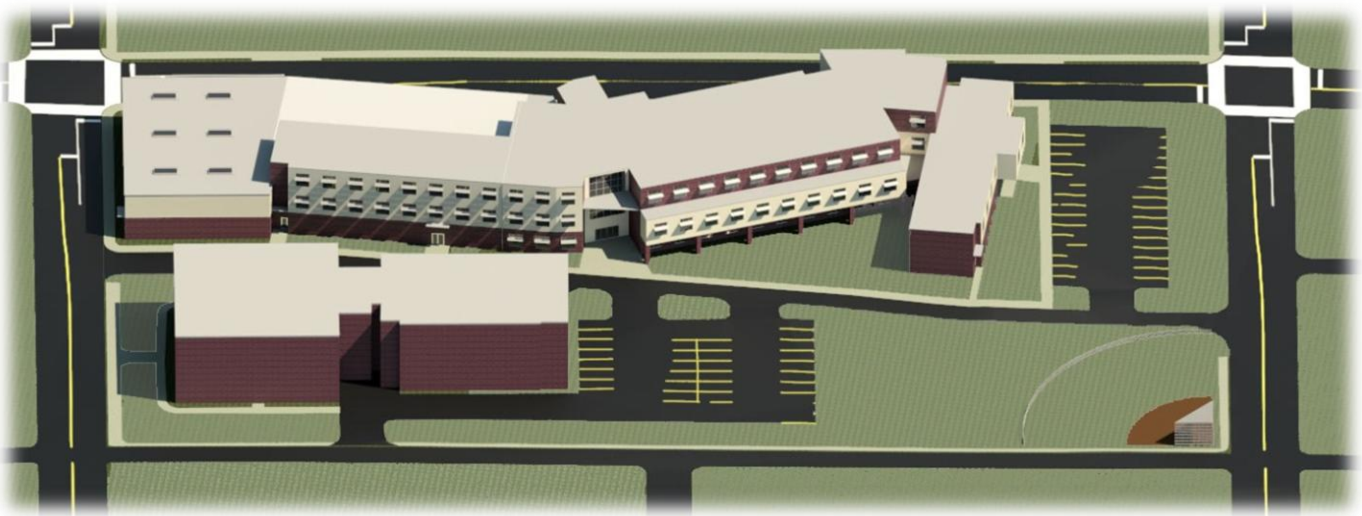
22 February 2013

2013 ASCE Charles Pankow Foundation
Annual Architectural Engineering Student Competition

nexus

CONSTRUCTION MANAGEMENT



Team Registration Number: 02-2013

Table of Contents

References

1. PlanCon data from the Commonwealth of Pennsylvania (2012) <http://www.portal.state.pa.us/portal/server.pt/community/reimbursable_projects/7463#CALCULATIONOF>
2. PA crime rates (2010) <http://www.cityrating.com/crime-statistics/pennsylvania/reading.html#.UQAdifUrMtg>
3. The Commonwealth Foundation (2011) <http://www.openpagov.org/education_revenue_and_expenses.asp>

1. Executive Summary

1.1 Introduction

The construction management portion of this project encompasses the three design engineering disciplines. The construction managers were tasked with ensuring an integrated building design that addressed the delivery method, project planning, budget, and schedule. This integration began by developing a BIM Execution Plan, which helped define team dynamics. For further explanation, see **Page 2**.

The most essential goal of both the Reading School District and Nexus is everyone's **safety** and wellbeing. Nexus approached safety from the inception of the project – from design to construction and most importantly end use. For a further explanation, see **Page 5**.

The construction **delivery method** proposed for this project meets Pennsylvania state regulations, which states that the construction manager must act as an agent and not hold any contracts. Nexus proposes utilizing 17 subcontractors. For a further explanation, see **Page 6** and page 20 of Supporting Documentation.

The **project planning** portion of this project is largely composed of site logistics planning during and after construction. The site logistics plans developed for construction show how the various trades will flow on site. The new site plan shows how the building was repositioned to the center of the northern half of the site to accommodate space for the potential pool. For further explanation, see **Page 7**.

For most construction projects, the **budget** is the first item defined during the feasibility study and programming phases. Based on PlanCon funding limits for elementary schools, the state funding would total $5,297,230[1] (see Appendix H). As local funding will be low due to the economic status of Reading, this state allocation will help the community construct a school that can be used by all local residents, not just the elementary students. Thus, Nexus proposes a $200 cost per square foot and total project cost of $17.5 million. For further explanation, see **Page 9**, and pages 22-27 of Supporting Documentation.

Nexus plans for the new school to be built in a 15 month **schedule**. This fast track project must start immediately following the end of the 2013-2014 school year (June 9, 2014), continue throughout the following school year (2014-2015), and finally end before the subsequent academic year commences (August 21, 2015). For more details on the total project schedule, see **Page 13**, and pages 28-31 of Supporting Documentation.

1.2 BIM Execution Plan

The inception of this project involved understanding the given data and information regarding the new elementary school in Reading, Pennsylvania. As the team coordinators, the construction managers developed a BIM Execution Plan to help all four disciplines integrate their designs. This execution plan specifically defines the roles to be fulfilled by the construction managers, along with the structural, mechanical, and lighting/electrical engineers (see page 16 of Supporting Documentation). In addition, it defines the information exchanges between the four disciplines, and what information is needed by and for each discipline to allow Nexus' design to progress (see pages 17 and 18 of Supporting Documentation). See pages 43 and 44 of Drawings for more BIM Execution Plan details.

Outlining objectives and goals was necessary to facilitate each discipline's ability to work independently and produce their respective system designs. By defining these goals, each of Nexus' disciplines had a mutual understanding of the expectations of the team's final product. These goals guided Nexus' decisions and ultimately helped to prevent unnecessary work. Increasing the team's efficiency and effectiveness was critical throughout this project for each discipline to meet the several interim submissions scheduled by Nexus. Thus, the construction managers' time spent planning in the early phases of this competition's project facilitate more productive team communication and progress meetings. As a result, the interrelatedness of Nexus' building systems reduces redundancy and enhances the architecture of the school building (see Figure 1).

Nexus' Mission Statement:

To develop a design that merges education with the community in a facility that is safe and cost effective while functioning as a learning tool.

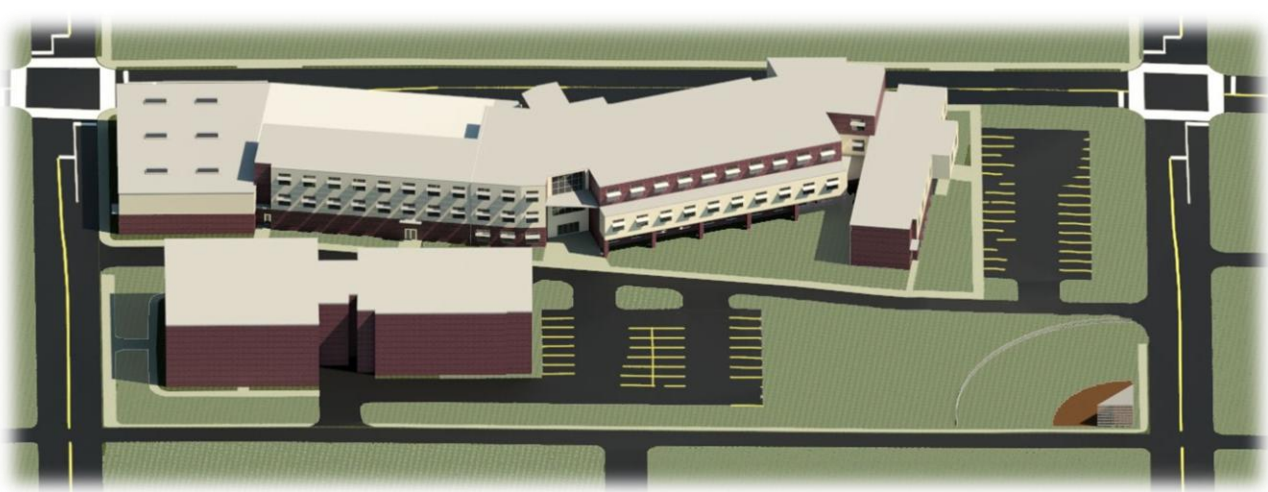


Figure 1: Final Building Rendering (existing building not shown for clarity of the new design)

