**Submission Criteria**

Technical
Project Description
Innovative Technical Features
Awards, Patents, Licenses
Commercial
Original Schedule versus Actual Schedule
Original Budget versus Actual Budget
Unique Contractual Conditions
Performance Warranties and Tests
Benefit to Society
Impact on Employment
Impact on Safety, Health and Environment for Workers and for the Outside General Public
Public Relations Activities Associated with the Project

**Project Title:**

David A. Tepper Quadrangle

**Owner:**

Carnegie Mellon University

**Project Team Address:**

5000 Forbes Avenue, Pittsburgh, PA 15213

**Phone:**

412-268-2914

**Email:**

areilly@andrew.cmu.edu

**Identify Lead Agents (engineer of record, architect, construction manager):**

Architect:

Moore Ruble Yudell

Construction Manager:

PJ Dick

**Project Description**

PJ Dick provided construction management at risk services to Carnegie Mellon University for the David A. Tepper Quadrangle (Tepper Quad), a five-story, 315,000-sf building that houses the Tepper School of Business and acts as
a central hub on campus, intended to foster collaboration among students and faculty from Carnegie Mellon’s six other colleges and schools.

Project features include:

- University Welcome Center, 24 total classrooms, dedicated commons areas including 12 breakout spaces for master’s students and six breakout spaces for undergraduate students, and a new 7,500-sf fitness center
- 600-seat flexible auditorium with state-of-the-art audiovisual technology
- 2,825 sf of dining and food service space
- 130-car underground parking garage and 290-car surface parking lot
- Landscaping and site utility infrastructure
- Specialized areas such as an Entrepreneurship Center and the TEL Center (Technology Enhances Learning)

The Tepper Quad is currently the largest BubbleDeck project in North America. BubbleDeck is a voided slab system that involves placing hollow recycled plastic balls or “bubbles” within a steel rebar cage, around which the concrete slab is poured. The BubbleDeck was used to increase column bays and reduce foundation sizes by replacing concrete with the voids, thus reducing the weight of the structure. This method produces floors 20 percent faster with less formwork and beams, reduces the amount construction costs by 10 percent and reduces the amount of concrete needed by 25 percent. On the Tepper Quad nearly 2,000 cubic yards of concrete was replaced by approximately 220,000 “bubbles.” The BubbleDeck also reduced carbon use in construction by 30 percent.

The building was designed to offer nearly 360-degree views of Oakland and 85% of the building has access to natural light. It features 82,000-sf of exterior glass including four stories of fritted glass surrounding the grand atrium.

**Why this project should receive the ESWP Project of the Year**

The Tepper Quad is an iconic project that serves as Carnegie Mellon’s “front door” to campus. The project was a tremendous success on all fronts, from the incredible building with its 11,000-sf skylight above the atrium, which is open to four floor with amazing expansive views, to the Quad and its beautiful and inviting landscaping, and finally to the project team of Carnegie Mellon, PJ Dick and Moore Ruble Yudell Architect who’s collaborative efforts were able to complete the project on time and on budget.

The project is worthy of the ESWP Project of the Year Award for the following reasons:

- Tepper Quad is the currently the largest BubbleDeck project in North America and the first constructed in the Pittsburgh market.
- The building is located on a tight jobsite on an active university campus, so PJ Dick had to coordinate all construction closely with Carnegie Mellon, PennDot, and neighboring buildings, including WQED and Central Catholic High School.
- This project required extensive safety planning to ensure all students, faculty, visitors, and crew were protected throughout construction.
- To complete the job on time and on budget, we used a fast-track approach for site and structure packages; the foundations and garage structure were being constructed well before the architectural design was finalized.

