

Pennsylvania State University Burrowes Building: Technical Report I

September 16, 2015



Courtesy of BLT Architects

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Executive Summary

The Burrowes Building located on the Pennsylvania State University campus is a renovation project that was selected for use as part of an AE Senior Capstone Thesis. The purpose of the AE Senior Capstone Thesis is to test a Construction Management students' knowledge they've obtained over the past 4 years in the AE program by researching and presenting on a construction project from beginning to end. This Technical Report I will focus on the key details of the project, as well as an overview of the different parties involved in construction of the building. The report below may contain: project schedule/budget, an overview of the different building systems, existing/local conditions, client/owner requirements and goals for the project, the project delivery method, and staffing plan of the construction manager.

The Burrowes Building is a 95,975 SF office building for the School of Liberal Arts that is currently under renovation to improve the facility. The \$28.5 million dollar renovation will strive to make offices more efficient and spacious, improve mechanical systems, improve building circulation, and implement ADA into the building. This will be achieved with a dedicated project team of architects, a construction manager, contractors, and the owner who will put forth their best effort to produce a finished project.

For the project some goals were issued by the owner before the project began. The owner stressed to stay well under the GMP budget, matching new masonry to existing, and obtain an extra 4 feet of basement space for mechanical equipment. Another major goal of the project is to achieve LEED Gold certification for new construction from the USGBC. This will be achieved with recycling efforts, using approved materials, installing energy efficient equipment, and other energy saving methods.

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Project Analysis

Client/Owner Information

The client/owner for the Burrowes Building project is the Pennsylvania State University. They are financing the project with the help of the School of Liberal Arts. The owner made the decision to move forward with this project after it was determined that the building systems were outdated, there was no ADA access, circulation was very confusing, and the offices were very small and inefficient. Penn State has their own project managers that oversee the different projects on campus. The project manager for this project is Chad Spackman. Mr. Spackman stressed that this is a project on campus and there are some major safety factors that need to be addressed for this project. The site is right next to the Paterno Library which is a major pedestrian area for students. To help address these issues the CM has been given a large contingency in the budget to provide the greatest amount of safety possible. Some implementations for this project included: site fencing with blue mesh to provide privacy, deliveries need to be before 7am, gates need to be closed at all possible times, and ensuring there is proper walkways around the site for students.

Another issue stressed was the budget and schedule of the project. This project has a stiff completion date of December 4th, 2015 because there are many on going and upcoming construction projects on campus which limits the amount of swing space available for the displaced professors and graduate students. This date will also allow the occupants to move in before the spring semester starts. There are many unforeseen issues/problems when it comes to renovation projects with demolition and trying to match new construction to existing structures. The big driving items for the schedule are the new knuckles that will connect to the Core and Wing buildings. The budget for the project was set forth by the Board of Trustees and is a Guaranteed Maximum Price contract between Penn State and PJ Dick.

Project Delivery System

PJ Dick was chosen as the Construction Manager through a competitive bid where they were awarded the project after being short listed. The contract for this project is a CM @ risk with a negotiated GMP. This means that the CM PJ Dick will deliver the project in a Guaranteed Maximum Price and will cover any amount it goes over budget. This method was chosen for the idea that it is a very durable contract because it can handle changes in the design or scope better than other contract types. This is important especially on university projects and renovations because they have many unforeseen issues. It also helps to eliminate a low-bid project which gives more flexibility in choice of contractors. The CM can begin estimating in the design phase for the project with this contract. This will save time and money in the long run and allows the CM to be involved before construction begins which can result in value engineering and cost savings. The contract between PJ Dick and contractors is a Standard Subcontract Agreement. The architect (BLT Architects) holds the contract with the engineers/consultants on the project.

