BIM PROJECT EXECUTION PLAN

VERSION 1.0 FOR

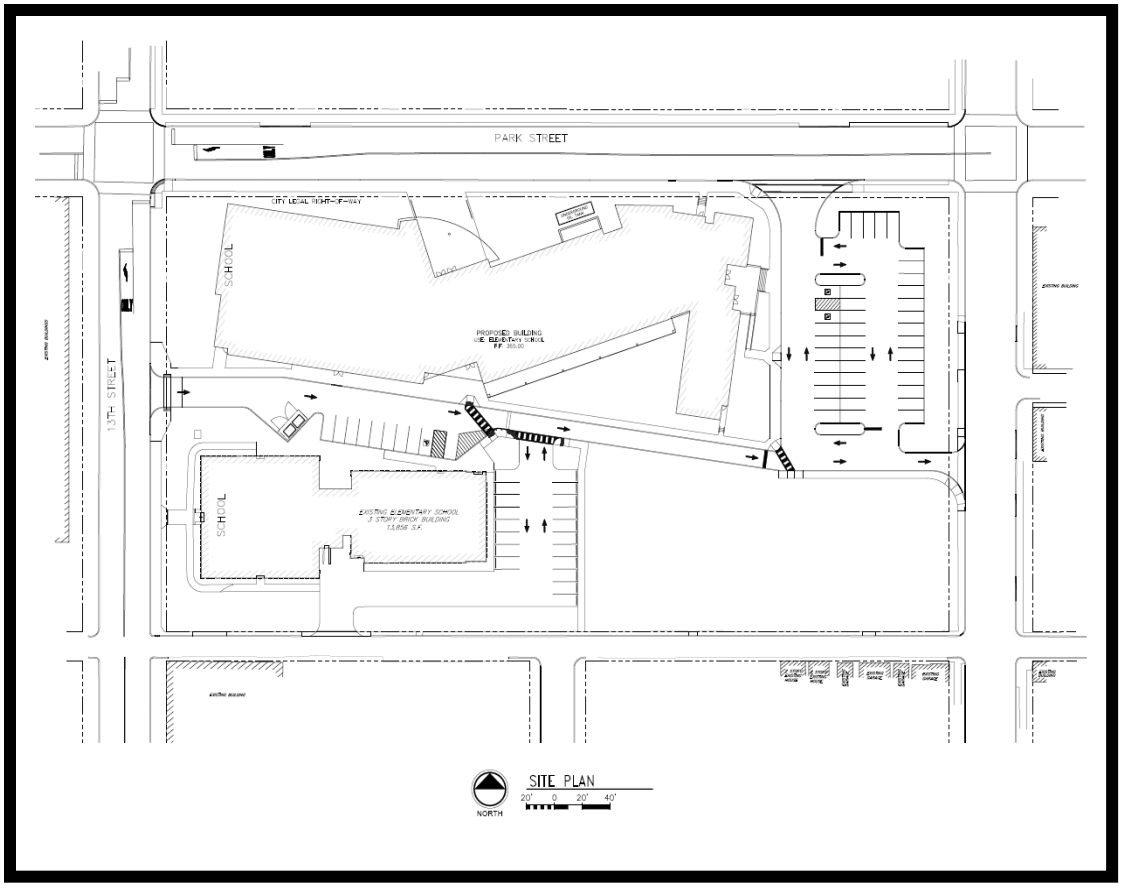
AEI STUDENT COMPETITION

ELEMENTARY SCHOOL – READING, PA

DEVELOPED BY

creation.

9/7/12



Jenna Dumke . Michael Hoffacker . Abigail Kun . Kristiana McMunn . Amanda Small. Jeff Sopinski . Emily Wychock . Patrick Zuza

BIM PROJECT EXECUTION PLAN
VERSION 1.0 FOR
AEI STUDENT COMPETITION
ELEMENTARY SCHOOL – READING, PA

DEVELOPED BY

creation.

TABLE OF CONTENTS

1.0 SECTION 1: BIM PROJECT EXECUTION PLAN OVERVIEW

creation's BIM Project Execution Plan outlines the overall purpose along with specific implementation steps for the student team to follow throughout the extent of the project. Our team goal is to effectively integrate BIM into the project with a carefully thought out plan that will provide a means for successful communication, coordination and innovation from all team members throughout the phases of the project.

The BIM Project Execution Plan for this project will be developed using the OPP BIM Project Execution Plan Template provided by the OPP at the start of this student competition and will be the basis for our team's decision making in regards to incorporating BIM throughout the process.

Our Mission Statement

"creation's one true aim is to enhance the quality of the communities we work with through innovative ideas and sustainable design."

Our Core Values

-ingenuity
-quality
-enjoyment
-integrity

Project Mission Statement

"To create a 'high performance' elementary school that functions as a multipurpose space for the community through a collaborative, multi-disciplinary environment."

Project Overview

The competition will challenge students to address the design issues that must be considered for an Elementary School to be located in an urban setting in Reading, Pennsylvania.