Construction Management Goals	Nexus' Project Goals	Owner Objectives
Efficiency →	Integration →	Safety & Security
Lifecycle →	Lean Practices →	Lifecycle and Maintenance
Cost Advantage →	Learning Tool →	Cost Effectiveness

Figure 2: Arrows indicate flow of support via project goals, ultimately achieving the owner objectives

1.3 Owner Goals

Nexus defined several owner objectives for the construction of Reading School District's new elementary school. Nexus was able to meet these objectives through team-defined project goals and individual discipline goals. The objectives can be lumped into three categories.

safety & security

First, safety is a concern for Reading School District, the parents in the community, and most importantly the students of the district. By increasing the safety on the elementary school campus, students will feel more comfortable and willing to come to school. As a result of Nexus' design, student attendance rates are expected to rise. In addition, having a sense of 'unseen' security will enhance the feeling of safety in the new building.

lifecycle & maintenance

Second, Reading School District desires a building that can endure for 100 years. Yet, this building must be adaptable, flexible, and able to accommodate new emerging technologies, learning styles, and teaching techniques. The flexibility of the spaces designed into the building help increase its lifecycle, while the systems selected reduce the need for routine maintenance.

cost effective

Third, Reading School District wants a building that is both cost effective in both the short and long term. The city of Reading is economically disadvantaged and therefore will not independently have the necessary funds to support the construction of a new elementary school. By reducing the building's initial cost and maintaining a low operations and maintenance cost, Reading will be able to afford a new school both now and in the future.

1.4 Nexus Goals

Nexus' project goals help achieve the owner objectives and are supported by the individual discipline goals. Nexus' project goals can also be lumped into three main categories.

integration

First, integration is the all-encompassing goal of meeting the owner's objectives. Integration involves not only team work and collaboration, but also the integration of the building systems and components. As the main theme of the architecture of the building was already established, Nexus focused on integrating the structural, mechanical, and electrical aspects of the building through predefined discipline goals and information exchanges.

reduce, recover, reuse

Second, this holistic building integration was produced through lean practices. These lean practices include reduce, reuse, and recover, which pertain to all disciplines. Specific lean focuses of construction management include producing less construction waste, maintaining a shorter construction schedule, and utilizing sustainable materials.

learning tool

Third, Nexus desired to create a building that could be used as a learning tool for the end users. The building has exposed ceilings, which highlights its structural, mechanical, and electrical elements, along with an exterior façade and site that can be used as teaching tools. All of these items were coordinated through extensive planning and team performance requirements.

The six icons representative of the owner objectives and Nexus goals above will be utilized next to section subtitles throughout this report to express achievement of the objectives or goals.

1.5 Project Goals / Requirements

To reinforce the project goals, and meet the owner objectives, the construction management team also defined three goals for the construction discipline. The decisions made in the narrative and rationale sections below reflect these goals and in turn the team and owner goals (see Figure 3).

Construction Management Goals
Efficiency
Lifecycle
Cost Advantage

Figure 3: Construction Management

First, efficiency incorporates the constructability, lifecycle, and cost advantages by teaching the owner to use the building and its systems as they were designed. This will allow the owner to reap the full potential of the integrated building systems. However, for construction, this is best evidenced through the construction process explained in this report. The total project schedule explains the importance of planning in the early stages of the project's conception to help reduce actual construction time on site, which, as a result, reduces disturbances to the neighborhood and existing school on site.

Second, lifecycle is accomplished through material and building system selection and maintainability. Through value engineering, with both quality and cost considerations, Nexus chose building systems that were simple to operate and maintain by the Reading School District maintenance staff. LEED requirements were also taken into consideration when making building system design decisions.

Third, cost advantage comes from value engineering principles implemented through building material and system selection, construction labor costs, schedule sequencing, and lifecycle analyses. Cost advantage assists in finding the comfortable medium between first costs and lifecycle costs.

2. Safety and Security

2.1 Building Security

Safety is of upmost importance to Nexus. Nexus has taken the approach that safety is not solely a field responsibility, but rather an obligation to be borne by all parties involved. Both safety and security were addressed from the design phase through operations and maintenance.

Nexus' School Security and Occupant Safety Checklist		
Level of Integration	Significant	Acceptable
Secure Main Entrance	√	
Safe Main Entrance	√	
Parking Lot Balusters		√
Public Address System	√	
Security Alarms	√	
Intrusion Detection System	√	
Lockdown Security Doors	√	
Manual Window Shades		√
Video Surveillance	√	
First Floor Bullet-Resistant Glass	√	

Figure 4: Security Analysis

Reading's violent crime rate was 133.52% higher than the national average in 2010[2]. This, along with recent events, had a major impact on the approach that Nexus took towards designing for safety. The original main entrance of the school was located on the North side of the building next to a highly trafficked road. Nexus moved the main entrance to the South side of the building, so it faces the interior of the school campus. Balusters were added to prevent unwanted cross traffic through the center of the educational campus (see page 40 of Drawings). To further ensure student and faculty safety, all windows on the first floor have been designed as bullet-resistant glass (see Figure 4).

2.2 Occupant Safety

Safety was carried into the building by providing a single secure main entrance that requires visitors to pass through the reception area prior to entering the school. Nexus provides a sense of unseen security through the use of hidden cameras monitoring the main entrance. Some of the other security features that were designed include a public address system with speakers in each classroom (not only for daily announcements, but also security purposes), security alarms triggered by an intrusion detection system at all exterior doors, automatic lockdown security doors in the corridors that double as fire doors, and manual shades to cover the classroom door window and sidelight. These measures were all considered prior to even excavating. See page 40 of Drawings for a lockdown plan.

Safety will also be the top priority for the project during construction. Safe site working conditions will be achieved largely through contractor work practices. According to the contract all parties on site must meet, and in some cases exceed, OSHA regulations. Nexus recommends that additional safety precautions be considered such as daily toolbox talks (see page 19 of Supporting Documentation), subcontractor company safety procedures, and a mandatory five foot tie-off rule. A construction fence will be installed to protect the students, teachers, and staff members of the current elementary school, as well as pedestrians on the sidewalks and traffic passengers. The site fence will double as a security fence for the site during construction. Lastly, he building footprint will remain lit at night to prevent vandalism and theft.

3. Delivery Method

3.1 Delivery Method Selection

Reading School District's new 89,000 square foot elementary school will be built with the aid of several local contractors. With both state and local funding, the innovative learning facility will be constructed under a Construction Manager Agent with a multi-prime contractor delivery method (see page 20 of Supporting Documentation). This is a form of the standard design-bid-build delivery method. The construction management agent will act as the school district's advocate throughout the preconstruction and construction processes. However, the construction manager will not be responsible (own) any of the subcontracts on the project. Thus, the school district will incur the associated risks. This is not Nexus' preferred method; however, it is the state-mandated construction method.

Another aspect of the delivery method for this project involves the subcontractors. Pursuant to Pennsylvania contract law based on Pennsylvania state regulations for public school projects that receive state and local funding, there must be a minimum of nine prime contractors.