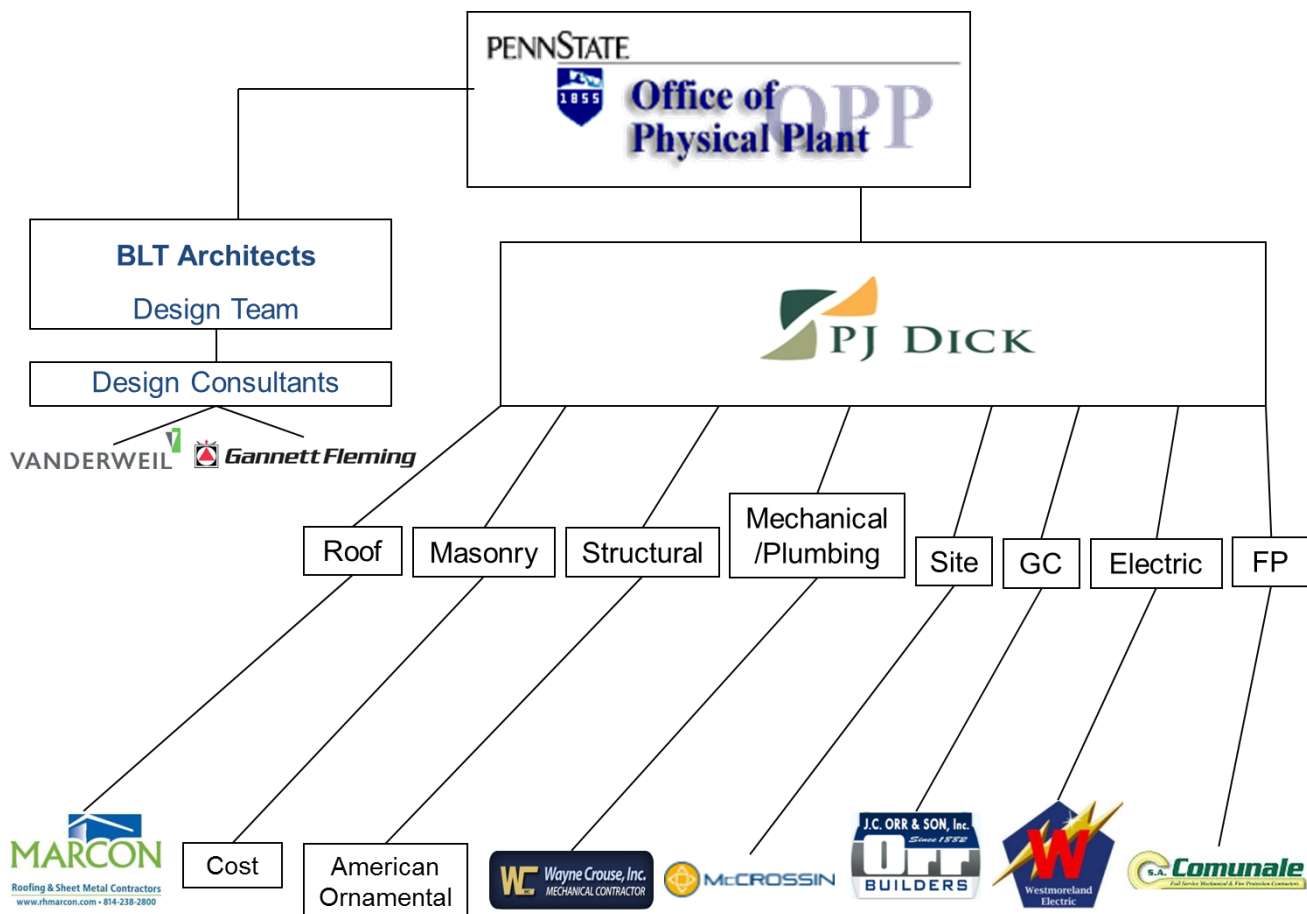


Figure 1: Project Organizational Chart

Staffing Plan

PJ Dick's staff plan for this project is the typical organizational layout for a project of this size. There will be off site management support from upper management positions such as the President Jeff Turconi. The field staff will be led by Andy Schrenk, the Senior Project Manager. Field supervision will be led by Head Superintendent Laurie Faunce. Other key staff members include: a Site Safety Manager, Field Engineer, MEP Specialist, BIM Coordinator, and a Diversity Coordinator.

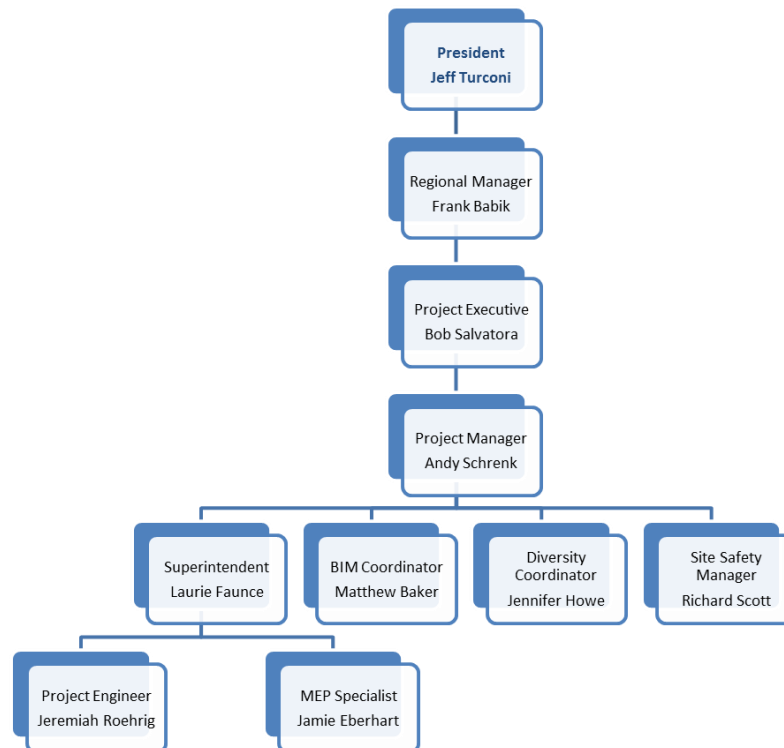


Figure 2: Project Staff Chart

Project Schedule

Construction began in February 2014 and is projected to be substantially completed this December 4, 2015. The knuckles will be the major driving factor of completing the schedule on time. The basement excavation and demolition of basement foundations will also be of utmost importance for the fact that this is a high risk process and can a lot longer than projected. The schedule will be pushed by the CM to try and cut down durations and finish the project before the substantial completion date with potential shared savings as an incentive from the owner. (Refer to Appendix A)

Project Budget

For this technical report a square foot estimate was performed using RS Means 2015 Square Foot Costs, to compare actual project costs in cost per square foot. The results can be seen below:

- RS Means 2015: \$26,183,620.46 or \$272.82/SF
- Construction Costs: \$28,500,736.00 or \$296.96/SF
- Difference in Estimate: ~8%

The RS Means value differs from the actual value likely because of the fact that this is a square foot estimate which does not take into account specific systems and equipment used that can significantly increase costs. As shown in Appendix B the major systems differ from one another and will be addressed in later estimates that should bring the estimated value closer to the actual construction costs.

