Joseph A. Kifus Jr.
AE Senior Thesis 2005
CM Option
04/08/05

Senior Thesis '05

Final Report

Penn State Fayette's

Multi-Purpose Community Center

Penn State Fayette's Multi-Purpose Community

General Information:

- Size (total Sq.ft.): 55,000 sq.ft.
- Number of Stories above grade/ Total Levels: 1/1
- Dates of Construction: 5/21/03 - 9/19/04
- Design Completed October 02
- Bid January 03 @ $8.4 Million
- Actual Cost Information: $10.4 Million (Overall)
- Project Delivery Method: Traditional

Model Codes/Zoning:

- BOCA
- Pennsylvania Accessibility Code
- International Plumbing Code
- National Electric Code 2002
- National Fire Protection
- Pennsylvania Code Labor and Industry
- Planning, Zoning and Community Development, Fayette County, PA

Primary Project Team:

- Owner: Penn State, www.fe.psu.edu/
- Architect, Engineer, Landscape Architect, Interior Designer: Burt Hill Rittleman Associates, Butler, PA (Vince Fazzoni– Project Architect), www.burthill.com
- CM: Mucci Construction
- PSU Project Manager: Bruce Rohrbach
- Structural Engineer: Barber and Hoffman, Inc.
- Food Service: Hammer Design Associates, Inc.
- Food Service Contractor: U3 Food Service Contract Design

Building Envelope:

- Construction: Masonry bearing cavity walls construction supplemented with steel columns
- Exterior: Utility brick (field and accents) exterior finish with aluminum storefronts, curtain wall, metal panels, and translucent clearstory panels
- Interior: Painted CMU and gypsum board panels. Exposed structure and lay-in acoustical panels
- Electrical: 277/480V, 3P 4W 1200 A
- Highly detailed commissioning process as per PSU policy

Architecture Design:

- The building is a 56,000 square feet, Multi-Purpose Community Center
- Holds a 2,000 seat NCAA-sized arena w/floating floor to provide better safety and support
- A theater with the ability/option to raise and lower the 500 seats as well as an orchestra pit
- A state-of-the-art fitness center and training room with an NCAA competition volleyball court, four auxiliary courts, numerous locker rooms that can be divided into two sections for tournaments, and a multipurpose room with a dividing wall for meetings
- It also features an outdoor courtyard and plaza with a 25' fountain, an outdoor tennis court, sand volleyball court, basketball courts, intramural practice fields and lighted walking areas.

Design Concepts:

- A building form that separates the athletic (active) functions from the social (passive) functions
- Introduce natural light throughout the facility
- New campus loop road to replace existing campus segment displaced by the new multipurpose building
- A concave arcade at the campus entry for a pedestrian scale and orientation to the campus
- New pedestrian walkway linking with existing campus walk
- Resolve a need for addition student parking

Table of Contents

1. Building Statistics Part 1 & 2

1.1 Project Systems Data:

Building Name:
- Multi-Purpose Community Center

Location and Site:
- Penn State Fayette, The Eberly Campus
- Route 119 North
- Uniontown, PA 15401

Building Occupant Name:
- Penn State University

Function Types (Type of building):
- Multi-Purpose (Academic, Theatrical, Collegiate, Faculty)

Size (total Sq.ft.):
- 56,000 sq.ft.

Project Delivery Method:
- Traditional (Design – Bid – Build)

1.2 Architecture Data:

Architecture Design:
- The building is 56000 square feet
- Holds a 2,000-retractable seat NCAA-sized arena with a floating floor to provide better safety and support
- A theater with the ability to raise and lower the 500 seats and an orchestra pit
- A state-of-the-art fitness center
- One competition basketball court, one competition volleyball court, two auxiliary courts, two racquetball courts
- Training rooms and locker rooms that can be divided into two sections for tournaments
- Multipurpose room with a dividing wall for meetings.
- It also features an outdoors courtyard and plaza and outdoor tennis court, sand volleyball court, basketball courts, intramural practice fields and lighted walking areas.
- Full service cafeteria
- Faculty Offices

1.3 Building System Summary:

Demolition Required:

- Grubbing and Site Preparation

Structural Steel Frame:

- Structural steel framing consisting mainly of simple bolted 325 Slip Critical moment connections.
- E70XX welded connections where applicable.
- All structural steel, W and S shapes ASTM572/50 or ASTM 992, hosted into position by a 25 ton crawler crane with a hydraulic boom, specific model unknown at this time

Cast in Place Concrete:

- Typical ACI 301 form braced against excavation for isolated spread footings supporting columns.
- Fasted and cheapest method used for placement of concrete which would be dumping off the back of the truck. Specific method was used due to the vast amount of unused project site space available

Precast Concrete:

- N/A

Mechanical System:

- Fire suppression – standard wet style system monitored by the campus system. Maximum sprinkler spacing for all occupancy type is 130 sq.ft.
- Air-Cooled Liquid Chiller Model number RTA C 225
- Unit heaters are Trane Model 38-S.
- Fan Coil Units
- Split System Air Conditioning Units
- Radiant Heating Panels
- Air Handling Units/Indirect Gas Fired

Electrical System:

- Main Distribution panels are 277/480 V 3P, 4W 1200
- Emergency Generator – 140kW
- Feeders (54), with the largest ones being 1600A – 3P/ 4W
- Lighting Fixtures – 277V Columbia or Lithonia

Masonry:

- Veneer masonry consisting of field brick, 2" air space, 2' rigid insulation, and 12" masonry units
- Brick veneer held in place by standard lintels, flashing, and dovetail masonry anchors
- Scaffolding used throughout was typical all around construction (building was broken-up in various sectors and therefore was not a true all around system)
- Scaffolding was moved various times to accomplish a speedy and efficient construction

Curtain Wall:

- Glazed aluminum curtain wall, insulated 1" clear annealed
- translucent wall panels with 3 way adjustable anchors
- Design responsibility requires structural framing to absorb the lateral wind forces. The glass panels' size and length are limited due to the flexural properties of glass which in-turn limits the distance between lateral and vertical supports.

Support of Excavation:

- Standard Excavator
- Perforated drain at footing level as well as a dewatering system which consists of a series of well-points around the general area
- Excess water removed by suction pump. Note - water retention was not an original problem by due to an excessive amount of rainfall in the area measures needed to be taken.

2. Technical Report #1: Existing Construction Conditions

2.1 Executive Summary

This technical assignment coves the existing conditions of the Penn State Fayette's Community Center located in Uniontown PA. Within this document, a summary of the project delivery system, contractual agreements, schedule, cost of the project, local market conditions, and cliental information can be found.

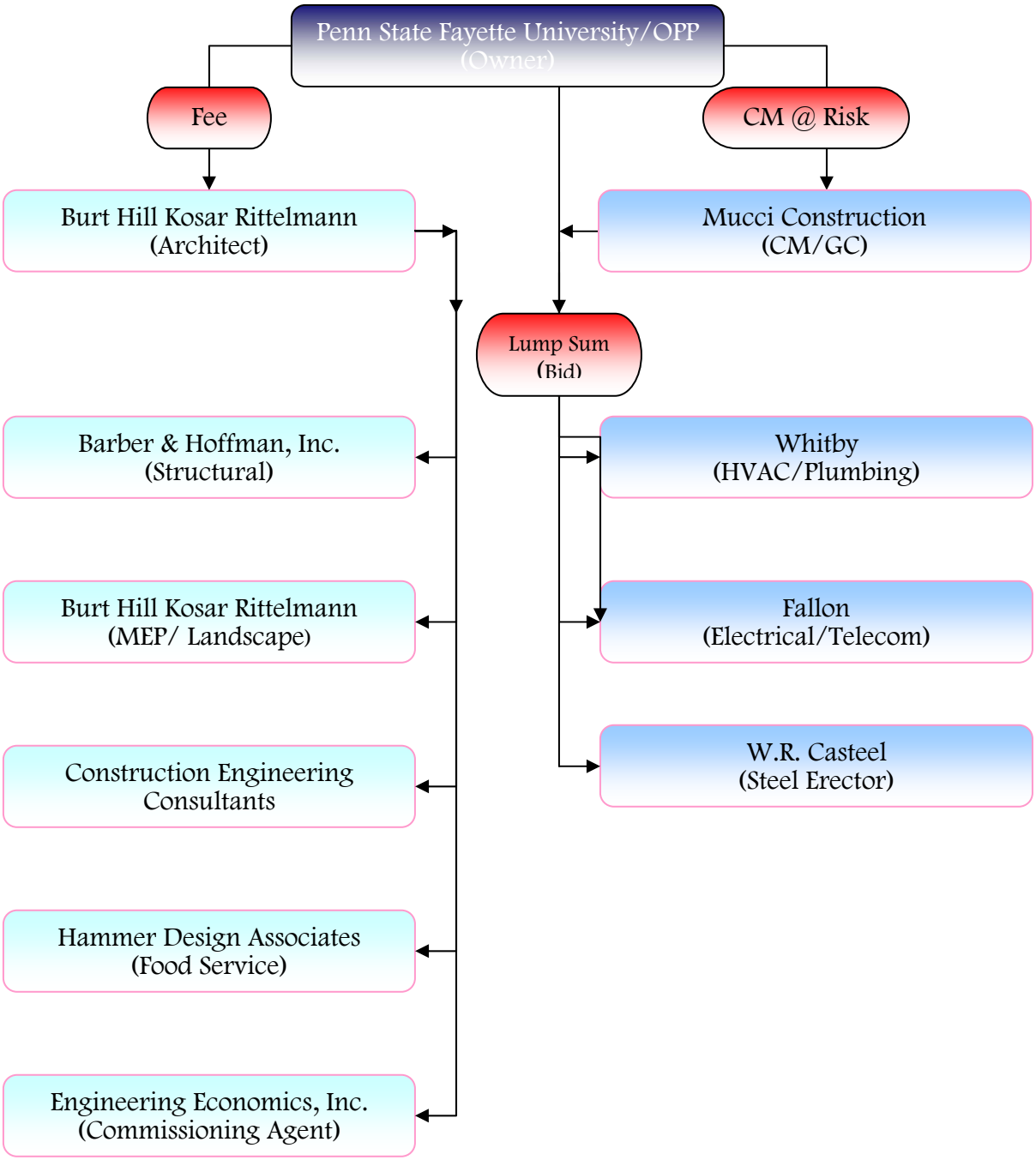
The project method is a standard design/bid based. The contracts to the architectural firm Burt Hill Rittelmann Kosar are a fee, where as the contractors all hold a lump sum agreement with Penn State. Mucci Construction is the CM @ risk on the project and all contractors report to them. A major concern for this Multi-Purpose Community Center is the accelerated schedule and complexity of the project. Penn State has a highly detailed Commissioning Plan to try and alleviate any issue that may arise with such a project.

The actual construction site allows for easy ingress/egress as well as large lay down, staging, storage, and parking areas. Unfortunately no site plans are available to me at this time to demonstrate the existing site conditions. From the geotechnical reports it has been determined that the existing soil conditions can support the 56,000 sq.ft. structure by the use of spread footings as a foundation and that subsurface water can be dealt with accordingly.

Due to the expected usage of the Multi-Purpose Community Center, it was hard to grasp a quality estimate from both R.S. Means and D4. The Community Center Architectural design is Architecture Design is a 56,000 square feet, holds a 2,000-retractable seat NCAA-sized arena with a floating floor to provide better safety and support, a theater with the ability to raise and lower the 500 seats and an orchestra pit; a state-of-the-art fitness center, one competition basketball court, one competition volleyball court, two auxiliary courts, two racquetball courts, training rooms, locker rooms that can be divided into two sections for tournaments, and a multipurpose room with a dividing wall for meetings. It also features an outdoor courtyard and plaza and outdoor tennis court, sand volleyball court, basketball courts, intramural practice fields and lighted walking areas. R.S. Means and D4 would unable to adjust for such a wide variety of specialty construction.

From this Technical Assignment #1, a basic understanding of the existing construction conditions can be gained.

2.2 Project Delivery System:



2.3 Project Directory

Owner:

Pennsylvania State University
Penn State Fayette Campus
Multi-Purpose Community Center
Rt. 119 North
Uniontown, PA 15401

John Hays
Phone: 724.430.4170

Architect:

Burt Hill Kosar Rittelmann Associates
101 East Diamond St.
400 Morgan Center
Butler, PA 16001

Vince Fazzoni
Phone: 724.394.7000

Commissioning Agent

Engineering Economics, Inc.
1911 Memorial Ave. SW
Roanoke, VA 24015

James Sledd (Project Manager)
James Coleman (Principal in Charge)
Phone: 540.344.5200

Landscape Architect:

Burt Hill Kosar Rittelmann Associates
650 Smithfield St.
Suite 2600
Pittsburgh, PA 15222

Phone: 412.396.7000

Structural Engineer:

Barber & Hoffman, Inc.
215 Executive Drive
Suite 202
Cranberry Twp, PA 16066

Michael R. Miller, P.E.
Phone: 724.741.0848

MEP Engineer

Burt Hill Kosar Rittelmann Associates
101 East Diamond St.
400 Morgan Center
Butler, PA 16001

Phone: 724.285.4761

Food Service:

Hammer Design Associates
1106 Ohio River Boulevard
Suite 606
Sewickley, PA 15143

Gary C. Hammer
Phone: 412.749.0749

Geotechnical Engineer:

Construction Engineering Consultants Inc.
2018 Waverly Street
Pittsburgh, PA 15218-2402

Mr. Ralph Artuso
Phone: 412.351.6465

Topographical Survey:

Fayette Engineering Company Inc.
P.O. Box 1030
2200 University Drive
Uniontown, PA 15401-1030

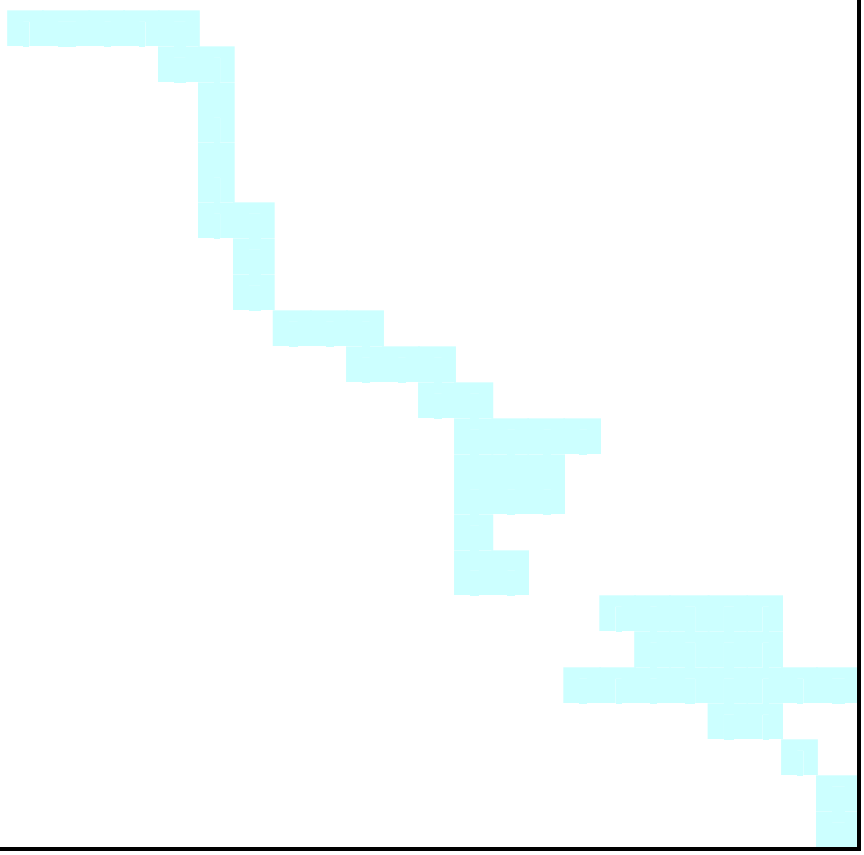
Phone: 724.438.5573

Standard procedure project delivery system – design/bid/build

- PSU and Burt Hill Kosar Rittelmann have a full service Owner/Professional agreement between them.
- PSU and Mucci Construction have an Owner/Contractor agreement between them. Jim Nichols is the Project Superintend for Mucci. All sub contractors are responsible to him and Mucci Construction Co.
- Kent Crossland is the on-site representative for Penn State Fayette.
- Bruce Rohrbach is the Project Manager for OPP. Paul Shirer is the Project Coordinator and the on-site inspector.
- Vince Fazzoni is the Project Architect for Burt Hill.

2.4 Project Schedule Summary:

Activity Name	Start Date	Finish Date	Days
Design/Bidding	11/15/02	3/5/03	110
Mobilization	3/28/03	4/3/03	6
Underground Utilities/Tie-ins	4/1/03	4/15/03	14
Foundation Excavation	4/16/03	4/25/03	9
Spread Footings	4/25/03	5/10/03	15
Slab Rough-In	5/8/03	5/14/03	6
Slab on Grad	5/15/03	5/22/03	7
Steel Structure	6/1/03	8/1/03	61
CMU Walls	8/4/03	10/22/03	79
Steel Joists	10/23/03	11/10/03	18
MEP Rough-in	11/11/03	2/10/04	91
Curtain Wall and Storefront	11/14/03	1/10/04	57
Roof Decking	11/15/03	11/23/03	8
Roof Membrane	11/24/03	12/31/03	37
Masonry	3/10/04	6/20/04	102
FF & E	4/15/04	7/30/04	106
Site work	2/20/04	9/17/04	210
Finishes	7/15/04	8/9/04	25
Commissioning	8/1/04	8/30/04	29
Punch list	9/1/04	9/17/04	16
Turnover	9/17/04	9/17/04	0



2.5 Building System Summary

Demolition Required: N/A (Basic cleaning and grubbing)

Structural Steel Frame: Structural steel framing consisting mainly of simple bolted A325 Slip Critical moment connections. E70XX welded connections where applicable. All structural steel, W and S shapes ASTM572/50 or ASTM 992, hosted into position by a 25 ton crawler crane with a hydraulic boom, specific model unknown at this time.

Cast in Place Concrete: Typical ACI 301 form braced against excavation for isolated spread footings supporting columns. Fasted and cheapest method used for placement of concrete which would be dumping off the back of the truck. Specific method was used due to the vast amount of unused space.

Precast Concrete: N/A

Mechanical System: Fire suppression – standard wet style system monitored by the campus system. Maximum sprinkler spacing for all occupancy type is 130 sq.ft.
Air-Cooled Liquid Chiller Model number RTA C 225
Unit heaters are Trane Model 38-S.
Fan Coil Units
Split System Air Conditioning Units
Radiant Heating Panels
Air Handling Units/Indirect Gas Fired

Electrical System: Main Distribution panels are 277/480 V 3P, 4W 1200 A
Emergency Generator – 140kW
Feeders (54), with the largest ones being 1600A – 3P/ 4W
Lighting Fixtures – 277V Columbia or Lithonia

Masonry: Veneer masonry consisting of field brick, 2" air space, 2' rigid insulation, and 12" masonry units. Brick veneer held in place by standard lintels, flashing, and dovetail masonry anchors. Scaffolding was typical all around construction (building was broken-up in various sectors and therefore was not a true all around system. Scaffolding was moved various times to accomplish a speedy and efficient construction)

Curtain Wall: Glazed aluminum curtain wall, insulated 1" clear annealed translucent wall panels with 3 way adjustable anchors. Design responsibility requires structural framing to absorb the lateral wind forces. The glass panels' size and length are limited due to the flexural properties of glass which in-turn limits the distance between lateral and vertical supports.

Support of Excavation: Standard Excavator. Perforated drain at footing level as well as a dewatering system which consists of a series of well-points around the general area. Excess water removed by suction pump. Note - water retention was not an original problem by due to an excessive amount of rainfall in the area measures needed to be taken.