3.2 Delivery Method Rationale

The construction manager will be responsible for overseeing all of the preconstruction and construction efforts. The preconstruction efforts encompass preliminary cost estimates, schedule projections, and risk and constructability analyses. Additionally, the construction manager may define project execution guidelines and work flow interchanges. The work flow interchanges will be managed through an internet-based project management document system. These documents include construction drawings, shop drawings, change order requests, change orders, requests for information, cost accounting reports, architectural supplementary information, and additional information. Next, the construction manager will obtain the necessary construction permits from local jurisdictions, commence site investigation, verify the geotechnical report discoveries, and coordinate utility tie-in points. Moreover, the construction manager will develop a sustainability work plan with explicit strategies that will reinforce Reading School District's emphasis on addressing energy conservation and environmentalism in the new school.

At this junction, the construction manager analyzes the design and engineering aspects of the building and determines the construction schedule. Thereafter, the construction manager will develop a cost estimate for the entire project. Then, they will write and develop cost estimates for each scope of work. Once a bid schedule for the entire project is defined, the construction manager will send out bid invitations to prequalified subcontractors, with an emphasis on local contractors. Once bids are received in March 2014, the construction manager will conduct scope reviews of the subcontractors' bids and select the lowest bidder for each scope (based on Pennsylvania state regulations for public school projects that receive federal, state, and local funding). The school district, as the owner of the subcontracts, will award and hold the subcontracts throughout the entirety of the project.

Long Lead Items
Steel Mill Order
Insulated Concrete Form Order
Concrete Order
Sheetmetal Order
Mechanical Units and Equipment

Figure 5: Lead Items Identified by

It is important to note that while writing scopes of work, the construction manager, with the architect and engineers, must identify long lead items (see Figure 5). It is necessary for the respective subcontractors to order these items from their vendors so that they are delivered to the site and installed on time. These requirements are normal on most projects, but even more so on this project since 89,000 square feet need to be constructed in 15 months. The next step involves submittals. The construction manager will need to require the subcontractors to have all submittals approved before construction starts in June 2014. Having the submittals approved will help ensure all lead times are met and construction begins on the scheduled mobilization date (June 9, 2014).

4. Project Planning

4.1 Site Planning

The site logistics plans were created with Nexus' team goals of integration and sustainability and the school district's objectives of safety, accessibility, flexibility, and cost benefit in mind. To begin, the site logistics plan encompasses the entire project site, surrounding roads, and the existing elementary school on site (see Figure 6). First, it is imperative to note that Nexus repositioned the proposed elementary school to the center of the top of the site (see Figure 7). This was done to accommodate for the pool on the west end. As seen in the final site plan for the finished building, the parking area in the northeast corner was reduced in size due to the building moving east. This displaced parking was moved to a new central lot, increasing the size of the existing lot. The baseball field proportions were not affected, thus maintaining the existing playground area. The bus lane will remain one way, with traffic progressing from west to east. For an existing utilities plan, see page 21 of Supporting Documentation.

Prior to creating a learning environment, safety had to be established. In order to maintain the feeling of security, Nexus turned the educational campus in on itself to shelter the students (see Figure 7). This inward turn allows students to congregate on the inside of the campus, away from the main roads and the dangers of the community.

Even though Nexus believes it is not in the district's best interest to build a swimming pool at this point in time, the pool has been designed and incorporated into the project as best as possible. The pool sits on the west end of the site and shares a wall with the gymnasium and a stairwell. The building was shifted towards the east end of the site in order to accommodate the pool. The pool's mechanical, structural and electrical systems are all independent of the rest of the school building to allow for a potential second phase. The projected cost of the pool is \$2.68 million, which increases the cost per square foot of the school from \$200/SF to \$231/SF (see page 25 of Supporting Documentation). If Reading chooses not to build the pool, the building will stay shifted to the east to provide a small safety buffer between 13th Street and the building. This will also allow for the necessary space to potentially build a pool in the future.

4.2 Site Plans Rationale

Nexus chose to leave the existing elementary school in place to be repurposed as the Reading School District sees fit. Choosing to keep the elementary school was driven by a few factors. Not demolishing the building created a large savings in both cost and schedule. The reuse of a building is also a sustainable principle and helps keep unnecessary waste out of landfills. The economic status of Reading was already addressed, and Nexus did not think it was very logical to eliminate an already existing resource.

The proposed bus lane will be the guide for the main access road during construction. It is important to note that this access road will only have an entrance to it from the west end during excavation work. This will help with dump truck flow continuity in removal of the contaminated soil since no soil will be stockpiled on site due to contamination. It is also important to note that the north gate will only be utilized as an entrance while the east gate will only be utilized as an exit (see Figure 8). By having two gates, Nexus is allowing for the possibility of a union and non-union gate, along with the possibility of having a third gate (the west gate) for site access in the case of a labor strike.

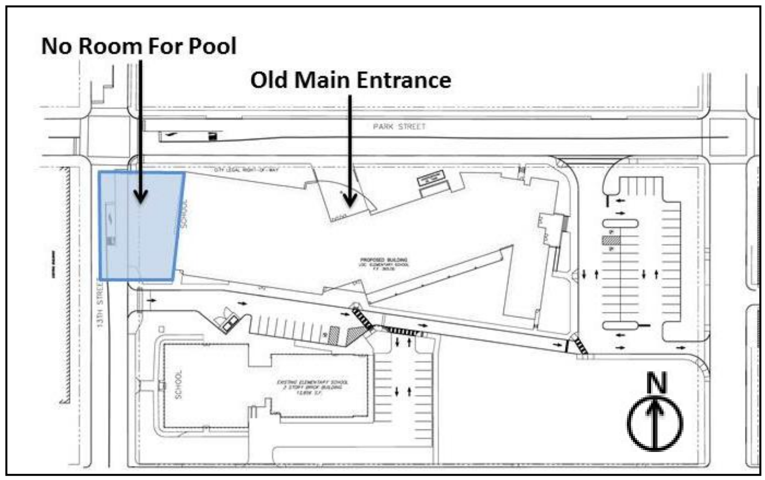


Figure 6: Original Site Plan Provided by the AEI Competition

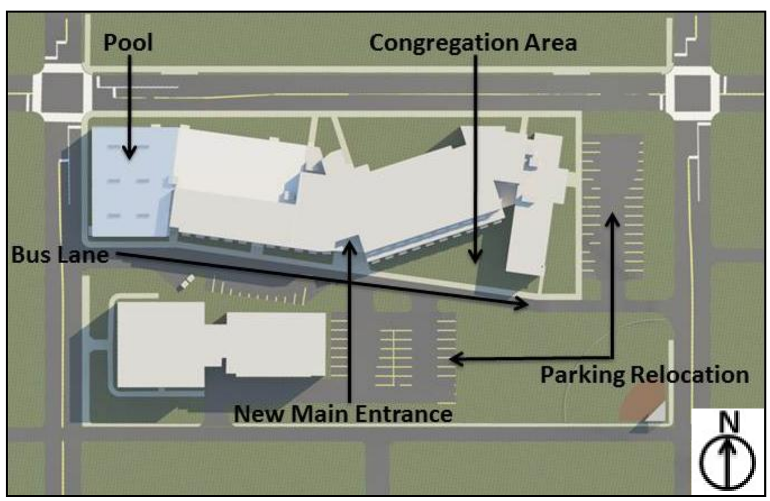


Figure 7: Nexus' Revised Campus Plan (building moved east, parking reallocated, and pool addition)

General site logistics items to note are the site trailers (most likely utilized by the construction manager and four prime contractors) with space available for parking. The placement of the trailers between the two main gates is to oversee deliveries and other vehicles arriving on site. Various storage containers and laydown areas can be staged in the south-eastern region of the site. The concrete pump will be staged between the south access road and building at all times to leave the road open for concrete trucks. In addition, this road will be used for the crawler crane and steel delivery trucks (see page 42 of Drawings). In the case of a bottleneck, due to the safety concerns of the crane and its delivery trucks, the steel contractor will have priority of the access road over the concrete contractor (who has more mobile equipment and trucks).