Existing/Local Conditions

Penn State has a very firm landscape plan. There are a lot of Heritage Trees located around the Burrowes Building which affects construction and lay down areas. The PSU Arborist requires that these trees must be unharmed during all construction and must be preserved. There is one tree in particular that was donated by John W. Oswald that sits right at the entrance to the site. There is also a lot of bedrock located throughout the PSU campus. The Burrowes Building is located on top of a field of bedrock which would make excavation difficult depending on the depth of the stone. Parking is another issue that is a result of undertaking construction on campus. Penn State allows each foreman from the Burrowes project to have one parking pass that grant them access to certain lots near the project. All other workers must park in one the public parking decks or in the lot by Beaver Stadium.

Building Systems

Demolition: There is a large amount of demolition and asbestos abatement required for this project. Most of the piping throughout the building is wrapped in asbestos. There is also some lead paint from the original construction that will need to be addressed before construction can begin in those areas. The demo will include a complete gut of the Core and Wing buildings as well as completely demolishing the knuckles down to the foundation.

Mechanical: The new mechanical system will consist of a completely new dedicated outside air handling system with VAV boxes. The original building contained only radiant heating with no air conditioning that made the space very uncomfortable throughout the year. Six new air handling units will be set in the basement after it is excavated down to provide enough

clearance and access to the equipment for OPP to perform maintenance and service. The two end AHU's will each contain an enthalpy energy recovery wheel. These will be the units to provide air to the Wings and will provide 4100 CFM each. The four central units will provide all the air to the Core. These units will provide a total of 11,400 CFM to the Core. There will be duct shafts located at each end of the Core building and at each Wing building. This will allow duct work to be ran up to the top floor from the basement to provide conditioned air to these spaces. Each floor will contain a different zone of cooling. The corridors of the Wings will contain ceiling mounted Fan Coil Units (FCU) and the offices will contain wall FCU's. In the Core there will be finned tube radiators along the bottom of the walls to provide heat. The knuckles are utilizing Blower Coil Units (BCU) for cooling.

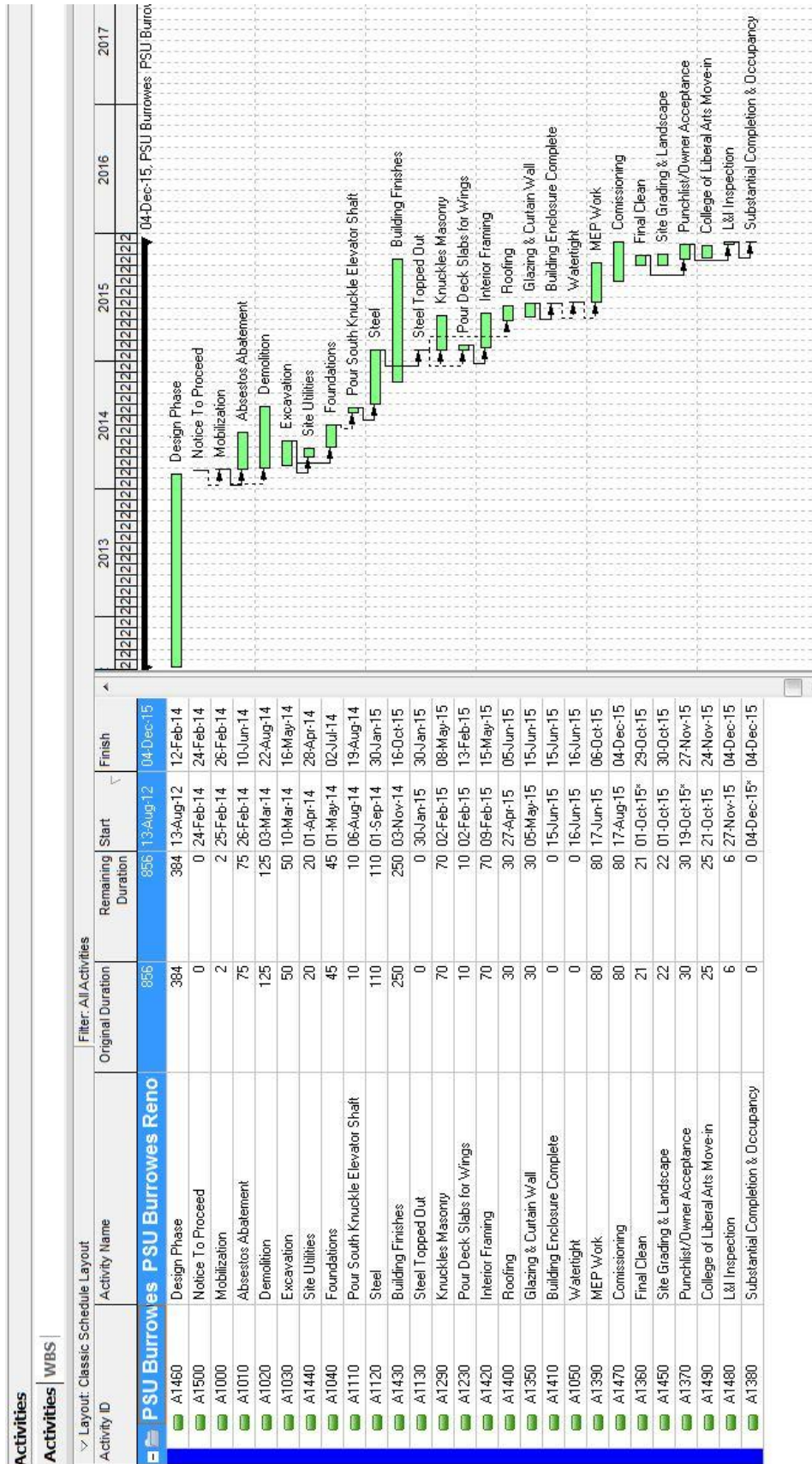
Masonry: The new masonry system will utilize a grid system to attach limestone panels on the knuckle towards the mall. On the East side of the knuckles toward Oswald Tower will be where scaffolding will be erected to install the brick up to the roof. The scaffolding will consist of a standard steel frame with wood planks as the floor material. The masonry is not load bearing except for the fact that it holds its own weight. Waterproofing will be applied using "blue skin" which is a sheet membrane that attaches directly to the elevator shaft on the East side.

