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How Do You Make A Building More Functional? Make It Moveable

By: Jeffrey Steele. Contributor



Operable wall panels at U.S. Bank Stadium in Minneapolis pivot to provide fresh air, among other benefits.

THORNTON TOMASETTI

Imagine an unchanging building whose form and function is inflexible. Now conjure the same building capable of being transformed into multiple purposes by moving various aspects of its structural form. Just think how much more marketable the building would become. That's the reality made possible by kinetic engineering, a term unknown to many. But with each new high-profile project helmed by Thomas Duffy, principal at New York City's [Thornton Tomasetti](#), the concept is growing in recognition.

Kinetic engineering possesses the ability to transform the nature of a facility, or the occupants' conception of the space, resulting in a completely different user experience in the same footprint,

said Duffy, who joined Thornton Tomasetti in 2012, after a 25-year career in structural engineering as a specialist in kinetic structures.

Kinetic engineering, Duffy said, “is the application of mechanical properties to structures to induce motion. Kinetic engineering allows flexible use of space, which in real estate is a valuable commodity. This is useful for completely transforming a space from one use to another, simply improving occupant sensory experience or comfort or providing sustainability measures such as limiting solar gain, and thus lowering cooling costs.”

Consider a rotating restaurant, a carousel or even a bridge that opens for boat traffic, he said. In each case the structure leverages kinetic engineering. Physical security features in and around buildings often employ kinetic engineering to compel barriers to appear or not.

Sports facilities such as Arthur Ashe Stadium, the tennis stadium that is part of the USTA Billie Jean King National Tennis Center in Queens, New York, often use kinetic engineering to open roofs, operate wall panels and vary the rise of seating to improve sight lines depending on the sport, Duffy said.

Examples of kinetic engineering in stadiums range from retractable roofs like the ones on Milwaukee’s Miller Park or Seattle’s Safeco Field, home to MLB’s Milwaukee Brewers and Seattle Mariners respectively, to more subtle uses, Duffy said.

Alternative feel

The operable wall panels at U.S. Bank Stadium, which opened in summer 2016 to host the NFL’s Minnesota Vikings, are “not subtle,” he adds:

Ninety-five-foot tall pivoting panels are a significant example on the west side of the facility, facing downtown Minneapolis. They provide a 275-foot grand entrance from the front porch into, and more importantly out of, the facility. When closed they provide the same performance as the balance of curtain wall on that side. When opened they provide an alternative feel and user experience, welcoming patrons to the stadium and providing fresh outdoor air inside in a way that a fixed domed or retractable roofed stadium could not.

Highly coordinated systems at the heart of such venues demand design teams invest considerable thought in the architectural, structural and mechanical response. These are interdependent disciplines, requiring coordination in a well-functioning installation.

“There can be no afterthoughts after the design philosophy is set, certainly not during construction, without ensuring the changes will not affect performance,” Duffy says. “Decisions made during fabrication and erection may decrease capital cost by thousands, only to cost millions during the life of the structure.”

Moving the needle

“The future is bright,” says Duffy. “Changing a sports facility into an event space for conventions, or for art exhibits, or into a performing arts space, can mean an increase in selling the space from 50 to 250 events per year.

“Add a 'thrill' component to an otherwise static observation deck. Create buildings that are more sustainable by incorporating moveable louvers for solar shading or ventilation that respond to the time of day, week and month. Kinetic engineering can also create event spaces that are more secure, without having the look and feel of a fortress.”