Figure 8: Excavation Site Plan

The site will contain a comingled dumpster for offsite recycling. This will help cut down on contractor material waste and promote material reuse, garnering LEED points as well. Due to the relatively short 15 month construction duration, the school district will be able to gain quicker access to their recreational field and auxiliary spaces. This will help reduce the impact on the local traffic patterns and neighborhood inconveniences.

5. Cost Estimate

5.1 Reading School District

Reading School District is one of the least affluent school districts in Pennsylvania. The state average for dollars allocated to each student is $14,535, whereas Reading only allocates $12,989 per student. The vast majority (84%) of Reading's educational revenue comes from state and federal revenue. Only 12% of the district's educational revenue is locally funded[3]. Reading's economic situation had a major impact on the projected cost budget for the project and ultimately Nexus' design.

Reading School District's students consistently underperform in comparison to their Pennsylvania counterparts[2] (see Figure 9). This may be a product of the fact that they do not have the same resources as students in other districts. The environment in which

Grade 5 - Non-proficient Students		
	PA State Average	Reading SD
Math	23%	38%
Reading	32%	53%

Figure 9: Student Proficiency Statistics

they learn may also have an impact on how they perform. Thus, Nexus strove to design a cost effective building that encourages students to attend class and creates a flexible environment which accommodates each student's individual learning style.

5.2 Cost Estimate Summary

Nexus' design development level cost estimate breaks the building into eight broad categories (see Figure 11 and page 23 of Supporting Documentation). One of the things to note about this estimate is that there are no funds allocated to Special Construction & Demolition. Nexus does not include the pool in this estimate; however, there is a breakout of additional pool costs (see Section 5.5). It should also be noted that more than 70% of the money is allotted to the Shell and Services categories. This was made possible thanks to a significant effort by Nexus to minimize unnecessary Interiors costs (see section 5.3).

Nexus further broke down the project costs into 17 scopes of work (see page 27 of Supporting Documentation). These scopes of work are not meant to be bid to individual subcontractors, but rather provide a means by which to ensure that all facets of the project are covered.

Cost Estimate			
	Total Cost	$ / SF	% of Cost
A. Substructure	$ 713,750	$ 8.02	4%
B. Shell	$ 6,516,250	$ 73.22	37%
C. Interiors	$ 1,970,000	$ 22.13	11%
D. Services	$ 6,475,000	$ 72.75	36%
E. Equipment & Furnishings	$ 300,000	$ 3.37	2%
F. Special Construction & Demolition	$ -	$ -	0%
G. Building Sitework	$ 475,000	$ 5.34	3%
Z. General Conditions	$ 1,385,545	$ 15.57	8%
*Uniformat Categories (A-G, Z)	$ 17,835,545	$200.40	89,000 SF

Figure 11: Summary Cost Estimate

In order to help fund the project, Nexus delved into the multiple resources available to public school districts in Pennsylvania. The largest contribution by the state comes from PlanCon funds. The estimated $5,296,915 from PlanCon will help alleviate the financial burden of the new school on the local residents (see page 26 of Supporting Documentation).

Figure 14 displays the construction cost and schedule along with student data for two elementary schools built in the last few years. Despite having the highest total cost (by $1,335,545), Nexus' design has the shortest construction schedule (by one month), lowest cost per square foot (by $55.41), and lowest cost per student (by $18, 867). The other two schools

School Cost Comparison							
	Total Cost	Construction Schedule	Total SF	$ / SF	# of Students	$ / Student	SF / Student
Mount Nittany Elementary School	$15,700,000	16 months	60,000	$261.67	400	$ 39,250	150
Ferguson Township Elementary School	$16,500,000	16 months	64,500	$255.81	400	$ 41,250	161
Nexus' Proposed New RSD Elementary School	**$17,835,545**	**15 months**	**89,000**	**$200.40**	**875**	**$ 20,383**	**102**

Figure 14: This data documents Nexus' efforts to reduce cost and schedule for RSD's new elementary school

have a fewer number of students (by 475) yet more square feet allocated per student (by 48 square feet). Therefore, Nexus believes it has provided Reading School District with one of the most economical designs for new elementary schools in recent years.

5.3 Cost Rationale - Value Engineering & Lifecycle

The objectives and goals that were laid out at the outset of the project drove the value engineering process. It was essential to Nexus that quality not be sacrificed in order to reduce costs. Nexus strove to eliminate unnecessary interior finishes to reduce the upfront cost, while increasing lifecycle savings.

The first thing that Nexus value engineered out of the original design was vinyl composition tile in the hallways. The cost of using VCT in the hallways was $90,510 which was significantly more expensive than using an epoxy concrete finish which cost $10,710 (see Figure 10). Nexus understands that when concrete cures that it tends to develop hairline cracks that would be covered by the VCT, but Nexus feels that the cost saving here outweigh the minor aesthetic benefits. There are also maintenance savings that go along with not using VCT. Using finished concrete eliminates the need to replace VCT tiles that beak or crack which is cost effective and saves time.

Value Engineered Finishes			
	SF	$/SF	Total
Concrete with Epoxy Finish	21,000	$ 0.51	$ 10,710
VCT	21,000	$ (4.31)	$ (90,510)
Acoustic Ceiling Tile	55,600	$ (3.51)	$(195,156)
Total Savings			$(296,376)

Figure 10: Cost Savings

Originally Nexus proposed to use no drop ceiling solely in the classrooms, and instead use an acoustical decking to help reduce noise issues. This would aide in the use of the building as a learning tool by exposing the structural, mechanical, and lighting systems (see Figure 11). Eliminating the ceiling grid also makes adding future telecom or electrical cables more feasible, which plays into the owner objective of flexibility.
This idea was then expanded into the corridors and auxiliary spaces as well when it was discovered that it was not acoustically necessary. There was a savings of $195,156 by not using acoustic ceiling tile in these spaces. Similar to the VCT, eliminating

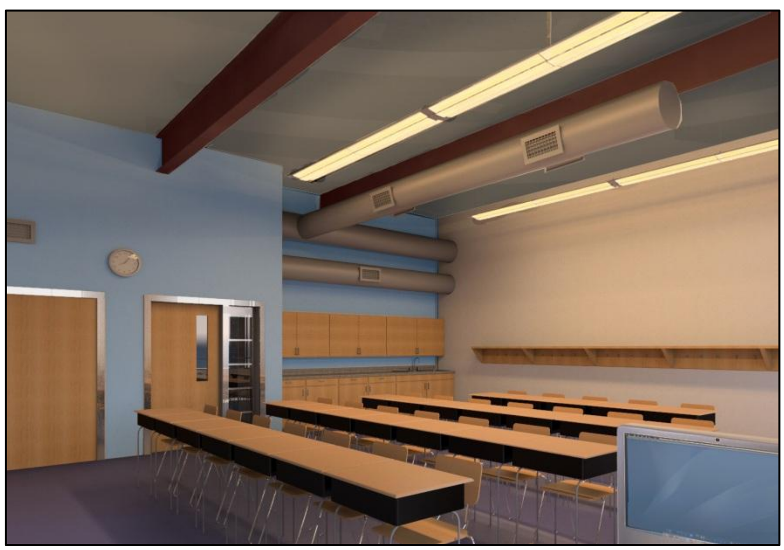


Figure 11: Teacher Perspective of a Typical Classroom

acoustical ceiling tiles has substantial maintenance savings such as the cost of replacement tiles and the labor associated with changing the tiles.

Using exposed ductwork as opposed to a bulkhead saved money which was allocated to upgrading the gypsum wall board in the corridors and classrooms to impact resistant wall board. Impact resistant wall board will increase the durability of the classrooms and reduce future maintenance costs. The floor of the classrooms needed to be carpet to be acoustically acceptable, so carpet tile will be used. Carpet tile was chosen over carpet so that when they are damaged they can be easily replaced as opposed to re-carpeting the entire room. The louvers on the windows are all optimally designed so as that they do not need to be operable. This saves on training employees to use a more complex system and also saves on maintaining the system. These are just a few of the measures that Nexus took to reduce both the upfront and lifecycle costs of the building without reducing the quality of the end product.

