Rachel J. Detwiler

A parking structure in Moscow

With growing prosperity in Russia, the increasing number of cars necessitates more places to park them. The state program for the city of Moscow[1] estimates that 1.5 million additional parking spaces will be needed in that city alone by 2016.

Boris Dobashin, founder of the Nabad Design Bureau and one of only four PCI members in Russia, needed to design a parking structure with spaces for 1315 cars for the Golovino residential complex in Moscow as part of a design-build contract with the Krost Companies. For this parking structure to be profitable to investors, it needed to provide sufficient spaces not only for the residents of the Golovino complex but also for local businesses and the public.

Precast concrete parking structures using double-tee beams are not new to Russia, but structures with pretopped double tees had not been built there before. Instead, precast concrete double tees had cast-in-place toppings, and the toppings always cracked. As in North America, cracks can be detrimental to the service life of parking decks that are exposed to melted snow and road salt tracked in by cars.

A friend of Dobashin's, Boris Sverdlov, president of Building Design International, sent him photographs of cast-in-place, post-tensioned concrete parking structures in the United States. Dobashin considered this type of construction impractical in Russia because the high-quality concrete needed for durability under the harsh exposure conditions would be difficult to produce consistently on a jobsite. Sverdlov then sent him a photo of the parking structure at Old Orchard shopping mall in Skokie, Ill. Dobashin came to see it himself and decided to bring the technology to Moscow.

Obtaining the building permit

To obtain a building permit, the design had to be approved by a panel of experts employed by the Moscow city government. The design for this particular structure underwent careful scrutiny because it incorporated a number of features that had never been used in Russia before. Due to the unique nature of the project, Dobashin had to submit a copy of the project's procedural manual, similar to a project specification but more detailed, spelling out how everything was to be fabricated and erected, for examination by the panel of experts. He also submitted the structural calculations.

Precast concrete connections in Russia are usually welded. The design for the Golovino parking structure used anchor bolts for the column-to-column and column-to-footing connections. Also, stainless steel connections had not been used there before due to the cost and difficulty of welding.

Some of the innovations had to be verified by test to obtain approval. The local building code specifies a design live load of 350 kg/m^2 (72 lb/ft^2) in the parking stalls and 500 kg/m^2 (100 lb/ft^2) in the drive lanes, with a load factor of 1.2. Because these loads are higher than in the United States, full-scale load tests were necessary to demonstrate acceptable load-deflection behavior.

The local building code requires that parking structures be enclosed on any side where the structure is within 50 m (160 ft) of a residence. This provision applied on three sides of the Golovino parking structure. As in the United States, enclosed parking structures must meet requirements for sprinklers, ventilation, and fire rating that do not apply to open structures. The precast concrete elements themselves did not raise any concerns regarding fire resistance, but the flange-to-flange connections were required to have at least a 1½-hour fire rating. Full-sized sections of two connected double tees were tested and found to have a 2½-hour fire rating; thus no additional fire protection needed to be applied in the field.

The parking structure at the Golovino residential complex in Moscow opened in March 2013. The local building code requires parking structures to be enclosed by glass on all sides within 50 m (160 ft) of residences (three sides in this case) to protect them from exposure to exhaust and fires. Sprinklers, ventilation, and a 90-minute fire rating are required in enclosed structures. Courtesy of Building Design International.