Goals for BIM

- Design a constructable elementary school for the community
- Integrate on the design to enhance the building for a broader user group
- Incorporate energy efficiency while being mindful of cost by focusing on both short term and lifetime cost benefits
- Achieve LEED Certification for the building
- Understand the effects of discipline specific decisions on the broader project team

1.1 OWNERSHIP AND USE OF BIM MODEL

The BIM Model created for the elementary school project will be used as a tool for the design and construction of the project and is property of the project team. Students of each discipline will be responsible for creating their respective models. For example, lighting students will be responsible for creating and completing the needed work sets for the lighting and power plans within the building. Construction management students will be responsible for the means and methods, cost analysis of the building, scheduling, along with constructability analyses. All students will be responsible for the collective value engineering effort in an attempt to integrate all options and make decisions with all options in mind. At the completion of the project, creation will release the BIM model to the owner to be used as a record model for the building.

2.0 SECTION 2: PROJECT INFORMATION

2.1 PROJECT OVERVIEW INFORMATION

Project Overview Information	
Facility Owner	The City of Reading
Project Name	Elementary School
Project Location	Reading, Pennsylvania
Contract Type/Delivery Method	GMP/Integrated Project Delivery

2.2 PROJECT NUMBERS

Project Numbers	
PROJECT INFORMATION	**2012.001**
creation	2012.001
Project Location	13th & Park Avenue Reading, Pennsylvania

2.3 PROJECT DESCRIPTION

The design competition provides the team with a task to create an elementary school located within an urban setting in Reading, Pennsylvania. The elementary school will be used as a multipurpose space with functions including but not limited to afterhours classes, emergency shelter facilities, community sports programs, and non-school related events. The proposed design of the school needs to be both impressive and impactful as a high performance building. High performance, in this case, means “the building shall be designed to integrate and optimize on a life cycle basis all major high performance attributes, including energy conservation, environment, safety, building security, durability, accessibility, cost-benefit, productivity, sustainability, functionality and operational considerations" (AEI Student Competition).

2.4 ADDITIONAL PROJECT INFORMATION

- The project is intended to achieve LEED Certification under LEED 2009 for Schools New Construction and Major Renovations.

2.5 PROJECT MILESTONES

PROJECT MILESTONE	ESTIMATED START	ESTIMATED COMPLETION	PROJECT DELIVERABLE	INVOLVED PROJECT STAKEHOLDERS
Preliminary Planning	9/1/12	9/14/12	Presentation 1	MEP, Struct, CM
Schematic Design	9/14/12	10/3/12	Presentation 2	MEP, Struct, CM
Design Development	10/3/12	10/24/12	Presentation3	MEP, Struct, CM
Construction Documents	10/24/12	11/12/12	Proposal	MEP, Struct, CM
AEI Submission	11/12/12	2/22/12	Electronic Submission	MEP, Struct, CM
Short List Selection	2/22/12	3/8/12	None	MEP, Struct, CM
Finalist Presentation	3/8/12	4/3/12	Final Presentation	MEP, Struct, CM
Award	4/5/12	4/5/12	None	MEP, Struct, CM

3.0 SECTION 3: KEY PROJECT CONTACTS & STAFFING

3.1 KEY PROJECT CONTACTS

Role	Company	Name	Contact Information
Owner	City of Reading, Pennsylvania	-	815 Washington St Reading PA 19601
Architect (Collaborative Effort)	creation. Design & Construction Services	-	creationD+C@gmail.com
Civil Engineer (Collaborative Effort)	creation. Design & Construction Services	-	creationD+C@gmail.com
Structural Engineer	creation. Design & Construction Services	Emily Wychock/ Patrick Zuza	evw5033@psu.edu pjz5017@psu.edu
Electrical/Lighting Engineer	creation. Design & Construction Services	Abigal Kun/ Amanda Small	alk308@psu.edu aws5252@psu.edu
Mechanical Engineer	creation. Design & Construction Services	Michael Hoffacker/ Kristiana McMunn	mth202@psu.edu knm161@psu.edu
Construction Manager	creation. Design & Construction Services	Jenna Dumke/ Jeff Sopinski	Jmd5432@psu.edu Jds5326@psu.edu
Website Manager	creation. Design & Construction Services	Emily Wychock	evw5033@psu.edu
Consultants	The Pennsylvania State University Architectural Engineering Dept University Park, Pa 16802		
		M. Kevin Parfitt	mkp@psu.edu
		Robert Holland	rjh32@psu.edu
		Ryan Solnosky	rls5008@psu.edu
Advising Team	he Pennsylvania State University Architectural Engineering Dept University Park, Pa 16802		
		Dr. Craig Dubler Construction Option	crd@psu.edu
		Dr. Richard Mistrick Lighting/Electrical Option	rgm1@psu.edu
		Dr. Jelena Srebric Mechanical Option	jis12@psu.edu
		Dr. Andres Lepage Structural Option	aul11@psu.edu

4.0 SECTION 4: BIM ROLES AND ORGANIZATION

4.1 BIM MODEL MANAGEMENT

The BIM Model will be managed by the project team throughout the design process by assigning specific roles to each option in order to maintain accuracy within the model, detect deficiencies and clashes, and create an integrated design benefiting the project outcome.

For each phase of the project, the project team will:

- Check and ensure completeness and accuracy of model
- Check & ensure completeness and accuracy of BIM Project Execution Plan
- Coordinate all updates for individual models, specialized discipline models, and construction updates

4.1.1 BIM RESPONSIBILITES

Team creation will meet every Thursday with the task of specifically regrouping and assigning deliverables on an individual basis for the following work in order to meet the project schedule. By doing this, creation intends to enhance the collaboration between the option students, deliberate on design issues, and commit to an innovative solution for the design objectives. The responsibilities for students in each option is outlined below, however the responsibilities will often cross over between disciplines.