Electrical: The electrical system will consist of a 480 V (1600 A) service transformer and a 120/280 V (1200 A) step-down transformer that will service panels through the Core and Wing buildings. These pieces of equipment will be located on the mall side of the building. A new emergency power system will be installed using a 100 KW generator and will be located in the new electrical room with the switchgear. All of the interior and exterior lighting will be upgraded to include high efficiency bulbs and fixtures to help achieve LEED points.

Structural: The knuckles will contain the only new structural steel. The steel will be connected to the elevator shaft and the existing Wing and Core buildings. The structural steel system will consist of W flange columns and beams ranging from W10x19 to W12x65. There will be HSS used as the columns for the knuckle's four most exterior corners. The floors will be a composite deck consisting on metal decking with a 4 inch thick concrete slab. The roof will contain 18 gauge roof decking and there will be no concrete poured on this decking. All of the interior steel beams and columns will be fireproofed to achieve the required 2 hr. fire rating. There will be two different cranes used for erecting the steel of the knuckles. The first crane will be located on the Southeast side of the building toward Oswald Tower. The other crane will be located on the Northwest side near the Library mall.

APPENDIX A:

PROJECT SCHEDULE SUMMARY



APPENDIX B:

PROJECT COST SUMMARY

| PSU Burrowes Renovation Square Foot Estimate | | | |
|--|-------------------------------|--------------------|-------------------------|
| Building Parameters | | | |
| Gross Area | 95975 | | |
| Perimeter | 1194 | | |
| Story Height | 12ft | | |
| Office-95,975 SF | | System Selected | |
| Exterior Wall Type | Face Brick w/Concrete Back-up | | |
| Roof Structure | Steel Roof Deck | | |
| Cost Adjustments | Adjustment Value | Adjusted SF Cost | |
| Base SF Cost | n/a | \$ | 166.21 |
| Perimeter Adjustment | 6.76 | \$ | 50.16 |
| Story Ht. Adjustment | 0 | \$ | - |
| | SF Cost | \$ | 216.37 |
| | | | |
| | | | |
| System | Office | | |
| | % | \$/SF | Cost |
| D20-Plumbing | 2.7 | \$ 3.54 | \$ 339,751.50 |
| D30-HVAC | 13.3 | \$ 17.65 | \$ 1,693,958.75 |
| D40-FP | 3 | \$ 4.00 | \$ 383,900.00 |
| D50-Electrical | 14.3 | \$ 19.02 | \$ 1,825,444.50 |
| | | | |
| | | | |
| Cost Breakdown | Sq. Ft. | \$/SF | Total |
| Office | 95975 | \$ 216.37 | \$ 20,766,110.75 |
| | | Grand Total | \$ 20,766,110.75 |