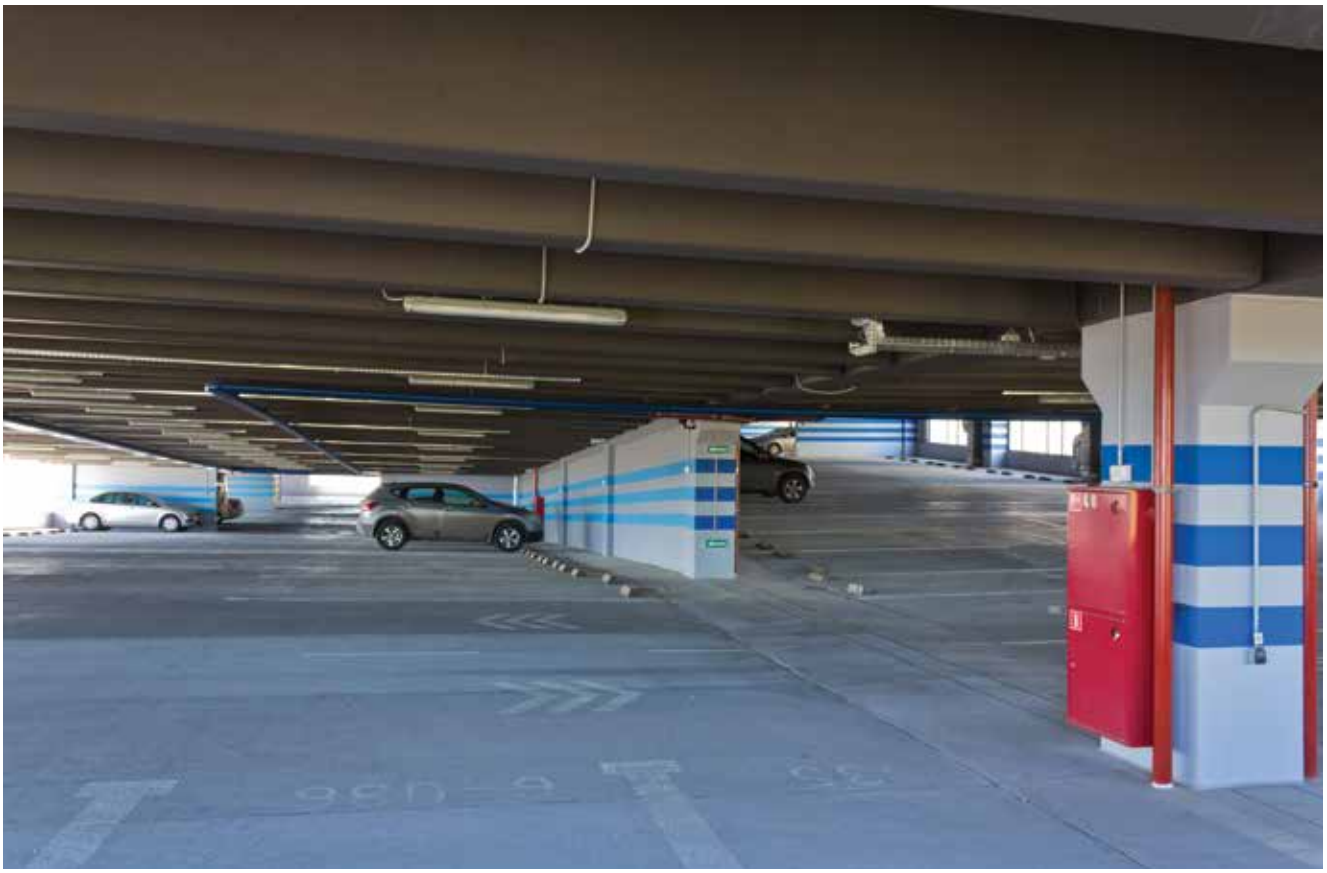
Getting the concrete right

The most critical challenge was to develop and consistently produce the right concrete mixture for durability in cycles of freezing and thawing and resistance to chloride-ion intrusion. In particular, it was difficult to get 6% to 7% air in the double-tee slabs. Abrasion resistance was also important to maintaining the surface texture under traffic from studded tires. Dobashin contacted several precast concrete plants in Illinois, Wisconsin, and Massachusetts for help, including Desman, Spancrete, Dukane, and Unistress, as well as Power Construction, which served as general contractor.

Meeting the challenges

As is to be expected when introducing new technology, the project team faced many challenges. Obtaining the necessary permits, preparing the specifications, equipping the production facility, and training the crews all required assistance from Americans who already had the necessary experience and expertise. Dobashin had to provide for translation of documents from Russian into English, logistics to obtain details and materials from the United States, and American consultants.

The use of anchor bolts for the column-to-column and column-to-footing connections was a departure from the normal Russian practice of welded connections in precast concrete construction. Bolted connections are commonly used in steel construction, however. Courtesy of Building Design International.



The structure has more walls than necessary to resist lateral forces due to the need for fire walls. Courtesy of Building Design International.

From the inception of the project through its completion, American firms and individuals were instrumental to its success. Once Dobashin decided on pretopped precast concrete, he contacted Marty McIntyre, then–executive director of PCI's Illinois and Wisconsin chapter, for introductions to precasters who could share their expertise and JVI in Lincolnwood, Ill., to find out more about connectors.

During erection of the structure, an American crew of four, led by Jeff Metzger of Precast Services, Inc., worked closely with the four-person Russian crew for the first two months. Another American helped with the joints and connections, and another provided expertise with the pour strips. Chuck Magnesio and Jim Voss, both of JVI, inspected the precast concrete plant, and Magnesio returned to Moscow to inspect the field operations.

Dobashin reports that getting the right texture for the deck surface involved a great deal of trial and error. The texture had to provide adequate traction and be durable under harsh conditions. The use of studded tires necessitated high resistance to abrasion. His goal was to achieve a surface texture of such high quality that it would not require additional finishing or topping in the field.

Unfortunately, the tools sent by Sverdlov from the United States did not prove satisfactory in the Krost plant. Dobashin did an internet search and found what he was looking for in the texture used in parking structures at John F. Kennedy International Airport in New York, N.Y. He was then able to develop a drum to provide the right texture for the deck.

Cost savings

Although the main reason for choosing precast concrete pretopped double tees for this parking structure was the ability to produce consistently high-quality, durable concrete, the cost savings over typical cast-in-place concrete construction were considerable. In Russia, each parking stall requires 20 to 25 m^2 (215 to 270 ft^2) of deck area. The typical cast-in-place concrete parking structure uses 12 m^3 (16 yd^3) of concrete per parking stall. In the Golovino parking structure, only 6 m^3 (8 yd^3) of concrete per stall was needed. Typical Russian parking structures have horizontal parking decks with spiral ramps for the cars to drive up. The Golovino parking structure borrowed another idea from the United States: the ramped parking deck.

Maximizing the use of precast concrete allowed construction to proceed even during the 20°C (4°F) Moscow

Dobashin developed this drum for texturing the double-tee slabs. He found the information he needed on the internet. **Courtesy of Leo Abramovich and Building Design International.**

winter. Erection of the precast concrete components was limited to a maximum of three months

Reference

1. City Department of Transportation and Development of Road Infrastructure. 2011. *State Program for the City of Moscow Development of Transportation System 2011-2016* [in Russian]. https://www.mos.ru/documents/index php?id_4=127164.

About the author

Rachel J. Detwiler, PhD, PE, is editor-in-chief of *PCI Journal.*

Abstract

A parking structure in Moscow, Russia, uses American precast concrete techniques for a design unique to the country.

Keywords

Code, connection, cracking, deck, double tee, durability, fire, load, parking, pretopped

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