Team Responsibilities:
- Develop BIM Model
- Update & Synchronize changes with Central Files
- Proper Maintenance of Model and File Saving
- Maintain & Revise BIM Plan
- Integrate Discipline Models into Architectural BIM Model

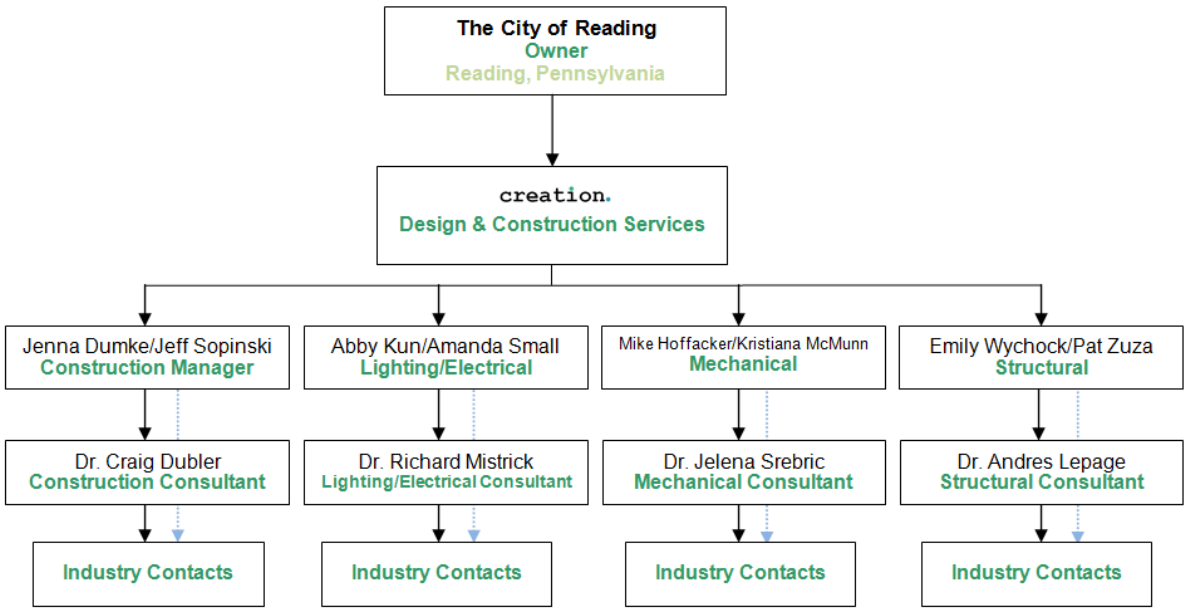
Construction Management:
- Scheduling & Sequencing
- Site Logistics
- Equipment Procurement
- Cost Estimating
- Constructability Analysis
- 4D Modeling Needs
- Construction Trends
- Clash Detection & Coordination
- Value Engineering

Lighting/Electrical
- Lighting Plan
- Power Plan
- Load Calculations
- Electrical Equipment Proposal
- Daylighting
- Clash Detection & Coordination
- Value Engineering

Mechanical
- Heating & Cooling Loading
- Mechanical System Design
- Plumbing Design
- Energy Saving Analysis
- Clash Detection & Coordination
- Value Engineering

Structural
- Structural System Design
- Analysis of Structural System Options
- Load Calculations
- Clash Detection & Coordination
- Value Engineering

4.1.2 PROJECT ORGANIZATIONAL CHART



4.1.3 BIM RESOURCE ALLOCATION PLAN

TASK	ROLE	Staff Size	Hours Planned	Weeks
Model Development	Architect(Collaborative)	8	2 hrs/wk	3
	CM	2	8 hrs/wk	8
	Electrical	2	8 hrs/wk	8
	Lighting	2	8 hrs/wk	8
	Mechanical	2	8 hrs/wk	8
	Structural	2	8 hrs/wk	8
Model Review	CM	2	1 hr/wk	16
	Electrical	2	1 hr/wk	16
	Lighting	2	1 hr/wk	16
	Mechanical	2	1 hr/wk	16
	Structural	2	1 hr/wk	16
Structural Analysis & Design	Structural	2	10 hrs/wk	8
Lighting/Electrical Analysis & Design	Lighting/Electrical	2	10 hrs/wk	8
Mechanical Analysis & Design	Mechanical	2	10 hrs/wk	8
LEED Certification Plus+ Reviews	Collaborative	8	4 hrs/wk	6
Schedule	Construction	2	5 hrs/wk	2

Development	Manager			
Cost Estimating	Construction Manager	2	10 hrs/wk	2
Value Engineering	Collaborative	8	3 hrs/wk	Ongoing
3D Coordination	Structural	2	4 hrs/wk	3
	Lighting/Electrical	2	4 hrs/wk	3
	Mechanical	2	4 hrs/wk	3
	Construction Manager	2	7 hrs/wk	3
4D Modeling	Construction Manager	2	5 hrs/wk	3

5.0 SECTION 5: PROJECT BIM OBJECTIVES AND PROJECT BIM USES

5.1 PROJECT BIM GOALS/OBJECTIVES

The following goals have been established for BIM execution associated with this project:

PRIORITY (HIGH/MED/LOW)	GOAL DESCRIPTION
Required	Develop BIM model to be utilized within design and construction planning.
Required	Utilize clash detection analysis throughout the design process to quickly resolve clashing issues between design disciplines.
Required	Link BIM model to developed schedule and estimate to provide more understanding of the effects of design on the construction timeframe and cost of the building
Required	Increase awareness and collaboration between design disciplines in order to decrease the upfront construction cost, as well as energy and maintenance costs of the building.
Required	Analyze the constructability of the building throughout the design process through use of the BIM model to decrease the cost of construction, as well as the quantity of on-site issues. This will subsequently ensure a timely and smoother project turnover to the Reading School District
Required	Develop energy analysis through use of the BIM model to obtain an understanding of the loading and systems efficiencies throughout the building. This will help to achieve desired LEED rating as well.
	[Insert Additional Project Goal]

5.2 PROJECT BIM USES

A BIM Use is defined as a task or procedure on a project which can benefit from the application and integration of BIM technologies and add value to the overall project.

BIM USE CLASSIFICATION	DEFINITION
Mandatory	Required by AEI
Significant Effort	Project team will make serious attempt to pursue BIM Use.
Minimal Effort	Project team will make no additional effort to pursue this BIM Use.
Not Pursued	BIM use will not be pursued at this time

5.2.1 BIM USES DURING PLANNING

BIM USE	OBJECTIVE	RESPONSIBLE PARTY	EFFORT
Schematic Model	Develop preliminary model based off plans supplied by AEI. This model will be altered throughout the design process; however a basic understanding of the building characteristics will be developed.	**All Members**	**Significant Effort**
Preliminary Site Logistics	Brainstorm possible site logistics layouts based on schematic model. Develop advantages and possible issues with various logistics layouts.	**CM**	**Significant Effort**
Energy Analysis	Develop energy analysis based on building size, expected occupancy and other loading factors. This will narrow design options for each discipline.	**L/E, HVAC, Structural**	**Significant Effort**

5.2.2 BIM USES DURING DESIGN

BIM USE	OBJECTIVE	RESPONSIBLE PARTY	EFFORT
Advanced Model	Develop an advanced model to analyze the relationship of electrical, mechanical and structural systems and their effect on the building in terms of construction and maintenance cost as well as energy efficiency.	**All Members**	**Significant Effort**
Clash Detection	Use advanced model to find clashes between systems which can be adjusted before installation on site.	**All Members**	**Significant Effort**
4-D Model	Link model to construction schedule to create a visual of construction sequencing and schedule.	**CM**	**Significant Effort**
Detailed Estimate	Develop an estimate as design process progresses. Quantities for the estimate will be determined based on advanced model.	**CM**	**Significant Effort**
Cash Flow Analysis	Use 4-D model to develop a cash flow analysis, which will give the owner an understanding of the expected cash flow throughout the construction of the project.	**CM**	**Significant Effort**
Systems Analysis	Conduct analyses of structural, mechanical and electrical systems to ensure a quality design.	**L/E, HVAC**	**Significant Effort**
LEED Analysis	Conduct tabulation of LEED points achieved through design and construction intent to gain an understanding for LEED Certification level.	**All Members**	**Significant Effort**
Advanced Site Logistics Plan	Develop a detailed site logistics plan based on the final design and configuration of the building.	**CM**	**Significant Effort**

6.0 SECTION 6: BIM PROCESS DESIGN

6.1 MAPPING THE BIM EXECUTION PROCESS

The Creation Team has created a process diagram of how BIM will be incorporated throughout the project. The process diagram is intended to lay out a roadmap of how each discipline will collaborate with the team. It will also ensure that BIM technologies are used to their full potential throughout the extent of design and preconstruction activities. The BIM Execution Process Diagram can be found in Attachment 1.

6.2 DEVELOPING INFORMATION EXCHANGES

The American Institute of Architects (AIA) Level of Development has developed the E202 Document, which outlines the Level of Development (LOD) of the building model throughout the development of design and construction. Refer to Attachment 2 for a detailed breakdown of each Level of Development. Our model will develop from LOD 200 through LOD 300, and final design will be at LOD 400 level. LOD 500 will not be attained, as final construction of the Reading Middle School will not be in place to create project as-built's.

6.3 BIM INFORMATION EXCHANGE METHODOLOGY

The following section lists the typical procedures for information exchanges, model sharing, and coordination throughout the project. Please validate accordingly for the project.

6.3.1 COORDINATION AND CONFLICT RESOLUTION

When conflicts are discovered in the model, regardless of project phase or LOD, the discovering party shall promptly notify the Model Element Author. Upon notification, the Model Element Author shall act promptly to mitigate the conflict. All project stakeholders and responsible parties must post their models to the designated shared server on a weekly basis as specified. Before the model(s) are shared and/or transferred, the model should be audited to conform to the following standards:

- Begin coordination process as early as possible
  - Designate the Project Model Manager
  - Designate BIM contact for each project stakeholder
  - Specify LOD for all Model Attributes
  - Create file storage and transfer process (workspace, model naming convention, model protocol)
  - Verify file type, compatibility, and needs
- Create schedule of expectations for model delivery
  - Deadlines for each project stakeholder based on level, area, phase
  - Set file upload dates (weekly) with time for interdisciplinary coordination
- Validate Model
  - Apply construction means and methods to architectural and structural model
  - Ensure model integrity and accuracy
- Establish conceptual placement of components within the architectural space
- Determine coordination hierarchy, for example:
  - Architectural
  - Structural
  - Equipment
  - HVAC Duct
  - Wet Mechanical
  - Gravity Plumbing
  - MEPF Risers
  - HVAC Distribution
  - Plumbing Distribution
  - Electrical Distribution
  - Fire Protection Distribution
- Clash Detection process
  - Project stakeholders access each other's models to work on specific level, area, phase
  - Clash resolution to be worked out among project stakeholders

- BIM Model Manager will check models for interference and conflicts
- BIM Model Manager will distribute composite model in .nwd format showing unresolved clashes and clash report document for project stakeholder review and resolution before next coordination meeting
- Weekly coordination meetings will take place to address unresolved issues with the composite model
- BIM Model Manager will distribute meeting minutes and resolution decisions after each meeting to project team
- Process begins again to address the next level, area, phase
- Clash-free model is then distributed to all parties and signed off as per project phase

6.3.2 ADDITIONAL BIM METHODOLOGY

If necessary, additional procedures can be developed as required for the project in narrative form, suggestions include:

- Design Reviews
- 4D Modeling

7.0 SECTION 7: COLLABORATION PROCEDURES

7.1 COLLABORATION STRATEGY OVERVIEW

The Creation team has developed a team integration plan to ensure reliable and efficient communication between all team members and disciplines. For BIM model development, all team members will have an individual local model of the central model to work from. Development of the model will be performed in individual local models, which will then be uploaded into the central group model when design is finished. This will allow for more efficient modeling, as more than one team member will be able to work simultaneously.

The team will meet on Thursdays at 4:30 PM, as well as by appointment when necessary to ensure timely progress. Creation has decided that Google Documents will be effective and convenient for document sharing, as documents can be easily accessed from any computer or smartphone with internet capability. An availability chart has been developed in a Google Document as a means of easily scheduling meetings with team members. This will be useful when conflict resolution meetings need to be scheduled. Meeting minutes will be backed up on our predetermined Penn State Drive, and also distributed as Google Documents. Large documents will be saved and stored on a predetermined Penn State drive which is accessible by all team members. A Google Calendar will be developed to plan for hard deadlines determined by AEI and Penn State Advisor. Intermediate deadlines are also being planned as a means of balancing work flow throughout the course of the project.

A group texting application has been implemented via smart phones as a quick communication method which will also keep the entire team constantly updated on daily procedures, issues, deadlines and other important information. The team has also developed a Contact Information Google Document which includes each member's phone number and email address.

7.2 MEETING PROCEDURES

A meeting agenda will be developed for each discipline prior to each progress meeting. A weekly schedule will also be developed at the meeting to keep all disciplines on track throughout the week and leading into the next progress meeting. Below is a scheduling matrix on how the team plans to organize all meetings.

MEETING TYPE	PROJECT STAGE	FREQUENCY	PARTICIPANTS	LOCATION
Preliminary Team Development Meeting	Planning	Once	All Creation Members	314 Sackett
Weekly Progress Meetings	All	Weekly	All Creation Members	Thesis Lab
Design Coordination Meetings	Design Development	To Be Determined	Design Team	Thesis Lab
Constructability Review Meetings	Design Development	To Be Determined	All Creation Members	Thesis Lab
Presentation Preparation Meetings	All	Prior to Presentations	All Creation Members	To Be Determined
Discipline Development Meetings	All	To Be Determined by Individual Disciplines	All Creation Members	To Be Determined
Conflict resolution Meetings	All	As Needed/By Appointment	Variable	To Be Determined

7.3 MODEL DELIVERY/ EXCHANGE SCHEDULE FOR SUBMISSION AND APPROVAL

The BIM Model Manager will manage and maintain all user accounts and model access rights that include the creation, deletion, and modification of elements. All project participants will be given view and download rights to the federated model files. The BIM Model Manager will apply access controls to users so that only authorized users of the model can add the files for their respective component model(s). The following table consists of the model and data access rights for the project

MODEL ACCESS RIGHTS

FTP FILE BREAKDOWN STRUCTURE	Project Stakeholders								
	O	**A/E**	S	M/P	P	E	FP	**C**	**SC**
Virtual Construction									
BIM Requirements	D	D	D	D	D	D	D	M	D
BIM Execution Plan	M	D	D	D	D	D	D	M	D
Coordination									
Coordination Key Plans									
Subfolders per Design Aspect	D	D	D	D	D	D	D	M	D
Architect CAD Files	D	M	D	D	D	D	D	M	D
Coordination Background Data Sets	D	V	D	D	D	D	D	M	D
Origin	D	M	D	D	D	D	D	M	D
Object Enablers	D	M	M	M	M	M	M	M	M
Component Models									
Subfolders per Design Aspect	D	D/M	D/M	D/M	D/M	D/M	D/M	D	D/M
Federated Models/Interference Reports									
Subfolders per Level/Area/Zone	D	D	D	D	D	D	D	M	D
Signed-off Coordination Component Models									
Subfolders per Level/Area/Zone	D	D	V	V	V	V	V	M	V
Asset Database	M	M	V	V	V	V	V	M	M
Construction Submittals	D	D	V	V	V	V	V	D	M
Miscellaneous									
Test Folders	M	M	M	M	M	M	M	M	M
[Additional]									