**Meeting the challenge of a difficult job:**

One of the initial challenges of the project was utilities site preparation. A concrete utility tunnel had to be installed in a 28-foot-deep trench under Forbes Avenue (one of the busiest streets in Oakland) so utility lines from
main campus could be brought to the Tepper Quad site at the Morewood parking lot. Work took place during the summer and shut down two lanes of traffic on Forbes Avenue; work was closely coordinated with Carnegie Mellon, the Port Authority and PennDot. Because of the building’s close proximity to a bridge abutment over Panther Hallow, we also had to work with PennDot’s engineers during construction of the basement levels of the Tepper Quad to ensure our work did not undermine the structural integrity of the bridge.

The concrete installation, which PJ Dick self-performed, was another challenging element of the project. The project utilized a cast-in-place voided slab system (BubbleDeck). This was the first time a voided slab system was constructed in the region. The advantage of the voided slab system is that it allows for the structural slabs to be lightened by more efficiently using the concrete. To help the entire team better understand the system from not only a constructability standpoint, but also for in-slab raceway routing and systems support and anchorage, PJ Dick constructed a 900-sf elevated void slab mock up. Other challenges associated with the concrete included: logistics, design, site location, terrain, and schedule.

Logistics
Off-hour deliveries were required due to the urban, college setting. Off-hour concrete placements were needed due to necessary closure of a main campus artery and the permitted oversized loads of the BubbleDeck. There was zero laydown area, therefore just-in-time deliveries were required.

Design
This was a complex concrete design including cantilevered slabs, two-way slabs, BubbleDecks, transfer beams, post tensioning, bridges, atriums, and large column bays.

- The BubbleDeck was used to increase column bays and reduce foundation sizes by replacing concrete with the voids, thus reducing the weight of the structure.
- Post-tension beams were used on floors above to hang columns for an open auditorium.
- Extensive collaboration with the design team was required to ensure the form work met the aesthetic expectations.

Site Location
The site is located in the city on a busy college campus adjacent to one of the busiest intersections in Pittsburgh. The project required close coordination with campus management to protect the safety of pedestrian and vehicular traffic.

Terrain
Because the building was construction into a hillside, had such a large footprint, and presented limited access points, detailed planning and sequencing was required to ensure safe, timely construction.

Schedule
Multiple shifts were necessary for 18 months, including weekends, to make sure all schedule milestones were met. This included construction through two winters. On average, the team constructed 10,000 sf of deck per week, which included shear walls, columns, and cores.

Excellence in project management:
The project was completed on time and on budget using a fast track approach for the structure as the foundations and garage structure were being constructed well before the architectural design was finalized, which allowed for significant time savings. PJ Dick utilized Plangrid for the Project, which enabled the entire project team to have live/updated documents at their fingertips at all times. Additionally, PJ Dick’s virtual construction group utilized BIM to fully coordinate the building MEP/FP systems, thus eliminating coordination issues in the field, saving time and money. Our team planned and sequenced the project so that, to the extent possible, aspects of the construction that would impact the general public, thus requiring lane/sidewalk closures, parking restrictions, etc.
would be performed over the summer months when pedestrian traffic volumes were lower, thus minimizing impacts to students and faculty.

PJ Dick worked closely with Carnegie Mellon to evaluate building materials and systems for constructability, economic feasibility, and that they met Carnegie Mellon’s overall project goals. The university employed a third-party, independent cost consultant who we were able to successfully able to reconcile with at every estimating stage. Through collaboration with the design team and owner, we were able to develop a realistic GMP that met the project budget without compromising the design intent.

Using innovative construction practices:
The Tepper Quad was constructed with an innovative BubbleDeck voided slab system. This is a relatively new technology to the United States: in fact, this is the largest bubble deck constructed in North America and the first in Pittsburgh. The methodology produces floors 20 percent faster with less formwork and beams, reduces construction costs by 10 percent and reduces the amount of concrete needed by 25 percent. This voided slab methodology involves placing hollow plastic balls or “bubbles” within a steel rebar cage, around which the concrete is poured.