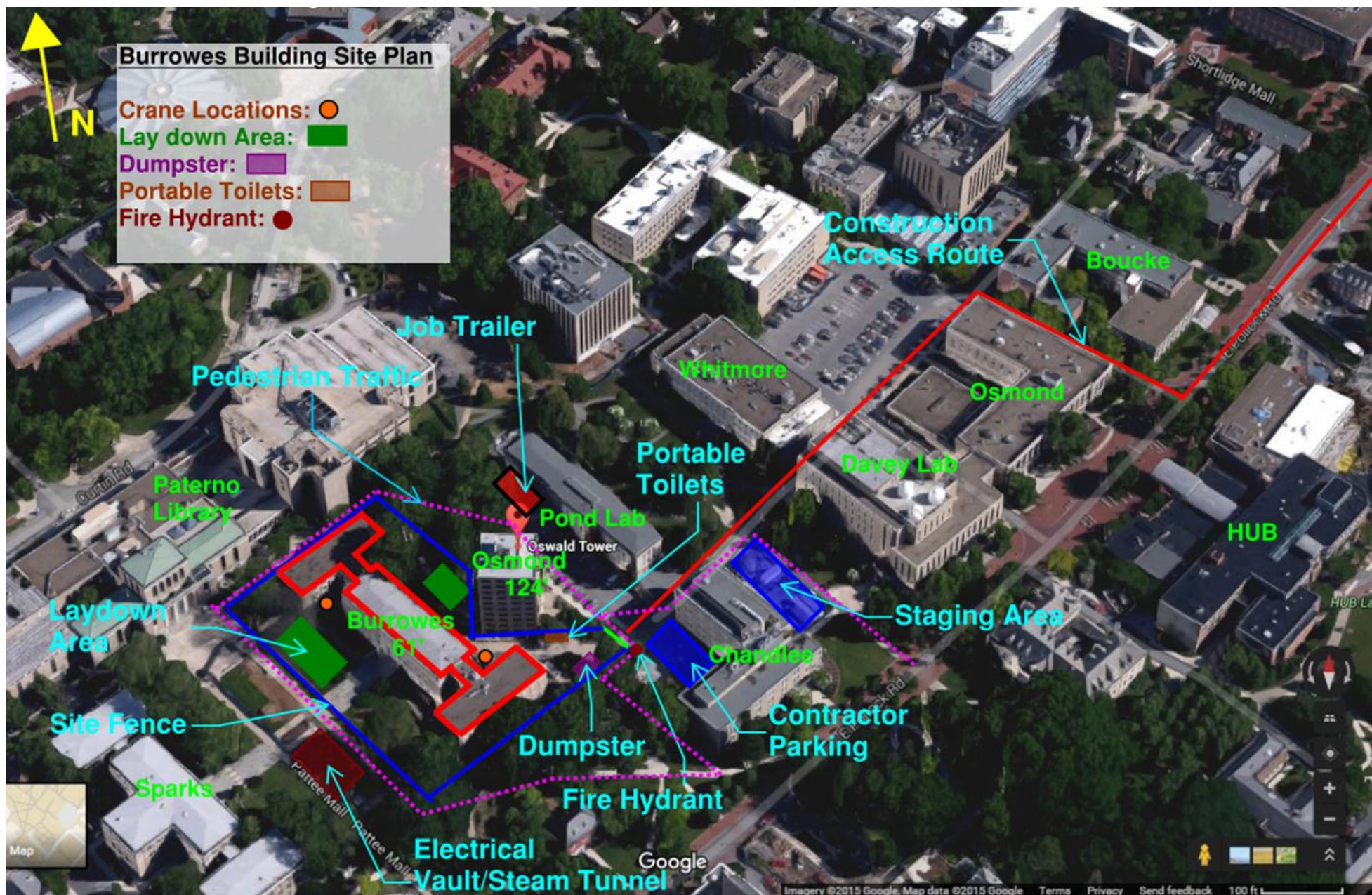
| Total Cost Plus Fee | | |
|-------------------------------|--------------------|-------------------------|
| Cost Breakdown | Value | Total |
| Total Cost Before Adjustments | | \$ 20,766,110.75 |
| Elevators | 2 @ \$296,200 | \$ 592,400.00 |
| Size Adjustment | 1.0 | \$ - |
| Location Adjustment | 0.94 | \$ 20,077,000.11 |
| Time Adjustment | 0.988 | \$ 19,836,076.10 |
| | Total | \$ 19,836,076.10 |
| General Requirement | 10% | \$ 1,983,607.61 |
| Architectural Fees | 6% | \$ 1,190,164.57 |
| Contingency | 1% | \$ 198,360.76 |
| Overhead | 5% | \$ 991,803.81 |
| Profit | 10% | \$ 1,983,607.61 |
| | Grand Total | \$ 26,183,620.46 |

| Actual vs. RS Means Plumbing Estimate Cost/SF | | | |
|---|-----------|------------|------------------|
| | Cost/SF | Sq Footage | Total |
| RS Means | \$ 3.54 | 95975 | \$ 339,751.50 |
| Actual | \$ 8.02 | 95975 | \$ 769,500.00 |
| | | Difference | \$ 429,748.50 |
| | | | |
| | | | |
| Actual vs. RS Means HVAC Estimate Cost/SF | | | |
| | Cost/SF | Sq Footage | Total |
| RS Means | \$ 17.65 | 95975 | \$ 1,693,958.75 |
| Actual | \$ 39.49 | 95975 | \$ 3,790,500.00 |
| | | Difference | \$ 2,096,541.25 |
| | | | |
| | | | |
| Actual vs. RS Means Electrical Estimate Cost/SF | | | |
| | Cost/SF | Sq Footage | Total |
| RS Means | \$ 19.02 | 95975 | \$ 1,825,444.50 |
| Actual | \$ 42.46 | 95975 | \$ 4,075,500.00 |
| | | Difference | \$ 2,250,055.50 |
| | | | |
| | | | |
| Actual vs. RS Means Building Estimate Cost/SF | | | |
| | Cost/SF | Sq Footage | Total |
| RS Means | \$ 272.82 | 95975 | \$ 26,183,620.46 |
| Actual | \$ 296.96 | 95975 | \$ 28,500,736.00 |
| | | Difference | \$ 2,317,115.54 |
| | | | |
| | | | |