Project Stakeholders: O = Owner, A/E = Architect/Engineer, C = Contractor, SC = Specialty Contractor
Permissions: V = View, M = Modify, D = Download

8.0 SECTION 8: TECHNOLOGICAL INFRASTRUCTURE

8.1 COMPUTERS / HARDWARE

The following computer hardware will be utilized by the Team for this project during design:

HARDWARE	SPECIFICATIONS	OWNER OF HARDWARE	TASK TYPE
Alienware Aurora	Intel Core i7 CPU 2.67 GHz, 24.00 GB RAM Nvidia GTX 260 Graphics Card Dual Dell P190S Digital Monitors Windows 7 Professional 64-bit OS	AE Department 332 Sackett	Design Authoring
DELL		AE Department 332 Sackett	Design Authoring
DELL OPTIPLEX 980	Intel Core i7 2.79 GHz, Windows 7 64 Bit 8.00 GB RAM ATI Radeon HD 4550 Graphics Card Dual 17” Monitors	AE Department 308 Sackett	Design Engineering
DELL OPTIPLEX 960	Intel Core 2 Duo 3.17 GHz, Windows 7 64 Bit 8.00 GB RAM ATI Radeon HD 3450 Graphics Card Dual 17” Monitors	AE Department 307 Sackett	Design Engineering

8.2 SOFTWARE

8.2.1 APPLICABLE SOFTWARE APPLICATIONS FOR DESIGN

The following software applications will be utilized by the Team for this project during design:

SOFTWARE	VERSION	PROJECT STAKE HOLDER	TASK TYPE
Revit	2013	ARCH	Design Authoring
3DS Max	2013	ARCH,L/E	Design Rendering
Revit MEP	2013	ME	Mechanical Authoring
Trane Trace	v700	ME	Mechanical Calculations
Revit MEP	2013	L/E	Lighting/Electrical Authoring
ComCheck	2013	L/E	Lighting Requirements
DaySim	2013	L/E	Lighting Daylighting
Agi32	Version 2.2	L/E	L/E Calculations
ComFen	2013	L/E	Glazing Analysis
Revit Structure	2013	STRUCT	Structural Authoring
RAM	v14.03	STRUCT	Structural Analysis
SAP	2013	STRUCT	Frame Analysis
Structure Point	2013	STRUCT	Structural Analysis
RS Means CostWorks	2013	CM	Cost Estimation
Primavera	2013	CM	Project Scheduling
Navisworks	2013	CM	4D Modeling

Navisworks	2013	CM	Clash Detection
Record Modeling	2013	CM	Revit
Revit, Navisworks	2013	MEP,CM	Revit, Navisworks

9.0 SECTION 9: MODEL AND DATABASE STRUCTURE

9.1 PROJECT NAMING CONVENTIONS

9.1.1 FILE NAMING CONVENTIONS

FILE SHOULD BE NAMED ACCORDING TO THE FOLLOWING: AEITEAMNUMBER_DISCIPLINE_PHASE_DATE.XYZ	
ARCHITECTURAL MODEL	AEI1_ARCH_SCHEMATIC_DATE.RVT
MECHANICAL/PLUMBING MODEL	AEI1_MECH_SCHEMATIC_DATE.RVT
ELECTRICAL MODEL	AEI1_ELEC_SCHEMATIC_DATE.RVT
LIGHTING MODEL	AEI1_LTG_SCHEMATIC_DATE.RVT
STRUCTURAL MODEL	AEI1_STRUCT_SCHEMATIC_DATE.RVT
CONSTRUCTION MODEL	AEI1_CONST_SCHEMATIC_DATE.RVT
COORDINATION MODEL	AEI1_COORD_SCHEMATIC_DATE.RVT
ENERGY MODEL	AEI1_ENERGY_SCHEMATIC.RVT

9.2 MODEL STRUCTURE

The success of a BIM enabled project delivery process is highly dependent upon the level at which the entire project team can communicate and work collaboratively for the duration of the project.

- For buildings with a large footprint or multiple floors, the project team may split the model into several zones (or floors) with the corresponding trades
- All trades will be modeled at the correct elevation
- All elements of the building must be represented in only one file and should be modeled by their specific trade. (For example, the architectural model provided for 3D Coordination should not include any of the structural elements contained in the structural model. Lights should be modeled by the electrical engineer, not the architect)
- All 3D model files must strip extraneous 2D and/or 3D elements from the model before submission for clash detection
- The architectural ceilings should contain information for openings for lights, registers, etc. as required by design. (For example, lights are to be centered on a grid with proper spacing)
- All models should include separate 3D representations of required clearances and/or access requirements for equipment access, light clearances, overhead cable tray access, etc. These clearance/access models should be in a separate layer(s)/level(s) per each trade and labeled as such

9.2.1 MEASUREMENT AND COORDINATE SYSTEM

Define X-reference point prior to proceeding with model development.

9.2.2 MODEL ELEMENT REQUIREMENTS BY DISCIPLINE

The following section lists the typical BIM model and related elements by discipline and/or exclusions. Please refer to the LOD Matrix for responsible party, project phase, and level of detail information. **This is only an example of the expected model elements and components and not a requirements list, please validate accordingly.**

Every discipline is required to provide all relevant schedules, reports, and intelligent attribute data defined by the project scope and BIM Plan.