Structurally, the floor slabs are constructed using a voided slab methodology. The construction is comprised of approximately 220,000 hollow plastic balls, made from recycled plastic, sandwiched between the two reinforcing steel mats within the concrete slab. This process eliminates concrete that is not required in transferring loads across floor plates. This technology allows for longer structural spans, reducing the amount of beams and columns. On this project, PJ Dick also used smart technology to monitor the concrete temperature and maturity in real time. During concrete pours, small orbs with wireless technology were placed in the concrete; a device manager (pictured in lower right corner) was installed on the tower crane. The orbs transmitted information to the superintendent so that he could continuously monitor the concrete; this information was useful in timing formwork removal, enabling us to work cost efficiently as no guesswork was involved. We also used the orbs to establish winter concrete procedures.

Challenges associated with the bubble deck included:
- The individual bubbles were delivered to a local manufacturer who then packaged them into specified wire cage dimensions, the largest size being 10 feet by 20 feet. This was both a schedule and logistical challenge. Just-in-time deliveries were required – this meant that the decks had to be formed and the first layer of rebar installed before the bubble cages could be installed.
- Most of the bubble installation had to occur on second shift because they needed to be installed before the top layer of rebar could be installed.
- To prevent the bubble racks from floating out of the concrete during concrete placement, PJ Dick poured the concrete in two lifts. The first lift had to encapsulate the bottom layer of reinforcing; accelerators were used to decrease the set time. This enabled us to perform the second pour on the same day.
- Night placements were required due to limited lane closure permits
- Racks were fabricated to allow for multiple bubble cage assemblies to be picked off the truck at one time.
- MEP pathways had to be created through the bubble deck, which required field modifications.

Quality
For every project undertaken by our company, a Quality Control Plan is required. This plan details the steps that assure quality results are achieved. Projects are audited to verify that the project team is compliant with the
established quality control plan including the project manager to the superintendent, to the foreman/craft personnel and subcontractors, supplier and third-party consultants.

On the Tepper Quad we also used mock-ups to allow all project stakeholders (users, designers, and subcontractors) to clearly define and understand final expected quality results, which contributed greatly to improving the overall quality on the project and reduced punchlist items. Mock-ups were used for the polished concrete on the structural slab and topping slab as well as the bubble deck to ensure the owner and architect were satisfied with the expected level of finish.

**Excellence in Client Service:**
PJ Dick was able to deliver the project on time and on budget; this was accomplished through extensive preplanning and collaboration. PJ Dick’s philosophy to preconstruction services during the Tepper Quad was to understand how to build the facility before pricing the project. The site logistics plan, phasing plan, safety plan, and schedule were all developed in coordination with the initial estimate to ensure they would be accurately included in the overall project budget. PJ Dick’s ability to carefully plan each activity resulted in a more accurate project budget and schedule. Our team thrived on brainstorming means and methods to build more effectively and efficiently and established a collaborative environment with Carnegie Mellon and the design team to deliver the best solutions for the university. This allowed us to work together to identify and resolve project challenges before actual construction even began.

An example of this was the selection of the exterior brick. Early in the preconstruction phase, the architect and Carnegie Mellon had different visions for the exterior. We understood this was an important detail to the owner and would be crucial to client satisfaction. To help find a solution early in the preconstruction process, PJ Dick created seven 10’ x 10’ brick wall mock ups at the project site. These allowed the owner and designer to accurately see color variation, pattern, texture of the different brick options. The team was able to select an exterior brick that is reminiscent of the Kittanning brick that was used in early construction at the university, so the project looks cohesive with the campus.

Throughout the project PJ Dick communicated and coordinated our sequencing plan and schedule of construction activities with Carnegie Mellon’s facilities staff and department heads with plenty of advanced notice so upcoming activities construction activities could be communicated to faculty and students, so we could adjust our schedule as needed to minimize impacts to planned events. PJ Dick also utilized this schedule as a tool to make sure that deadlines were met, and progress was maintained for the entire project team.