Assumptions:

- Only performed % breakdown of 4 major building systems
- Estimate performed using RS Means 2015 Square Foot Cost
- Difference in actual vs. estimated is most likely the result of how detailed the estimate is.
- All adjustments were made based on State College, PA as the location of construction

APPENDIX C: EXISTING CONDITIONS/LOGISTICS SITE PLAN



APPENDIX D: PRESENTATION SLIDES

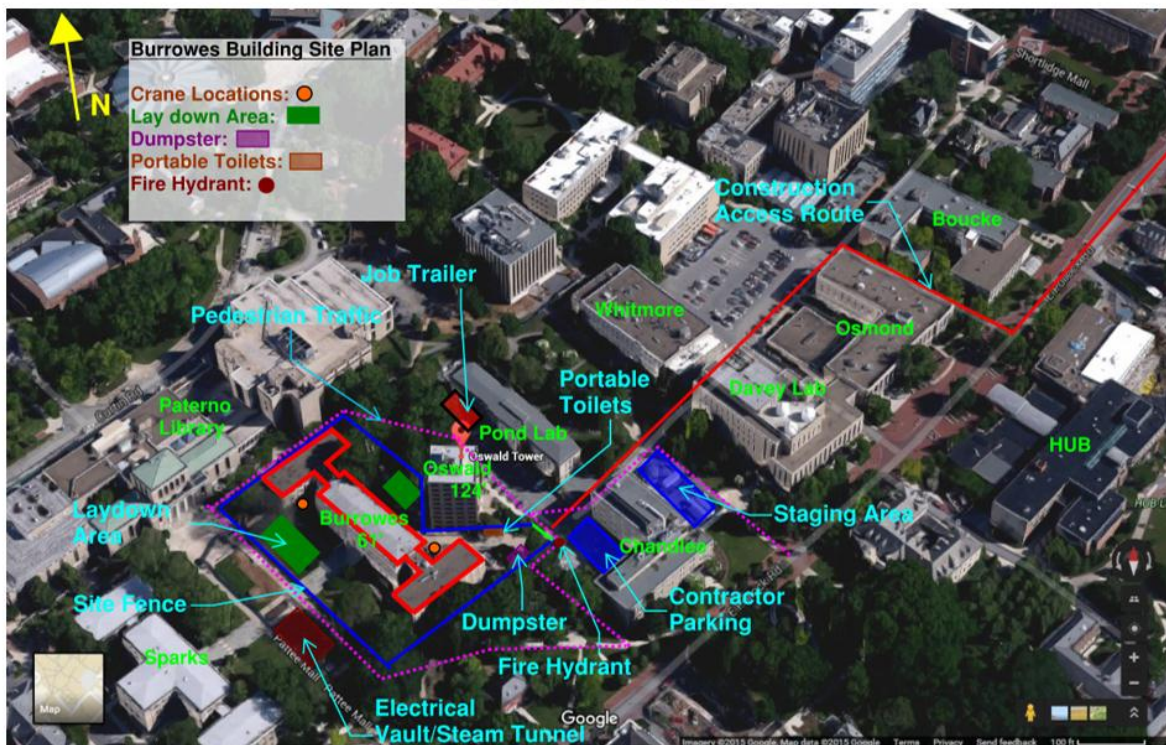
Penn State Burrowes Building Renovation 135 Burrowes Building State College, PA 16802



**Josh Fry
Construction Management
AE 48IW
Dr. Somayeh Asadi**

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Existing Conditions Site Plan/Local Conditions



Building Systems Summary

- **Demolition:** There is a large amount of demolition and asbestos abatement required for this project. There is also some lead paints from the original construction that will need to be addressed before construction can begin in those areas. The demo will include a complete gut of the Core and Wing buildings as well and completely demolishing the knuckles down to the foundation. All of the piping throughout the building is wrapped in asbestos.
- **Mechanical:** The new mechanical system will consist of a completely new dedicated outside air w/ VAV air handling system. The original building contained only radiant heating with no air conditioning which made the space very uncomfortable in the summer months. 6 new air handlers will be set in the basement after it is excavated down to provide enough clearance and access to the equipment for OPP to perform maintenance and service. The two end AHU's will contain enthalpy energy recovery wheels and will be the units to provide air to the Wings. These units will provide 4100 CFM each. The four central units will provide all the air to the Core. These units will provide a total of 11,400 CFM to the Core. There will be duct shafts located at each end of the Core building and at each wing that will allow duct work to be ran up to the top floor from the basement to provide conditioned air to these spaces. Each floor will contain a different zone of cooling. The corridors of the Wings will contain ceiling mounted Fan Coil Units (FCU) and the rooms will contain wall FCU's. In the Core there will be finned tube radiators along the bottom of the walls to provide heat. The knuckles are utilizing Blower Coil Units (BCU) for cooling.
- **Masonry:** The new masonry system will utilize a grid system to attach limestone panels on the knuckle towards the mall. On the East side of the knuckles toward Oswald Tower will be where scaffolding will be erected to install the brick up to the roof. The scaffolding will consist of a standard steel frame with wood planks and the floor material. The masonry is not load bearing except for the fact that it holds its own weight.

