MONUMENTAL STAIR WELCOMES STUDENTS

By Robin A. Kemper, P.E., Allan Kehrt, AIA, and Timothy S. Czarnik, P.E.

A university library's new addition features a dramatic stairway as a focal point for students and faculty

As with many universities, the focal point of students and faculty at Kean College of New Jersey is the school's main library. So when the decision was made to expand the Nancy Thompson Library, the designers chose to create a dramatic main stairway as a focal point to both draw users into and up through the building.

The stair was designed to be both a visual and functional focus within the new portion of the building. The intention was to make the stair a strong visual element within a newly created atrium—a sculptural piece in its own right, standing independent of the surrounding enclosure, visually drawing people into the opening with its color and form, and then providing them with vertical access to the upper floors. It exposes all of the structural elements that give it strength and deals as simply as possibly with its constituent materials: structural steel, slate treads and wooden handrails.

EXISTING CONDITIONS

The existing building is a cast-in-place, one-way concrete joist structure. The main portion of the building is three stories with a one-story section on either side. Project architect was Kerht Shatken Sharon Architects, Princeton, NJ and structural engineer was French & Parrello Associates. After several studies, it was decided to add two stories

The new stairway in the Nancy Thompson Library at Keane College is designed to both visually and physically draw visitors up into the structure.

over a portion of an existing one-story section. Additons also were added in front and behind this area, including the new main entrance. The new construction is structural steel with concrete slab on composite metal floor deck and metal roof deck.

French & Parello's task on the stair was to analyze the architect's concept and ensure that the stair could support the required BOCA live loads of 100 psf.

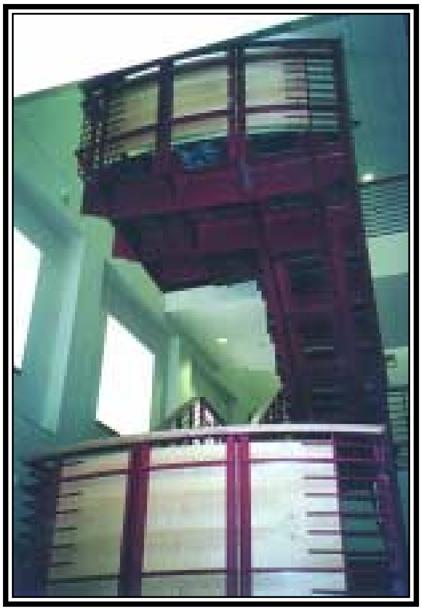
The stair's most distinguishing feature is its cantilevered design. The switch-back stair extends up from the first floor to a landing and back to the existing concrete beam at the second floor; up to another landing and back to the steel-framed third floor. The design required careful consideration of deflection and of the connections of the stringers to the new and existing floor structures.

At the second floor, a large section of the existing concrete joist structure had to be removed and the remaining concrete beam analyzed laterally for the large, horizontal stringer reactions. At the third floor, the new steel girder had to be similarly analyzed. A horizontal truss made up of angles was designed to carry the horizontal reactions into the third floor diaphragm, while at the existing concrete beam, epoxy grouted anchors were used to connect the stringers. The stair was analyzed with pinned support points to minimize the forces on the support structure.

The stringers consist of two WT16.5x65 members located 11 in. from the ends of the treads. The cross members at the landings also are WT16.5x65 members. Stair treads and risers are ¼-in. bent plates with a slate overlay. Most of the connections are welded to provide for the maximum continuity and reduce torsional effects on the members. A three dimensional model was developed using STAAD-III to analyze the stair for vertical dead and live loads and a lateral load. Although analysis of the lateral load is not required by code, it was felt that movement in all directions should be investigated.

Serviceability Concerns

The computer model showed that movement in all directions was well within acceptable tolerances. Still, there as a perception of excessive sidesway due to resonance in the partially completed stair. The concern was noted prior to the installation of the slate treads and finishes. Although it was believed that the installation of the slate treads and railing would stiffen the structure, additional "stiffening" elements were added to reduce the lateral movement. More than eight models were generated to investigate the effects of adding truss elements to the stringers, changing the support conditions and adding



various types of stiffening elements. The final solution was to add WT10.5x36.5 members between the stringers at approximately one-quarter points, which the computer model indicated would reduce the static deflection by 50%. After the additional WT sections and finishes were added, the stair was rechecked for lateral movement. As a result of adding the additional stiffening elements, the sidesway is now imperceptible as people walk up and down the stairs.

Approximately 15 tons of steel were used in the stair, which, including the railings but excluding the slate and wood finishes, cost $90,000 to install. The architect was able to maintain his concept of a "floating" stair through its cantilevered design and exposed steel. And the exposed structural elements and juxtaposition of materials on the project provides a visual transition between the original concrete structure below and the new steel addition above.

Robin A. Kemper and Timothy S. Czarnik are project managers wotj French & Parrello Associates in Holmdel, NJ. Allan Kehrt, AIA, is a principal with Kerht Shatken Sharon Architects in Princeton, NJ.