5.4 LEED

The owner has specified that at a minimum LEED certification must be achieved. One of Nexus' team goals was to reduce, reuse, and recover which aligned with LEED on many counts. LEED certification was achieved without any additional cost to the project (see page 32 of Supporting Documentation). Upon further investigation into PlanCon it was discovered that the state provides additional funding for a LEED Silver certification. Through minimal additional effort and cost Nexus was able to attain LEED Silver, and in turn an additional $542,850 in state funding (see page 26 of Supporting Documentation). Nexus used the LEED checklist as a confirmation that the owner's goals of an energy efficient and environmentally conscious building were being provided.

5.5 Pool Cost Analysis

One of the major concerns that Nexus has is the addition of a pool. The first concern is that the pool is a considerable strain on the project budget (see Figure 12). The maintenance required for a pool also greatly increases life-cycle costs. Additionally, a pool imposes a safety threat (drowning) to the occupants of the school. Nexus has provided the pool as a potential later phase to help accommodate Reading School District's budget. Nexus believes that it might be in the school district's best interest to inquire about accessing Albright University's aquatic facilities prior to taking on the upfront and maintenance costs associated with a pool. Due to the cost and time a constraint on this project, Nexus recommends that the pool not be included at this time.

Pool Phase 1	
SF	8,925
$/SF	$ 225.50
Total Cost	$ 2,012,588
Pool Phase 2	
SF	8,925
$ / SF	$ 300.69
Total Cost	$ 2,683,654
Variance	
	$ 671,067

Figure 12: Pool Cost Comparisons

6. Construction Schedule

6.1 Schedule and Sequencing

The two largest preconstruction endeavors involve scheduling and cost estimations. For this project, Nexus determined that the construction schedule will start in early June, immediately after school adjourns for the summer. Construction must then be completed by the end of the following August, approximately 15 months later. Thus, preliminary schedule estimates show that the design phase of the project will need to begin in September 2012.

As stated above, with the scopes of work defined, a bid schedule will then be developed. This schedule will be utilized to hold the subcontractors to the dates that they bid. The sequencing of the schedule was done in conjunction with the development of a 4-dimensional model in Navisworks. To develop this model, a 3-dimensional model was imported from Revit. The Revit model incorporated architectural, structural, mechanical, plumbing, and lighting / electrical aspects. The Navisworks model was utilized for scheduling, sequencing, constructability analysis, and clash-detection (see page 45 of Drawings). Thus, the Navisworks model was the best tool to show systems integration and team collaboration.

The last day of the 2013-2014 Reading School District academic year is Friday, June 6, 2014. On Monday, June 9, 2014, the construction manager will be given a Notice to Proceed. This first major construction milestone means that the site is ready to be mobilized (see Figure 15).

6.2 Schedule Rationale

The construction schedule reinforces Nexus' project goal of reducing construction time on site. Reducing this duration will have a smaller impact on the environment and will most likely reduce construction costs since labor is the most expensive part of construction. All of these factors meet the school district's objectives of cost benefit, sustainability, and functionality.

Immediately after the Notice to Proceed, excavation will begin and last for approximately five weeks. No other contractor will be permitted on site due to the presence of contaminated soils. Thereafter, prior to the foundation work commencing, the utilities contractor will perform their necessary work on site. The sequencing of the foundation work will proceed as it did during excavation, from the west to east side of the site. After the steel-driven piles are installed, the concrete strip footers and pile caps will follow. Lastly, the pool and basement walls and slabs will be cast.

In essence, the concrete work on each floor will lead the steel work (see Figure 16). The steel work will remain one to two building sections behind. On the first floor, the structural steel columns will be erected first. They will be braced to the ground with guyed wires. This will require the use of a crawler crane positioned on the south access road of the site. As the crane moves eastward to erect the basement beams, the concrete pump will be positioned in the pool and gym region of the site to start placing the slabs-on-grade and first lift of insulated concrete form walls. This end of the building is the most concrete intensive. The insulated concrete form walls, although only cast in 14 foot lifts, will be temporarily braced until the steel members supporting them are erected. Then, the first floor beams (second level floor support) will be erected. The classroom area is the most steel-intensive erection area. Consequently, the second and third levels will proceed in a very similar manner.

Next on the schedule is the metal decking placement and slab-on-deck placement. Following this, the curtain wall (brick and metal stud backup) will be stick-built and insulated to meet the same thermal requirements as the insulated concrete form walls. Then, the masonry contractor can mobilize and set up scaffolding to start the face-brick installation. In concurrence with this work on the upper floors, the curtain wall contractor will begin the aluminum panel installations. Once the exterior walls are complete, the glazing contractor will install the window modules. While this is happening, the roofing contractor will make the building water-tight for interior construction to begin.

The main entrance of the building is a glass curtain wall on the upper two floors, and aluminum paneled curtain wall on the first level. This area will be left open and unconstructed in order for a hoist to be positioned there for material access into the building. Once this is underway, the mechanical, plumbing, electrical, and fire protection work can begin. These various rough-ins will be followed by the metal stud wall framing and gypsum wallboard tasks. Finishing work by the general works contractor will include casework installation, fixtures, and painting. Then, the carpet tile floors can be installed in the classrooms along with the concrete finished flooring in the corridors. Lastly, the testing, adjusting, and balancing contractor can test the building automated systems.

RSD - New Elementary School

ID	Task Name	Duration	Start	Finish
1	**Construction**	**317 days**	**Fri 6/6/14**	**Mon 8/24/15**
2	**Last Day of School - Spring 2014**	**1 day**	**Fri 6/6/14**	**Fri 6/6/14**
3	*Notice to Proceed*	*0 days*	*Mon 6/9/14*	*Mon 6/9/14*
4	*Mobilization*	*5 days*	*Mon 6/9/14*	*Fri 6/13/14*
5	Excavation	25 days	Mon 6/16/14	Fri 7/18/14
6	Utilities	10 days	Mon 7/21/14	Fri 8/1/14
7	**First Day of School - Fall 2014**	**1 day**	**Mon 8/25/14**	**Mon 8/25/14**
8	Foundation	20 days	Mon 8/4/14	Fri 8/29/14
9	Structural Steel	65 days	Fri 8/29/14	Thu 11/27/14
10	ICF Walls	51 days	Tue 9/9/14	Tue 11/18/14
11	Roofing	49 days	Mon 12/8/14	Thu 2/12/15
12	Building Façade	40 days	Fri 2/13/15	Thu 4/9/15
13	MEP Rough-Ins	75 days	Fri 2/13/15	Thu 5/28/15
14	Glazing	33 days	Fri 3/6/15	Tue 4/21/15
15	**Last Day of School - Spring 2015**	**1 day**	**Fri 6/5/15**	**Fri 6/5/15**
16	Interiors	66 days	Fri 4/3/15	Fri 7/3/15
17	Finishes	20 days	Mon 7/6/15	Fri 7/31/15
18	*Commissioning*	*55 days*	*Fri 5/29/15*	*Thu 8/13/15*
19	*Demobilization*	*5 days*	*Mon 8/3/15*	*Fri 8/7/15*
20	**Teacher Move-in / FF&E**	**10 days**	**Mon 8/10/15**	**Fri 8/21/15**
21	*Substantial Completion*	*0 days*	*Fri 8/21/15*	*Fri 8/21/15*
22	**First Day of School - Fall 2015**	**1 day**	**Mon 8/24/15**	**Mon 8/24/15**

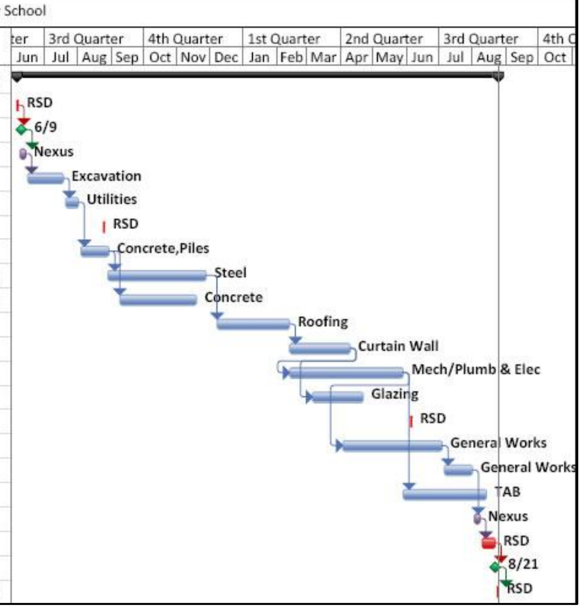


Figure 15: Construction Milestone Schedule

To reach substantial completion, the construction manager and remaining subcontractors on site will demobilize so the end-users have two weeks to move into the building. Also during these two weeks, any new equipment training for the end-users will be conducted. Finally, school will begin on Monday, August 24, 2015 for the 2015-2016 academic year.