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- **Electrical:** The electrical system will consist of a 480 V (1600 A) service transformer and a 120/280 V (1200 A) step-down transformer that will service panels through the Core and Wing buildings. These pieces of equipment will be located on the mall side of the building. A new emergency power system will be installed and use a 100 KW generator and will be located in the new electrical room with the switchgear. All of the interior and exterior lighting will be upgraded to include high efficiency bulbs and fixtures to help achieve LEED points. The other major electrical rooms such as the switchgear room will be located on the ground floor of the Core building.
- **Structural:** The knuckles will contain the only new structural steel. The steel will be connected to the elevator shaft and the existing Wing and Core buildings. The structural steel system will consist of W flange columns and beams ranging from W10x19 to W12x65. There will also be HSS used as the columns for the knuckles four most exterior corners. The floors will be a composite deck consisting on metal decking with a 4 inch thick concrete slab. The roof will contain 18 gauge roof decking and there will be no concrete poured on this decking. All of the interior steel beams and columns will be fireproofed to achieve the required 2 hr fire rating. There will be two different cranes used for erecting the steel of the knuckles. The first crane will be located on the Southeast side of the building toward Oswald Tower. The other crane will be located on the Northwest side near the Library mall.
- **Cast in Place Concrete:** The foundation in the basement will be demolished in sections and then the ground will be excavated to provide more ceiling height than the original ceiling of 6ft. To provide room for new mechanical equipment. The existing steel columns will be jacked up and supported using two W flange beams to distribute the building weight until the new footings are formed and poured. The footings will then be poured with 8000psi high yield strength concrete. The knuckles will consist of an formed and poured elevator shaft. The majority of the concrete mixtures used throughout the project include 3500psi and 6000 psi for the elevator shafts. Concrete will be placed with a variety of methods. To get concrete to the basement for the new foundation holes will be cut in the ground floor to allow for a chute to be used to place concrete throughout the basement. The crane will lift a 5 yd. bucket with concrete for the elevator shafts. The stairs in the knuckles will be poured by lifting 5 gallon buckets up to each floor with a JLG lift.

Project Cost Evaluation

PSU Burrowes Renovation Square Foot Estimate

| Building Parameters | | | |
|----------------------|-----------------------|--------------------|-------------------------|
| Gross Area | 95975 | | |
| Perimeter | 1194 | | |
| Story Height | 12ft | | |
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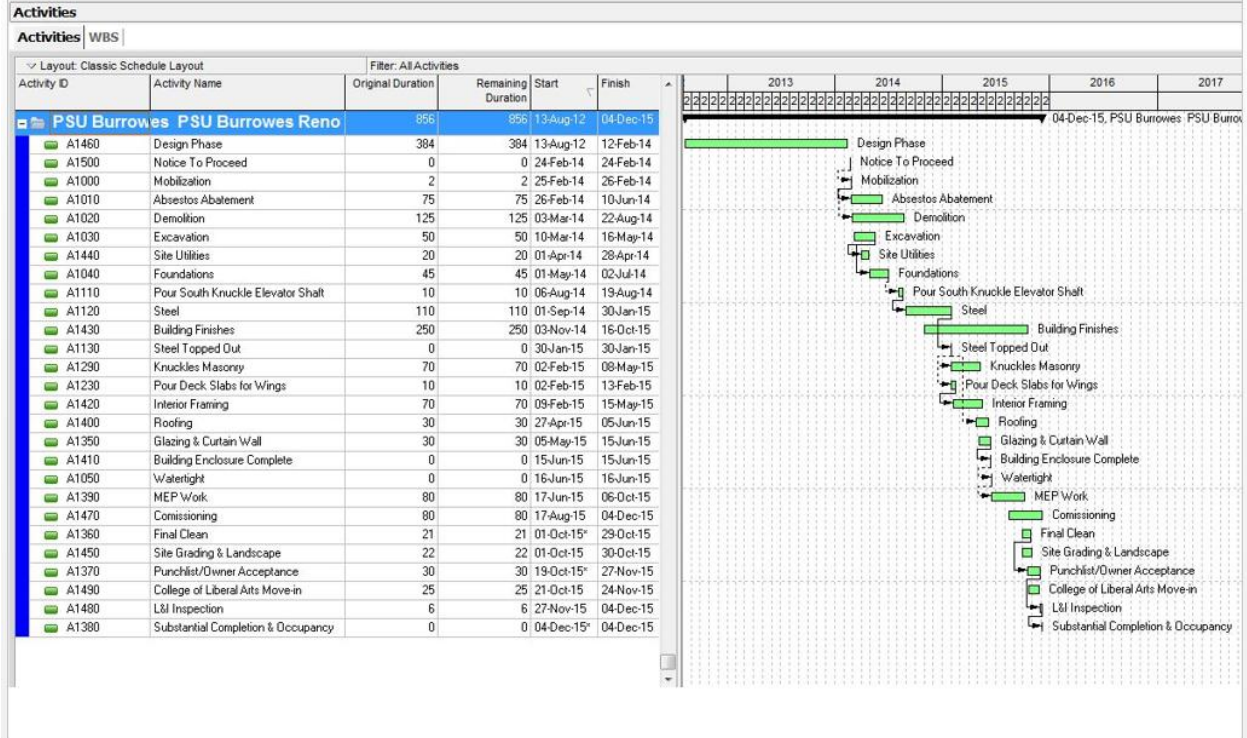
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| | | Difference | \$ 2,317,115.54 |

