Brian Miller, P.E., LEED AP

Innovative PARKING STRUCTURE

Design Puts Cars "On Display"

All design is done in context. Designers have always realized that newly designed structures must relate to their surroundings and either expand upon the local architectural vision or, more often, complement the nearby historical, natural or manmade environment. But in the past, the powerful architectural vision for the individual structure sometimes overrode the broader considerations of the building's context.

Photo courtesy NORR Ltd, Architects Engineers Planners.

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The strong trend today is to place the primary emphasis of the design on the surrounding environment — to visualize the creation of a new parking structure as part of an architectural and functioning community and to carefully consider a structure's architectural design in the context of its setting, neighborhood environment and functional surroundings.

Display Window for Cars

Case in point is the recently completed Halifax International Airport parking structure and rental car facility in Enfield, Nova Scotia. The five-story, 935,108-square-foot structure contains both a 2,000-space parking garage on the top four floors and a 400-space rental car facility on the first level.

The design goal for this unique, open air structure was to establish a visual connection to the nearby airport. To capitalize on the structure's context — directly adjacent to the airport terminal — designers sought to showcase both the convenience of nearby public parking spaces and the ready availability of rental cars to the air travelers. This was achieved by aligning the primary east-facing facade of the structure towards the terminal building and removing all possible architectural elements on this façade, thus putting the cars "on display" for airport passengers.

"From the garage, passengers have a full view of the airport terminal, terminal support road, bridges and access points. From the airport, the animation of the garage is in full view. At night, the garage glows and the movement of people and cars provides for an extremely interesting connection for the traveling public," explains Rolfe Kaartinen, OAA, MRAIC, who is vice president of transportation for NORR Ltd, Architects Engineers Planners in Toronto and served as architect and precast specialty engineer for the project.

Inspiration for the design, says Kaartinen, came from the boxes or sleeves with clear acetate fronts that children use to hold and showcase their toy cars.

The design team also included Barrie & Langille Architects Ltd, BMR Structural Engineering, and F. C. O'Neill, Scriven and Associates Ltd. (mechanical/electrical engineers), all from Halifax; as well as Walker Parking Consultants, Boston. Vertical transportation design was by HH Angus Ltd., Toronto. Precast concrete components were provided by Strescon Ltd, Bedford, Nova Scotia.

A Double Tee Facade

To make this visual connection, north and south facades of the structure were designed as structural shear elements, with support provided by precast columns and inverted tee beams, while the east and west facades where left completely open.

Sixty-foot precast concrete double tees, ten feet wide, provide the sole exterior edge of the five-story garage on the side facing the airport, creating clear spans and maximum openness for full views to the interior, as well as providing for natural ventilation and light. To achieve this design vision, the double tees were aligned to run the length of the garage, north to south, in the same direction as the drive aisles on each floor. The clean edge of the double tees along these facades, without the need for washes or over pours, is clearly visible from the exterior of the structure and becomes part of the architectural statement.

The double tees were also set at an absolute horizontal plane, without sloping at the exterior. The double tees were designed and positioned to slope downward from their outer long side edge into the building and toward drain ports inside the structure. Strescon used a pre-topped tee system and was able to cast all the drains inside the tees.

"Architecturally, the demand was that the edges of the double tees be perfectly horizontal," explains Roy McBride, president of BMR Structural Engineering. "The project called for a cable rail system and stainless steel mesh that is a very linear type of installation and they did not want the typical up and down slope of tees for drainage to detract from the horizontal look."

From a design point of view, McBride adds, this meant very strict control on the sloping of

Photo courtesy NORR Ltd, Architects Engineers Planners.

the tees and reworking of the layout to incorporate the drainage system in the structure to obtain proper drainage. "Tees and bearing points had to be designed to produce a straight line at the outside edge but also to be warped in such a way so as to drain inward without the linear sloping of the perimeter edge."