SITE/CIVIL MODEL

Model(s) shall contain all site-related features of the project which are not integral with the building envelope:

- Utilities
- Topography
- Water Quality Ponds
- Storm water Detention and Filtration Structures
- Planting Materials
- Paving
- Site stairs, ramps, and railings
- Retaining walls
- Site furnishings
- Erosion Control (Temporary and Permanent)

ARCHITECTURAL MODEL

Model(s) shall contain all architectural features for a building and site-related features extending 5'-0" beyond the facility footprint:

- Exterior wall systems
- Interior wall systems
- Fire rated walls
- Architectural floor slabs
- Roofing system
- Equipment (including owner provided equipment)
- Reflected ceiling plans
- Core and vertical systems (including elevators, stairs, escalators, and railings)
- Doors (including frames, hardware information, lockset information)
- Glazing (including windows, interior glazing, curtain walls, and storefronts)
- Millwork and Casework
- Furniture
- Finishes
- Toilet Accessories
- Toilet Partitions

STRUCTURAL MODEL

Model(s) shall contain all structural features for a building:

- Foundations (as solid mass), footings piers, walls (including areaways), and pits
- Structural slab (as solid mass)
- Framing (as solid mass), hollow core floor plank and solid floor slabs, T-beams, L-Beams, columns, CMU bearing walls, exterior perimeter CMU walls, brace frames, shear walls
- All structural steel members in their true shape and dimensions with corresponding connection details
- Exclusions: nuts and bolts
- Column Gridline
- Primary floor openings (stairs, elevators, mechanical shafts)
- Primary bearing wall openings
- Elevator hoist and separator beams
- Miscellaneous structural components

MECHANICAL, ELECTRICAL, PLUMBING, FIRE PROTECTION MODEL(S)

Model(s) shall contain all MEP features for a building:

Mechanical Model:

- Mechanical ductwork and associated systems (including VAV boxes, flanges, dampers, flex duct, heat exchangers)
- Ducts will be modeled using their outside dimension and will include insulation if applicable
- Hangers and structural supports, unless they do not influence the coordination process of other trades
- Access spaces
- Mechanical piping and associated systems (including valves, cleanouts, vents, meters)
- HVAC equipment and associated systems (including control panels, tanks, pumps)
- Clearance requirements for equipment access, service space requirements, gauge reading, valve clearances, panel access, and other operation clearances

Electrical Model:

- Electrical conduit 1" and larger (or two or more regardless of size)
- Telecommunication racks and under floor tray(s)
- Safety and security systems
- Electrical equipment including specialty systems and pads
- Power feeds to equipment, transformers, panels, gear, junction boxes, cable trays, distribution boxes, etc
- Hangers and structural supports, unless they do not influence the coordination process of other trades
- Electrical light fixtures and ceiling devices
- Electrical panels and panel schedules
- Clearance requirements for equipment access, service space requirements, gauge reading, valve clearances, panel access, and other operation clearances

Plumbing Model:

- Piping 1" and larger (or two or more regardless of size)
- Insulation, vents, pipe racks, supports, valves, meters, cleanouts
- Spring hangers and anchors
- Hangers and structural supports, unless they do not influence the coordination process of other trades
- Plumbing equipment and fixtures
- Pipe slope
- Clearance requirements for equipment access, service space requirements, gauge reading, valve clearances, panel access, and other operation clearances

Fire Protection Model:

- Fire protection mains/standpipes
- Fire/smoke dampers, thermostats, pressure sensors, other in-line devices
- Gauges and valves with corresponding tags (only when necessary for coordination)
- Complete typical bay to include sprinkler heads and all other devices not commonly modeled
- Hangers and structural supports, unless they do not influence the coordination process of other trades
- Clearance requirements for equipment access, service space requirements, gauge reading, valve clearances, panel access, and other operation clearances

ADDITIONAL MODEL(S)

- Add model components as necessary

9.3 MODEL ORGANIZATION DIAGRAMS

To be defined by Creation. at a future date.

9.4 DATABASE STRUCTURE

To be defined by Creation. at a future date.

10.0 SECTION 10: QUALITY CONTROL PROCEDURES

10.1 OVERALL STRATEGY FOR QUALITY CONTROL

The purpose of this process is to ensure project teams are using best practices in the development and file exchange of models and facility data. This is an ongoing process, which is to be conducted by each discipline where seen fit. It is to be validated at both project milestones and at random intervals to ensure that each model is being suitably modeled for its intended use. The goal is to ensure that there are no unresolved issues during construction or any significant loss of data upon transfer of as-built models and record documents at facility turnover.

Each discipline will be responsible for running quality control checks on their model(s) on a consistent and frequent basis. For issues involving other disciplines, the issue shall be made known to the corresponding discipline(s).

10.2 QUALITY CONTROL CHECKS

CHECKS	DEFINITION	RESPONSIBLE PARTY	RECOMMENDED PROJECT MILESTONES
Visual	Ensure there are no unintended model components and the design intent has been followed	ALL	Daily
Interference Check	Ensure there are no collisions among disciplines through clash detection methods	CM	Daily
Model Integrity	Ensure that the BIM model has no undefined, incorrectly defined, or duplicated elements; ensure a reporting process and corrective action plans have been developed for noncompliant elements; ensure all disciplines are using same origin and dimension scale	All	Daily

10.3 QUALITY CONTROL PROCEDURES

Team Quality Control Procedures Minimum Standard

- If percent error is greater than 5%, project team member is to revise and resubmit information immediately to next responsible team member and have work inspected. This process will foster an environment of responsibility for one's own work and avoid delaying the downstream user's progress.