2.6: Project Cost Evaluation

CONSTRUCTION

Base Bid		$7,886,456.00
Alternate 1 / Automated Logic Controls		209,000.00
Alternate 2 / Lift Station & Force Main		70,500.00
Alternate 3 / Ceramic Tile		53,895.00
Alternate 4 / Roadway Improvements & Walkway to Campus		67,437.00
Alternate 5 /Aluminum Entry Systems		4,300.00
Alternate 6 / Built-Up Roofing System		48,000.00
Alternate 7 / Racquetball Courts		73,247.00
	Total	$8,412,835.00

PROFESSIONAL FEES

Architect's Fees		$667,500.00
Architect's Expenses		36,000.00
Architect's Additional Services		37,751.00
	Total	$741,251.00

FURNISHINGS AND EQUIPMENT

Includes Food Service Equipment & PSU/OTC Electronics

	Total	$575,000.00

OTHER COSTS

APR / High Voltage		25,000.00
EEI / Commissioning		80,000.00
FPN / Sanitary Sewer Tap-in Fee		108,000.00
L&I / Review Fee		3,000.00
OPP / Construction Inspection		65,000.00
OPP / Feasibility Study		15,430.00
OPP / Miscellaneous Costs and Expenses		17,484.00
TNR / Peer Review of Estimate		12,000.00
	Total	$325,914.00

CONTINGENCIES

6.1% of Construction Total		$512,500.00
Project		44,500.00
	Total	557,000.00
TOTAL PROJECT BUDGET		**$10,612,000.00**

The funding plan supporting the above TPE is as follows:

Original Allocation	$10,200,000.00
Penn State Fayette / Additional	150,000.00
Central / Lift Station & Force Main	262,000.00
TOTAL PROJECT FUNDING	**$10,612,000.00**

Actual Construction Cost (CC) - $8,412,835 and (CC/SF) - $150.25/sq.ft.

Total Cost (TC) - $10,612,000 and (TC/SF) - $189.50/sq.ft.

Design - $ 741, 251 and (CC)/ (Design) - 11.35%

Mechanical System Cost - $2,045,000

Electrical System Cost - $2,580,000

Structural System - $1,067,000

2.7: D4 Parametric Estimate

	Division	Square Foot Cost	Projected Cost
00XX	General Condition	$8.55	$478,800.00
02XX	Site Work	$18.25	$1,022,000.00
03XX	Concrete	$1.50	$84,000.00
04XX	Masonry	$6.78	$379,680.00
05XX	Metals	$7.50	$420,000.00
06XX	Woods and Plastics	$4.11	$230,160.00
07XX	Thermal and Moisture Protection	$4.95	$277,200.00
08XX	Doors and Windows	$7.10	$397,600.00
09XX	Finishes	$10.72	$600,320.00
10XX	Specialty Items	$12.53	$701,680.00
11XX	Equipment	$6.98	$390,880.00
12XX	Furnishings	$12.45	$697,200.00
13XX	Special Construction	$8.34	$467,040.00
14XX	Conveying Systems	$3.56	$199,360.00
15XX	Mechanical	$14.00	$784,000.00
16XX	Electrical	$16.75	$938,000.00
Total Building Cost			$8,067,920.00

*Based upon the smart average of 4 similar buildings i.e. usage/type, size, floors as well as being adjusted for time and location the D4 software produced a number relatively close to the actual building cost for the Multi-Purpose Community Center. (I had actually chosen various project types such as recreational and educational, to receive an accurate estimate to meet the criteria of the Multi-Purpose Community Center). This was a little unexpected due to the lack of similar buildings in the data base. For the full print out of the D4 estimating software please contact Joe Kifus at jak354@psu.edu.

2.8: R.S. Means

Based upon the R.S. Means 2000 edition, the median cost per square foot of a community center is approximately $ 85.05 as opposed to the actual cost $150.25. If you take this $85.05 times the actual square footage of the center this equates to a total building cost of $4, 762,800. There is obviously a great variance between the actual of cost of $10,612,000 and the R.S. Means estimate of approximately 5 million. This is most likely due to a variety of legitimate reasons. Whither the discrepancy was cause by the recent, dramatic increase in steel material prices or the lack of ability to take into account that the community center as a multi-purpose center having various specialty construction and features such as a cafeteria, basketball arena, and theatre the exact reason has yet to be determined. Another valid rationale would include that the Means catalog had the typical square footage for a community center as 9,400 square feet; where as the Penn State Fayette Multi-Purpose Community Center had a square footage of 56,000. But regardless of the reason the R.S. Means was not able to provide as accurate of an estimate as the D4 software did.
*Note- Location and Time factors were used to adjust the numbers.

2.9: Local Conditions

There is no preferred method of construction in the Fayette County area. The population of contractors seems to be very well rounded in several different types of construction methods and knowledge of the specific systems used throughout. Construction parking will not be an issue either. The Community Center is located on the Fayette Campus in Uniontown which has vast area for future expansion. The surrounding areas are relatively flat and excessive in size for any type of construction parking, staging, lay down etc. The Community Center project also has provisions for a new parking lot consisting of approximately 100 additional spaces, this was the general area used for construction parking throughout the construction process.

There are no requirements for recycling or tipping fees on this specific project, anything of this nature was left under the discretion of the CM. As stated before, through boring samples and general knowledge of the region, quality bearing soil was found throughout the site and was determined acceptable to support the load of the new Multi-Purpose Community Center through the use of spread footings. As for any subsurface water conditions, this was also determined not to be a major issue as well by the geotechnical engineers.

2.10: Client Information

Penn State University is a very experienced owner. They are constantly working on improving their campus as well as branch campuses regularly. Penn State Fayette is constructing this new Multi-Purpose Community Center to basically replace a few out dated building such as the Williams Building and Rec. Hall. Penn State Fayette would like to construct this new center to serve as what its name implies; the center of campus and the figure head of that campus. They would like to attract new students and athletes from across the country while expanding there schools base at the same time. Penn State wants to group and expand on the out dated cafeteria, gymnasium, and weight rooms, all in one new and unique building.

Penn State has some of the highest quality of standard around. Penn State has OPP to manage the job site. Penn State has also hired a commissioning agent to test, balance, and demand the utmost quality from all of their contractors with the extensive mechanical and electrical equipment found thought the building Penn State demands that the building come in on time (at beginning of the fall '04 school year), with-in schedule and require that a safe and tightly site is maintained thought out this process, on time, within budget and to the clients satisfaction. As well as the above mentioned information, Penn State wants a quality building that is astatically pleasing and will last a good number of years.

3. Technical Report #2: Analysis of Key Construction Features

3.1 Executive Summary

This technical assignment covers the analysis of key construction features of the Penn State Fayette's Multi-Purpose Community Center located in Uniontown, PA. Within this document a detailed project schedule, an assemblies estimate on the foundation system, an expanded report of contractual agreements, a staffing plan, a breakdown of the MEP design coordination, and critical industry issues discussed during the PACE roundtable can be found within this document.

The detailed project schedule expands upon the schedule found in tech report 1. This schedule reflects how the project was built over its 307 days, 14 month construction time. This schedule is the basis by which all coordination and planning will be made and or resolved.

Cost Works was utilized to perform an assemblies estimate. The foundation system was estimated to roughly 10% of actually construction, both material and installation, costs. The take off of the substructure system includes spread footings, strip footings, and slab on grade. The total estimate cost of the foundation system is approximately $320,000. In the following technical report, technical report 3, a more detailed unit price system estimate will be performed and include the foundation system and structural system, as these system are a possibility for further investigation into value engineering ideas.

The contract, staffing plan, and design coordination sections have an in-depth evaluation of the contractual agreements between parties, there interaction with one another, challenges, pre-qualifications, insurances, bonding, and the commissioning processes found on the Multi-Purpose Community Center's job site. The project delivery method used on this project along with contractual agreements and project staffing are standard among the constructing industry. Penn State is an experienced owner and has a highly detailed direction they take with most of there projects, as they have on this specific one.

Critical Industry Issues covers the PACE roundtable discussions had between key industry members and their soon to be colleagues as well as possible topics of interest for my senior thesis. Green buildings, LEED rating, Value Engineering, and Sustainability are of great interest to me as I will be perusing them in future reports for Architectural Engineering Senior Thesis 2005.

This Technical Assignment #2 will allow the analysis of key construction features on the project that affect the overall project execution.

3.2 Assemblies Estimate:

A change/revision to the foundation system/substructure has been considered for a possible value engineering idea on the Multi-Purpose Community Center. In considering V.E. the foundation system it was decided to perform an assemblies estimate for the specific system. The assemblies estimate is a fast and efficient way to produce a quality cost analysis of a specific system in under a day's time and with an accuracy of approximately 10%. A more in-depth and accurate unit price estimate will be submitted in Technical assignment #3.

The first spreadsheet provides information on the cost, both material and installation, of a single unit. The second spreadsheet provides a quantity takeoff on the footings and slab-on-grade as well as provides an overall assemblies estimate/cost of the substructure found on the Community Center.

Penn State Fayette Multi-Purpose Community Center (Foundations Est.)					
Qty	**Description**	**Unit**	**Mat.**	**Inst.**	**Total**
1	Strip footing, load 11.1KLF, soil cap 6 KSF, 24"wide x 12"deep, reinf	L.F.	9.00	17.90	26.90
1	Strip footing, load 14.8 KLF, soil cap 6 KSF, 32"wide x 12"d, reinf	L.F.	11.20	19.60	30.80
1	Strip footing, load 22KLF, soil cap 6 KSF, 48"wide, 16"deep, reinf	L.F.	19.50	27.50	47.00
1	Strip footing, load 25.6KLF, soil cap 6 KSF, 56"wide x 16"deep, reinf	L.F.	23.00	39.50	62.50
1	Spread ftgs,3000 PSI conc, load 50K, soil cap 6 KSF, 3'-0" sq x 12" d	Ea.	38.50	91.50	130.00
1	Spread ftgs,3000 PSI conc, load 75K, soil cap 6 KSF, 4'-0" sq x 12" d	Ea.	66.00	136.00	202.00
1	Spread ftgs,3000 PSI conc, ld 100K, soil cap 6 KSF, 4'-6" sq x 15" d	Ea.	99.50	186.00	285.50
1	Spread ftgs,3000 PSI conc, ld 125K, soil cap 6 KSF, 5'-0" sq x 16" d	Ea.	128.00	224.00	352.00
1	Spread ftgs,3000 PSI conc, ld 200K, soil cap 6 KSF, 6'-0" sq x 20" d	Ea.	223.00	350.00	573.00
1	Spread ftgs,3000 PSI conc, ld 400K, soil cap 6 KSF, 8'-6" sq x 27" d	Ea.	585.00	765.00	1,350.00
1	Spread ftgs,3000 PSI conc, ld 800K, soil cap 6 KSF, 12'-0" sq x 37" d	Ea.	1,550.00	1,700.00	3,250.00
1	Slab on grade, 5" thick, non industrial, reinforced	S.F.	1.54	2.33	3.87
	Totals		**$2,754.24**	**$3,559.33**	**$6,313.57**

Penn State Fayette Multi-Purpose Community Center (Foundations Est.)					
Qty	**Description**	**Unit**	**Mat.**	**Inst.**	**Total**
40	Strip footing, load 11.1KLF, soil cap 6 KSF, 24"wide x 12"deep, reinf	L.F.	360	716	1,076
1,475	Strip footing, load 14.8 KLF, soil cap 6 KSF, 32"wide x 12"d, reinf	L.F.	16,520	28,910	45,430
700	Strip footing, load 22KLF, soil cap 6 KSF, 48"wide, 16"deep, reinf	L.F.	13,650	19,250	32,900
340	Strip footing, load 25.6KLF, soil cap 6 KSF, 56"wide x 16"deep, reinf	L.F.	7,820	13,430	21,250
11	Spread ftgs,3000 PSI conc, load 50K, soil cap 6 KSF, 3'-0" sq x 12" d	Ea.	424	1,007	1,430
5	Spread ftgs,3000 PSI conc, load 75K, soil cap 6 KSF, 4'-0" sq x 12" d	Ea.	330	680	1,010
5	Spread ftgs,3000 PSI conc, ld 100K, soil cap 6 KSF, 4'-6" sq x 15" d	Ea.	498	930	1,428
17	Spread ftgs,3000 PSI conc, ld 125K, soil cap 6 KSF, 5'-0" sq x 16" d	Ea.	2,176	3,808	5,984
2	Spread ftgs,3000 PSI conc, ld 200K, soil cap 6 KSF, 6'-0" sq x 20" d	Ea.	446	700	1,146
4	Spread ftgs,3000 PSI conc, ld 400K, soil cap 6 KSF, 8'-6" sq x 27" d	Ea.	2,340	3,060	5,400
1	Spread ftgs,3000 PSI conc, ld 800K, soil cap 6 KSF, 12'-0" sq x 37" d	Ea.	1,550	1,700	3,250
50,700	Slab on grade, 5" thick, non industrial, reinforced	S.F.	78,078	118,131	196,209
	Totals		**$ 124,191**	**$ 192,322**	**$ 316,513**

*Note – construction costs listed here are only material and installation estimates. This estimate does not take into account:

- General Conditions
- Home office overhead
- Design fees
- Contingencies
- Profit.

These specific fees and project costs will be looked at more in depth during Technical Assignment #3. The estimate was adjusted for time and location.

The Cost Works software used to produce the assemblies estimate was very user friendly and efficient in design. The soft ware helped produce quality numbers in a short amount of time. It helped save time because the estimate was able to be exported to excel with all the formulas for tabulation already assigned. The Cost Works software, in my opinion, is an efficient means to produce an assemblies estimate and with a little more time or tutorial I am sure I would find new features which enable me to produce a more accurate result.

The Cost Works did have it short comings though. The amount of various sizes, reinforcements, and under filling hurt the estimate. Various sizes for the footings, strip and spread, were not found with in the data base. The majority of the dimensions were not accurate to specs. Most footing sizes were found to be too large or too small in numerous directions, so a smart average was taken to produce the best overall results. This is most notably the cause for only 12 line items being shown even though there were many more 12 items that were taken off. Another item that was not found on the Cost Works software was the usage of an under filling consisting of 1,500 PSI concrete below the footers were the geo-technical engineer determined the soil to be less than sufficient to support the required loads.

3.3 Contracts / Staffing Plan / Design Coordination

Contractor Selection:

Project No: 04-11866.01, Single Prime Contract No.1

- General
- HVAC
- Plumbing
- Electrical
- Telecommunications

Notes:

- Mandatory Pre-Bid Conference
- Prequalification- All contractors bidding directly to Penn State and certain other contractors (even if acting in a subcontractor capacity) are required to be pre-qualified. For prequalification consult or see below: www.opp.psu.edu/divisions/dc/bids/index.html

Requirements for Prequalification

1. Submit on Corporate Letterhead:
   A. Firm's legal name, address, primary contact, phone and fax numbers, and corporate e-mail address.
   B. Summary of Financial Statement indicating firm's positive equity. (Attach a current reviewed financial statement covering at least a one-year period. All Accountants' Notes to the Financial Statement must be included.)
   C. Summary of both single and aggregate bonding capacities. (Attach a current statement from bonding company (on bonding company's letterhead) identifying single and aggregate bonding capacity in dollar amounts.)
   D. List of Penn State campuses where firm desires to be considered for work.
   E. Prequalification categories. (Attach three (3) references each on reference forms for recently completed projects and architectural or engineering firms. Penn State has a preference for projects performed in Pennsylvania. Provide separate forms for each category that firm requests prequalification.) Penn State requires six (6) references (use two pages for project references and two pages for AE references) if applying for telecommunications trade category.

* Penn State requires Contractors performing the following categories of work to be prequalified.

1. Construction Manager	2. General	3. Asbestos Abatement
4. Earthwork	5. Paving	6. Landscaping
7. Concrete	8. Pre Cast	9. Masonry
10. Structural Steel	11. Mill Work	12. Roofing
13. Painting	14. Elevators	15. HVAC
16. Fire Protection	17. Plumbing	18. Building Mgt. Systems
19. Electrical	20. Telecommunications	21. Erectors
22. Underground Site Utilities		

2. List your firm's Interstate Experience Modification Rate (EMR) and Commonwealth of Pennsylvania Experience Modification Rate (EMR) for the three most recent years including total hours worked and total hours worked in the Commonwealth of Pennsylvania.

3. Upon completion, send the information to:
   Manager, Contract Administration
   The Pennsylvania State University
   Physical Plant Building, Room 106
   University Park, PA 16802-1118

   INCOMPLETE PACKAGES WILL NOT BE CONSIDERED.

4. The Prequalification Process typically requires two weeks.

5. After required information is reviewed, contractor will be notified by e-mail that either (1) company is now on Prequalified List or (2) application has not met Penn State requirements.

Requirements for Remaining On Prequalified List

1. Acceptable ratings on Contractor Performance Evaluation Form.
2. Annual submission of complete and current reviewed financial statement with all Accountants' Notes.
   Financial Statements older than six months will not be accepted.
3. Annual submission of updated bonding capacity (single and aggregate) on bonding company letterhead.
4. Written verification of Company name, address, phone and fax numbers, and corporate e-mail address, and trade category(ies) from web site when updating information.

5. Annual submission of most recent Interstate Experience Modification Rate (EMR) and (EMR) for the Commonwealth of Pennsylvania. Include also total hours worked and total hours worked in the Commonwealth of Pennsylvania.
6. IT IS THE COMPANY'S RESPONSIBILITY TO PROVIDE UPDATED INFORMATION TO THE UNIVERSITY.

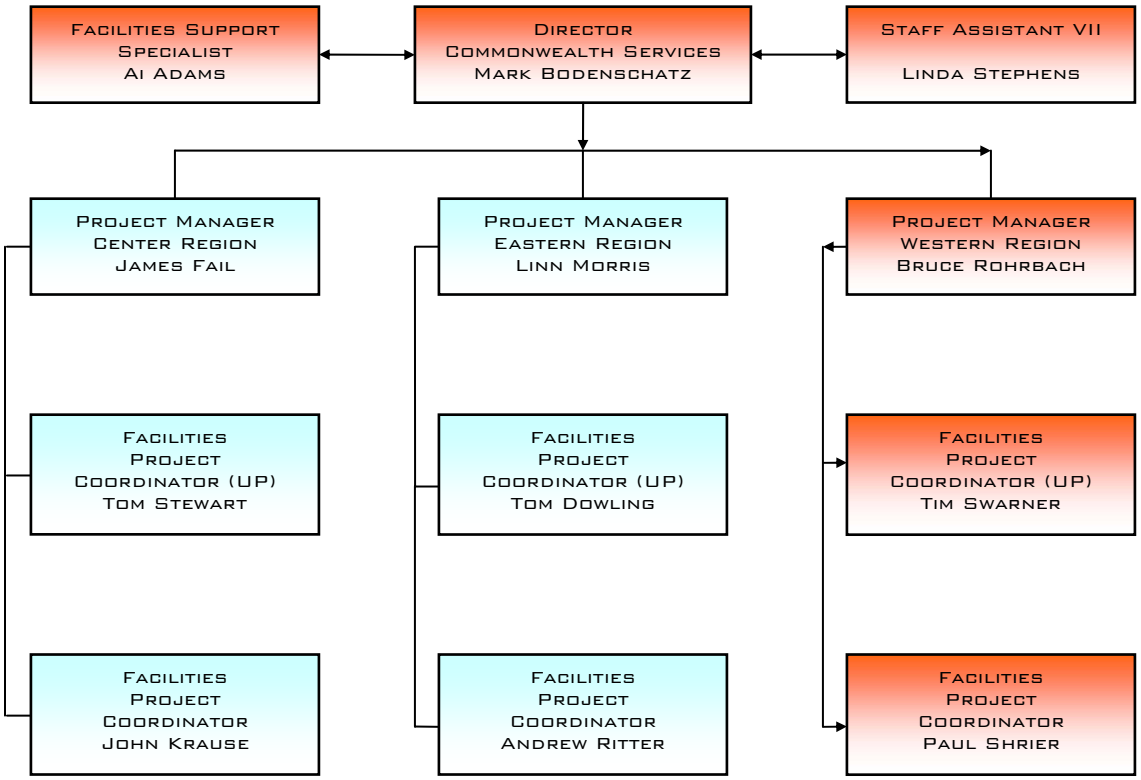
- Bonding Required
  - Bid – 5% of the total bid amount
  - Performance – 100% of the contract price
  - Payment – 100% of the contract price
  - Worker's Compensation Insurance
  - General Liability Insurance
- Owners are not obligate to accept the lowest bid.
- Owner shall have the right to accept alternatives.
- Bidders shall to commence work at the site within ten days (10) after the date of "Notice to Proceed" of the contract is awarded.
- Building permits are to be included in the cost of the bid.
- Prevailing wage.