Andrew LeVatte, Business Development, Strescon, describes how this cross slope was accomplished: "Cross slope is not built into the double tee in the factory; your bearing points for each double tee are set at different elevations, which causes the double tee to warp when placed in the field. When you introduce a cross slope to a double tee you have to be careful not to exceed the Precast/Prestressed Concrete Institute's recommended guidelines for the size of double tee being used."

Cable guard rails and stainless steel mesh were installed along the open elevations to both provide passenger and vehicle safety and maintain the desired slim side profile of the structure. The mesh both enhances safety and provides the maximum amount of open air ventilation. An unexpected benefit, adds Kaartinen, is that it actually keeps birds out of the building.

Tensioned barrier cables were threaded through inserts and guide ways that were embedded in the precast columns during manufacturing. Not only did this provide extreme accuracy for positioning of the cables, it also avoided the need for drilling and connector work in the field. The mesh is capped with precast concrete eyebrow panels.

Shear Walls in a Basket Weave

On the opposing sides of the structure, litewalls were used as loadbearing structural shearwalls. These provide for additional open air and visibility, both on the end walls and at traditionally solid areas such as ramps and stairwells. Since they require less concrete, the litewalls helped reduce costs. They also increased safety by allowing drivers at the ends of lanes to see if a vehicle is coming in the opposite direction. Signage was by Semaphor Design Company Inc.

The north and south shear walls were cast in the factory in a facetted basket weave pattern. Punched windows were inserted to provide more natural light and to liven up what typically would be a bare, flat wall.

Strictly decorative, the unique basket weave design required exacting coordination of the casting profiles by the precaster, and extensive bookkeeping by the formwork carpenters, to ensure that all the profiles from piece to piece lined up upon installation. "We started with a design that required a whole series of small pieces," says Kaartinen, "but Strescon was able to execute the design in large panels to reduce costs."

The basket weave design was a challenge, says LaVatte. Typically the end wall would have consisted of columns and spandrels. But to hang concrete basket weave panels, on the spandrels would have caused excess dead and torsion load on the spandrel. Instead, they designed a vertical litewall. Only one form was needed to create the panels, which shift up and down in alternate rows to create the basket weave pattern.

Locally sourced, light blue stone aggregate was used in the concrete mix for precast components on major elements such as the exterior stairwells and "L" framing members. The precast was washed and sandblasted to expose the colored aggregate.

When Less is More

The openness of the east and west elevations allows the structure to take full advantage of prevailing westerly winds and maximize the use of natural ventilation and natural lighting. With only the outer edge of a double tee on these two building sides, there is little obstruction for air and light. High speed ramps connect the five levels and multi-lane exit plazas are located at each end of the structure.

The structure also incorporates a Parking and Revenue Control System (PARCS), including parking level controls and Pay-on-Foot kiosks located both in the garage and in the nearby terminal. The controls link to the bridge authority's MacPass system.

Started in November 2007, the $41.6 million project was completed in March 2009. Accordingly, much of the construction took place in generally inclement weather during the winter of 2008. The project required an accelerated construction schedule that ensured minimal disruption of the activities at the airport terminal. This was made possible by using precast concrete components, which were manufactured off site. The precast was trucked in and off-loaded immediately upon delivery. Erection of the components was staged so that trucks remained on site for not more than 10 minutes during peak hours. Use of precast construction also allowed component fabrication to start prior to the project's general tender call, resulting in cost and time savings.

The Halifax airport parking project was a co-winner in the recent 2010 Design Awards of the Precast/Prestressed Concrete Institute. In addition to precast double tees, litewalls and basket weave panels, precast components included columns, shearwalls, infill panels, inverted tee beams, elevator panels, roof panels, L panels, NLB spandrels, solid slabs, vehicle bollards, stair panels, stairs and landings. Contractor for the project was Three C's Contractors Ltd., Lower Sackville, Nova Scotia. ■

Brian Miller, P.E., LEED AP, is the managing director, business development, for the Precast/Prestressed Concrete Institute. He can be reached at *bmiller@pci.org* or 312.360.3216.

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