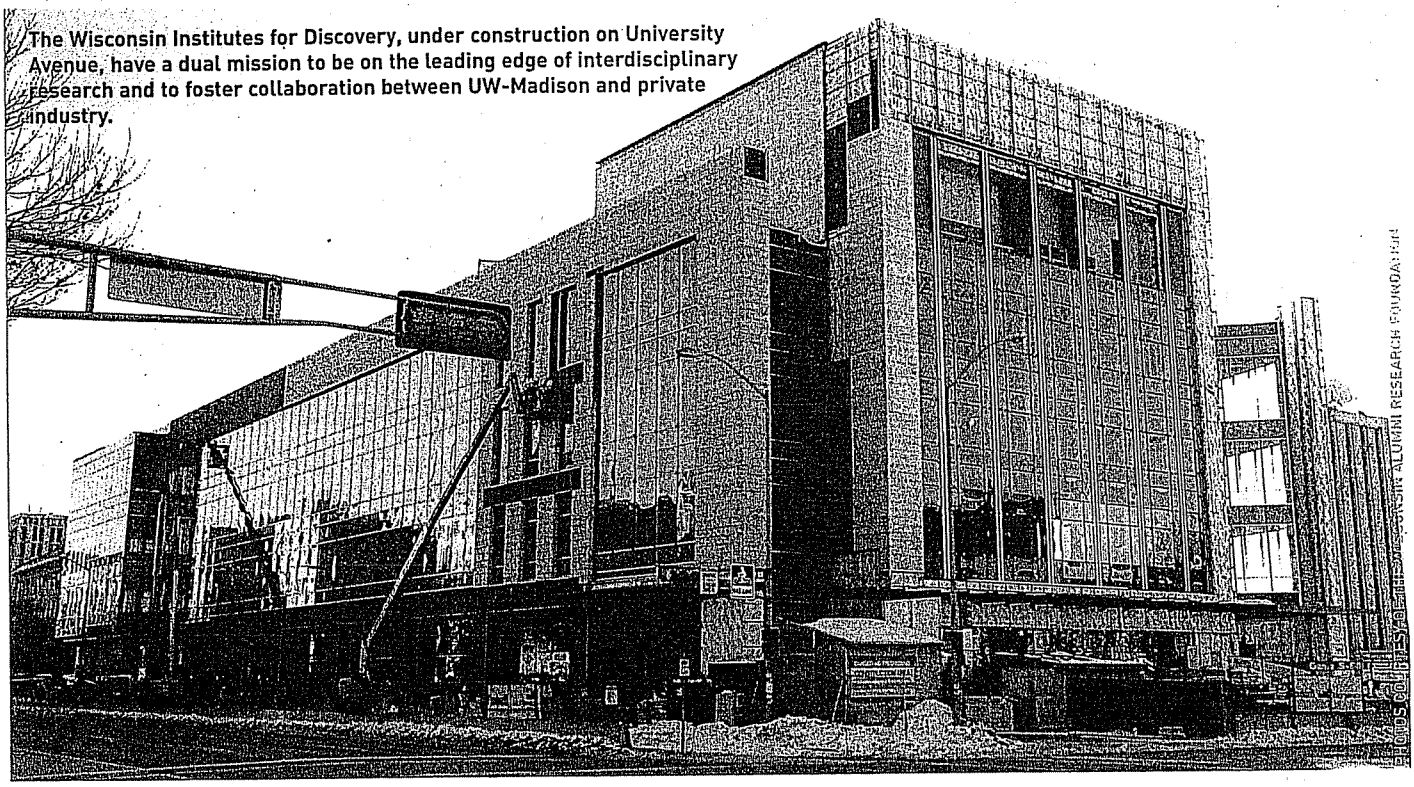
DISCOVERING INSTITUTIONAL DESIGNS

CONSTRUCTION | The collaborative, public-private, and sustainability features of the Wisconsin Institutes for Discovery make it unique among research facilities.

By Joe Vanden Plas



The Wisconsin Institutes for Discovery, under construction on University Avenue, have a dual mission to be on the leading edge of interdisciplinary research and to foster collaboration between UW-Madison and private industry.

The three pillars of the Wisconsin Institutes for Discovery, which is on track for a December 2010 public opening, have little to do with concrete, but they drove its design and construction process nonetheless.