Penn State usually bids out all of their construction projects. To be eligible for bidding the contractor must meet the above requirements found in the prequalification for Penn State, located in the previous paragraphs. The bonding capacity as well as the companies financial security is taken into account to qualify. Once the contractor has been approved, they are then invited to bid on that specific project. Penn State will usually award the contract to the low contract bidder, although as stated earlier, Penn State is not required to award the contract to the low bidder. On this specific project Penn State only need to fund approximately $4.5 for the project as $6.1 million was donated by Mr. Eberly, a wealth and generous entrepreneur from Uniontown.

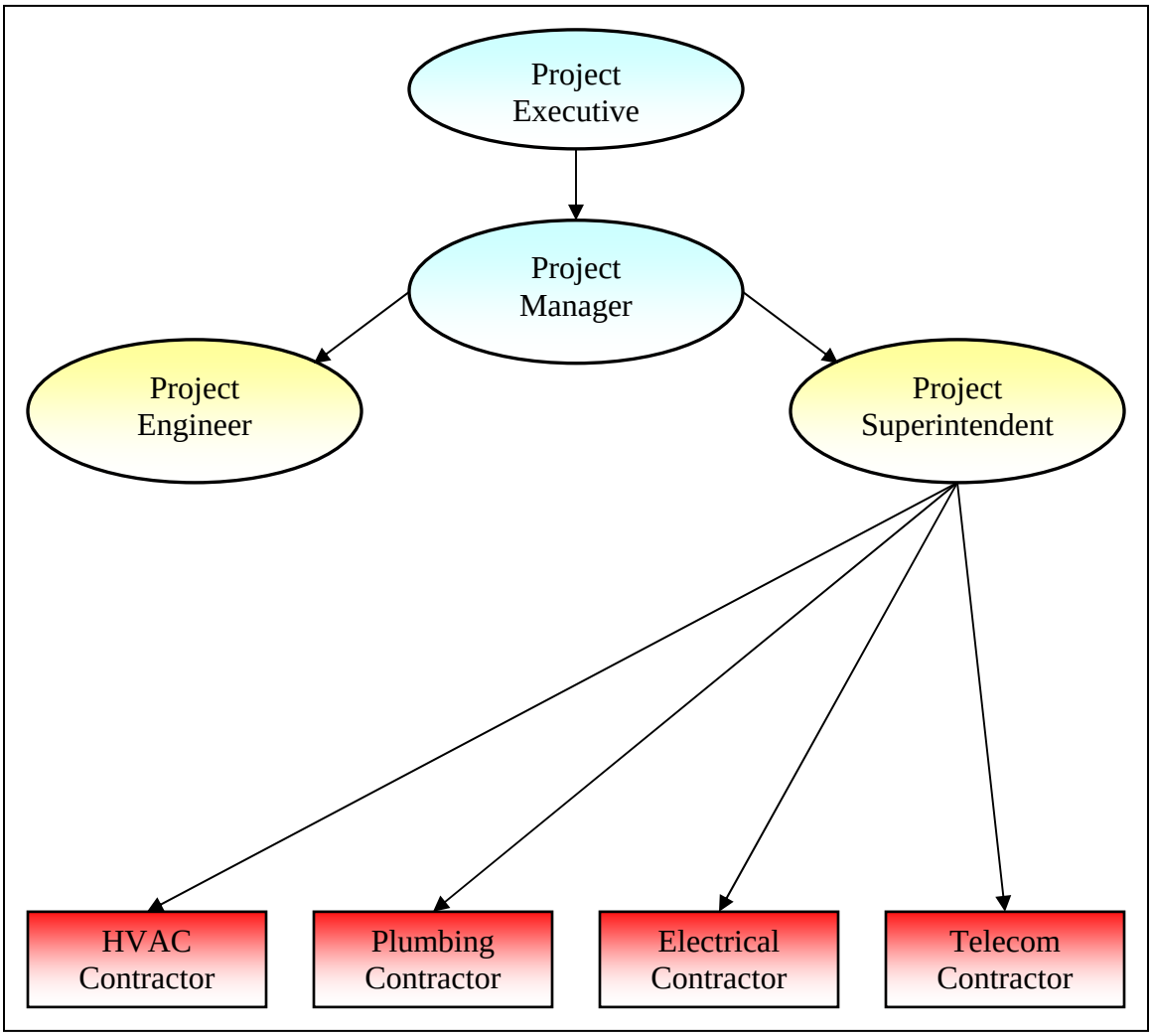
Penn State as an owner is very experienced. They build and finance numerous multi-million dollars projects every year at University Park or any of there 28 branch campuses. Penn State usually chooses the appropriate contract type and delivery system to get the desired job done on time and within budget with their desired high level of quality. This project specifically in particular was no different. The job is currently operating smooth with no major hiccups thus far.

As stated in this and past technical reports, Penn State has a highly detailed qualification and commissioning process/plan. Penn State / OPP have teams designated to specifically work with the branch campuses. The Commonwealth Services (CS) is a division within OPP that helps the supplemental staff at each campus with establishment, origination, planning, coordination, monitoring, and enforcement for policies, and procedures to ensure a quality, and a well coordinated construction project within the various branch campuses of Penn State. The organization chart of the Commonwealth Services of OPP can be found below. The specific team (the Western Region) utilized on this project is highlighted in this organizational chart.

3.4 Commonwealth Services Chart



3.5 Staffing Plan:



The General Contractor, Mucci Construction is in charge of all project coordination. The Project Manager, Engineer, and Superintendent are all located on site full time during this 14 month, highly MEP intensive project. With the help of OPP and a set of detailed MEP coordination drawings from Mechanical Contractor, Whitby, everything on the Multi-Purpose Community Center at Penn State Fayette has proceeded with little fuss.

Mucci Construction has the Project Manager, Engineer, and Superintendent on the site full time. As usual various other member of the General Contracting team are involved throughout the project such as the estimator, secretary, scheduler, purchasing agent, accountant, and Project Executive, but are commonly involved with some of the behind the scenes processes such as financing, change orders, and RFI's.

Proposed Staffing Plan - GC- Mucci Construction				
Month	PM	Exec.	PE	Super
1	1	1	1	1
2	1	1	1	1
3	1	0.5	1	1
4	1	0.5	1	1
5	1	0.5	1	1
6	1	0.5	1	1
7	1	0.5	1	1
8	1	0.5	1	1
9	1	0.5	1	1
10	1	0.5	1	1
11	1	0.5	1	1
12	1	0.5	1	1
13	1	1	1	1
14	1	1	1	1

Note*

- Biweekly project meeting required.
- PM, PE, and Super are all located on the job site full time (40 hours).
- Table value is equal to 1 full month's time.

Coordination:

- The General Contractor shall be responsible for the overall coordination, control, and progress of the work for all of the other Prime Contractors, Subcontractors, and material suppliers involved in the project.
- The Contractor shall also be responsible for preparing the progress schedule indicating the sequence and time required for the varied disciplines of the work. The progress schedule shall be submitted by the General Contractor to the other Prime Contractors requesting their sequence and time requirement input. The Prime Contractors will be required to either approve the progress schedule submitted by the General Contractor or give comments for correction.
- After approval by all Prime Contractors, one progress schedule showing all disciplines shall be prepared. The completed progress schedule shall then be submitted to the Professional for review and approval. The approved progress schedule shall then be issued by the General Contractor to all Prime Contractors, the Professional, and the University.
- The General Contractor shall coordinate all work on the project so as to insure the proper incorporation, within the project, of all necessary items and to insure the proper execution or the work.

Project Meetings:

- Preconstruction Conference- Prior to commencement of the work, the Contractors shall meet in conference with the representatives of the Owner, to discuss and develop a mutual understanding, relative to administration of the project, general conduct of the work, progress schedules, safety programs, labor provisions, and other contract procedures relating to the work.
- The General Contractor shall provide space to conduct a regularly scheduled, biweekly meeting at the site for the purpose of coordinating the work. The General Contractor shall require representation from all Prime Contractors and by any Subcontractors upon the request of the Professional or the University.
- The Professional shall take and retain a verbatim record of the biweekly meeting by tape recorder, and shall prepare and distribute summary minutes of each meeting within four (4) days to the University, the Contractors, and all other interested parties.

The main issue of concern during MEP coordination is as usual ductwork, as it is usually the most space consuming and rigid task. As stated prior, Penn State has a detailed commissioning plan and coordination plan. Burt Hill the Architect does a comprehensive "Ready Check" review. Then, the coordination requirement of the GC contract takes over. Burt Hill & PSU do on-site inspections to see that all is in order. The commissioning agent does this as well; please see the commissioning plan for further detain.

3.6 Critical Industries Issues (PACE Roundtable)

Integrated Design and Construction I – Dr. Messner

Within the integrated design and construction session with Dr. Messner we cover topics that I considered to be general knowledge and some which surprised me. We covered issues that will concern me within the near future such as the time and coordination required to produce quality building from a distance. Other topics of concern to me are the overall impact to globalization and the various aspects of distribution team and how they have and will deal with the design and construction process. As stated before, some of the issues/solutions to some of these problems seem like common knowledge, such as early CM involvement, and more detailed front end planning.

There were a few thinks that had surprised me as well, such as a new movement to overseas detailing and fabrication. producers can have a choke hold on the market if they can roll, design, and fabricate quality structural steel members in one general location, so why not? Obviously the financial benefits out weigh the coordination costs. Another issue that I found interesting was the fact that if you are designing a structure on East Coast but are based on the West Coast, you need to familiarize yourself with local codes, regulations, material availability, and construction techniques. We discussed and analyzed some horror stories of such a situation. I find it hard to believe that a PE would make such foolish mistakes but I guess that it is common as we have discussed numerous real life examples.

Although I did learn a few valuable lesions throughout this session I really didn't find anything in particular that would apply to my specific project. I had never really heard any mention about this until the PACE roundtable. I knew that the majority of steel was now being shipped from across the ocean, but detailing and fabrication as well. Seems a little difficult to coordinate such an activity, but I guess since the steel is being rolled over there, the

Integrated Design Management II – Mike Pulaski

I walked away from this session feeling much more knowledgeable about the construction industry, value engineering, value enhancement, and green building. This session in particular was definitely a worthwhile experience for me. I received some good ideas about my thesis project and made very knowledgeable contact in Mike Pulaski.

We covered an array of topics in this session. We covered easy value engineering ideas called low hanging fruit that can basically be applied to any project. Some examples of low hanging fruit are: resizing cable trays, brick facades, flooring types, mechanical types, and even water less toilets. Another topic of interest to me is value engineering more specifically value engineering vs. life cycle cost, and how exactly they intertwine with one another. Value engineering has often been given a negative connotation, most notably with cost cutting when a project is coming in over budget. There are two very distinct value engineering approaches, cost cutting exercises and value adding efforts. A major movement to green buildings has made the ladder more apparent to the construction industry. The VE ideas in green buildings are helping solve some of the industries issues by getting the CM involved with the process earlier. Construction teams are using tools such as life cycle costing and return on investments to make an educated decision on the best option. The CM is spending more time evaluating VE options and learning what the owner truly wants and what is the best course of action to get there.

I found a topic that I would be interested in researching for my thesis project, funding and LEED rating for green buildings. Through this session I made a quality contact in Mike Pulaski. He is very knowledgeable in the area of sustainability and green buildings. Penn State is soon going to require that building built by Penn State be LEED rated. Even though my project, Penn State Fayette Multi-Purpose Community Center is not rated, I would like to see what ranking my building currently could obtain, and what ranking it could receive with a few tweaks in the design. Follow that up with a cost analysis of these proposed changes in the design and provide some insight on where the funding would possibly come from.

4. Technical Report #3: Alternate System and Methods Analysis

4.1. Executive Summary

This technical assignment covers the analysis of various building system cost, scheduling, site planning, and general conditions which will identify valid candidates for further research in areas such as value engineering, schedule compression, and alternative systems or methods of construction.

Site Layout Planning:

Site Plans for excavation, superstructure and finishing phases of the Penn State Fayette's Multi-Purpose Community Center can be located within this Technical Report.

Temporary Utilities:

Descriptions of specific requirements for electrical power, water, staging, lighting, heating, ventilation and cooling for both people and the structure itself can be found, which were need to construct the Community Center efficiently and to engineering specifications.

Detailed Structural System Estimate:

A detailed structural system estimate of the Multi-Purpose Community Center has been prepared. The estimate includes the foundations, steel beams and girders, roofing, and various other misc. costs.

General Conditions Estimate:

A general conditions estimate from the Mucci Construction has been utilized. The estimate includes such costs as staffing, bonding, and temp utilities. This estimate shows the costs that the General Contractor Mucci Construction will incur during the 14 month project duration, which is approximately $775,000 of the total construction cost.

Research and Analysis Methods:

This specific section will start to develop the methods and analysis that will be needed to research a desired topic for thesis. These research ideas will then be implemented throughout next semester to possible show quality alternative method of construction, value engineering ideas, schedule compression, and alternative building systems.

4.2. Site layout Planning

The Site Layout will be made available on the web version of my AE Senior Thesis Web Site found at; www.arche.psu.edu/thesis/2005/jak354, also refer to Appendix B

4.3. Temporary Utilities

Close attention to material handling, i.e. installation, storage, and fabrication, will need to be managed to achieve the best quality, safest and most efficient job site construction possible. Section F of the specifications describes the general requirements for temporary utilities. This specific section states the necessities for an efficient and safe work environment. Section F, General Conduct of The Work and Special Requirements describes temporary utilities such as light, power, heat, water, and ventilation.

- Temp. Heat is required to provide suitable working conditions, as well as proper temperature for curing of products and materials. Temp heat requirements are divided into two categories; i.e., (1) temp heating required prior to enclosure of the structure; (2) temp heating required to enclose the structure. Cast in place concrete is used throughout the project. Attention needs to be taken when placing the concrete. If placing concrete in temperatures above 90 degrees F, the contractor must reduce the mixing and delivery time in order for the concrete to cure to its designed strength. Care also needs to be taken when curing the concrete. A lack of hydration, i.e. warmer climates, will cause a premature hardening of the concrete mix. In a cooler weather below 40 degrees F temporary heat is required help properly cure the concrete.
- Temp. Lighting and power is required for the site, building, field trailers, etc. to ensure quality lighting and ample power to run and operate machinery. Warning lights are required; they shall be the blinker type, battery or electrically operated. The Electrical Contractor shall provide three (3) 208 volt, single phase power receptacles, each rated at 4,000 watts, outside the building. The maximum size motor to be used by any contractor shall be limited to five horsepower. The Electrical Contractor shall provide a 100 watt electric lamp and 120 volt power receptacles approximately every (50) fifty feet on the line in weatherproof sockets. One light and receptacle shall be provided for each 1,000 square foot in all spaces which exceed 1,000 square feet.
- Temp. Facilities are required to provide on site offices and bathroom facilities for contractors and subs.
- Temp. Ventilation is required for proper air circulation and curing of materials.
- Parking will be assigned by the University
- All trees, shrubs, lawn area, curbing, walks, roadways, and ground areas shall be adequately protected from damage during the course of the construction
- A 6' chain-link fence with galv. Frame and fabric, and adequate gates are required. 2" dia. Posts spaced at a max of 8' O.C. Anchor posts in concrete footing shall be 10" in dia. with a depth of 36". Post tops shall be closed

- Temp facilities are required; offices, storage sheds, toilets, scaffolding and staging, design and appearances of offices, refuse removal are all managed by the General Contractor. Penn State and OPP shall intervene if need be
- General Contractor shall pay all costs for water, electric power, and fuel required for the operation of temporary services
- Temp Water shall be provided by the plumbing contractor, at its own cost and expense, install, meter, operate, protect, and maintain and adequate water supply for the use of all Contractors on the projects during the period of construction
- All sanitary facilities shall be fully enclosed buildings, screened against insects. Open-pit facilities will not be permitted. The use of self-contained "Job-Johnny" units will be permitted upon approval by the Owner. The Plumbing Contractor shall install two temporary water closets and two lavatories.
- The GC shall maintain and enforce regulations covering all fire hazards, including smoking, and shall provide during construction, the required number of suitable fire extinguishers in the proper locations.
- Spray-Applied Fireproofing must be stored in a cool dry area. Specific environmental conditions are required for the proper application of the fireproofing. A period of 72 hours total is required at or above 40 degrees F is required before, during and after for the proper curing to occur. Ventilation as well as temperature must be adequate, if not the General Contractor must make provisions such that it is adequate.

4.4. Detailed Systems Estimate

Roof Framing/Decking Steel									
Member Size	# of Members	L.F.	Total Tons	Mat.	Labor	Equip.	Total	Total inc. O&P	Total Price
W 8x10	7	203	1.015	9.65	3.45	2.21	15.31	18.95	$3,846.85
W 8x24	3	37	0.444	23	3.75	2.41	29.17	34.50	$1,276.50
W 10x12	58	601	3.606	11.55	3.45	2.21	17.21	21.00	$12,621.00
W 12x14	127	2360	16.52	13.5	2.35	1.51	17.36	20.50	$48,380.00
W 12x22	29	600	6.6	21	2.35	1.51	24.86	29.00	$17,400.00
W 12x26	32	650	8.45	25	2.35	1.51	28.86	33.00	$21,450.00
W 12x35	6	144	2.52	33.5	2.56	1.64	37.7	43.00	$6,192.00
W 14x26	1	19	0.247	25	2.09	1.34	28.43	32.50	$617.50
W 16x26	4	120	1.56	25	2.07	1.33	28.4	32.50	$3,900.00
W 16x31	11	292	4.526	30	2.3	1.47	33.77	38.50	$11,242.00
W 16x40	4	114	2.28	38.5	2.59	1.66	42.75	49.00	$5,586.00
W 18x35	11	422	7.385	33.5	3.13	1.46	38.09	44.00	$18,568.00
W 21x44	4	140	3.08	42.5	2.82	1.32	46.64	53.00	$7,420.00
L 4x4x3/8	105	1606	7.81	3.78	16.35	1.42	21.55	34.50	$55,407.00
16K3	8	152	0.4788	3.84	1.67	0.83	6.34	8.05	$1,223.60
18K5	14	378	1.4553	4.69	1.5	0.74	6.93	8.60	$3,250.80
28K8	4	140	0.889	7.6	1.25	0.62	9.47	11.25	$1,575.00
52DLH16	10	800	18	32.5	1.5	0.74	34.74	39.00	$31,200.00
64DLH17	34	1469	38.194	37.5	1.36	0.68	39.54	44.00	$64,636.00
36LH09	15	750	7.875	14.15	1.67	0.83	16.65	19.40	$14,550.00
40LH15	9	510	9.18	24.5	1.36	0.68	26.54	29.50	$15,045.00
Acou Steel Galv Decking	N/A	56,020 S.F.	59.95	4.12	0.89	0.23	5.24	6.4	$358,528.00
Total	496	11507	202.0651						$703,915.25

Steel Columns									
Member Size	# of Members	L.F.	Total Tons	Mat.	Labor	Equip.	Total	Total inc. O&P	Total Price
6" Dia Pipe	15	270	1.728	300	38.5	24.5	363	425	$6,375.00
10" Dia Pipe	8	144	3.95	765	43	27.5	835.5	950	$7,600.00
12" Dia Pipe	3	54	1.77	1025	46	29.5	1100.5	1225	$3,675.00
W 8x31	2	36	0.558	30	1.92	1.23	33.15	37.5	$1,350.00
TS6"x4"x5/16"	6	108	1.53	219	38.5	24.5	282	335	$2,010.00
TS12"x8"x1/2"	4	72	2.25	945	43	27.5	1015.5	1150	$4,600.00
Totals	38	684	11.786						$25,610.00

