Reengineering Tradition

Structural Design of the University of Pennsylvania Commencement Ceremony Canopy and Staging

By Frederick C. Baumert, P.E. and Amanda Gibney Weko

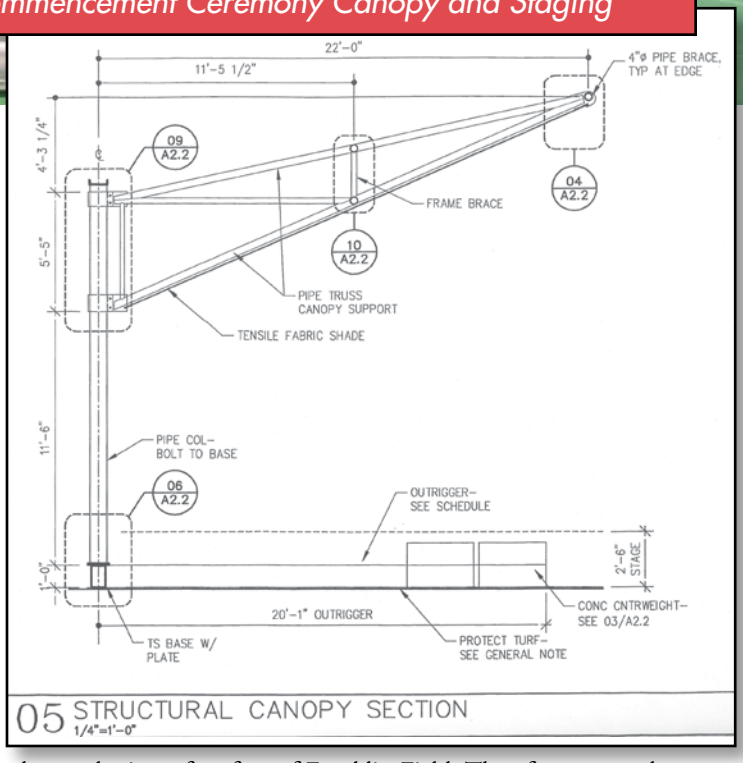
The University of Pennsylvania holds its commencement ceremonies in Franklin Field. The historic Italian Romanesque football stadium, built in 1922, is a campus icon. At just under 300,000 square feet, Franklin Field is capable of holding 52,000 spectators, a number significantly greater than the 15,000 to 20,000 guests who typically attend graduation events. In an attempt to reduce the scale of the building, and to enhance the activities of commencement, the University of Pennsylvania enlisted a design team to rethink the ceremony and its on-field architecture. The design team, including MGA Partners, Architects and Keast & Hood Co. structural engineers, developed an intimate stage area for placement on the field, and designed a collapsible, modular canopy and stage system as the focal point for the ceremony.

The original graduation configuration utilized a stage set up in the center of the field, with students seated in rows in front of the stage. While student sight lines were adequate, family members in the remote stands had a difficult time watching the ceremony. A tent roof placed over the stage for protection from sun and rain further obstructed audience views. Both the stage and tent were rented for each ceremony. The University knew there must be a better alternative.

MGA Partners was asked to submit ideas to improve the presentation. The university's basic programmatic requirements were for a larger stage, and improved sight lines for both students and spectators. As is often their penchant, the architects did not tinker with the former configuration, but instead overhauled the entire commencement concept and envisioned a sculptural fabric canopy as the focal point for the event.

The new commencement scheme subdivides the playing field, concentrating commencement activities and guests into the U-shaped eastern side of the arena. Modular components included a generous stage for hosting the presenters, an inverted umbrella canopy to offer weather protection but also provide direct sight lines for viewers seated in the stands, and side wings supporting translucent graphic panels and video screens. The stage would be flanked by flag stands for the banners of each of the participating schools. The handsome scheme and its sculptural canopy were lauded by all who reviewed it.