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In the absence of major private-sector projects, the institutes are the most watched construction project in Greater Madison. Tom Thayer, president of Tri-North Builders, said the local commercial construction market is bleak, and the federal stimulus bill hasn't helped much. "In and around Madison, it's still pretty tough out there on the commercial side," Thayer said, citing the general economy and more stringent requirements imposed by banks to lend money for commercial construction projects.

...stitutes for Discov... ...ation is build... ...d the public, ... Opening that ...ss by Dr. Bruce Al... ...the journal *Science*.

...Institutes for Discovery are ... two biomedical research institutes under one roof: the public Wisconsin Institute for Discovery (WID), and the private Morgridge Institute for Research (MIR). Sangtae Kim, executive director of the Morgridge Institute, said the idea is to take discoveries from the university's research labs and apply them in the private sector. Kim said delivering solutions to overarching societal problems requires collaboration across many disciplines because it's unusual for one discipline to be the one-point solution that magically solves a problem.

"The discovery-to-delivery paradigm requires that these different research activities collaborate with each other, so you go from basic research and discovery to commercialization to impacting human health," Kim said. "No one person can do everything from end to end."

With that, IB set out to take a different look at the $165 million, 330,000-square-foot project. We spoke to designers and builders who

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Sangtae Kim
Executive director, Morgridge Institute

Bill Gustafson/Mark Chadwick
Principal/Project Manager, Ballinger

John Feller/Dave Beck-Engel
Senior VP/Executive VP, J.H. Findorff

Jeff Madden
Construction executive, Mortenson Const.

are managing a very complex building project, the design of which is influenced by its interdisciplinary and public-private aspects.

Designs on research

The project is being developed through the state of Wisconsin's first integrated delivery program. Just as federal granting agencies are placing an emphasis on research collaboration when making their granting decisions, the construction industry is seeing the value of a more collaborative approach.

With the Wisconsin Institutes for Discovery, the state (building owner), the project architects (the Milwaukee architectural firm Uihlein Wilson and the Philadelphia architectural-engineering firm Ballinger), and the building team (J.H. Findorff & Sons and Mortenson Construction) all signed one document, a tri-party agreement, to design and deliver the building. "In essence, we all operate almost as one entity, as opposed to three or four separate entities," said Jeff Madden, a construction executive with Mortenson. "That's a trend that's catching on throughout the country."

From the beginning of the design process in 2005, architects began work on a generic design. According to Bill Gustafson, principal in charge for Ballinger, they engaged surrogate university research groups to work in collaborative teams. At the brain-storming level, they did not have preconceptions about the building, other than the basic goal of fostering a collaborative environment.

Over the course of five months, they emerged with some basic ideas. First, since the site has a fairly large footprint of 60,000 square feet, they purposely kept the building low to the ground. They didn't want a high rise on the site, so what emerged was the concept of three floors of research, a public Town Center floor at ground level, and a lower level for applied technologies.

With that large footprint – the norm for research buildings is 25,000 to 30,000 square feet – they came up with research neighborhoods, a combination of wet labs and dry labs so that computer scientists (dry lab) could work along side chemists and biologists, who work in a wet-lab configuration.

There are three research neighborhoods, or pods, on each floor, each about 5,000 square feet and set up so that the lab portion is enclosed in a glass box, surrounded by support people and offices for the researchers.

"The conception of the program was to have 20 PIs [private investigators] who were classic interdisciplinary research types, and 20 PIs who would be more of the application or industry-focus types," Gustafson said.

All of the early work was done without the university having identified any of the buildings users. That was being done as part of a competitive process, so designers were working with a prototypical model of space rather than a specific model for specific researchers. With one exception – stem cell researcher Jamie Thomson on the Morgridge side – it wasn't until the summer of 2009, well into the construction period, that project managers could identify the researchers who were going to occupy the facility.

The fact that the building was designed without the researchers being known is atypical for a lab facility, according to Madden. "The building was well under construction by the time those people were even identified, and that was just this past year," he said. "There were several months of very intensive meetings with those research groups, taking the original building design, which was very flexible, and seeing what things they might need modified or changed to meet their specific needs.

"The tough part was getting all that re-coordinated and actually built in the same time schedule as the building originally had."