Concrete Footings					
Qty	Description	Unit	Mat.	Labor/Equip	Total
40	Strip footing, load 11.1KLF, soil cap 6 KSF, 24"wide x 12"deep, reinf	L.F.	360	716	1,076
1,475	Strip footing, load 14.8 KLF, soil cap 6 KSF, 32"wide x 12"d, reinf	L.F.	16,520	28,910	45,430
700	Strip footing, load 22KLF, soil cap 6 KSF, 48"wide, 16"deep, reinf	L.F.	13,650	19,250	32,900
340	Strip footing, load 25.6KLF, soil cap 6 KSF, 56"wide x 16"deep, reinf	L.F.	7,820	13,430	21,250
11	Spread ftgs,3000 PSI conc, load 50K, soil cap 6 KSF, 3'-0" sq x 12" d	Ea.	424	1,007	1,430
5	Spread ftgs,3000 PSI conc, load 75K, soil cap 6 KSF, 4'-0" sq x 12" d	Ea.	330	680	1,010
5	Spread ftgs,3000 PSI conc, ld 100K, soil cap 6 KSF, 4'-6" sq x 15" d	Ea.	498	930	1,428
17	Spread ftgs,3000 PSI conc, ld 125K, soil cap 6 KSF, 5'-0" sq x 16" d	Ea.	2,176	3,808	5,984
2	Spread ftgs,3000 PSI conc, ld 200K, soil cap 6 KSF, 6'-0" sq x 20" d	Ea.	446	700	1,146
4	Spread ftgs,3000 PSI conc, ld 400K, soil cap 6 KSF, 8'-6" sq x 27" d	Ea.	2,340	3,060	5,400
1	Spread ftgs,3000 PSI conc, ld 800K, soil cap 6 KSF, 12'-0" sq x 37" d	Ea.	1,550	1,700	3,250
50,700	Slab on grade, 5" thick, non industrial, reinforced	S.F.	78,078	118,131	196,209
Totals			$ 124,191	$ 192,322	$ 316,513

- Total Tons of Steel ~ 214 Tons
- Total Cost of Structural Steel ~ $ 729,525
- Total No. Of Pieces of Steel ~ 534 pieces
- Total C.Y. of Concrete ~ 1291.35 C.Y. of Concrete

4.5 General Conditions Estimate

General Conditions Report/Estimate			
Description of Work	Cost/Month	Duration(months)	Total Cost
Bonds & Insurance	$9,789.21	14	$137,049
Misc.	$13,175.29	14	$184,454
Clean-up	$428.57	14	$6,000
Temp Heating	$1,698.29	7	$11,888
Mobilization HVAC	$10,587.00	1	$10,587
Submittals HVAC	$6,178.00	1	$6,178
Duct Drawings	$7,312.00	1	$7,312
ATC Engineering	$2,716.00	7	$19,012
ATC Project Mgmt.	$1,057.43	7	$7,402
ATC Commissioning	$2,507.00	7	$17,549
Demobilization HVAC	$4,659.00	1	$4,659
Mobilization Plumbing	$5,500.00	1	$5,500
Submittals Plumbing	$3,100.00	1	$3,100
Demobilization Plumbing	$2,100.00	1	$2,100
Cold Metal Framing Mobilization	$2,857.00	1	$2,857
Cold Metal Framing Demobilization	$1,000.00	1	$1,000
Shop Dwgs.-Metal Stud Framing	$1,558.00	1	$1,558
Shop Dwgs.-Acoustical Wall Panels	$2,337.00	1	$2,337
Shop Dwgs.-Tectum Wall Panels	$1,558.00	1	$1,558
Site Layout	$2,078.00	1	$2,078
Clean-up/Stocking	$1,957.25	4	$7,829
Equipment Rentals	$315.36	14	$4,415
Electric	$3,817.57	14	$53,446
Testing	$2,683.86	7	$18,787
Temp Fencing	$603.07	14	$8,443
Balancing	$7,096.00	2	$14,192
Commissioning Coordination	$1,107.71	7	$7,754
HVAC Coordination	$1,249.71	7	$8,748
Electrical Inspection	$2,190.50	2	$4,381
Temp Power & Light	$1,376.79	14	$19,275
Project Close-out Document	$1,014.00	1	$1,014
Project Supervisor	$3,000.00	14	$42,000
Project Manager	$3,928.57	14	$55,000
Project Engineer	$3,428.57	14	$48,000
Project Execrative	$5,875.00	8	$47,000
Total			$774,462

The general conditions estimate has a total project value of approximately $774,462 which is about 7.5% of the total bid value of $10.6 million. This is with in the typical general conditions range of 5-15 percent of the project value. The general conditions billing on this specific project was not of a typical format i.e. trailers, dumpsters, crane, hoist, etc. found normally on construction projects. An area of interest within the general conditions estimate is the work labeled miscellaneous. The miscellaneous section was approximately $185,000 of the total cost. I have yet to determine the exact contents of this portion of the estimate, but hope to determine the billing of this misc. section through further research.

4.6. Research and Analysis Methods (Addendum)

The research for my senior thesis will consist of sustainability/green construction mainly. The general topic of discussion for my thesis project will be; ways to enhance the finances of LEED rated buildings and various incentives for Owners to go Green. The research for my AE Senior Thesis Project will like consist of 4 parts/aspects. I would like to further research the commissioning process, funding for LEED rated buildings, the current LEED rating status of my thesis building, and the possible cost-benefit analysis of adding LEED points to the building.

1. I would like to further research the overall effectiveness of the current commissioning process. The commissioning process is approximately 1% of a typical construction's total project cost. This alone does not seem like much improvement can be made here but where my research will lie is the quality and effectiveness of the process in general. The commissioning process has numerous benefits such as: ensuring the proper and efficient operation of mechanical and electrical systems, it also minimizes the operational costs, extends the life of the equipment, minimizes downtime due to component failure, and can reduce contractor call backs. The commissioning process seems fairly simple, but it is in fact a highly detailed process as can been seen in the diagram below. This process was used on the Penn State Fayette's Multi-Purpose Community Center by OPP to ensure that all mechanical, electrical, fire suppression, and telecommunications systems were working properly before turnover occurred. As stated before my main concern is the overall effectiveness of the commissioning process. Why do owners take part in the process? What is the benefit to cost ratio? How can the current commissioning process be changed or adjusted to better suite the needs of the owner, the project, the cost, and the schedule? What is the most efficient, cost effective way to provide optimized performance systems that support thermal comfort and indoor air quality, which are essential to the health and performance of occupants? Some quality references that I have already have found are;
    a. ASHRE Guideline – Guideline for commissioning of HVAC systems
    b. Building Commissioning by Anthony Berheim
    c. Commissioning: Getting it Right by Rebecca Ellis
    d. www.ci.nyc.ny.us/html/ddc/html/ddcgreen/documents/guidelines/greeng
    e. www.holderconstruction.com/Home.nsf/content/ServicesCommissioningServices

2. Another area of interest to me that I would also consider doing research on are the financial benefits and long term cost analysis of designing and constructing a LEED rated building as opposed to a standard building. Penn State is now going to only construct LEED rated green building. I would like to find out why? What are the benefits of going to such a build, wither it is financially better, possibly provide better sustainability, or is there a more lucrative reason, such as some form of finical backing from the government or state? All issues that I would like to address in greater detail. I have spoken to Mike Pulaski and he is willing to help guide me in this research. We have not discussed in detail yet what my specific course of action will be.

3. Another area that will require further research would be the current statues of my senior thesis building concerning the LEED rating. Since Penn State is now only going to construct rated building, where does the Penn State Fayette's Multi-Purpose Community Center build rate in its current state of construction? Can the build in its current form meet a LEED rating certification? How much time and money would it require to convert or redesign the build to meet a LEED rating certification? What are the benefits of doing so? What are the impact to the overall construction cost and schedule of the project? Is it worthwhile to pursue such actions? Do the benefits out weigh the costs?

5. Senior Thesis Spring '04 Proposal

Penn State along with numerous other college campuses, such as Stanford, Virginia Tech, and John Hopkins University are moving to a more sustainable, "thinking green" construction and design attitude. These prestigious colleges have recognized the benefits of a more sustainable and environmentally friendly building. Benefits of these buildings range from a lower energy consumption cost to a more environmentally friendly face for the public which can gain publicity and generate awareness and enrollment. My Senior Thesis proposal will look into the various incentives for Owners to go Green.

5.1. Analysis #1 – MEP Commissioning

Aim: This analysis will look at the overall effectiveness and required processes of the current commissioning process. The commissioning process on such an MEP intensive project such as the Penn State Community Center has numerous benefits such as: ensuring the proper and efficient operation of mechanical and electrical systems, it also minimizes the operational costs, extends the life of the equipment, minimizes downtime due to component failure, and can reduce contractor call backs. This process, as diagramed below, was used on.

Purpose: Questions of relevance that will be answered through further research and surveys are;

- What is the benefit to cost ratio of early involvement in commissioning in regards to providing correctly operating MEP and Telecom systems.
- What is the most efficient, cost effective way to provide and check for optimized performance of the various systems that support thermal comfort and indoor air quality?
- What are the guidelines that lead to an effective and efficient commissioning process?
  - Internal vs. External Commissioning
- How can the current commissioning process used by OPP be changed or adjusted to better suite the needs of the owner, the project, the cost, and the schedule?
  - A cost-benefit analysis of the whole process.
  - Can the commissioning process be adjusted and or steps removed to make it simpler and more efficient, i.e. saving time, money, and man power.
- What is the exact process used by OPP on the Penn State Fayette's Multi-Purpose Community Center to ensure that all mechanical, electrical, fire suppression and telecommunications systems were working properly before turnover to PSU has occurred.

Methods:

- Develop a detailed flow chart of the commission process used by OPP.
- Research the effectiveness and address possible changes to improve the efficiency to the currently used commissioning process.
- Case studies based upon other similarly constructed PSU projects, i.e. SALA and IST buildings.
- Compare contrast the commissioning process used on similar Community Center with intensive MEP work and provide conclusions on the best way to provide MEP commissioning to a building of similar features.

Expected Results: I would like to provide factual evidence, i.e. a flow chart that can recommend the best possible way to chose for a commissioning plan based on such variables as size, type, and methods of construction.

5.2 Analysis #2 – Façade Redesign

Aim: The second area of research will look at a façade redesign. I want to look at an alternate system to brick veneer. Hopefully I will be able to value engineer a system that can maintain and meet the required stipulations set forth by the spec book.

Purpose:

- Maintain aesthetic value
- Improve project duration
- Determine cost savings, if any
- Provide a ligament alternative

Methods: Determine various substitute systems for brick veneer. Narrow the list by determining which systems can meet the desired criteria, as stated above. Look further into the narrowed systems, and provide hard numbers for each. Look at the pros and cons of each system. R.S. Means will be referenced to provide information concerning productivity rates, and costs associated with the installation. Next the heat transfer rates will need to be found so a possible cost analysis of Btu usage per hr can be found and then a cost difference between various systems can be determined. Finally provide data that concludes a viable alternative to the proposed façade system.

Expected Results: I would like to determine an alternative façade system to brick veneer that has added significant value engineering appeal as well as solved some of the projects problems. I want to save time by accelerating the schedule, money by finding a cheaper alternative, maintain the aesthetic properties of the facility, and increase the savings from energy consumption by having a system that is more efficient in terms of heat transfer.

5.3 Analysis #3 – LEED Analysis

Aim: The third area of research has been a result of many major Universities moving to Green Buildings. Green Buildings refer to a building with a different mind set than the normal construction/design attitude. Green Buildings look at improving the sustainability, longevity, and are more environmentally responsible than your typically designed building. I am going to conduct an analysis from the aspect of green construction dealing with the added benefits, impact to schedule, and a benefit to cost ration analysis.

Purpose: This analysis may prove that the current design and construction methods of the Penn State Multi-Purpose Community Center located on the Penn State Fayette Campus has fulfilled the requirements necessary to place the building in the LEED, Leadership in Energy and Environmental Design, Certification level in its current state of design and construction, basically I want to evaluate LEED on my thesis building. Through further analysis I want to provide several suggestions, based upon sustainability and constructability, that will benefit the Community Center, and to help the building reach a Gold level of certification. An analysis of the recommended changes will include a break down of the impact to cost, time, and schedule along with the added benefits and acknowledgments that come with such a certification. An increase in energy efficiency, sustainability as well as gained publicity and a more environmentally friendly building will result with a LEED certification.

Methods:

- Assessment of the current LEED rating, if any points are obtainable, of Penn State Fayette's Multi-Purpose Community Center.
- Overall conclusion based on worth of a LEED certified building, i.e. cost-benefit analysis.
    - Compare/Contrast various LEED points on my thesis building and determine which are worthwhile or shall be considered "low hanging fruit" that can be used on any building, i.e. which LEED points are easily obtainable with relatively low construction/design costs.
    - Determine the impact on my schedule based upon these proposed changes as well as the added or reduced cost associated with the changes, for example changes in general condition costs.
    - Evaluate the added benefits to the owner and or occupant for these proposed LEED based revisions.

Expected Results: The expected results are to show how changing to the design/construction of a building to a more sustainable and environmentally friendly one also numerous and beneficial repercussions with respect to cost, schedule, quality, building systems efficiency, publicity and owner/occupant satisfaction.

6. Analysis #1 - MEP Commissioning Process

6.1. What is Commissioning?

Commissioning is a systematic process of ensuring , verifying and documenting that a building facilities and systems performs in accordance with the design intent, contract documents, and the owner's operational needs. Commissioning is a quality-assurance process that is performed to increase the performance and likelihood that a newly constructed building and its systems meet the clients/owners expectations and needs.

6.2. Types of Commissioning:

Commissioning is the term used for the Cx of a new building.

Re-Commissioning is the term used for Cx of a building that has been previously been commissioned.

Retro-Commissioning is the term used for an existing building that has never previously been commissioned.

6.3. Why Owners Need Building Commissioning (Benefits of):

There are numerous benefits to Commissioning which are, but are not limited to:

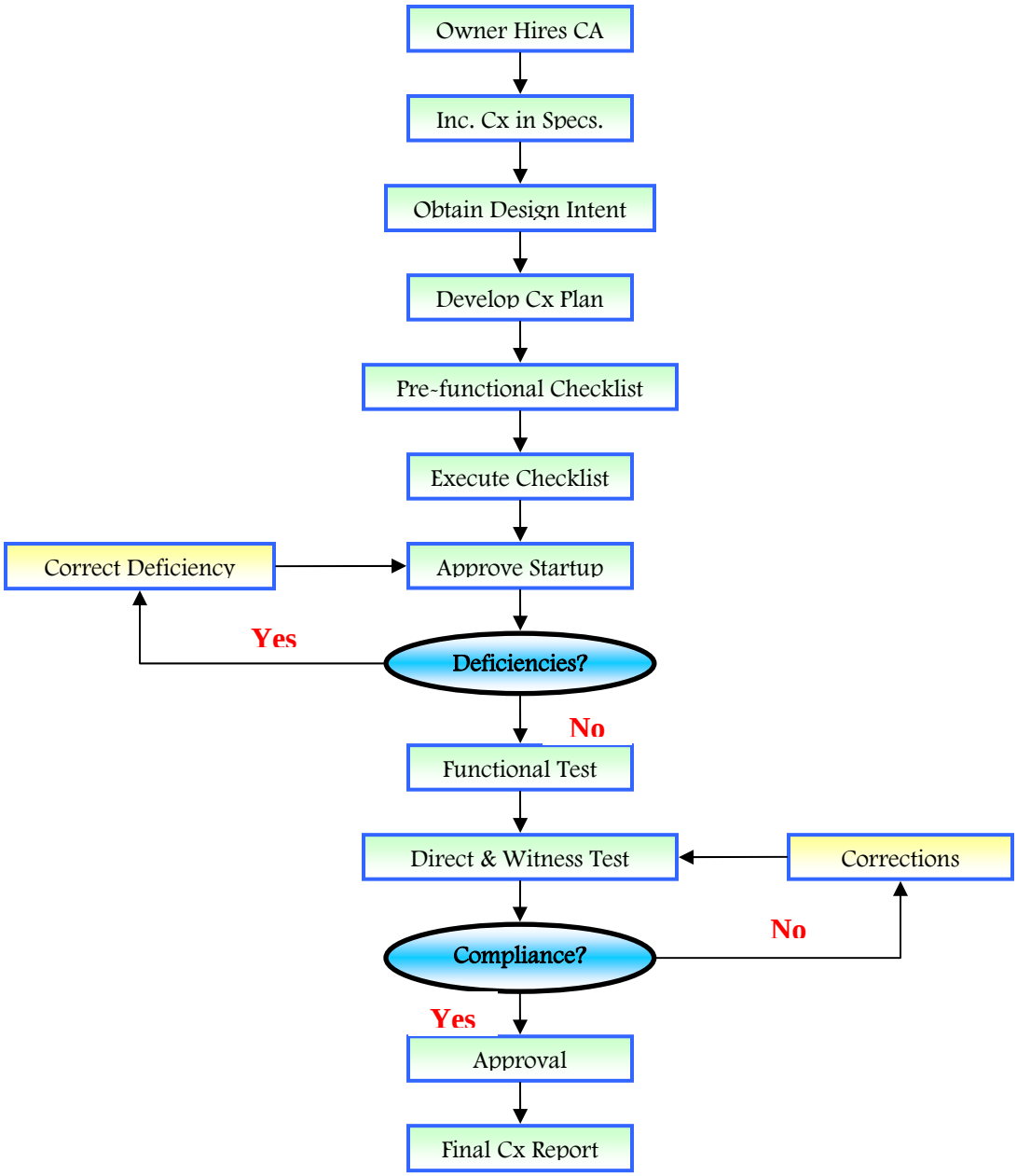
- Maintain Construction Budget
  - Reduced change orders
  - Fewer cost overruns
- Insure the building will meet the Owners Design Intent
- Less contractor call-backs
  - Tests and verifies system which helps identifies future problems in the field.
    - Contractors are still available and on site
    - Helps clarify and determine the appropriate course of action to take in order for proper MEP performance
- Provide Interdisciplinary Coordination between the Design Team, Contractors and Owners.
- Reduction in insurance claims. "Most insurance claims have to do with the integrity of the buildings envelope-wall and roof leaks" David Reid Senior VP and construction industry practice leader for national insurer, Marsh USA Inc.
- Prevents and resolves problems during the early stages of a project when cast are lower in additional cost to the owner

- Shortens project duration
  - Expedites and clarify RFI's
  - Reviews design documents and specifications to perform them right the first time
  - Validates that the building systems perform as designed and specified
    - Can support its designed usage/intent
- Improve the buildings design and functionality
  - Lower energy bills and reduced energy consumption
  - Improved indoor air quality and occupant comfort
  - Improved systems and equipment functions
  - Reduced energy and operations and maintenance costs
  - Proper operations
  - Maintenance training
  - Improved IAQ
  - Occupant comfort and productivity
  - Prevent inaccessibility of mechanical equipment
    - Allows equipment accessibility for maintenance
- Long term tenant/owner satisfaction
- Complete project documentation
- Reduction in project delays
- Additional and easily obtainable LEED points
- Avoided costly equipment replacement/repairs
  - Reduces warrant and replacement and repair costs

6.4. Basic Commissioning Process:

- Design Intent
- Basis of Design
- Develop Commissioning plan
- Design reviews
- Incorporate commissioning into the specifications
- Develop Pre-functional checklist
- Construction review, coordination and inspection
- Schedule testing
- Perform test for system acceptance
  - Testing and verification
- Operations and Maintenance manuals
- System and building training
- Commissioning Report
- Warranty Review

6.5. Typical Commissioning Plan



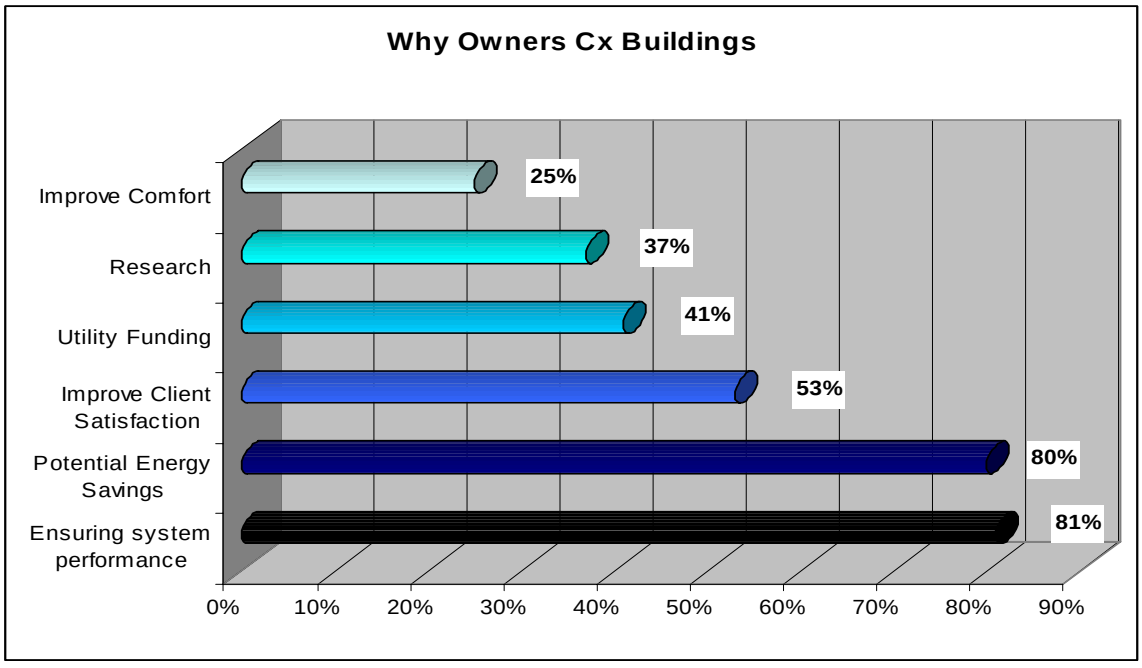
6.6 Deficiencies Found in Non-Commissioned Buildings:

- Incorrect cooling and heating sequence of operation
- Incorrect calibration of sensors and instrumentation
- Disables systems and equipment
- IAQ issues
- Under-utilized computer based control systems
- Premature failure of HVAC equipment due to short cycling
- Malfunctioning air and water side economizer cycles
- Dirty filters and coils
    - Efficiency
- Lack of building documentation
- Missing or unspecified equipment
- Lack of training for building operators

6.7 Cost Saving from Building Commissioning:

- Energy savings from 20 to 50 percent ($0.50 to $1.25 per sq. ft.)
- Maintenance savings of 15 to 35 percent, typical.
- Reduced Claims of 2 to 10 percent
- Lower maintenance costs due to properly operating MEP equipment
- Elimination of additional overtime costs due to project deficiencies

6.8 Why owners Commission their buildings:



*To ensure optimum system performance and the potential energy savings from doing so, is the main reason why owners are willing to commission their buildings as per a survey of owners who have commissioned their buildings since 1994.