Upon approval of the design, Keast & Hood Co. was enlisted to engineer the structure. Naturally, the engineers' initial thoughts were "magnificent" and "how do we keep it from blowing over?" Two major structural challenges were clear from the onset. Nothing could permeate

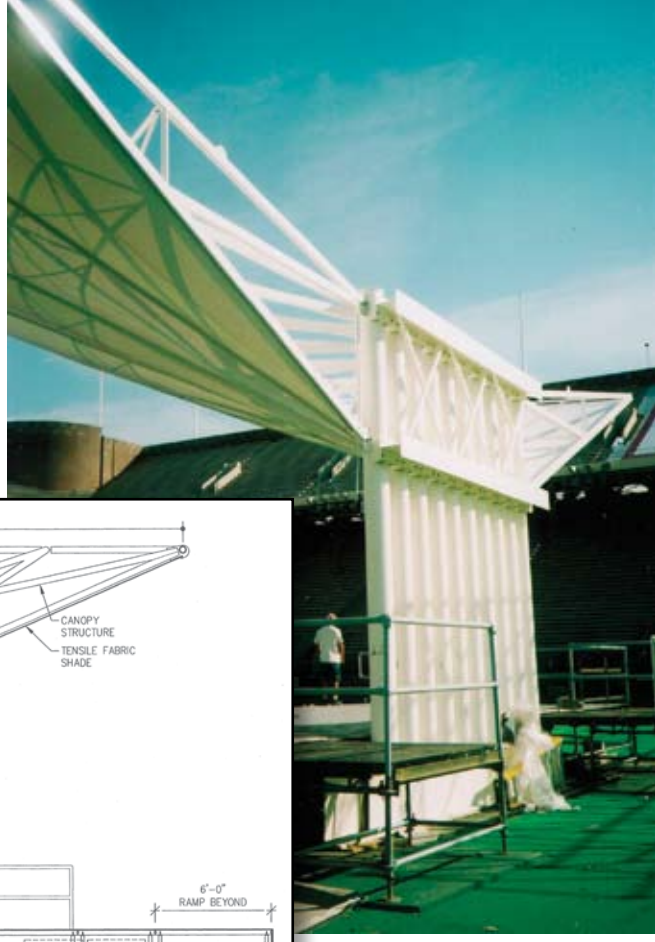


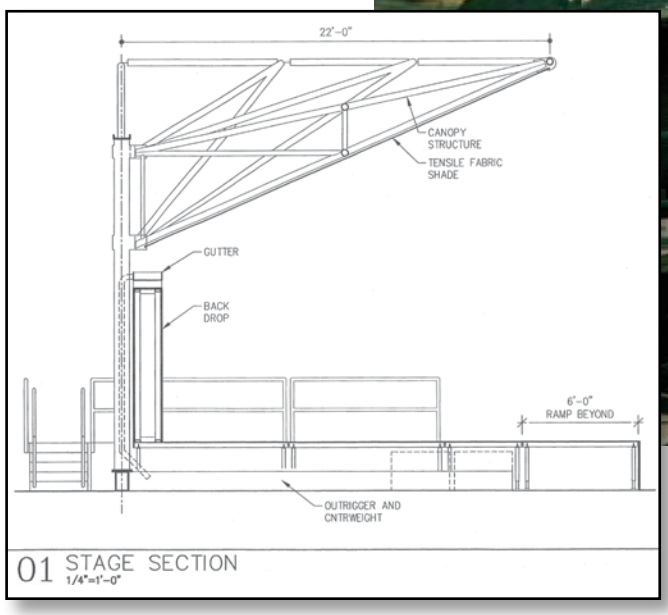
the synthetic turf surface of Franklin Field. Therefore, no anchorages could be constructed within the playing field, and all structures needed to be counterweighted and balanced for self-support. The design also required flexibility and portability to accommodate large or small commencement ceremonies and the relatively short-term timeframes for set-up and dismantle before and after each ceremony. Concerns about the maximum wheel loads of vehicles used to transport the canopy elements were also evaluated, to limit tire impressions in the playing field surface.

