

Research News

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A concrete idea takes on a new shape

BY SEAN MOORE
Research Promotion

Until architecture's Mark West altered a design process, concrete was not a medium readily used to display or create elegant building components.

But thanks to flexible fabric membrane construction, the words sensual and concrete can be used in the same sentence, and this is good news for architects and artists – and even engineers.

In the late 1980s West took polypropylene sheets, a new material at the time, and began shaping concrete. It started as a sculptural practice, but he soon realized that this process could be used in building design.

These membranes offer resistance only through tension, and the resulting geometries they create are of a natural, and so highly efficient order. And since natural forces move through matter in curved paths, building supports can now be formed to follow these paths, thereby reducing materials consumed in construction.

"It started with the beauty of these things cast in the fabric," West said. "But there were these sustainability, beauty and ease of construction aspects that made it worth investigating for building applications. And when we investigated it, we found that it works really, really well."

Working out of the Centre for Architectural Structures and Technology (C.A.S.T.) lab, a unique architectural research facility, West has developed a way to use single, unaltered polypropylene sheets in shaping concrete into various forms.

The method not only uses hundreds of times less material to create the formwork molds, but it allows for an expansion of creative visions. In essence, the lab is creating a new language through which architects can communicate. With this new language comes the ability to express new ideas, and there's no shortage of those.

"Personally, I would like to stop doing this work," West said. "I don't want to be a fabric mold guy till I die. But the problem is, there appears to be no end in sight to the things that we can do."

So if this method marries poetics with pragmatism, why isn't every new building incorporating it? Because, West said, the construction industry is very conservative; buildings are some of the most capital-intensive things we make and contracts go to the lowest bidder who is loath to try something new when profit margins are so small.

But West has a background in construction and has developed this method with builders in mind – the new process requires minimal training,



Photo by Sean Moore

Mark West, architecture, has developed a method to shape concrete into elegant and structurally sound forms for use in buildings.

and the reusable, easily transported formwork fabrics are less than a tenth of the cost of formwork plywood.

As for architects, West said they have long had an appetite for new materials and forms. What's more, cooking up the design is simple.

In the lab, a lead-knitted string droops in a natural parabola in front of a wood board. When West needs to calculate the shape of a beam, he hangs fishing weights on it in the corresponding load areas and the

string instantly displays the optimal shape of resistance. He then sprays paint over the string, stenciling the pattern on the wood for him to cut into the mold.

"This is really basic stuff but it's amazing how few people work in basic terms. Builders, though, work basically. I'm always in search of the simple builder's solution because I admire them so much. And this method gives us the form of a resistance in a very simple, beautiful way."

The challenges of developing a vaccine

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Nearly everyone on the planet will, at some point, have a run in with a species of *Chlamydia*, an obligate intracellular bacterium that mainly infects epithelial cells.

There is no vaccine against the two common species that cause human diseases, but Xi Yang, Canada Research Chair in Infection and Immunology, has recently made some profound discoveries that will impact the development of one.

About 150 million people worldwide suffer from *Chlamydia trachomatis*. It breeds under eyelids and causes so much inflammation and scarring that eyelashes turn inwards and begin scratching the cornea; blindness usually results. It is also a sexually transmitted disease that can cause pelvic inflammatory diseases and infertility. *C. muridarum* is a species of this bacterium used to study the pathogenesis of *C. trachomatis* infection in mouse models.

The second species infecting humans is *C. pneumoniae*, which causes mild pneumonia and appears to be linked to cardiovascular and

neurological diseases. Half of all people in their 20s have been exposed to it. By the time you're a senior, you've likely hosted it at least once.

Yang wants to know how and when a body defends itself from *Chlamydia*. He uses gene knockout mice to study the cellular and molecular basis of immune responses to the different strains with the goal of developing a vaccine. He's paying particular attention to the correlation that certain cells have with protection and pathology.

Antibodies, Yang has found, offer little protection. But cell-mediated responses seem to provide better protection. This immune-response uses T cells, which develop in the thymus and come in a variety of types, with each impacting health in different ways – sometimes good, sometimes bad.

"When we talk about immune response, we mostly think of it as bestowing positive effects, but certain immune responses to *Chlamydia* can be harmful," Yang said.

What has become of particular interest to him is Natural Killer T cells (NKT). These cells job description straddles innate immunity and adaptive immunity.



Photo by Sean Moore

Xi Yang, immunology, has made some profound discoveries in his efforts to develop an effective vaccine against *Chlamydia*.

"People believe NKT cells play a protective role in host defense. But there is a very interesting finding from our lab. What we found was for one type of *Chlamydia* NKT is protective, but for another type it promotes infection. Isn't that weird?"

When NKT-free knockout mice were infected with *C. muridarum* they fared better than the normal mice. Conversely, NKT-free knockout mice developed serious symptoms (compared to normal mice) when infected with *C. pneumoniae*.

This discrepancy happens because NKT cells modulate T cell responses. Different *Chlamydia* strains cause NKT cells to signal T cells in different ways.

The *pneumoniae* strain makes NKT cells activate Th1 cells – a particular type of T cell. The more Th1 a host produces, the better it will battle the bacterium. So here NKT cells are vital.

The *muridarum* strain, however, causes the NKT cells to activate cells called Th2. Compared to Th1, they are inferior opponents to *Chlamydia*. But since NKT cells are being told to produce it, they do, which undermines both Th1 production and the host's health. But when NKT cells are absent, the Th1 response gets elevated.

"It was surprising to find this," Yang said. "And it shows that universally activating NKT cells is not always the best way to go about designing drug therapies because you may actually be doing harm in some instances."

Bringing Research To Life

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