6.9 Typical Cost Saving per Building Type/Usage:

Building Type	Cx Cost	Annual Savings	Simple Payback (yrs.)
Facility Offices	$24,000	$89,760	0.3
High Rise Buildings	$12,745	$8,150	1.6
Medical Institutions	$24,770	$65,535	0.4
Retail	$12,800	$8,050	1.6

*Average Commissioning costs and savings along with payback based upon the most commonly Commissioned building types.

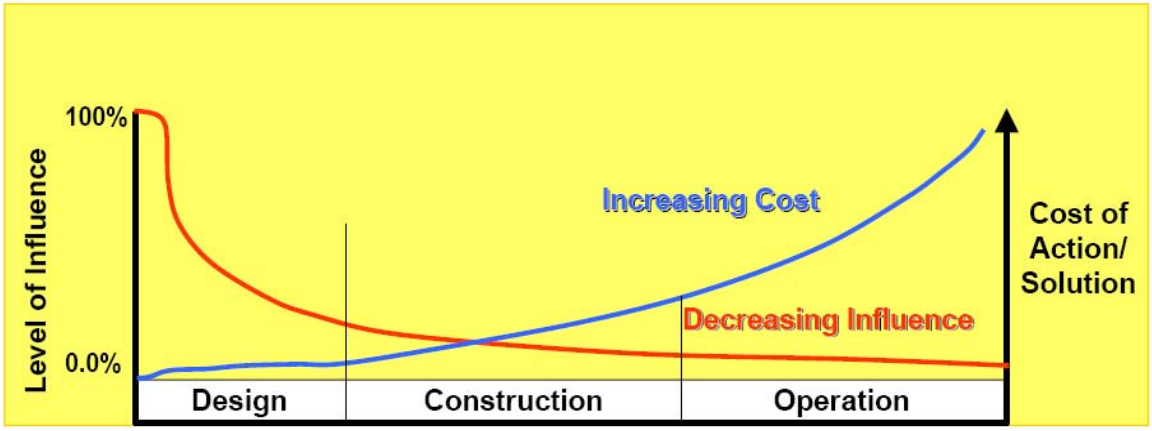
Commissioning historically has had a cost saving of 8-20% over non-commissioned buildings. General costs of commissioning are relatively cheap, on the magnitude of 0.5-1.5 % of the construction cost, which is a bargain in any owner's book given the added benefits listed above. MEP Commissioning is the focus, understandably, of numerous owners as it is one of the most complex and expensive systems in a building and is required to perform properly day in and day out for the life of the building. MEP Commissioning can include numerous subsystems.

The "Iceberg Theory" recognizes national benchmarks which state only 20% of the building cost over the life of the building is in first cost. The other 80% is in the operation, maintenance, and rejuvenation costs of managing a facility over its lifetime Champaign. It is easy to see how a detailed MEP Commissioning Plan can save a project time and money. With all the added benefits and low cost of commissioning it is difficult to understand why it is not used more often.

The charts below illustrate the cost per scope of commissioning a newly constructed building and the level of influence in relationship to the buildings design, construction and operations costs.

Commissioning Scope	$ Cost $
Entire Building (HVAC, Controls, Electrical, Mechanical)	0.5%-1.5% of total construction cost
HVAC and Automated Control System	1.5%-2.5% of mechanical system cost
Electrical Systems	1.0%-1.5% of electrical system cost
Energy Efficiency Measures	$0.23-$0.28 per square foot

* Displays the individual average costs associated with Commissioning various scopes and systems with respect to the entire construction cost, system cost, or square footage.



*Shows a direct relationship between level of influence associated during the design aspect of a project in reference to an increasing cost to fix, replace, and rectify a problem as a projects duration increases over time.

6.10. Process improvement/Recommendations::

What can be done or implemented to increase the effectiveness of the commissioning process?

- Improve Owner awareness
  - Benefits of MEP Commissioning
  - Various Case Studies
- Stream line the Commissioning Process
  - Detailed flow chart, keeping everyone involved
- Additional 17th / 18th CSI Division
  - 17th Being Telecommunications/ Controls
    - Should include Integrated Systems
- Internal vs. External Commissioning
  - CM involvement vs. 3rd party

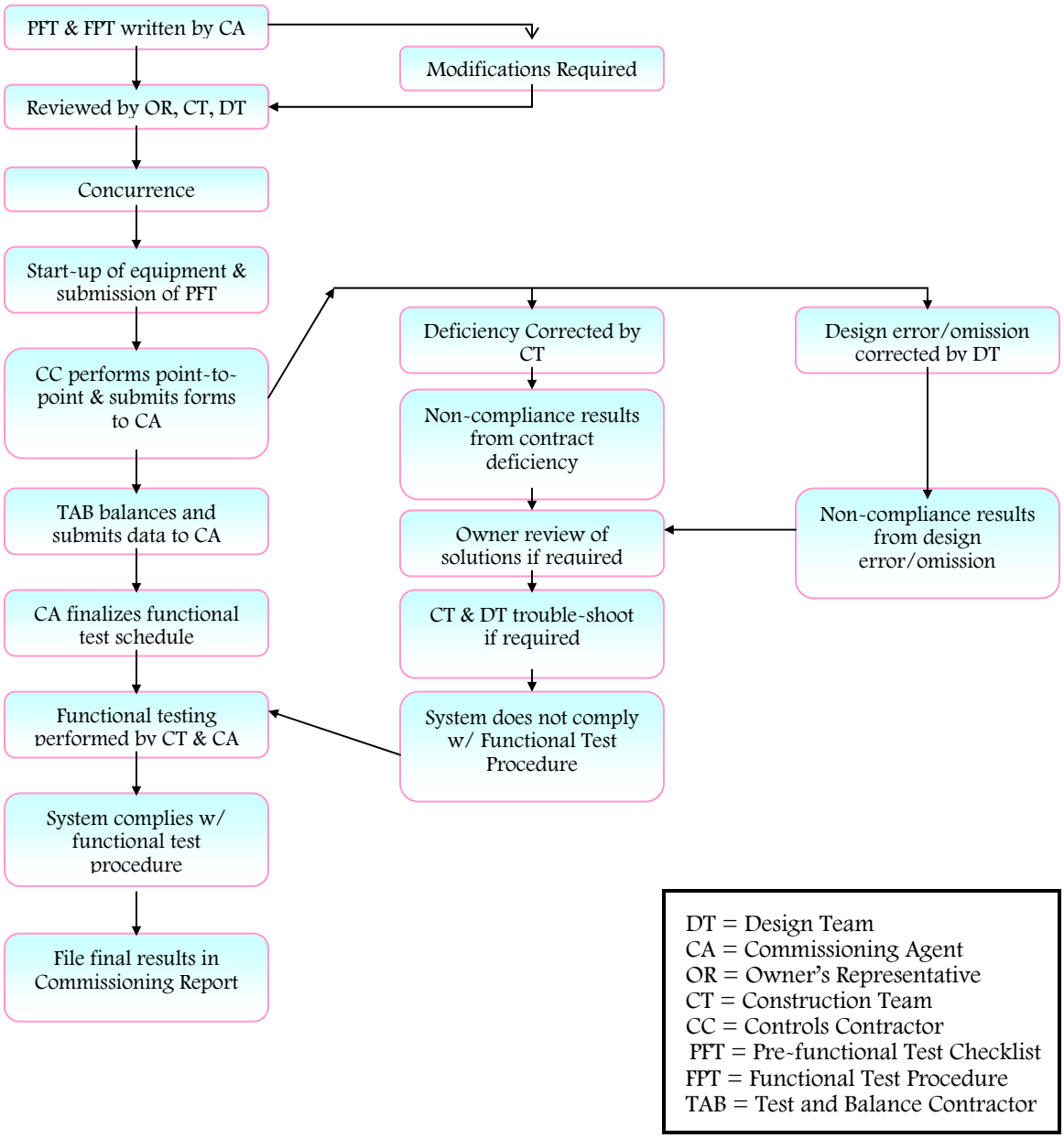
6.11. Improve Owners Awareness:

One possible way to make owners more aware of the benefits of the Commissioning process is to provide them with factual evidence, such as the numerous facts and figures stated above. Another possible way is through various case studies providing numerical values of projects gone a miss and the possible saving that can be had by using a detailed commissioning plan.

In each of these following cases the issues could have been solved during the design phase. Changes could have been placed in order to prevent these failures or flaws and would have not had a impact to the schedule or cost of the construction projects. The bottom line is that if a Commissioning plan was in place, all of these problems would have been solved beforehand.

- Walt Disney Caribbean Beach Resort, Florida
  - $5.5 Million in problems with HVAC and Building Envelope
- Hale Koa Hotel, Hawaii
  - $ 6.5 Million dollar repair, moisture and mildew. Simple HVAC Fix
- Martin County Courthouse, Florida
  - $ 16 Million plus, which was more than the building original construction cost alone
- Omni Hotel, South Carolina
  - $ 11 Million dollar fix, issues with HVAC and building envelope

6.12. Detailed 3rd MEP Commissioning Flow Chart:



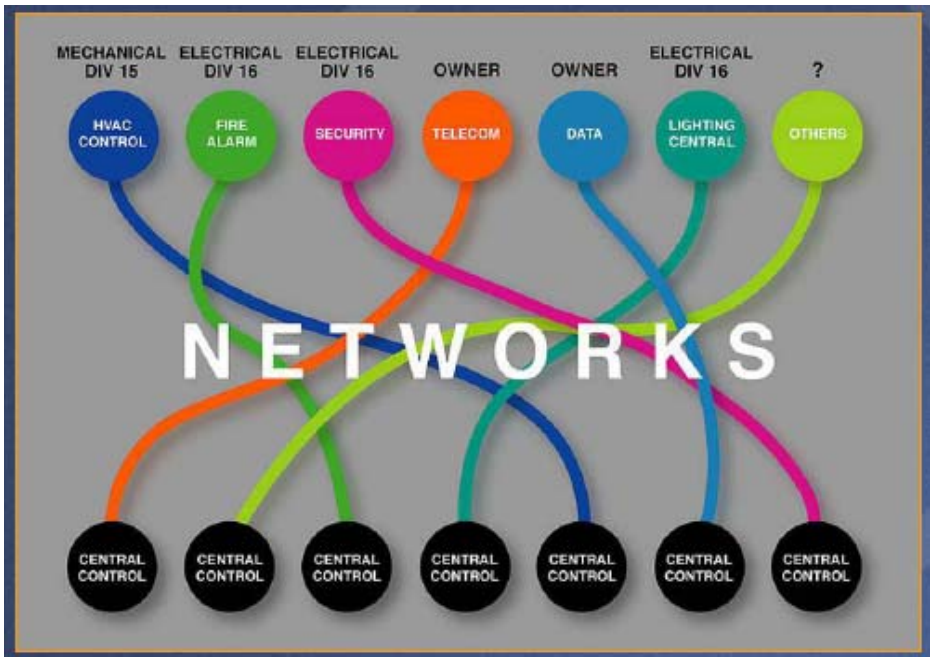
*A developed and detailed flow chart can help keep everyone be informed and aware of various scopes of work that need to be performed as a group so that a building can be Commissioned correctly and as efficiently as possible.

6.13. Additional CSI Division:

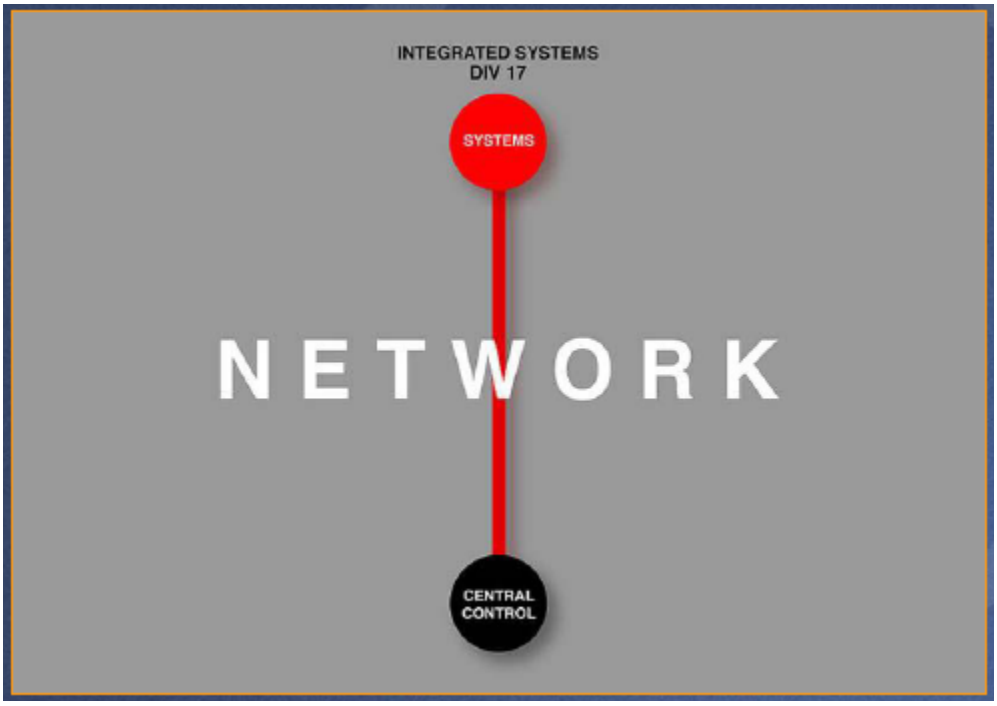
With the new advent of "smart building", a building scope of work has been ever changing and expanding with technology. Systems are becoming more and more complex, to install, test, balance, ensure, and manage. CSI Divisions will also need to adapt to the changing market. We have started to see this as a 17th division is now being dedicated to telecommunications and a building controls should also include Integrating Systems (IS), making the prime contractor responsible for;

- Provide the installation of all low voltage, and network driven systems such as fire alarms, security, and various process systems.
- Providing the test engineer with responsibility for functional performance testing, i.e. commissioning
- Provide the test start and balance for all MEP systems

With the current CSI Master format, Networking can become a little confusing. Assigning responsibility for various problems and fixes of numerous networks is, well, becoming very complicated.



Vs.



Advantages of Integrated Systems:

- Construction Quality
  - The IS Contractor will have direct contract responsibility and will selected based on competency in providing and efficiently installing low voltage network driven systems.
  - One IS Contractor will ensure cohesion and organization between prime contractors as well as consistency with various manufacturers systems.
- Optimum Operational Performance
  - IS contractor will own all work with respect to network, controls and operation systems and will be held liable for ensuring that all systems are tested, adjusted, balanced, and commissioned. As a result this will help achieve the most efficiently integrated and functioning results.
- MEP Construction Quality
  - Typical MEP prime contractors can return their core focus to installing there equipment, pipe, wire, conduit, and ductwork, and not be bothered by issues concerning networking and integration.
- Schedule
  - The IS Contractor will be the single point of contact for all technology and operational issues for the construction team as well as the owner and his representatives.
  - A single test engineer will be available, thereby increasing the project team's ability to manage schedules and perform start up and the commissioning process more efficiently.

6.14. Benefits of Internal/In-House Commissioning:

Among the typical benefits of Commissioning, a new market trend is now moving toward CM In-house commissioning, which in turn has additional benefits such as:

- Qualified to gain additional LEED point for various commissioning processes
- In-depth knowledge of managerial skills and tactics
- Ability to provide various services on all type of facility types and systems
- Familiarity with construction CPM schedules
- Vast/Imperishable experience with in the construction industry and its composition

All the recommendations and the commissioning process in general is a great way to take a small initial investment and gain a return on that investment that is immeasurable. Commissioning when done correctly by qualified individuals is a priceless commodity that should be serious considered by all owners when constructing, renovating, or updating a facility. The recommendations only seem to strength the progression of Commissioning and add beneficial features that can streamline the process making it more efficient and effective.

7. Analysis #2: Facade Redesign

7.1. Intro:

The purpose of this analysis is to provide a suitable, more economical and efficient (i.e. in terms of schedule and R-Value), façade material, to replace the proposed brick veneer wall system. The Penn State Multi-Purpose Community Center is located at the Fayette Campus in Uniontown, PA. The Community Center will house numerous state of the art spaces such as an NCAA arena, training facility, theater, full service cafeteria, and faculty offices, as well as becoming the new center/heart of the campus. Therefore the structure must be aesthetically pleasing as well as functional sound. Another area of concern, as always, is price. The Community Center is privately funded project by a local business man, Mr. Eberly providing almost $10 Million dollars for this new structure, and as a result the best bang for the buck is a must as funds are limited.

As stated above, I wanted to look at value engineering the buildings façade. The façade along with the buildings structure/foundation are commonly V.E. systems. Value Engineering is defined as an organized approach to optimizing both cost and performance in a facility or eliminating items that add cost without contributing to the desired function. The proposed façade consists of 12" veneer masonry, color specified by PSU and Architect, Burt Hill, typical 2" air space, 2" rigid insulation, held in place by standard lintels, flashings, and dovetail anchors. This system, while standard among most of Penn States buildings, is typically expensive and slow façade to construct. The Multi-Purpose Community Center is on a tight budget and construction schedule and therefore a prime system to look at value engineering.

After further investigation through R.S. Means and consultations with industry members and peers it was determined that EIFS, Exterior Insulated Finish System was the best possible solution to V.E. to the facade based upon the desired criteria as opposed to various others systems such as Architectural pre-cast concrete panels or perforated metal panels which were considered, briefly but could not meet the design requirements set in place by Penn State or the Architect. More research was then conducted again to determine if the EFIS system is indeed superior to a brick veneer system based upon schedule, cost, and efficiency. After determining that the EIFS system was a suitable and superior alternative to veneer, research need to be conducted to determine exactly what the impact on cost and schedule would be.

