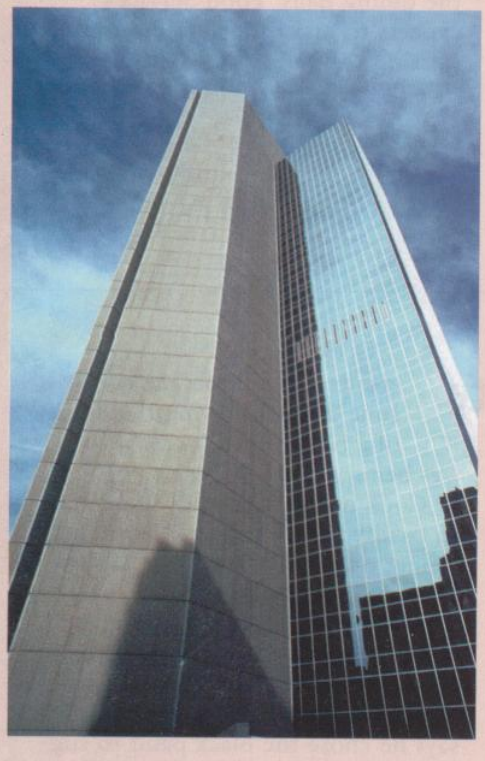
## Charting the Skyscraper Dance

When the wind gusts, skyscrapers gently swing, sway and twist. Sometimes they creak and groan. But that's okay because they're designed to do that, and most of the time the movement is imperceptible. "Tall buildings dance; the flexibility allows them to handle wind load, the force of the wind," says Tracy Kijewski-Correa, Notre Dame assistant professor of civil engineering.

Those dance steps are of particular interest to Kijewski-Correa and Professor Ahsan Kareem of Notre Dame's NatHaz Modeling Laboratory. In cooperation with the architectural design firm Skidmore, Owings, Merrill, and researchers from the University of Western Ontario, the Notre Dame engineers are measuring wind-induced motion in three Chicago skyscapers. For legal reasons, the researchers cannot reveal the designated buildings.

The project is the first-ever attempt to validate tall-building design procedures by comparing full-scale observations against wind-tunnel-generated estimates of building movement. Typically, results from wind-tunnel tests are used in computational models to design beams and components of the building. But no one has ever before done full-scale tests in the United States to see how well theory and reality match.



To provide the needed reality check, the Notre Dame engineers have set up a novel monitoring scheme of traditional movement sensors and global positioning system (GPS) navigational devices. The network, which operates 24 hours a day, seven days a week on each building, detects movement as slight as 5 millimeters.

"The wind environment in a downtown city is complex and can't be predicted very well," Kijewski-Correa says. "When wind hits a structure it wraps around the side and back, creating a wake like the swirling edge trailing a motor boat. So in a city with many tall buildings there are all sorts of eddies impacting buildings."

Besides yielding design-improvement information, Kijewski-Correa says, the study can offer building owners useful information for the operation of their structure. "For instance, on a windy day elevators may not operate properly as a building moves," she notes. To prevent that, an alert from sensors could be sent to the building's operations center to shut down elevator operation in times of very high winds.

In the next phase of the study, the Notre Dame engineers hope to add other tall buildings, including one under construction. "This would allow us to see what the building is like when it's just a steel skeleton and also determine the contribution of each added component to the building's performance," Kijewski-Correa says.