Madden said design customization was required for each of the actual research groups, who had tremendous input over the course of several months. How diverse are the research groups? Five principal investigators came out of the competitive program to produce WID's research themes, a program that attracted more than 200 proposals. On the WID side, the five PIs and their research themes include:

- Patricia Flatley Brennan, professor of nursing and industrial and systems engineering, and her living environments lab.
- John Denu, professor of biomolecular chemistry, and his epigenetics lab group.
- John Yin, professor of chemical and biological engineering, and his systems biology group.
- Lih-Sheng Turng, professor of mechanical engineering, and his tissue-engineering scaffold research.
- Michael Ferris, professor of computer science, and his optimization in biology and medicine group.

The Morgridge side features seven researchers, including Thomson, lead scientist in the regenerative biology focus area, and Kim, who will lead the pharmaceutical informatics area. Other lead scientists, who are recruiting scientific talent to fill out their staffs, include:

- Paul Ahlquist, professor of oncology, in the virology area.
- Thomas Mackie, professor of medical physics and a co-founder of TomoTherapy, in the medical devices area.
- Anthropologist Susan Millar, senior

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scientist for the Wisconsin Center of Education Research, in the education research area.

• Miron Livny, professor of computer sciences, in the core computational technology focus area.

• Nirupama "Rupa" Shevde, senior scientist and director of education and outreach at the WiCell Research Institute, who will lead Morgridge Outreach Experiences.

In addition to accommodating 12 different research teams, designers wanted to incorporate enough flexibility to serve future research. They had to decide whether to go ahead and build the generic spaces and make adjustments later on, or simply wait for the customization to be finished and then start the build out.

"We decided to hold off on those specific lab areas and work with the design team to interview the research groups and really figure out exactly what they needed," Madden said, "and then tweak the design and still have time to finish all those spaces within the building without having the project go into overtime. We're still finishing on the same date as planned, and we'll be able to accommodate all of these individual customizations the research groups need."

While the adjustments were time consuming to gather and incorporate, they also were fairly easy to make. "We worked with them over the summer and fall to adapt the generic design to their specific needs," Gustafson recounted. "There were not a whole lot of adjustments outside the boundaries of the generic design that needed to occur. We made sure we had enough flexibility."

John Feller, senior vice president of J.H. Findorff, said a lot of the equipment is of the "plug and play" variety. "All the gasses and the fume hoods are just left off at a ceiling interface," he explained. "If they reconfigure the space, they just unplug and replug. All the lab equipment is movable, and lab casework is all on castors and moves around."

When Thomson, who wasn't involved in any of the surrogate groups, came on board early on, designers interviewed him, looked at his existing labs, and came to understand how many people he had, the equipment he needed, and how this would fit into the pods.

The adjustments were fairly simple: Thomson, a cell biologist, did not need nearly as many fume hoods as planned for in the generic design; he needed enclosed spaces to serve as tissue culture rooms with appropriate furnishings like bio safety cabinets, he needed a couple of microscopy rooms, and he needed space for automated equipment.

"Jamie was the first person that we tested the prototypical design against with real use requirements," Gustafson said. "We've since gone on and done that many times over. The good news is that the basic design thinking we did way back in 2005 has held up very well."

In addition, designers surveyed major research institutes, and various members of the project team went to places like Stanford, the University of California-Berkeley, and the Howard Hughes Labs in Washington D.C. in an attempt to benchmark the best research labs. What they found was that none of them had the desired qualities; the closest example was the Clark Center at Stanford, but that facility was found wanting because of the lack of enclosed lab space.

In contrast, the Wisconsin Institutes for Discovery are designed to allow for flexibility over time. Mark Chadwick, a Ballinger project manager with a focus on sustainability, said the intent was to make generic patterns and then incorporate enough flexibility to add or

reduce partitions, fume hoods, and other features. "One of the premises is that researchers won't stay there forever," he stated. "Now, Jamie might and some others on the Morgridge side might, but on the WID side the intent is that there will be relatively frequent turnover. There is a modular, movable, flexible changeable quality to the lab space that allows things to ebb and flow over time."

Another design premise was that there be no figurative walls separating public and private researchers. "The intent of the public-private aspect was really that it be seamless," Feller said. "There is a legal boundary description to the building, but you don't see it in the building. You don't know where public ends and private begins. The design concepts were made to maintain equivalence so that the public side does not have something the private side does not."

