PRECAST CONCRETE & SUSTAINABILITY

NCC RESIDENTIAL/RECREATION CENTER

Project Type:	**College dormitory & recreation center**
Location:	**Naperville, Ill.**
Owner:	**North Central College**
Architect:	**Tom Buchar & Associates, Inc., Joliet, Ill.**
Engineer:	**Dukane Precast Inc., Naperville, Ill.**
Contractor:	**North Central College & Mustang Construction, Naperville, Ill.**
Precaster:	**Dukane Precast Inc., Naperville, Ill.**

OVERVIEW

Colleges and universities are often challenged by a demand for new student housing and expanded student facilities while being squeezed for funding. North Central College met that challenge with a unique two-buildings-in-one solution that can serve as a prototype for educational institutions across the country.

The college's 198,000-square-foot Residential/Recreation Center consists of a 265-bed rectangular dormitory facility surrounding an internal activity and track center. The four-story, 265-bed dormitory wraps around a 62,000-square-foot field house like a 34-foot-wide rectangular donut.

The totally precast project is built with precast concrete double-wall, double-floor and conventional sandwich panels, as well as precast concrete columns, beams, stairs, landings, elevator shafts, and water retention storage tanks. Precast sandwich panels form dormitory walls, floors and ceilings. Interior wall and ceiling panels have a paintable, smooth finish surface that does not require drywall. For the internal field house, 50-foot-tall precast walls and 180-foot-span roof trusses allow for an open-spaced, 200-meter indoor track, activity courts and a suspended walking track.

In addition, the building features energy-efficient windows, radiant heat, high-velocity air conditioning, heat recovery ventilators, a wastewater heat recovery system, a white membrane roof to reduce the heat island effect, low-flow plumbing fixtures and extensive use of recycled materials. It also capitalizes on low-emitting materials, uses materials with recycled content, and diverts the majority of construction waste through recycling. In addition, it features one of the largest geothermal installations in the Midwest with 65 650-foot deep geothermal wells, as well as underground precast storm-water retention tanks.

The two-buildings-in-one concept means that there is need for only one exterior façade and only one heating and cooling system for both facilities. Surrounded by dorm rooms, the center track facility stays cooler in summer and warmer in winter, saving energy. And, with the dorm rooms on the outside of the structure, the twin facility has a pleasing residential look. In addition, maintenance is required on the exterior of only one structure, rather than two.

Each dorm room is a six-sided box with five of the six sides made of precast concrete panels. The open, clear-span recreation center is surrounded by 50-foot-tall, 12-foot-wide, 12-in.-thick precast, prestressed concrete sandwich panels and is spanned by 180-foot-long steel trusses set every six feet. The center houses a 200-meter indoor track, a suspended walking track, exercise equipment, and multipurpose courts.

2 IN 1 BUILDINGS

Unique project consists of two buildings in one: a dorm wrapped around a field house like a rectangular donut

R19 RATING

Energy rating for the precast concrete Double Wall sandwich panels

40 PERCENT

Recycled content of the precast concrete wall panels

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Traditional residential-style dormitory structure surrounds a 62,000-square-foot recreation center.

Photo: North Central College

Fifty-foot-tall, 12-foot-wide precast panels form walls of the inner track and field area.

Photo: North Central College

Dorm rooms form like boxes on the outside of the recreation center with precast sandwich panels.

Photo: Dukane Precast Inc.

PCI

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The dormitory wall panels feature two 2 ½-in. concrete faces on either side of a 3-in. layer of bio-based insulating foam. Form liners were used to create the look of hand-laid brick with stone details at window headers and building corners—making the structure compatible with an adjacent brick structure. Electrical outlets and conduits for electronic cables were embedded in the wall panels during casting. Floor panels contain tubes for radiant heating and do not require on-site topping, saving construction time.

The precast concrete sandwich panel walls provide excellent energy efficiency, dramatically reduce air infiltration, offer a high level of soundproofing, are fire resistant, and can withstand an EF-5 tornado (winds over 200 mph).

It's projected that the project will qualify for 41 LEED credit points which is a LEED Silver rating.

PRECAST CONCRETE'S CONTRIBUTION TO SUSTAINABLE CONSTRUCTION PRACTICES

Sustainable Sites:

To reduce the heat island effect, the roof of the center consists of a white membrane adhered to composite roof deck panels. The panels are highly energy efficient, 7 ¼-in.-thick composite panels consisting of a substrate, expanded polystyrene insulation and OSB sheathing. Other green features are aimed at reducing traffic, including a car- and bike-sharing program.

Water Efficiency:

To reduce water use, the project features low-flow toilets, water-efficient fixtures, hand dryers, water-conserving indoor and outdoor plants, and no irrigation system.

Energy & Atmosphere:

Energy saving features include a tight building envelope with energy-efficient windows and insulated precast concrete Double Wall sandwich panels that provide low air infiltration, thermal mass benefits and an R19 energy rating.

An in-floor radiant heating system is used throughout the dormitory area. The recreation area is heated and cooled by forced air utilizing heat pumps, high-velocity air conditioning, HEPA air filters and heat recovery ventilators. Copper tubing wrapped around wastewater pipes captures the used water heat and transfers it to fresh water for reuse. Energy-efficient lighting is combined with individual room thermostat and lighting controls.

The project also makes use of geothermal energy and incorporates a geothermal field with 65 geothermal wells, each 650-feet deep.

Overall, the structure uses 21% less energy than a standard baseline structure of similar size.

Materials & Resources:

Nearly all the manufactured materials used in the project were produced within 500 miles—and many within 10 miles—of the building site, including the precast panels, cement aggregate and stressing steel.

Materials used contain at least 20% recycled content. A minimum of 75% of the development's construction waste was diverted through recycling.

Wood utilized is from sustainably-managed forests.

One of the key environmentally friendly features is the concrete mixture itself. Slag aggregate is used as a substitute for virgin limestone. In the factory, the self-compacting concrete mix incorporates 60% slag aggregate and fly ash replaces 30% of the cement. Overall, the precast panels are made with about 40% recycled materials. Moreover, the use of slag aggregate results in lower density concrete (125 pcf rather than 150 pcf). The reduced weight allows for more panels per truck load and lower shipping costs. A lighter weight structure can also result in savings in foundation construction. The panels have a 3- to 4-hour fire rating and an R19 energy rating.

Indoor Environmental Quality:

Low-emitting materials were selected for adhesives, sealants, paints and carpets. At the end of construction the building was flushed at 14,000 cubic feet per minute for 30 days to remove any gasses emitted by new materials, carpet and paint.

The precast concrete wall panels use bio-based insulating foam and are finished smooth in the factory so that no drywall or other VOC material is needed on inside surfaces.

Innnovation & Design Process

Precast concrete sandwich panels are used to form underground storm-water retention tanks both adjacent to the building and under a nearby site that will be covered over with a tennis court. Measuring approximately 60-feet by 200-feet by 12-feet deep, the tanks were made of precast Double Wall side panels with empty cavities (i.e. no insulation in the center of the panel) and were topped with a filigree floor used as a stay-in-place concrete form. Concrete was then site poured over the top, filling the floor panel and the wall cavities to produce a solid concrete tank.