7.2 Architectural Pre-cast Panels (Advantages/Disadvantages)

Advantages:

- Fast installation/erection time
  - Pick and place
  - Reduction in Schedule
- High Quality Assurance
- Various Finished Available
- Great for highly repetitious jobs
  - SIPS
- Durability
- Aesthetically Pleasing
  - Various shapes, thicknesses, contours, surfaces, colors, and textures

Disadvantages:

- High Initial Cost
  - Formwork
- Placement
  - Crane Required
  - Site/space constraints
- Shipping
- Cannot meet the specifications set forth by PSU and the Architect
  - Therefore no further investigation was put into this specific proposed façade change

7.3 Existing Brick Veneer (Advantages/Disadvantages)

Advantages:

- Color specked by Penn State
- Wide range of veneer choices

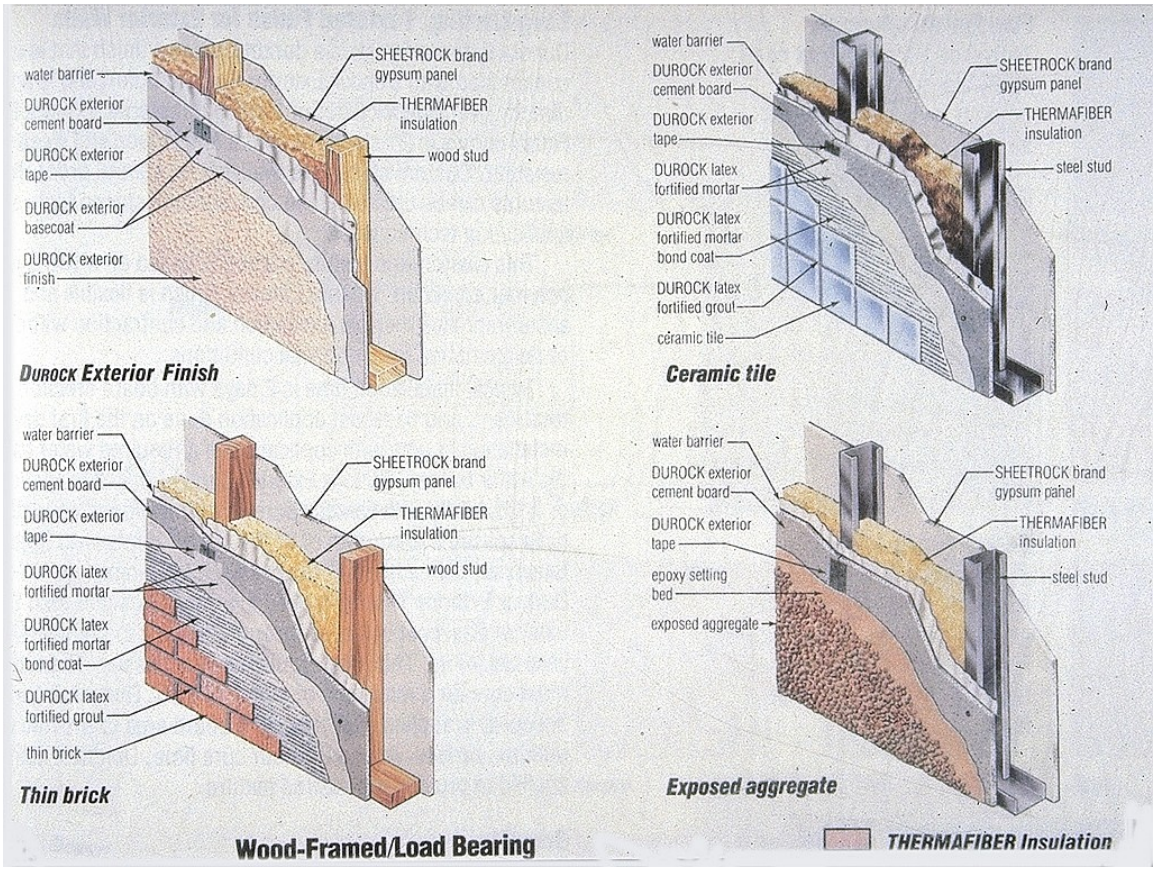
Disadvantages:

- Slow erection Time
- Special conditions
  - Heating in winter months
  - Mixing mortar
- Man power intensive
- Heavy
- Poor Insulation
- Space requirements
- Scaffolding

7.4 (EIFS) - Exterior Insulation and Finishes System

EIFS, Exterior Insulation and Finishes System are becoming a popular for of building façade. EIFS is aesthetically pleasing and has a relatively low cost compared to various other systems that are available in the construction market today. EIFS represents approximately 20% of exterior finishes found commercial buildings today. EIFS is suitable for industrial, commercial, and institutional facilities and is continually becoming more popular in each market. The common components of the EIFS system are:

- Finish Coat (Thin Brick)
- Latex Fortified Grout
- Latex Fortified Mortar Bond
- Mortar
- Exterior Tape
- Exterior Cement Board
- Water Barrier
- Wood Stud
- Insulation
- Gypsum Panel



*Typical EIFS construction sections

7.5 Advantages

- Ease of Construction/Erection
- Numerous styles of Finishes to choose from.
  - Aesthetically pleasing
- Improved Energy Efficiency
  - Continuous Insulated material
  - Prevents water penetration
- Reduces air infiltration up to 55% when compared to standard facades such as brick, wood, or stone
- Higher Resistance to conductivity than brick
  - Saving in heating and cooling
- Lower life cycle cost than brick and other façade materials
- Light weight in design
  - Approximately 1/10 that of a brick façade system
    - Brick typically is 40psf
    - EIFS is approximately 3.5 psf
  - Possible saving in structural redesign using smaller less expensive members/shapes and foundations
  - Very cost efficient material

7.6 Disadvantages:

- Moisture re-tension issues are the one major disadvantage of this system
  - No drainage/ventilation cavity
  - Requires special attention at joints to eliminate any possible re-tension of water
    - Proper sealant techniques and detailed drawings are a must to eliminate
      - Mold
      - Façade damage
      - Difficult to remove moisture from the system
- More susceptible to damage than brick veneer
  - Cracking
    - Due to shipping
    - Incorrect Reinforcement

7.7 Cost and Schedule Comparison

R.S. Means Assemblies Estimate and Building Construction Cost Data books were consulted to help determine the overall impact on the project schedule and budget in reference to the proposed façade redesign. The chart below will help summarize the findings when comparing each respective system.

EIFS can be placed at an average of 295 square feet per day where as brick is able to be placed at a rate of 222 square feet per day, that is a huge difference of 17 days or 3.4 weeks. In term of total project duration, 307 days, 17 days of project acceleration is approximately 6% of the whole projects duration. When considering that the façade is scheduled throughout the winter months in Southwestern PA, the 17 days saves primary cost such as time, and numerous secondary costs such as the required addition heating and scaffolding costs associated with the erection of the façade.

The costs associated with the façade redesign are just as substantial as the reduction in schedule. The installation cost differences between EIFS and brick was approximately $5.75/sq.ft., which equates to a savings of $88,751 with the proposed façade redesign.

A 1995 case study by Bill Egan was used to estimate the 30 year life cycle costs of the various facades. The brick veneer was determined to need only a cleaning after 30 years where as the EFIS system required 2 cleaning, and recoating during its 30 year life cycle. EIFS and its maintenance cost are roughly double that of the brick veneer, but when compared to the final costs and differences between the two, the maintenance costs are not substantial.

R.S. Means Estimate							
System Type	sq.ft.	$/sq.ft.	Installation Cost	Maintenance Cost	Energy Savings	Installation Time	Final Cost
EIFS	15,435	$13.75	$212,231.25	$20,000	-$32,550.00	53 Days	$199,681.25
Brick Veneer	15,435	$19.50	$300,982.50	$10,000	$0.00	70 Days	$310,982.50

7.8 Heat Transfer Calculations

A heat transfer comparison was also used to determined what additional benefits the EIFS system had when compared against the Brick veneer. The R-value were added up from each of the various components that make-up the façade system and then used to put a price on the possible savings of the EIFS over the brick. The higher the R-value the more efficient the system is as an insulator. The EIFS system has a computed R-value of approximately 16.78, which is far superior to the brick veneer system which on has an R-value of 11.75.

The equation for heat transfer is $q_x = (T_{\infty 1} - T_{\infty 2}) * (A/R_{total})$

This heat transfer equation (q_x) was used to determine the Btu/hr of each system:

EIFS:

Cooling: q_x = ((88-70)*15,435)/16.78 = 16,557 Btu/hr
Heating: q_x = ((70-12)*15,435)/16.78 = 53,351 Btu/hr

Brick:

Cooling: q_x = ((88-70)*15,435)/11.75 = 23,645 Btu/hr
Heating: q_x = ((70-12)*15,435)/11.75 = 76,190 Btu/hr

This equates to a heating and cooling difference of 29,925 Btu/hrs between the EIFS and Brick facades. These 30,000 Btu/hr equates to an approximate saving of $1,085 a year reduction in heating and cooling cost over the brick veneer system. This might not seem like much, but when added to the total saving of the EIFS over the brick, it equates to over $110,000.

7.9. Recommendations

I initial design called for a brick face façade veneer. Through research it has been proven that this system can be reengineered to save time and money with out any diminishment in overall quality, efficiency, effectiveness, and ascetics. Therefore it is recommended that this analysis be considered for further value engineering and passed on to the structural engineer to determine if any saving can be obtained by resizing the foundation/structure based upon the weight savings of the EIFS over the brick, which is on the magnitude of 280 tons.

Façade Weights			
System Type	lb./sq.ft.	sq.ft	Total lbs.
EIFS	3.5	15435	54022.5
Brick Veneer	40	15435	617400
Weight Difference (lbs.)			559777.5
Weight Difference (Tons.)			280

Through Value Engineering the change in façade type clearly shows EIFS to be far superior to that of brick. The addition costs associated with an EIFS design, such as additional time required to detail joints and special provisions to help reduce the possibility of moisture retention are only a foot hill to over come when considering the added value of the switch from a brick face to an EIFS façade, which equates to a total cost savings of $111,300 and a reduction in schedule of 17 days or 3.4 weeks along with the reduction in the buildings dead weight of 280 tons. The EIFS façade is a great Value Engineering alternative to brick and is recommended for further analysis and possible acceptance.

8. Analysis #3: - LEED Rating Sustainable Green Buildings

8.1: Intro:

The purpose of this analysis is to determine the possible LEED point status of the Multi-Purpose Community Center as it was originally designed and through research attempt to gain a certified status in the most cost effective way possible. The benefits of obtaining a LEED certification are many, such as:

- More cost effective / Lower Life cycle costs
- Provides 3rd party validation of the sustainability of the building in various degrees as well as its performance
- Distinct and prestigious
- Signifies environmental leadership
- Significant marketing tool
- Qualify for a growing array of state and local government incentives

What are the overall goals of sustainability?

- Using resources efficiently
- Minimizing raw material resource consumption, including energy, water, land, and materials, both during the construction as well as throughout the life of the facility
- Maximize renewable energy
- Create a healthy working environment
- Build facilities of long-term value
  - More efficient life cycles
- Protect and/or restore the natural environment

LEED Points system:

LEED Points	
Classification	Required Pts.
Certified	26-32
Silver	33-38
Gold	39-51
Platinum	52-69

LEED – Leadership in Energy and Environmental Design

LEED and its points system was created to:

- Define "Green Buildings" by establishing a common standard of measurement
- Promote integrated, whole-building design practices
- Stimulate green competition
- Transform the building market to one of environmentally concerned
- Raise consumer awareness of the numerous benefits of going green
- Recognize environmental leadership in the building industry

According to the U.S. Green Building Council (USGBC), "The Leadership in Energy and Environmental Design (LEED) Green Building Rating System is a voluntary, consensus-based national standard for developing high-performance, and sustainable buildings." The USGBC is composed of representatives from all facets of the building industry, and this council is charged with developing LEED standards to encourage a highly efficient sustainable design and construction performance. "LEED provides a complete framework for assessing building performance and meeting sustainability goals. Based on well-founded scientific standards, LEED emphasizes state of the art strategies for sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality. LEED recognizes achievements and promotes expertise in green building through a comprehensive system offering project certification, professional accreditation, training and practical resources."

8.2 Current LEED Points:

In determining the possible LEED points available, one (the building) must meet 7 prerequisites to even be considered a candidate for certification.

- Erosion and Sedimentation Control
- Fundamental Building Systems Commissioning
- Minimum Energy Performance
- CFC Reduction in HVAC and R Equipment
- Storage and Collection of Recyclables
- Minimum IAQ Performance
- Environmental Tobacco Smoke (ETS) Control

Of the 7 prerequisites, 6 can be met with out any special provisions. Storage and Collection of Recyclables is the one lacking. This is not a major hurdle to over come. To alleviate this issue some extra site layout space will be required as various materials such as glass, plastic, newspaper, cardboard, and organic wastes need to be separated and recycled appropriately. This is really a no cost fix, as the site allows space for extra recycling containers. The only real issue is a little extra time will be required on the part of the contractors to dispose of the wastes correctly.

Once all the prerequisites are met an analysis can be done to determine the facilities current LEED points which can be obtained with our further design or value engineering. It was determined that the Community Center has a total of 20 points available to the facility in its current design that can be used to obtain a certification. A LEED certification start at 26 points and since this is a privately funded project the budget is extremely tight. Therefore, through further research I will determine the best possible and most efficient way to obtain the 6 extra points and receive certification. See Appendix to see the LEED point's distribution.

8.3 Easily Obtainable LEED Points:

Through various cost analysis and comparisons of possible value engineering and redesign options to obtain the required 26 points for LEED certification, a list of easily obtainable solutions, seen below will be pursued to reach the certification.

Sustainable Sites:

- Credit 4.2 Alternative Transportation: Bicycle Storage
  - Bicycle racks can be purchased at an approximate cost of $750 per unit. It was estimated that 3 racks should provide sufficient storage for the building.
    - Total Cost of point = $2,250
- Credit 7.1 Landscape & Exterior Design to Reduce Heat Islands
  - Additional landscaping is required to help shade various constructed surfaces such as sidewalks and reduce the overall footprint of the facility.
    - Additional Landscaping costs of approximately = $ 10,700

Materials & Resources:

- Credit 2.1 Construction Waste Management, Divert 50%
  - Adopt a construction waste management plan to achieve this goal and not to mention its good construction/demolition practice as well.
    - Requires addition specialized dumpster at a price of approx = $18,250
    - Additional time lost by sorting the materials at the job site during construction by the laborers.
- Credit 4.1 Recycled Content, Specify 5%
  - Use recycled products to meet the requirements
    - No additional cost associated with, requires only additional time to locate materials that can meet the specifications

Indoor Environmental Quality:

All 4 of these credited points are easily obtainable as well with little (on the magnitude of a $1,000 difference)or no additional costs associated with the change other than the additional time and coordination required to spec. and locates the desired items.

- Credit 4.1 Low-Emitting Materials - Adhesives & Sealants
- Credit 4.2 Low-Emitting Materials - Paints
- Credit 4.3 Low-Emitting Materials - Carpet
- Credit 4.4 Low-Emitting Materials – Composite Wood & Agrifiber

Additional Costs

Some additional costs are prevalent to have your building registered and certified: $950 and $1,875 respectively.

More points are relatively available but these points are not easy to come by and/or cheap, and were not furthered pursued in this analysis as that was not it desired designed intent.

8.4 Conclusion/Recommendations:

In order to obtain LEED certification an additional $38,025 is required. The impact to the construction schedule is non-existent but additional time will be required in order to coordinate the design and specification changes needed to meet the desired goal. By providing a healthier environment, the University is increasing the productivity of the students and given them a better quality environment. The additional money spent well spent. The additional publicity through the local and nationwide news is priceless for a smaller college such as Penn State Fayette, when the registration is around 1,500 students. It is recommended that Penn State Fayette find the extra moneys to financial fund the pursuit of a LEED Certified building, as it would be the first in Fayette County. The additional benefits far outweigh the costs of obtaining such a status.

9. References:

MEP Commissioning Process:

- www.bcxa.org
- www.gbapgh.org
- www.mcps.k12.md.us
- www.dprinc.com
- www.efcog.org
- www.rdkengineers.com
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- Egan, W., "Projected Life Cycle Cost of EIFS," *EFIS: Materials, Properties, and Performance, ASTM STP 1269,* P.E.Nelson*, ASTM*, 1996.
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- www.toolbase.org

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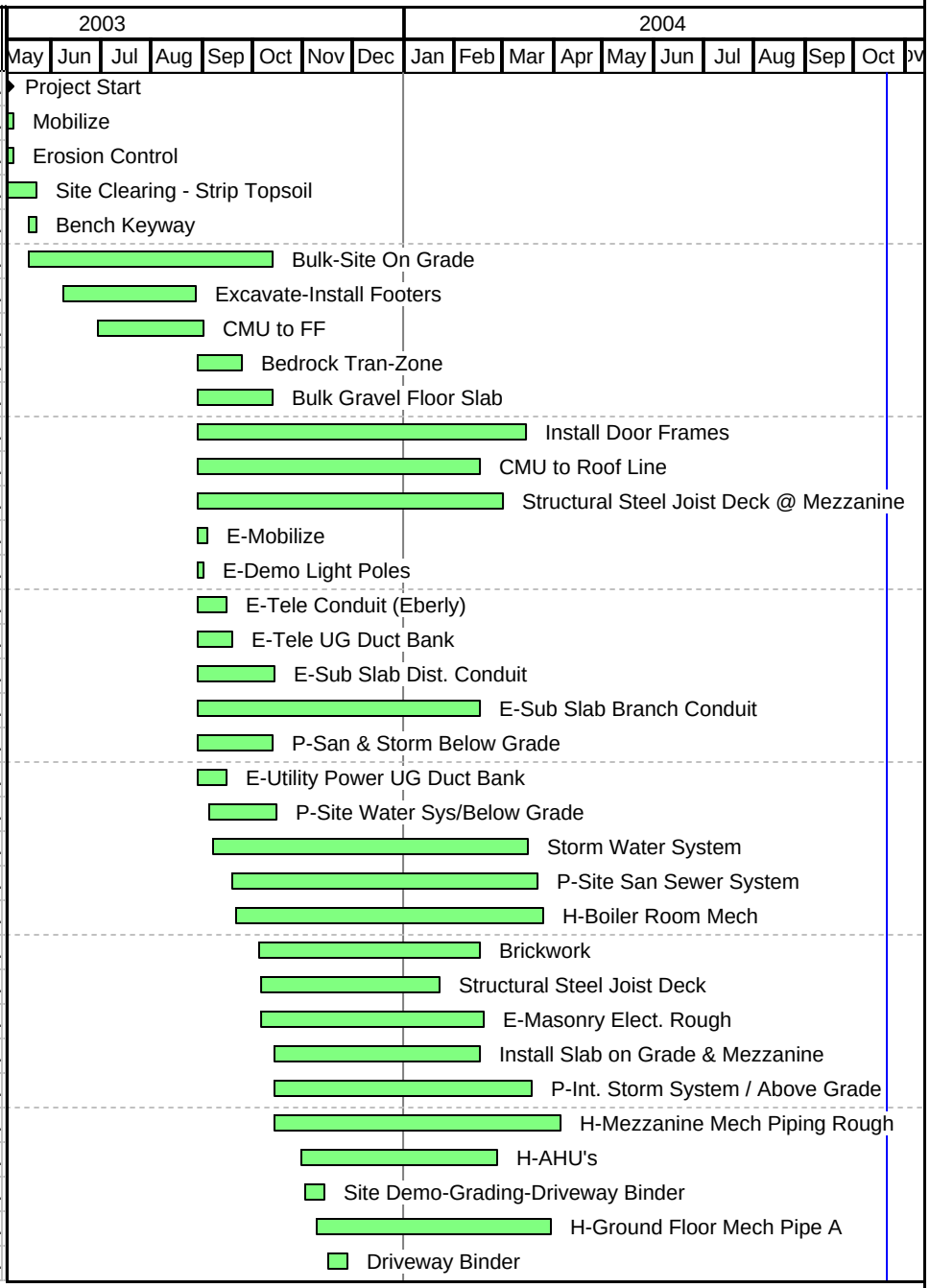
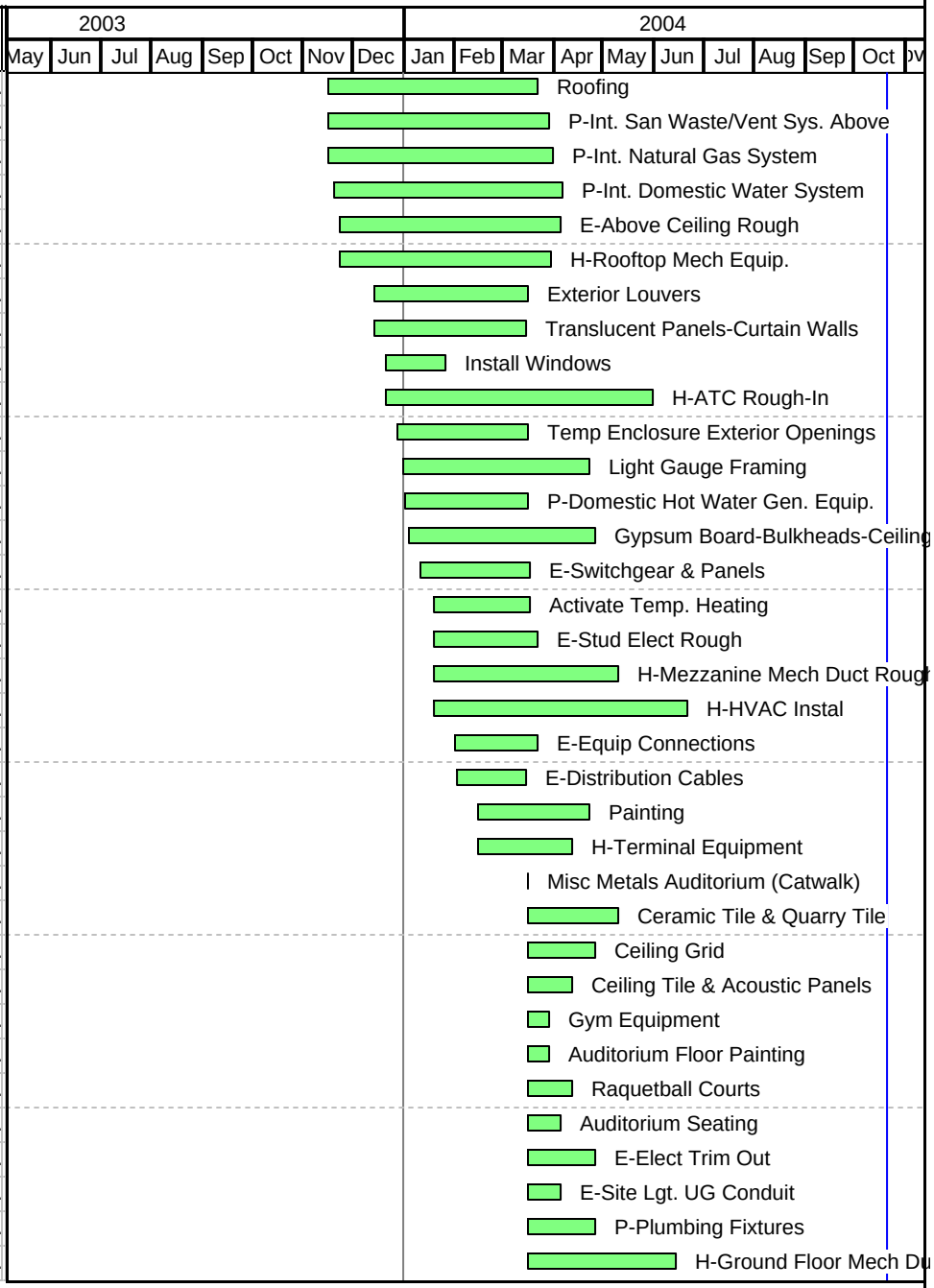
- www.e-pub.uni-weimar.de
- www.media.wiley.com.
- www.usgbc.org
- www.dprinc.com
- www.greenbuildingservices.com
- www.edcmag.com
- www.greenerbuildings.com

