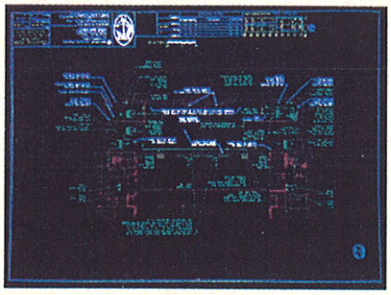


The new ductwork is located above the main historic concourse ceiling.

Copeland says when they took on the project, they tried to utilize the existing supply air systems. "For example, the lower concourse originally had just a warm air heating system, and the air came out of the old grilles willy-nilly. You can't do that with cooling. You have to project the air out to have proper coverage."

The old plant served many

In 1913, Grand Central Terminal was one of the last major structures built to transport passengers into and out of Manhattan. The terminal was constructed to house New York Central's new electric trains, which took the place of the dangerous steam locomotives of years past.



A conceptual drawing of the "new-and-improved" New York City Grand Central Terminal.

When the terminal was first constructed, there was no integrated utility system in New York City, so New York Central had to build its own plant to generate electricity and provide steam and hot water. The original plant was built at the site of the current Waldorf-Astoria Hotel. When the hotel decided to build in the late 1920s, the plant had to find a new home.

By that time, however, New York City had an established electric utility, Consolidated Edison Co., so New York Central built its 43rd St. steam plant. Some time in the late 1940s, New York Central opted to purchase its steam from the local utility as well.

An interesting note is that New York Central owned much of the property along Park Avenue. Originally the corporation provided all services (including electricity) from the New York Central plant to tenants who had buildings on that property. At some points in its history, the company provided utilities, including steam, to as many as 22 buildings.

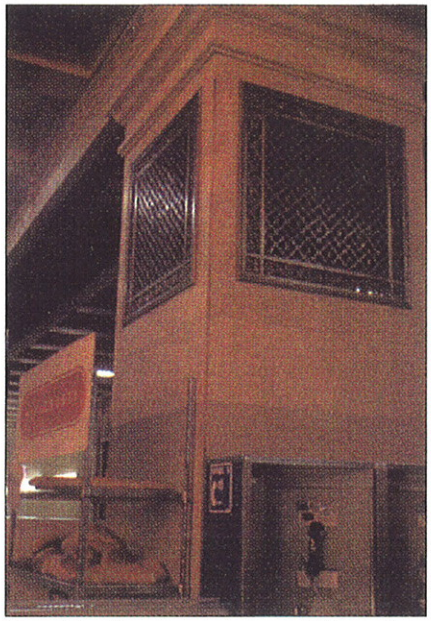
As the buildings were sold the services were discontinued, and by 1980, when Metro-North took over the railroad, there were only a handful of customers receiving services from the steam plant. When the renovation began in 1987, these customers were encouraged to connect directly to the local utility.

— Joanna R. Turpin

Complicating the issue is the fact that the terminal is a landmark building, and every change proposed is scrutinized by an architect. Copeland says that what would have worked best for air distribution, wouldn't necessarily fit in with the style of the building.

"Our first choice may not have been the kinds of grilles and discharge that we used on the main concourse. We might have used a different kind of diffuser, say a round diffuser that is used in stadiums to project the air efficiently. However, this would not be consistent with the historical design of the building."

For this reason, many compromises were made. But Copeland still enjoys the challenge of working on a landmark building. "Maybe you don't always know exactly how the results will turn out, but if you've done your homework, they should work out pretty well."



The original lower-concourse ventilation grilles will be adapted for air conditioning.

SMOKE CONTROL

In the original design, rosettes at either end of the barrel vault ceiling were used to exhaust air from the terminal. Copeland's office wanted the returns kept low as previously noted, to maintain stratification, and because they didn't want to bring airborne dirt up to the ceiling, "which was just cleaned at a major cost."

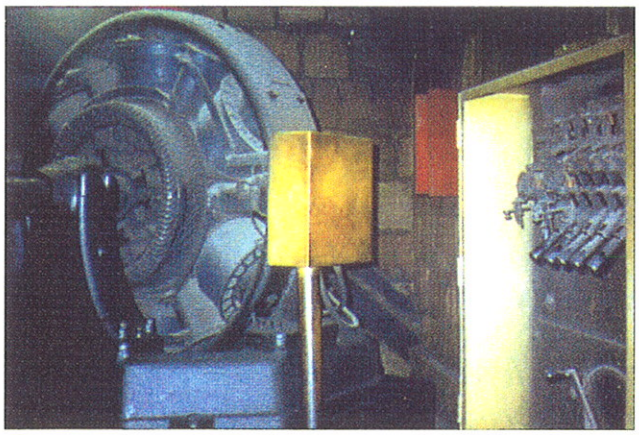
So they decided to use the rosettes at the top of the ceiling for smoke exhaust.

"In the event there's a fire in the terminal, the rosettes will exhaust the air," explains Copeland. "Above the ceiling, which has a lot of room above it, we have two major exhaust fans that allow us to exhaust the air out of the top of the rosettes."

There is more smoke-exhaust capability provided near the platforms. A new exhaust system at the south end, which was installed to better exhaust the platforms, doubles as a smoke-exhaust system.

The smoke and fire control system is very sophisticated, as can be expected in a place where so many people congregate. Smoke detectors throughout the facility will automatically turn the system on once enough of the fail-safes go into the alarm mode.

A GRAND OL' TIME



The original terminal equipment was removed in order to make room for the new hvac system.

The entire smoke and fire control system was modeled on a computer by another consultant, Shirmer Engineering. By playing with different scenarios in the computer, it was possible to come up with a design that, in the event of a fire, will keep the air above a certain minimum breathing zone, so people can safely exit the building.

ENERGY SAVINGS

Saving energy is a big concern at the terminal, which is why a complete Landis & Staefa energy management system was installed. The ems controls the chiller plant, all retail areas, and the air-handling systems.

Copeland notes that while the ems itself is not unique, the way in which it was purchased is different.

"We set up a contract that locked us into fixed parts-and-service prices with a reasonable escalation for at least five years, understanding that this project is on-going," he explains. "We needed to lock the vendor in and keep them honest, which is why we set up a whole system of how to control the prices for all the devices going long term."

In addition to installing an ems, variable-speed technology is used in various ways throughout the terminal. For example, variable-speed fans were installed on all of the main air-handling systems so that airflow can be reduced at low loads.

Copeland says this was a project of a lifetime.

"I like the way it looks and the way it came out," he says. "There aren't too many projects that an engineer can participate in like Grand Central Terminal." **ES**

Turpin is contributing editor, Engineered Systems.