Total SQ FT. Estimate: \$26,183,620.46
Actual Construction Cost: \$28,500,735
Percentage Off: 8.1%

Project Schedule



Owner: The Pennsylvania State University

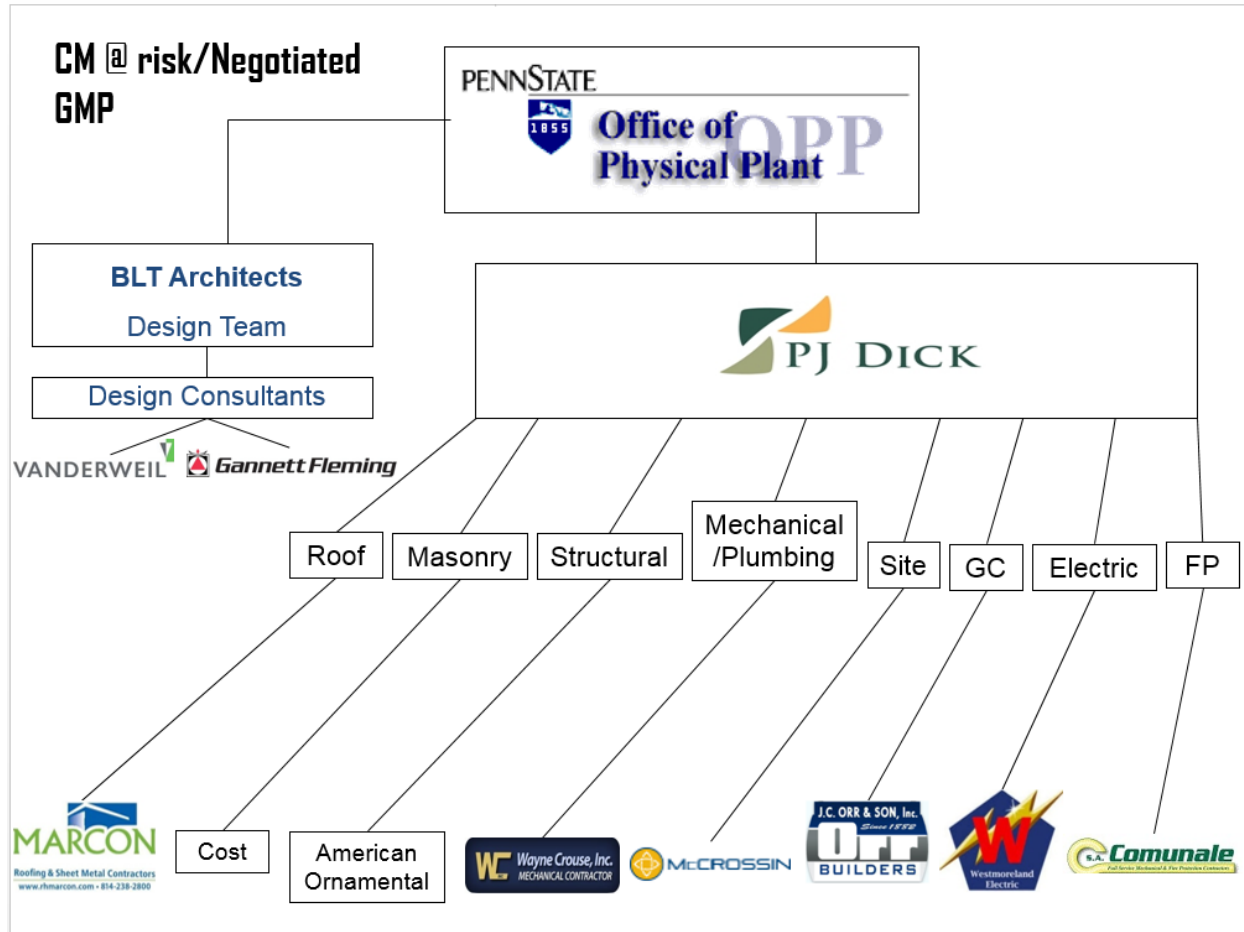


PSU Project Manager: Chad Spackman

- ☐ Chad Spackman, PE - Project Manager
- ☐ Jim Fail - Construction Administrator
- ☐ Vernon Davis - Contractor Liaison
- ☐ Todd Webber – Construction & Contract Specialist
- ☐ Chris Hort-College of Liberal Arts

PENNSTATE





PJ Dick Project Team



Questions?

Special Thanks to:

- Andy Schrenk-Project Manager for PJ Dick
- Chad Spackman-PSU Project Manager
- Chris Hort-College of Liberal Arts
- Kyle Kernozek-BLT Architects