10. Appendices: A – Detailed Schedule

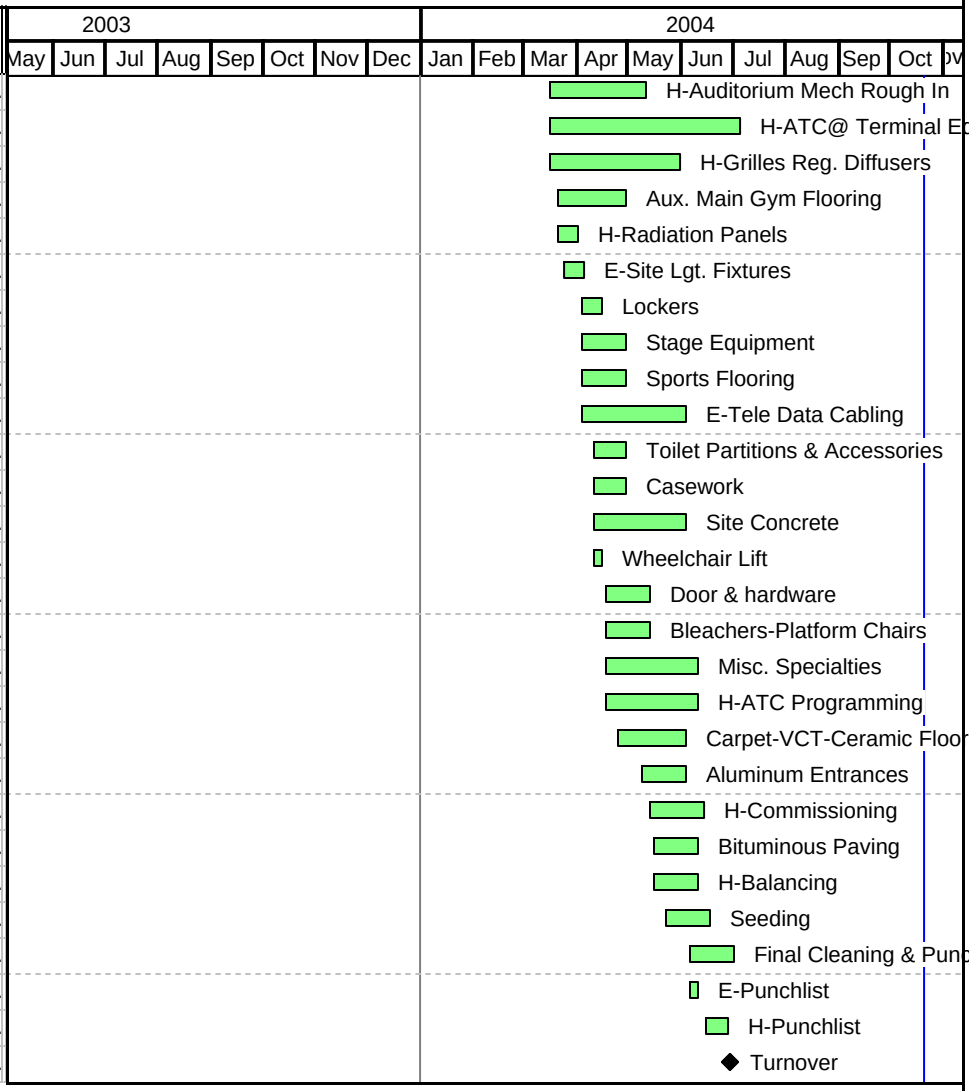
Activity ID	Activity Name	Original Duration	Remaining Duration	Start	Finish
0001	Project Start	0	0	05-May-...	
0002	Mobilize	5	5	05-May-...	09-May-03
0003	Erosion Control	5	5	05-May-...	09-May-03
0004	Site Clearing - Strip Topsoil	15	15	05-May-...	23-May-03
0005	Bench Keyway	5	5	19-May-...	23-May-03
0006	Bulk-Site On Grade	107	107	19-May-...	14-Oct-03
0007	Excavate-Install Footers	59	59	09-Jun-03	28-Aug-03
0008	CMU to FF	46	46	30-Jun-03	01-Sep-03
0009	Bedrock Tran-Zone	20	20	29-Aug-...	25-Sep-03
0010	Bulk Gravel Floor Slab	33	33	29-Aug-...	14-Oct-03
0011	Install Door Frames	143	143	29-Aug-...	16-Mar-04
0012	CMU to Roof Line	122	122	29-Aug-...	16-Feb-04
0014	Structural Steel Joist Deck @ Mezza...	133	133	29-Aug-...	02-Mar-04
0057	E-Mobilize	5	5	29-Aug-...	04-Sep-03
0067	E-Demo Light Poles	2	2	29-Aug-...	01-Sep-03
0077	E-Tele Conduit (Eberly)	12	12	29-Aug-...	15-Sep-03
0087	E-Tele UG Duct Bank	16	16	29-Aug-...	19-Sep-03
0107	E-Sub Slab Dist. Conduit	34	34	29-Aug-...	15-Oct-03
0117	E-Sub Slab Branch Conduit	123	123	29-Aug-...	17-Feb-04
0237	P-San & Storm Below Grade	33	33	29-Aug-...	14-Oct-03
0097	E-Utility Power UG Duct Bank	12	12	29-Aug-...	15-Sep-03
0247	P-Site Water Sys/Below Grade	30	30	05-Sep-...	16-Oct-03
0013	Storm Water System	138	138	08-Sep-...	17-Mar-04
0267	P-Site San Sewer System	132	132	19-Sep-...	22-Mar-04
0367	H-Boiler Room Mech	135	135	22-Sep-...	26-Mar-04
0016	Brickwork	96	96	06-Oct-03	16-Feb-04
0017	Structural Steel Joist Deck	79	79	07-Oct-03	23-Jan-04
0127	E-Masonry Elect. Rough	98	98	07-Oct-03	19-Feb-04
0015	Install Slab on Grade & Mezzanine	90	90	15-Oct-03	17-Feb-04
0277	P-Int. Storm System / Above Grade	113	113	15-Oct-03	19-Mar-04
0347	H-Mezzanine Mech Piping Rough	124	124	15-Oct-03	05-Apr-04
0417	H-AHU's	86	86	31-Oct-03	27-Feb-04
0018	Site Demo-Grading-Driveway Binder	10	10	03-Nov-...	14-Nov-03
0377	H-Ground Floor Mech Pipe A	103	103	10-Nov-...	31-Mar-04
0019	Driveway Binder	10	10	17-Nov-...	28-Nov-03



Activity ID	Activity Name	Original Duration	Remaining Duration	Start	Finish
0020	Roofing	92	92	17-Nov-...	23-Mar-04
0287	P-Int. San Waste/Vent Sys. Above	97	97	17-Nov-...	30-Mar-04
0297	P-Int. Natural Gas System	99	99	17-Nov-...	01-Apr-04
0307	P-Int. Domestic Water System	100	100	20-Nov-...	07-Apr-04
0147	E-Above Ceiling Rough	96	96	24-Nov-...	05-Apr-04
0387	H-Rooftop Mech Equip.	93	93	24-Nov-...	31-Mar-04
0021	Exterior Louvers	68	68	15-Dec-...	17-Mar-04
0022	Translucent Panels-Curtain Walls	67	67	15-Dec-...	16-Mar-04
0023	Install Windows	27	27	22-Dec-...	27-Jan-04
0337	H-ATC Rough-In	116	116	22-Dec-...	31-May-04
0024	Temp Enclosure Exterior Openings	58	58	29-Dec-...	17-Mar-04
0060	Light Gauge Framing	82	82	01-Jan-04	23-Apr-04
0317	P-Domestic Hot Water Gen. Equip.	54	54	02-Jan-04	17-Mar-04
0027	Gypsum Board-Bulkheads-Ceiling Fi...	82	82	05-Jan-04	27-Apr-04
0157	E-Switchgear & Panels	49	49	12-Jan-04	18-Mar-04
0025	Activate Temp. Heating	43	43	20-Jan-04	18-Mar-04
0137	E-Stud Elect Rough	46	46	20-Jan-04	23-Mar-04
0357	H-Mezzanine Mech Duct Rough	81	81	20-Jan-04	11-May-04
0427	H-HVAC Instal	111	111	20-Jan-04	22-Jun-04
0177	E-Equip Connections	36	36	02-Feb-04	22-Mar-04
0167	E-Distribution Cables	31	31	03-Feb-04	16-Mar-04
0029	Painting	50	50	16-Feb-04	23-Apr-04
0447	H-Terminal Equipment	41	41	16-Feb-04	12-Apr-04
0026	Misc Metals Auditorium (Catwalk)	1	1	17-Mar-04	17-Mar-04
0028	Ceramic Tile & Quarry Tile	40	40	17-Mar-04	11-May-04
0030	Ceiling Grid	30	30	17-Mar-04	27-Apr-04
0031	Ceiling Tile & Acoustic Panels	20	20	17-Mar-04	13-Apr-04
0032	Gym Equipment	10	10	17-Mar-04	30-Mar-04
0033	Auditorium Floor Painting	10	10	17-Mar-04	30-Mar-04
0034	Raquetball Courts	20	20	17-Mar-04	13-Apr-04
0035	Auditorium Seating	15	15	17-Mar-04	06-Apr-04
0187	E-Elect Trim Out	30	30	17-Mar-04	27-Apr-04
0207	E-Site Lgt. UG Conduit	15	15	17-Mar-04	06-Apr-04
0327	P-Plumbing Fixtures	30	30	17-Mar-04	27-Apr-04
0407	H-Ground Floor Mech Duct B	65	65	17-Mar-04	15-Jun-04



Activity ID	Activity Name	Original Duration	Remaining Duration	Start	Finish
0437	H-Auditorium Mech Rough In	41	41	17-Mar-04	12-May-04
0457	H-ATC@ Terminal Equip	80	80	17-Mar-04	06-Jul-04
0467	H-Grilles Reg. Diffusers	55	55	17-Mar-04	01-Jun-04
0036	Aux. Main Gym Flooring	30	30	22-Mar-04	30-Apr-04
0477	H-Radiation Panels	10	10	22-Mar-04	02-Apr-04
0217	E-Site Lgt. Fixtures	8	8	25-Mar-04	05-Apr-04
0037	Lockers	10	10	05-Apr-04	16-Apr-04
0038	Stage Equipment	20	20	05-Apr-04	30-Apr-04
0039	Sports Flooring	20	20	05-Apr-04	30-Apr-04
0197	E-Tele Data Cabling	45	45	05-Apr-04	04-Jun-04
0040	Toilet Partitions & Accessories	15	15	12-Apr-04	30-Apr-04
0041	Casework	15	15	12-Apr-04	30-Apr-04
0042	Site Concrete	40	40	12-Apr-04	04-Jun-04
0043	Wheelchair Lift	5	5	12-Apr-04	16-Apr-04
0044	Door & hardware	20	20	19-Apr-04	14-May-04
0045	Bleachers-Platform Chairs	20	20	19-Apr-04	14-May-04
0046	Misc. Specialties	40	40	19-Apr-04	11-Jun-04
0487	H-ATC Programming	40	40	19-Apr-04	11-Jun-04
0047	Carpet-VCT-Ceramic Flooring	30	30	26-Apr-04	04-Jun-04
0048	Aluminum Entrances	20	20	10-May-...	04-Jun-04
0507	H-Commissioning	23	23	14-May-...	15-Jun-04
0049	Bituminous Paving	20	20	17-May-...	11-Jun-04
0497	H-Balancing	20	20	17-May-...	11-Jun-04
0050	Seeding	20	20	24-May-...	18-Jun-04
0051	Final Cleaning & Punchlist	20	20	07-Jun-04	02-Jul-04
0227	E-Punchlist	5	5	07-Jun-04	11-Jun-04
0517	H-Punchlist	10	10	16-Jun-04	29-Jun-04
0600	Turnover	0	0		30-Jun-0...



Appendices: B – Site Plans

Excavation Phase

A vast and wide site location allowed for easy site access. Minimum excavation work was required due to a flat site location and through the use of various shallow sized spread footings. One large CAT dozer was used (~ 35 CY bucket) to level the site from top left to bottom right, as indicated on the site plan. One tractor mounted backhoe and an excavator were used to dig the spread and strip footings, depth ranged from 1'-8" x 1'-0" for the smallest strip footing to 9'-0" x 9'-0" x 3'-6" for largest spread footing. A new parking lot, included in the bid, was used as parking for the laborers. Parking lots near the contractors trailers provide parking for the PM, Superintendent, and Site Engineers. Site safety was a concern. The site was located on a college campus so a full perimeter fence was used to prevent vandalism and various security issues. A top soil stockpile was used to harbor excess soil from excavation and was later used for final grading and backfill.

Superstructure Phase

As stated before site access was not an issue, therefore making and keeping track of material deliveries to the site was an efficient process. Site trailers were placed at the main entrance of the job site to also help with the tracking of deliverables. The building design had provisions for loading docks, so naturally this is where the material was delivered and distributed for storage and staging. The main steel storage and staging were placed near the main structural steel locations. The Community Center was not a highly structural steel intensive project although a large area was required for the shear quantity of structural members found throughout the design. The structural steel can be found throughout the building and for this a mobile type crawler crane was used. The structural steel members were not large in size, but a large number of small beams were used, therefore it made sense to use a smaller, more mobile style crane on this specific project. Three material hoists and scaffolding all around the perimeter of the building were used on this project, as it was masonry intensive. Two, 30 cubic yard dumpster, as seen on the site plan, were placed at the front and rear of the site for easy waste dumping and removal. Temporary facilities were placed at the front of the job site to reduce the amount of worker downtime.

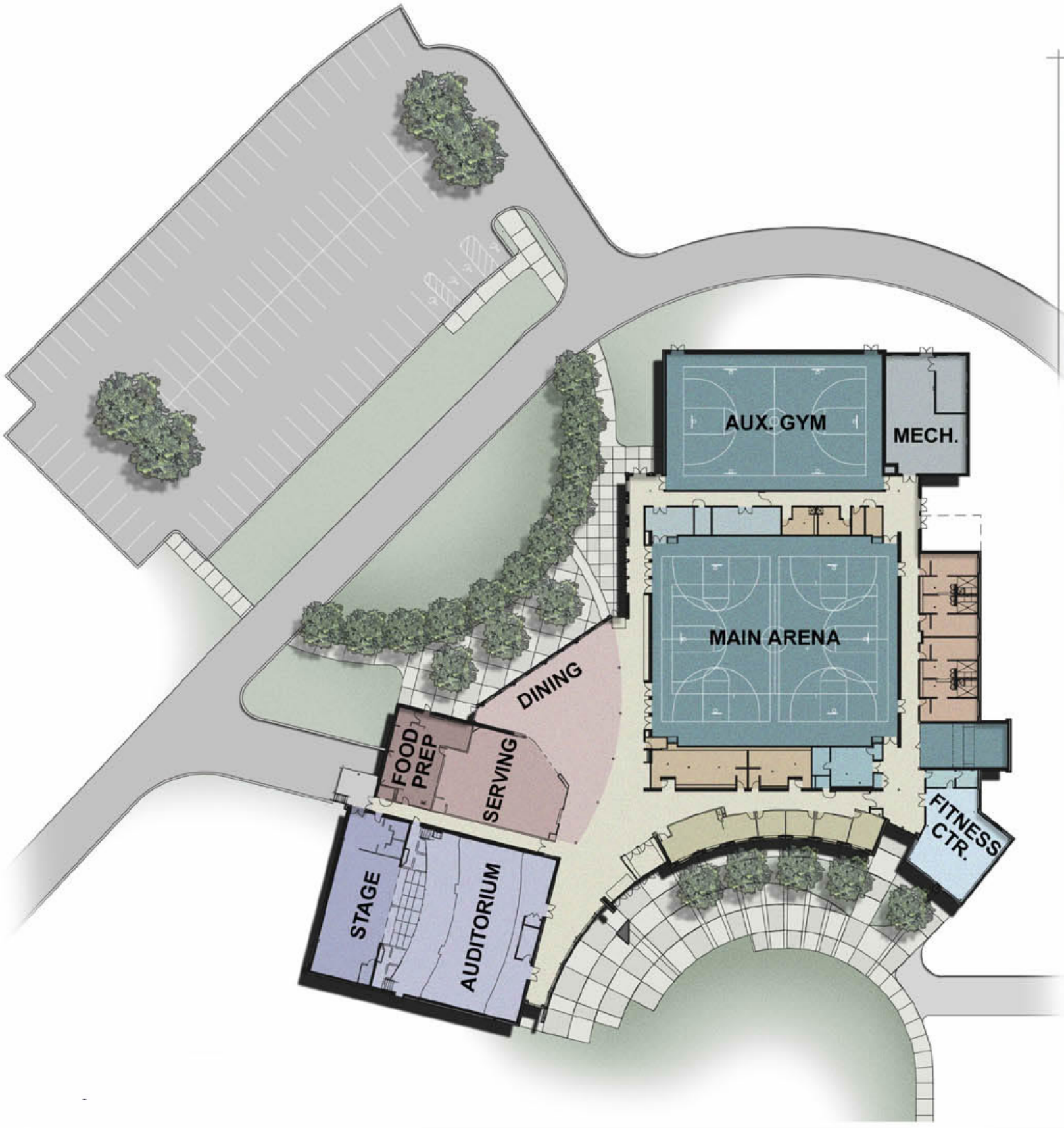
Finishing Phase

The finishing phases in the Multi-Purpose Community Center are an intensive, probably the most intensive minus the mechanical, scope of work during the construction process. The name says it all, the Community Center is a multi-purpose building with various uses and spaces such as a NCAA sized basketball arena, faculty offices, cafeteria, lounge, weight room, etc. and for this reason special attention needed to be considered and scheduled when performing the final phases of this project (refer to the Building Abstract for a more detailed description of the building and its various functions). As stated in prior Technical Assignments, this finishing phase along with the commissioning, testing, and balancing processes are an area of interest to me, and I will likely pursue for a possible topic for research (more information is available on these process which can be found in Technical Assignments 1 and 2).