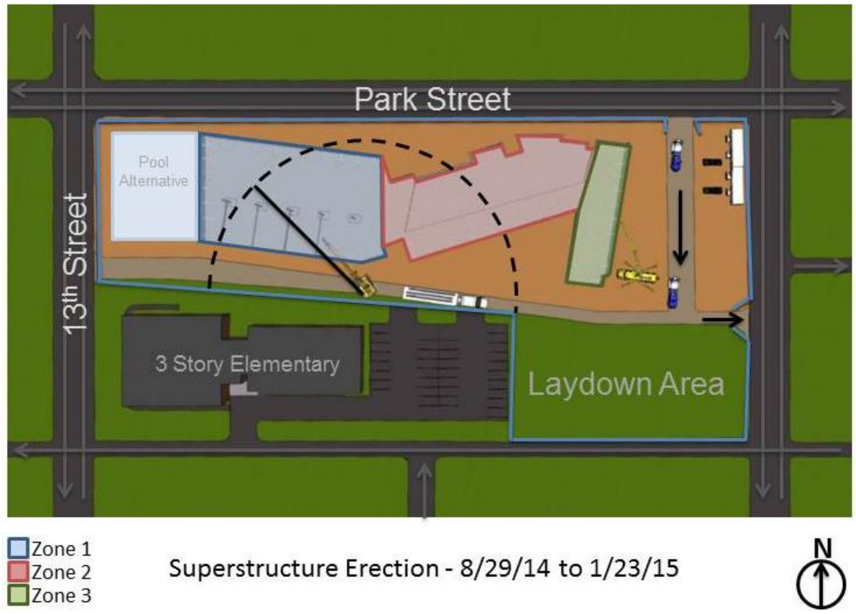


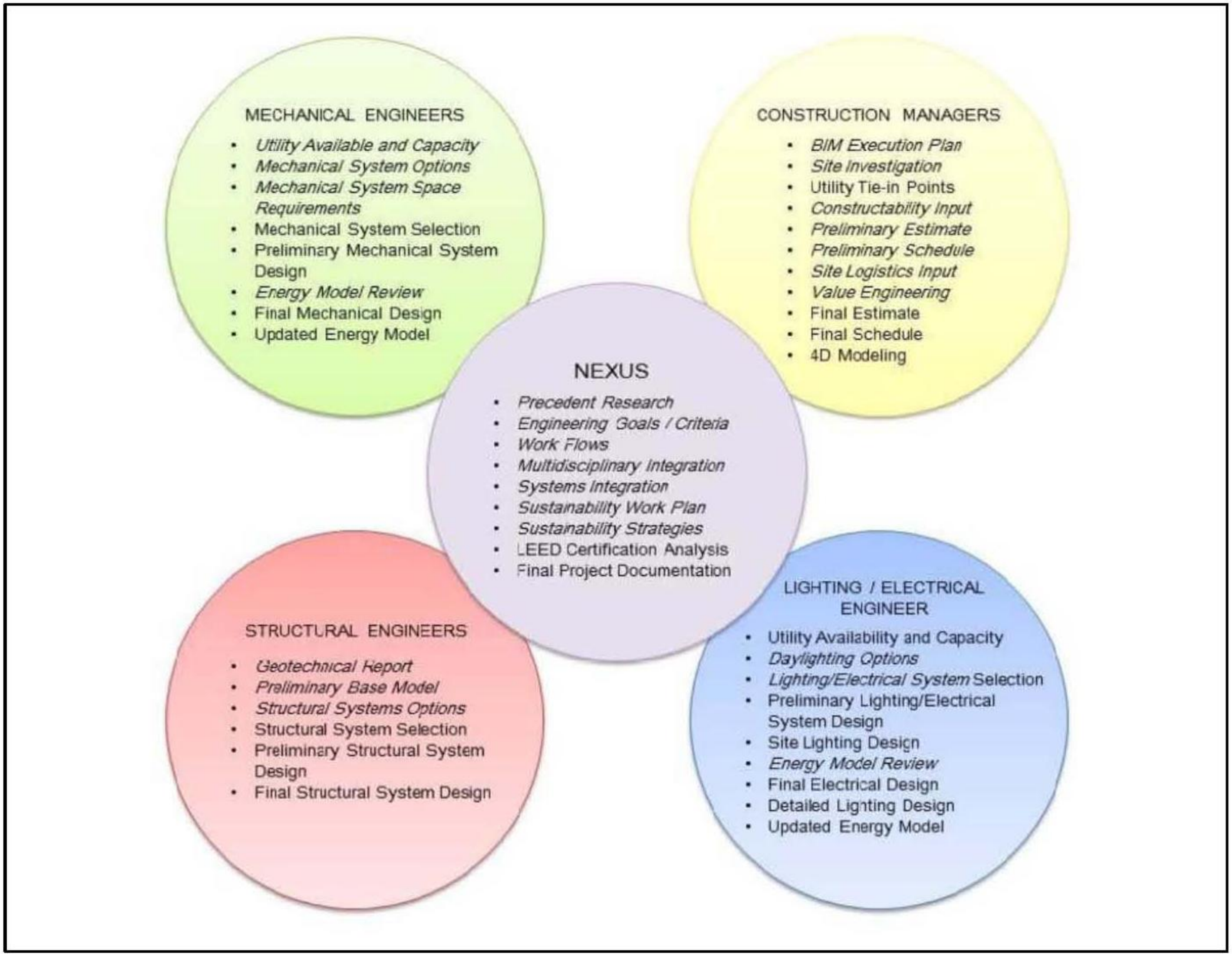
Figure 16: Superstructure Erection Plan

7. Conclusion

The goals set forth by Nexus were created in order to deliver a building that satisfies the needs of the students, teachers, and community members. Nexus' new proposed Reading Elementary School contains a plethora of examples of innovative design solutions through the integration of each of the disciplines working on the project. Nexus is confident that the proposed elementary school successfully achieves and exceeds the district's objectives. The hidden sense of security far exceeds a typical elementary school's safety protocols, ensuring the building cannot be penetrated and that all occupants are safe from outside dangers. The sustainable features incorporated into the building will lengthen the building's life-cycle and lower the maintenance and operation requirements. Lastly, the integration of the construction, structural, mechanical, and lighting/electrical discipline's systems created a school that acts as a learning tool for the teachers and students, while maintaining a low initial and life-cycle cost.