10.4 MODEL ACCURACY AND TOLERANCES

Model(s) should be developed as accurate as possible. Dimension tolerances should be set at 1/16" to facilitate the accuracy of the model, discipline worksets, and constructability of the project.

11.0 SECTION 11: PROJECT DELIVERABLES

The BIM deliverables indicated below are required to be submitted with the standard phase deliverables for each project phase. The BIM Plan should establish the responsible parties and corresponding tasks for each deliverable. The level of development for each BIM deliverable should be, at a minimum, sufficient to fulfill the 2D document submission requirement.

11.1 DESIGN DELIVERABLE REQUIREMENTS

BIM DELIVERABLE	RESPONSIBLE PARTY	DUE DATE	FORMAT	NOTES
Presentation #1: Research	ALL	9/14/2012	.ppt	Provide BIMEX Plan detailing team's approach plan (include overview of team strategies, roles, and integration), describe software to be utilized and specific uses, discuss document exchange process, provide operational model, discuss research of trends and precedents
Presentation #2: Schematic Design	ALL	10/3/2012	.ppt	Provide schematic design for all disciplines (primarily MEP/structural options), determine site location, utility tie in points, update BIMEX Plan *Ongoing*
Presentation #3:Design Development	ALL	10/24/2012	.ppt	Provide design development building and site plan, finalize discipline design selections, coordinated BIM model, discuss sustainability strategies utilized and LEED certification, update BIMEX Plan *Ongoing*
Presentation #4: Proposal	ALL	11/12/2012	.ppt	Finalize all discipline plans and BIM model, coordinate all disciplines, energy model, finalize site logistics, update BIMEX Plan *Ongoing*
Final Written Summary	ALL	12/14/2012	.pdf	Discuss initial information, proposed ideas, challenges, and solutions, show collaboration and coordination among all four disciplines *Ongoing*

12.0 SECTION 12: ATTACHMENTS

1. BIM Execution Process Diagram [From Section 6.1]
2. Information Exchange Worksheet [From Section 6.2]
3. Asset Attribute Information [From Section 7.1]
4. Model Organization Diagram [From Section 10.3]
5. [Additional Attachment] [From Section]

ATTACHMENT 2: BIM MODEL LOD MATRIX

The project team should document the information exchanges created as part of the planning process when creating the BIM Plan. The following table describes the Model Element Author (MEA) referenced by the BIM Model LOD Matrix:

MODEL ELEMENT AUTHOR		
ACRONYM	**ORGANIZATION**	**ROLE**
PSU	Penn State University	Owner
[Additional]		
[Additional]		

The level of development (LOD) for each model element is based on the model content criteria established by the AIA Document E202, Building Information Modeling protocol Exhibit. The LOD will assist in determining the level of involvement for each project stakeholder from project conception through project turnover. The content for the LOD is described as follows:

Level of Development	Description
LOD 100 Schematic Design	The LOD 100 model consists of overall building massing designed to perform whole building type analysis including building orientation, square foot costs. LOD 100 also pertains to 2D representation of elements as required by the 2D Construction Documents which may include drawings, narratives, and hand-built models.
LOD 200 Design Development	The LOD 200 model consists of generalized systems including approximate quantities, sizes, shapes, location, and orientation. The LOD 200 mode(s) are used for analysis of defined systems and general performance objectives. LOD 200 model(s) include attributes and parameters defined by the owner in the Owner Requirements document and BIM Plan.
LOD 300 Construction Documentation	Model will include elements equivalent to traditional construction documents and shop drawings. LOD 300 models are well suited for estimating as well construction coordination for clash detection, scheduling, and visualization purposes. LOD 300 model(s) include attributes and parameters defined by the owner in the Owner Requirements document and BIM Plan.
LOD 400 Construction Adminstration/ Shop Drawings	Model elements are modeled as specific assemblies which are accurate in terms of quantity, size, shape, location, and orientation. LOD 400 model(s) are virtual representations of the proposed elements and considered to be suitable for construction, fabrication, and assembly. This LOD is most likely used by specialty trade contractors and fabricators to build and fabricate project components including MEP systems.
LOD 500 Project Completion/ Record Drawings/ As-Built Conditions	Model elements represent the project as it has been constructed, including as-built conditions. The model is configured to be the central data storage for integration into the building maintenance and operations system(s). LOD 500 Model(s) will include completed parameters and attributes specified in the Owner Requirements document and BIM Plan. At the completion of construction, the BIM model(s) will be finalized, linked, and cross referenced.
LOD 510, 520, 530, 540	Model elements represent the project as it has been constructed, including as-built conditions. LOD 510, LOD 520, LOD 530, and LOD 540 models will contain LOD 100, LOD 200, LOD 300, LOD 400 facility and geometry data respectively and will be configured to contain the Operations and Maintenance manuals, warranty information, submittal information, and/or any other documents as applicable or required.
LOD 550 Owner Reserved	Owner reserved, LOD 550 model elements will not be generated during planning, design, or construction.

The BIM LOD Matrix worksheet shall be completed by project team during BIM Plan development.