Keast & Hood Co. engineers Thomas Leidigh, P.E., and Frederick Baumert, P.E., began with a review of the building code. At the time, Philadelphia had a proprietary building code, but the engineers knew they needed to review the wind provisions of the model national building codes to incorporate the "state-of-the-art" for wind loading on such an unusual configuration. The engineers were aware that the codes provided some relief in load requirements for temporary structures, but further investigation revealed that wind was unfortunately not an area of relief.

Anchoring a system against wind is not a particularly challenging problem. However, the difficulty at Franklin Field was that the structure could not be bolted to the ground – no penetrations of any kind were permitted. Thus, the design would have to work similarly to a gravity retaining wall. The base would have to resist the wind solely by dead weight. However, this objective had to balance against the requirements for easy and relatively quick assembly. Ideas of water barrels were considered and rejected, as were a half-dozen other solutions, ranging from sand bags to lead plates.

Working with the architects, the engineers developed a scheme that positioned a grid of steel beams under the stage, converging on a strong spine at the rear that formed the stem for the canopy. Frames for the two wings for the projection screens also were developed. Preliminary sizes were determined, and the scheme was obviously too heavy to be practical.





A return to the drawing board, and ensuing discussions, made it apparent that the key issue was the appropriate design wind load. The minimum force prescribed by the model codes was so high as to make the member sizes outlandish. The selected fabricator for the project, Mountain Productions, provided the answer. The fabrics and attachments they would recommend would only support the canopy with wind speeds up to approximately 50 miles per hour. Higher winds would tear the material, and the wind load would be relieved. Additionally, if gusts greater than 35 miles per hour were predicted in the weather forecast, the university would not hold its commencement events outdoors and the canopy would not be assembled. All members of the design and fabrication team agreed that the components of the new commencement structure could be designed for a maximum of 50 miles per hour winds rather than the 80 miles per hour required by the local codes. With this decision, the final sizes were determined, and a final structure that is both easy to assemble and relatively light-weight was established.

The design has been a great success for the University of Pennsylvania, and has been in use for commencement ceremonies for several years. One of the design team members, an intern in the structural engineer's office at the time, coincidentally was a part of the first graduating class to experience the new ceremony. In further coincidence, he recently joined the staff of the architect's office.

The University's budget for the project was approximately $400,000. The new "kit of parts" can be stored and re-used year after year, avoiding the past rental fees for rental tents and temporary carpentry. Lightweight, modular components also reduce set-up time and associated labor fees. The solution is both economical and practical.

The take-away lesson for the project is that not all structures are required to be designed for the full forces prescribed in the building code. If reasonable and thoughtful analysis of the project requirements can justify a lower design force, it is acceptable to utilize one.

In addition to the new commencement canopy and stage, the greater design challenge involved re-imagining the entire commencement procession and ceremony. MGA Partners designed the on-field seating arrangements and re-choreographed the event. New banners of fabric, in the school colors of red and blue, cover empty seats in the stands. White text on the banners spells out PENN. The expansive stadium now feels both intimate and festive, while the commencement procession and ceremony have been infused with new energy. The comprehensive commencement redesign, including the canopy and stage, earned an American Institute of Architects Philadelphia Chapter Award for Design Excellence in 2003.▪

Project Team Members

Client:	The University of Pennsylvania Philadelphia, PA
Architect:	MGA Partners, Architects Philadelphia, PA
Structural Engineer:	Keast & Hood Co. Philadelphia, PA
Canopy Fabricator:	Mountain Productions Wilkes-Barre, PA
Progress Photos:	Paul A. Thompson Philadelphia, PA
Finished Photos:	Barry Halkin Philadelphia, PA

Frederick C. Baumert, P.E., is a partner in the structural engineering firm Keast & Hood Co. His professional experience includes more than twenty years of structural design for new buildings and historic preservation.

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