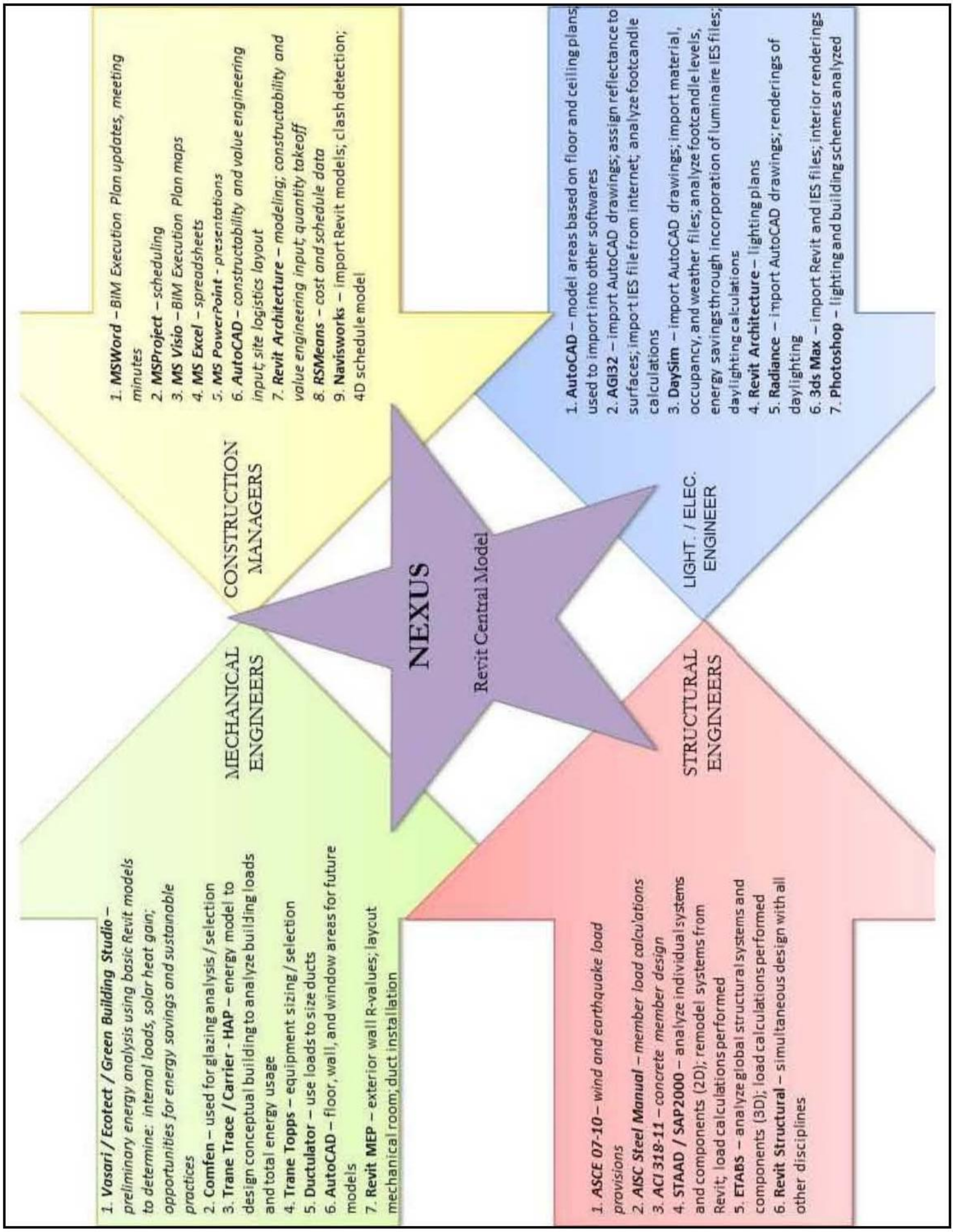
Nexus' construction managers believe they have met Reading School District's owner objectives through the support of the project and discipline specific goals. By integrating the three other design disciplines, maximizing the security and safety measures, utilizing the required delivery method, engineering efficient construction site plans, sustaining low first and lifecycle costs, and maintaining a short construction schedule arranged around the academic year, Nexus' construction management team will provide the owner with the highest quality elementary school and the most enjoyable construction services.

NEXUS DISCIPLINE ROLES AND RESPONSIBILITIES



This figure displays the discipline roles and responsibilities for Nexus' four divisions. Then, Nexus as a whole has roles and responsibilities to fulfill that all team members will contribute to. Many of these roles are in relation to the BIM Execution Plan BIM Uses and Goals. Read each individual report for more information.

NEXUS SOFTWARE INFORMATION EXCHANGES



This figure displays the software information exchanges amongst Nexus team members. Each team member is to fulfill their roles and responsibilities through the use of these technologies. Then, when one person has completed a task, the information can flow to the next responsible team member. There is a short description next to each software to describe its use for this project.

NEXUS BIM GOAL USE ANALYSIS WORKSHEET

BIM Goal Use Analysis Worksheet				
BIM Use	Project Importance	Disciplines Involved	Discipline Importance	Necessary Data
	High / Med / Low		High / Med / Low	
Design Phase				
Design Review	High	CM SE ME LE	High High High High	Constructability input to design models Structural design models Mechanical design models Lighting / Electrical design models
3D Coordination	High	CM SE ME LE	High High High High	Design models Design models, ETABS and SAP models Design models Design models, ceiling plans
Structural Analysis	High	SE	High	Local codes, ETABS and SAP models
Lighting Analysis	High	LE	High	AGI and Daysim models
Mechanical Analysis	High	ME	High	Energy model and equipment sizing and selection
Energy Analysis	High	ME LE	High High	Preliminary Vasari model and later more accurate energy model AGI - lighting power density information
Sustainability (LEED) Evaluation	High	CM SE ME LE	High High High High	Materials and energy data Material efficiency data Energy model and IAQ information AGI and Daysim analysis
Phase Planning (4D Modeling)	High	CM	High	Design models, project schedule
S.F. / Detailed Cost Estimation	High	CM	High	Materials, building statistics
Existing Conditions	Med	CM SE	Med Med	Site data Ggeotechnical report
Record Modeling	Med	CM SE ME LE	Med Med Med Med	4D coordinated model Structural and ETABS model Model and equipment selection Analyses and models
Site Utilization Planning	High	CM	High	Site layout, equipment, material laydown, project schedule

This figure displays data information exchanges based on BIM Uses. These BIM Uses are rated based on the importance to Nexus on a project whole, the disciplines involved with each BIM Use, and the importance to the individual disciplines. The necessary data refers to the information required to most efficiently utilize the BIM Use.

TOOLBOX TALK MEETING MINUTES TEMPLATE

nexus

TOOLBOX TALK MEETING MINUTES

Meeting #:
Location: Project Site
Time: Mondays at 8AM
Topic: Site safety
Subcontractor: General Works

Crew members present:		Initial	Date
	?	_____	_____
	?	_____	_____
	?	_____	_____
Guest(s) present:	?	_____	_____

1.1 Old Business
 1.1.1

1.2 New Business
 1.2.1 Site Deliveries
 1.2.2 Site Logistics
 1.2.3 Equipment Use
 1.2.4 Personal Protective Equipment
 1.2.5 Cleanup
 1.2.6 Communication