The building's lower level includes a 2,500 square foot computer server farm that will be the foundation for an extremely robust information technology backbone. There also is a 12,000- to 13,000-square-foot specialty labs area that includes a virtual reality lab and about 5,000 square feet of prototyping space for small-scale medical device manufacturing.

Elsewhere, the outreach dimension comes in the form of embedded teaching labs on each of the upper floors, and teaching space where students from across the campus and even summer students and K-12 students can come in and work with researchers.

The ground floor contains the Town Center and an array of functions that are designed to bring people into the building, whether or not they are researchers. Since the building sits on a central campus site, the Town Center will feature a restaurant, coffee shop, and dairy bar. In addition, there will be areas where people can come in and meet with the scientists to collaborate and develop business ideas.

Said Dave Beck-Engel, executive vice president of J.H. Findorff: "It's very intentional that public and private entities are interacting. The building is designed so the researchers interact and have the ability to communicate easily, not be separated so that one doesn't have the inability to communicate with the other."

Finally, there is space called The Forum, which is a central space on the ground floor for social events, symposia, and other gatherings. Everything from performance events like music or theater, to artistic displays, to the more formal scientific symposia is intended for this multi-use space. "You can put on an event for a couple of hundred people, and use the function of the ground floor as part of that," Chadwick said.

Green WID

Sustainability features are designed to meet project goals of operating with 50% less energy and 50% less water usage than the typical UW-Madison research lab facility. For energy reduction, the facility has tight exterior walls so there is minimal air infiltration. There are what Chadwick called "nested arrangements" in the building, meaning the space that has the most stringent temperature and humidity controls are toward the inside of the building – the lab pods – whereas the office space, which can fluctuate more with the heat load of the building over the seasons and time of day, envelopes those more stringent areas. There are two large atriums, one on north side and one on the south side, and they are interlinked with the ground floor, where the temperatures can fluctuate more.

Heat and energy recovery is accomplished in several ways. Energy exchange wheels will draw heat energy out of the existing air and transfer it to incoming air, and a fluid methodology transfers heat into a fluid and from fluid into the incoming air. In addition, there are chilled beams, actually chilled water coils, which allow the air within a room to be cooled without introducing additional air.

"The idea is to minimize air changes within good practice limitations, shutting down the areas not in use at night or not occupied at night," Chadwick said. "There will be some ventilation in those areas, but we'll be cutting the amount of air flow significantly."

The building also has a geothermal well system to provide heating and cooling to portions of the building. According to Chadwick, there are 98 tubes that go down into the ground, carrying a liquid that is circulated. A heat exchanger takes heat from the building and brings it to the earth mass, or takes heat from the earth mass and brings it into the building, depending on whether "you have heat load you're trying to reject, or whether you're heating the building," he said.

There also is solar water heating, and the facility, which has low-flow water fixtures, will attempt to recover some of the pure water used in labs. In the process of making pure water, a lot of water is processed and rejected, so the institutes will capture and use that water elsewhere in the building.

Madden said wells have been drilled 300 feet deep around the perimeter of the building as part of a ground water reclamation system. "Since we have a pretty deep basement, we're down roughly where the water table is," he noted, "so we're able to collect that groundwater in a system of pipes and sumps, and use it to do things like flush toilets."

Visitors will immediately notice a heavy use of glass. There is a tendency in climates like Wisconsin's to think "fewer windows, more solid walls," to produce a more thermally efficient building. In analyzing the institutes, Ballinger found it could add more glass on the exterior and still achieve an efficient "thermal envelope."

As the enclosed building heads toward completion, workers are building out research pods and other interior features. In April, crews will start commissioning and testing mechanical and electrical systems. Also left to be done are finishing work on interior glass, walls, flooring, and stairs.

The building will have a number of aesthetic water features, including a water fall "wall" with an LED (light emitting diode) system behind it, and ample interior plantings, including 30-foot tall trees now being grown in Miami. In keeping with the scientific motif, the plantings around the north atrium will represent species from the Mesozoic era.

Everyone associated with the project marveled about its unique qualities. "I've worked on projects that are larger research projects," Madden said, "but this is definitely the most unique building of its kind."

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