The majority of the site layout has remained the same with this phase as with the other phases. Most of the material storage has been moved inside from the elements for protection and installation. The now existing loading docks are used for material delivery were forklifts can now transfer larger items to the necessary positions for final installation. Building ingress/egress is made easy by the numerous entrances and exists. Construction of the new student/faculty parking lot, approximately 100 additional spaces, will begin as well as the final grading, site work and installation of the 23' fountain located at the buildings main entrance.

Conclusion

In conclusion, the Multi-Purpose Community Center site planning appears to be efficient in its layout. The large and flat site layout makes for easy site logistics. Ingress/egress to and from the site as well as the building itself are made in a proficient manner. Deliveries and material storage are also made easy by a large access road, and existing loading docks. Overall the project and its site seem to be a GC/CM's dream, but as I am sure I will discover with further research, all is not what it appears to be.


AUX. GYM
MECH.
MAIN ARENA
DINING
FOOD PREP
SERVING
FITNESS CTR.
STAGE
AUDITORIUM

Site Plan of Excavation and Superstructure

Legend/Key

Access Road flow

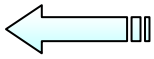
Excavation Phase (1 Cat Track-Type Dozer w Cap. Of ~ 35 cu.yd.)

Temp Electric

Mobile Crane

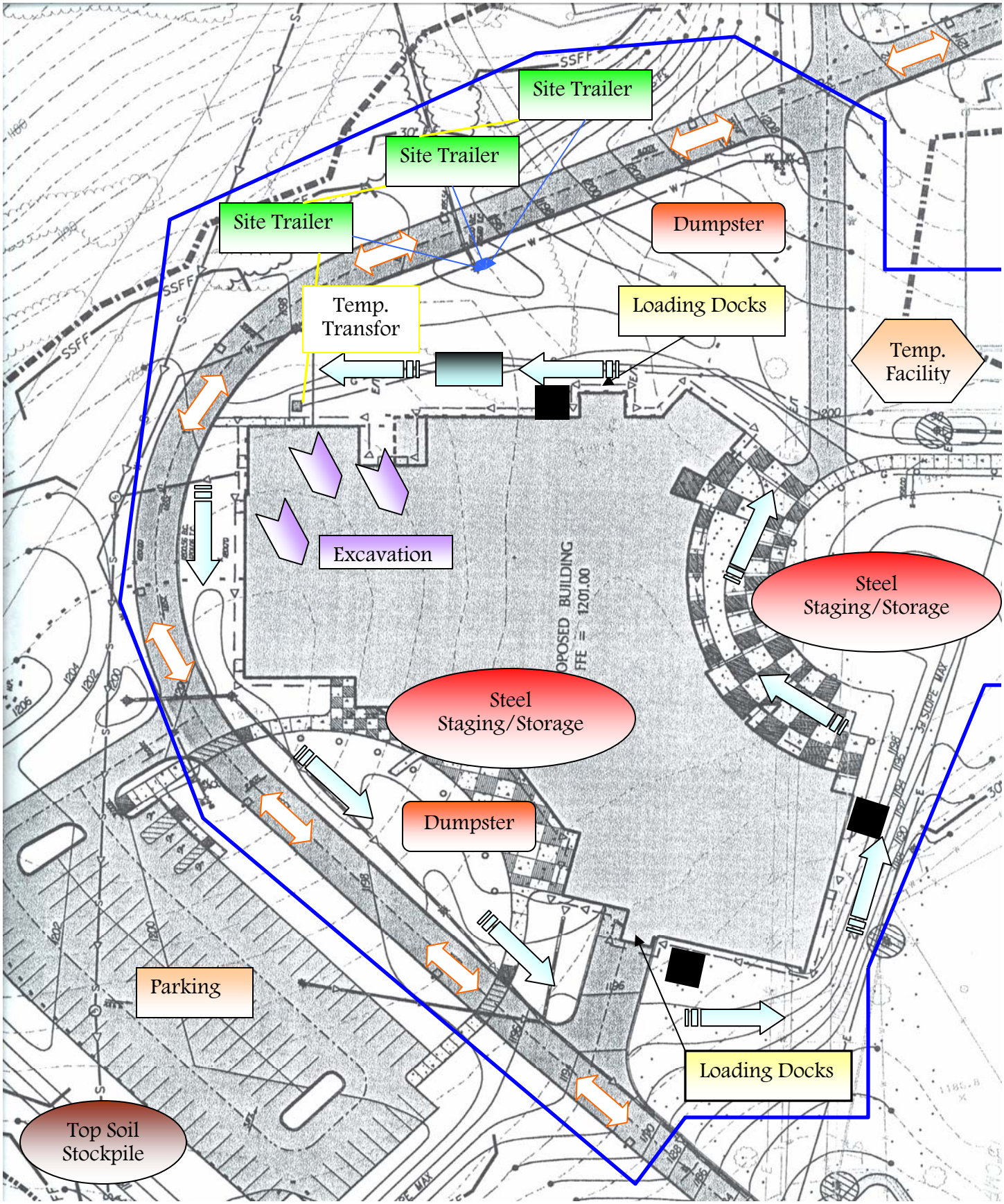
Hoists

Fencing



Crane Path

Steel
Staging/Storage


Site Trailer
Site Trailer
Site Trailer
Dumpster
Temp.
Transfor
Loading Docks
Temp.
Facility
Excavation
Steel
Staging/Storage
Steel
Staging/Storage
Dumpster
Parking
Loading Docks
Top Soil
Stockpile

Site Plan of Finishing Phases

Legend/Key

Access Road flow

Material Storage

Temp Electric

30CY Dumpster

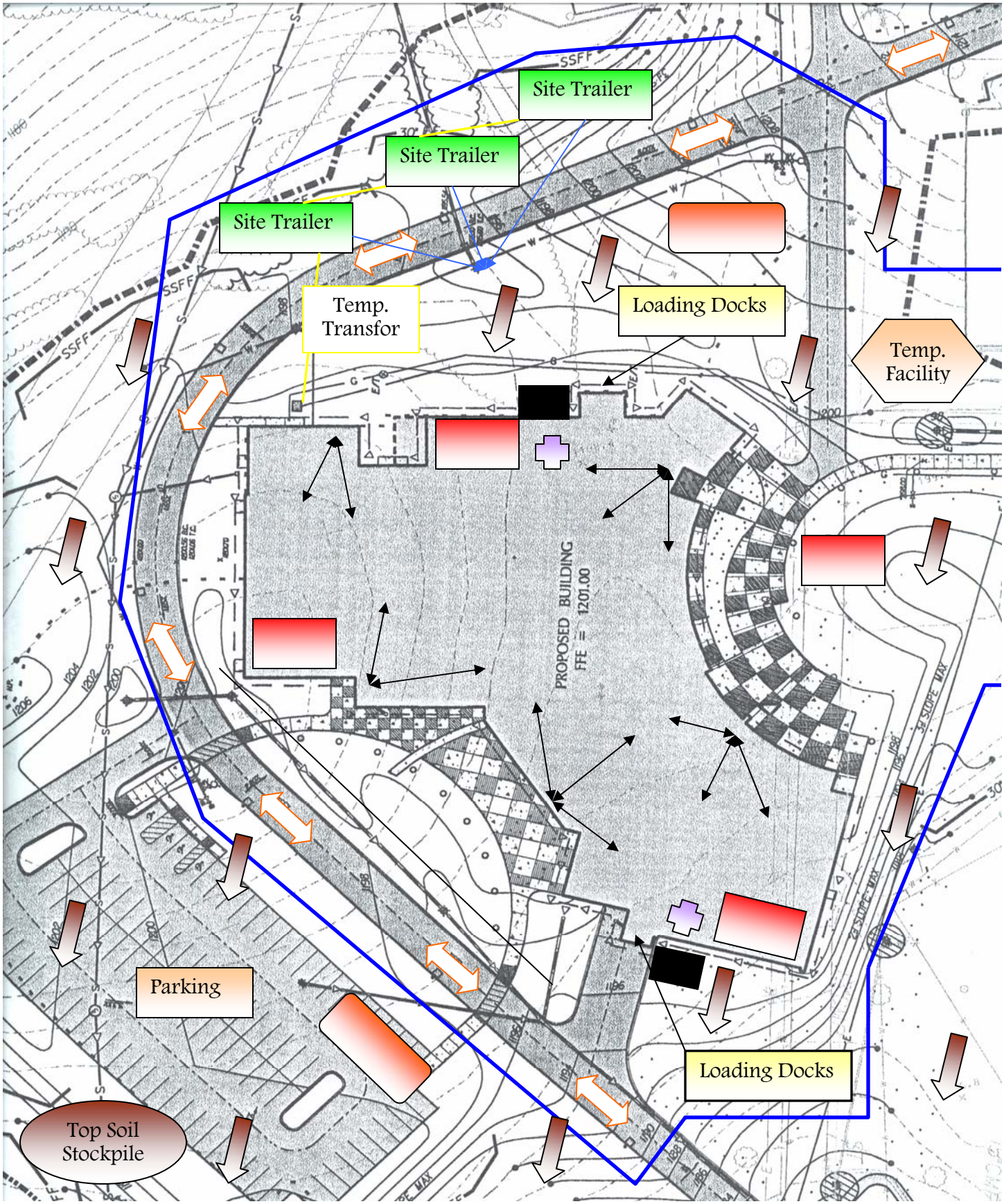
Hoists

Fencing

Final Grading/Site Work

Fork Lifts

Main Entrances/Exits (General Flow of Traffic)


Site Trailer
Site Trailer
Site Trailer
Temp.
Transfor
Loading Docks
Temp.
Facility
PROPOSED BUILDING
FFE = 1201.00
Parking
Loading Docks
Top Soil
Stockpile

Appendices: C – LEED Ratings

LEED-NC Version 2.1 Registered Project Checklist

Penn State Fayette's: Multi-Purpose Community Center
Uniontown, PA (Initial points)

Yes	?	No			
4		**10**	**Sustainable Sites**		**14** Points
Y			Prereq 1	**Erosion & Sedimentation Control**	Required
X			Credit 1	**Site Selection**	1
		X	Credit 2	**Development Density**	1
		X	Credit 3	**Brownfield Redevelopment**	1
		X	Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
		X	Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
		X	Credit 4.3	**Alternative Transportation**, Alternative Fuel Vehicles	1
		X	Credit 4.4	**Alternative Transportation**, Parking Capacity and Carpooling	1
X			Credit 5.1	**Reduced Site Disturbance**, Protect or Restore Open Space	1
X			Credit 5.2	**Reduced Site Disturbance**, Development Footprint	1
		X	Credit 6.1	**Stormwater Management**, Rate and Quantity	1
		X	Credit 6.2	**Stormwater Management**, Treatment	1
		X	Credit 7.1	**Landscape & Exterior Design to Reduce Heat Islands**, Non-Roof	1
		X	Credit 7.2	**Landscape & Exterior Design to Reduce Heat Islands**, Roof	1
X			Credit 8	**Light Pollution Reduction**	1

Yes	?	No			
1		**3**	**Water Efficiency**		**5** Points
		X	Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
X			Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
		X	Credit 2	**Innovative Wastewater Technologies**	1
		X	Credit 3.1	**Water Use Reduction**, 20% Reduction	1
		X	Credit 3.2	**Water Use Reduction**, 30% Reduction	1

Yes	?	No			
2		**6**	**Energy & Atmosphere**		**17** Points
Y			Prereq 1	**Fundamental Building Systems Commissioning**	Required
Y			Prereq 2	**Minimum Energy Performance**	Required
Y			Prereq 3	**CFC Reduction in HVAC&R Equipment**	Required
		X	Credit 1	**Optimize Energy Performance**	1 to 10
		X	Credit 2.1	**Renewable Energy**, 5%	1
		X	Credit 2.2	**Renewable Energy**, 10%	1
		X	Credit 2.3	**Renewable Energy**, 20%	1
X			Credit 3	**Additional Commissioning**	1
X			Credit 4	**Ozone Depletion**	1
		X	Credit 5	**Measurement & Verification**	1
		X	Credit 6	**Green Power**	1

continued…

Yes	?	No			
3		10	**Materials & Resources**		13 Points
N			Prereq 1	**Storage & Collection of Recyclables**	Required
		X	Credit 1.1	**Building Reuse**, Maintain 75% of Existing Shell	1
		X	Credit 1.2	**Building Reuse**, Maintain 100% of Shell	1
		X	Credit 1.3	**Building Reuse**, Maintain 100% Shell & 50% Non-Shell	1
		X	Credit 2.1	**Construction Waste Management**, Divert 50%	1
		X	Credit 2.2	**Construction Waste Management**, Divert 75%	1
X			Credit 3.1	**Resource Reuse**, Specify 5%	1
		X	Credit 3.2	**Resource Reuse**, Specify 10%	1
		X	Credit 4.1	**Recycled Content**, Specify 5% (post-consumer + ½ post-industrial)	1
		X	Credit 4.2	**Recycled Content**, Specify 10% (post-consumer + ½ post-industrial)	1
X			Credit 5.1	**Local/Regional Materials**, 20% Manufactured Locally	1
X			Credit 5.2	**Local/Regional Materials**, of 20% Above, 50% Harvested Locally	1
		X	Credit 6	**Rapidly Renewable Materials**	1
		X	Credit 7	**Certified Wood**	1

Yes	?	No			
10		5	**Indoor Environmental Quality**		15 Points
Y			Prereq 1	**Minimum IAQ Performance**	Required
Y			Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	Required
X			Credit 1	**Carbon Dioxide** (CO_2) **Monitoring**	1
X			Credit 2	**Ventilation Effectiveness**	1
X			Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
X			Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
		X	Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
		X	Credit 4.2	**Low-Emitting Materials**, Paints	1
		X	Credit 4.3	**Low-Emitting Materials**, Carpet	1
		X	Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber	1
X			Credit 5	**Indoor Chemical & Pollutant Source Control**	1
X			Credit 6.1	**Controllability of Systems**, Perimeter	1
		X	Credit 6.2	**Controllability of Systems**, Non-Perimeter	1
X			Credit 7.1	**Thermal Comfort**, Comply with ASHRAE 55-1992	1
X			Credit 7.2	**Thermal Comfort**, Permanent Monitoring System	1
X			Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
X			Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1

Yes	?	No			
		5	**Innovation & Design Process**		5 Points
		X	Credit 1.1	**Innovation in Design**: Provide Specific Title	1
		X	Credit 1.2	**Innovation in Design**: Provide Specific Title	1
		X	Credit 1.3	**Innovation in Design**: Provide Specific Title	1
		X	Credit 1.4	**Innovation in Design**: Provide Specific Title	1
		X	Credit 2	**LEED™ Accredited Professional**	1

Yes	?	No		
20		39	**Project Totals** (pre-certification estimates)	69 Points

Certified 26-32 points **Silver** 33-38 points **Gold** 39-51 points **Platinum** 52-69 points

LEED-NC Version 2.1 Registered Project Checklist

Penn State Fayette's: Multi-Purpose Community Center
Uniontown, PA (Revised points)

Yes	?	No			
6		**8**	**Sustainable Sites**		**14** Points
Y			Prereq 1	**Erosion & Sedimentation Control**	Required
X			Credit 1	**Site Selection**	1
		X	Credit 2	**Development Density**	1
		X	Credit 3	**Brownfield Redevelopment**	1
		X	Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
X			Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
		X	Credit 4.3	**Alternative Transportation**, Alternative Fuel Vehicles	1
		X	Credit 4.4	**Alternative Transportation**, Parking Capacity and Carpooling	1
X			Credit 5.1	**Reduced Site Disturbance**, Protect or Restore Open Space	1
X			Credit 5.2	**Reduced Site Disturbance**, Development Footprint	1
		X	Credit 6.1	**Stormwater Management**, Rate and Quantity	1
		X	Credit 6.2	**Stormwater Management**, Treatment	1
X			Credit 7.1	**Landscape & Exterior Design to Reduce Heat Islands**, Non-Roof	1
		X	Credit 7.2	**Landscape & Exterior Design to Reduce Heat Islands**, Roof	1
X			Credit 8	**Light Pollution Reduction**	1

Yes	?	No			
1		**3**	**Water Efficiency**		**5** Points
		X	Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
X			Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
		X	Credit 2	**Innovative Wastewater Technologies**	1
		X	Credit 3.1	**Water Use Reduction**, 20% Reduction	1
		X	Credit 3.2	**Water Use Reduction**, 30% Reduction	1

Yes	?	No			
2		**6**	**Energy & Atmosphere**		**17** Points
Y			Prereq 1	**Fundamental Building Systems Commissioning**	Required
Y			Prereq 2	**Minimum Energy Performance**	Required
Y			Prereq 3	**CFC Reduction in HVAC&R Equipment**	Required
		X	Credit 1	**Optimize Energy Performance**	1 to 10
		X	Credit 2.1	**Renewable Energy**, 5%	1
		X	Credit 2.2	**Renewable Energy**, 10%	1
		X	Credit 2.3	**Renewable Energy**, 20%	1
X			Credit 3	**Additional Commissioning**	1
X			Credit 4	**Ozone Depletion**	1
		X	Credit 5	**Measurement & Verification**	1
		X	Credit 6	**Green Power**	1

continued…

Yes	?	No			
5		8	**Materials & Resources**		13 Points
Y			Prereq 1	**Storage & Collection of Recyclables**	Required
		X	Credit 1.1	**Building Reuse**, Maintain 75% of Existing Shell	1
		X	Credit 1.2	**Building Reuse**, Maintain 100% of Shell	1
		X	Credit 1.3	**Building Reuse**, Maintain 100% Shell & 50% Non-Shell	1
X			Credit 2.1	**Construction Waste Management**, Divert 50%	1
		X	Credit 2.2	**Construction Waste Management**, Divert 75%	1
X			Credit 3.1	**Resource Reuse**, Specify 5%	1
		X	Credit 3.2	**Resource Reuse**, Specify 10%	1
X			Credit 4.1	**Recycled Content**, Specify 5% (post-consumer + ½ post-industrial)	1
		X	Credit 4.2	**Recycled Content**, Specify 10% (post-consumer + ½ post-industrial)	1
X			Credit 5.1	**Local/Regional Materials**, 20% Manufactured Locally	1
X			Credit 5.2	**Local/Regional Materials**, of 20% Above, 50% Harvested Locally	1
		X	Credit 6	**Rapidly Renewable Materials**	1
		X	Credit 7	**Certified Wood**	1

Yes	?	No			
14		1	**Indoor Environmental Quality**		15 Points
Y			Prereq 1	**Minimum IAQ Performance**	Required
Y			Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	Required
X			Credit 1	**Carbon Dioxide** (CO_2) **Monitoring**	1
X			Credit 2	**Ventilation Effectiveness**	1
X			Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
X			Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
X			Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
X			Credit 4.2	**Low-Emitting Materials**, Paints	1
X			Credit 4.3	**Low-Emitting Materials**, Carpet	1
X			Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber	1
X			Credit 5	**Indoor Chemical & Pollutant Source Control**	1
X			Credit 6.1	**Controllability of Systems**, Perimeter	1
		X	Credit 6.2	**Controllability of Systems**, Non-Perimeter	1
X			Credit 7.1	**Thermal Comfort**, Comply with ASHRAE 55-1992	1
X			Credit 7.2	**Thermal Comfort**, Permanent Monitoring System	1
X			Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
X			Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1

Yes	?	No			
		5	**Innovation & Design Process**		5 Points
		X	Credit 1.1	**Innovation in Design**: Provide Specific Title	1
		X	Credit 1.2	**Innovation in Design**: Provide Specific Title	1
		X	Credit 1.3	**Innovation in Design**: Provide Specific Title	1
		X	Credit 1.4	**Innovation in Design**: Provide Specific Title	1
		X	Credit 2	**LEED™ Accredited Professional**	1

28		31	**Project Totals** (pre-certification estimates)		69 Points

Certified 26-32 points **Silver** 33-38 points **Gold** 39-51 points **Platinum** 52-69 points