**Contractor’s Sensitivity to the Environment and Surroundings:**
The David A. Tepper Quadrangle Project site was formerly an asphalt parking lot, so there were no adjacent buildings to protect. Safety measures were taken to protect neighboring structures including Central Catholic High School’s football field, South Neville Street, Forbes Avenue and public utilities. E&S measures were implemented, inspected, and maintained around the site perimeter.

Sustainable construction practices were utilized on this job to protect the environment. By nature, the BubbleDeck methodology is a sustainable construction practice because it reduces the amount of concrete and steel needed, which also decreases the amount of CO2 created during the manufacturing of materials produced. The carbon use in construction was reduced by 30 percent and the concrete was reduced by 25 percent.

**Contractor’s Contribution to the Community:**
The Tepper Quad is directly adjacent to Central Catholic High School’s football field. Work had to be closely coordinated with the high school. To enhance neighbor relations, Carnegie Mellon added a few improvements for
Central Catholic High School to the Tepper Quad project. Work included padded benches, a padded retaining wall along the football field, and new sidewalks along South Neville Street.

Our team helped Carnegie Mellon use the construction as a real-world learning opportunity for students. Classes, student group, and community organizations were able to tour the site and members of our construction team guest lectured to an engineering class. PJ Dick also hired Carnegie Mellon interns as Summer Engineering Interns on the job.

PJ Dick also sponsored Carnegie Mellon’s Sustainability Weekend.

Safety
The importance of student, visitor, faculty, and worker safety cannot be stressed enough on this project. The Tepper Quad was a major project located in the middle of tight, urban college campus. At the start of this job, PJ Dick entered into an OSHA Partnership Agreement to encourage cooperation between OSHA, PJ Dick and trade contractors to foster a safe work environment for all project employees. This partnership agreement established a goal Days Away and Restricted Time (DART) Rate of 4.3. PJ Dick exceeded the goal and achieved a DART Rate of 3.8 for over 785,275 manhours worked.

Training and Compliance were crucial to our safety success. PJ Dick employed full-time safety personnel, enforced mandatory safety meetings, and required subcontractors to participate in detailed project onboarding.

Highlights included:
- OSHA National Fall Protection Stand Down conducted in May 2018.
- OSHA National Safe + Sound Campaign conducted in August 2018.
- OSHA performed three verification audits throughout construction; no deficiencies were notes during any of the inspections.
- PJ Dick utilized its Safety Snapshot Observation Program: Internal observation program that evaluates activities by various levels of PJ Dick Management; 1,970 safety snapshots were conducted throughout the project.
- MY SAFETY, PJ Dick’s company-wide safety program which focuses on integrating safety values into everything we do, was also followed on this project.

Media Coverage and Promotion
As Carnegie Mellon is one of the world’s most renowned educational institutions and the new Tepper Quad served as the new “front door” to campus, the project received significant media coverage.


Carnegie Mellon also publicized the project extensively. PJ Dick worked closely with the university throughout construction to provide construction statistics, guide tours and offer site access. The Tepper School of Business website included a Tepper Quad section which included a live webcam video that allowed viewer to watch construction activities 24/7 in real time. Tepper Magazine, the business school’s bi-yearly publication, featured “Keeping Up with the Quad,” a section that offered current construction news and photos.

Professor Bryan Routledge, co-chair of the Tepper Quad Committee, produced update videos on the Tepper Quad building process. One such video featured Carrie Deutsch, PJ Dick project engineer, where she explained the construction planning process.
Since the project was highly visible both locally and nationally, PJ Dick’s continued commitment to innovation, safety, quality, and client satisfaction positively reflected upon the construction industry as a whole.

Awards

- PJ Dick was awarded the Pittsburgh Area Chapter of the American Concrete Institute’s 2018 Excellence in Concrete Award for its work on the Tepper Quad project.
- The Tepper Quad project is LEED Gold Certified.