1.3 Future Business
 1.3.1

Published by,

Name

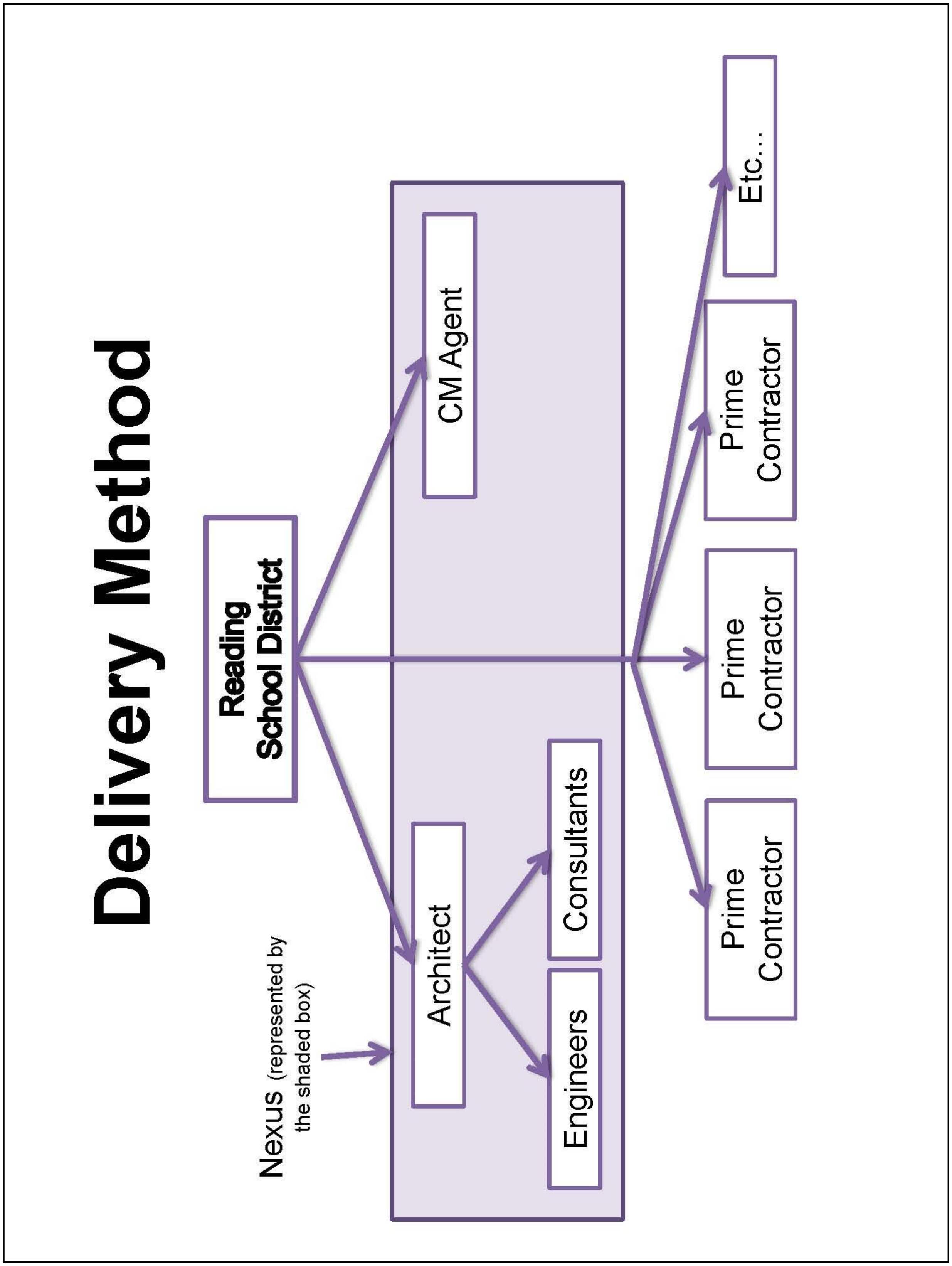
*Signed*______________________

*Dated*__________

By initialing and dating above, all crew members present, and any guests present, agree to being present at this official Toolbox Talk meeting, and agree to being held responsible for any information discussed. These meeting minutes accurately reflect what occurred during the specified time of the official Toolbox Talk meeting. Any crew members present, or guests present, that do not agree with what is contained within, must respond to the author of these meeting minutes within 48 hours to discuss revisions and a republication of amended meeting minutes.

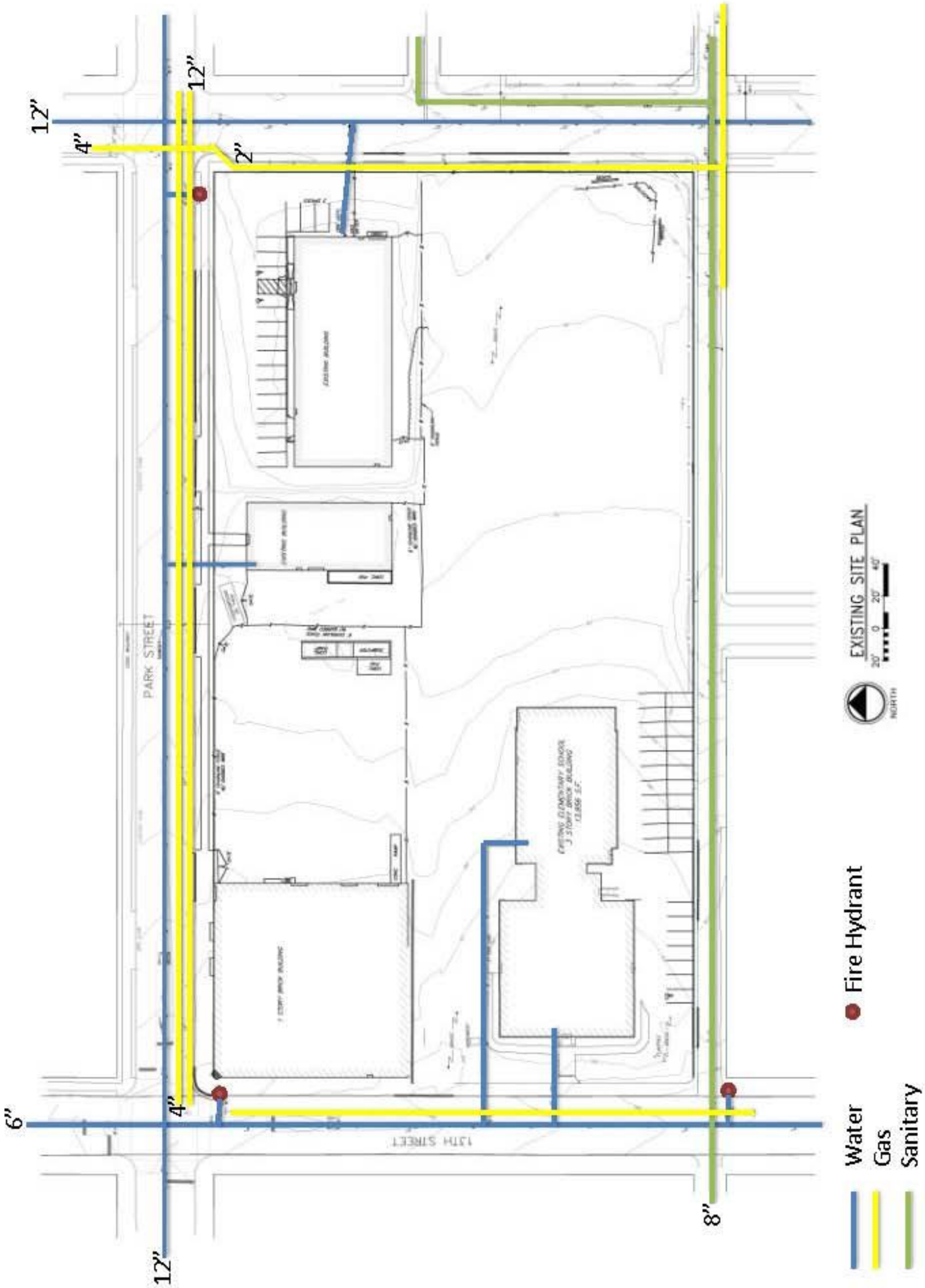
This template displays a typical toolbox talk meeting minutes templates. These will be required of all subcontractors to submit to Nexus each Monday morning. All safety issues must be discussed and documented on this form.

CONSTRUCTION MANAGER AGENT – MULTI-PRIME DESIGN-BID-BUILD



This figure displays the contractual set-up for the new Reading Elementary School proposed by Nexus. Nexus would normally act as a design-build firm, but with Pennsylvania law, Nexus must act as a CM agent and hire prime contractors. The school must hold all contracts and assume all risk from the architect CM agent, and subcontractors.

EXISTING UTILITY PLAN



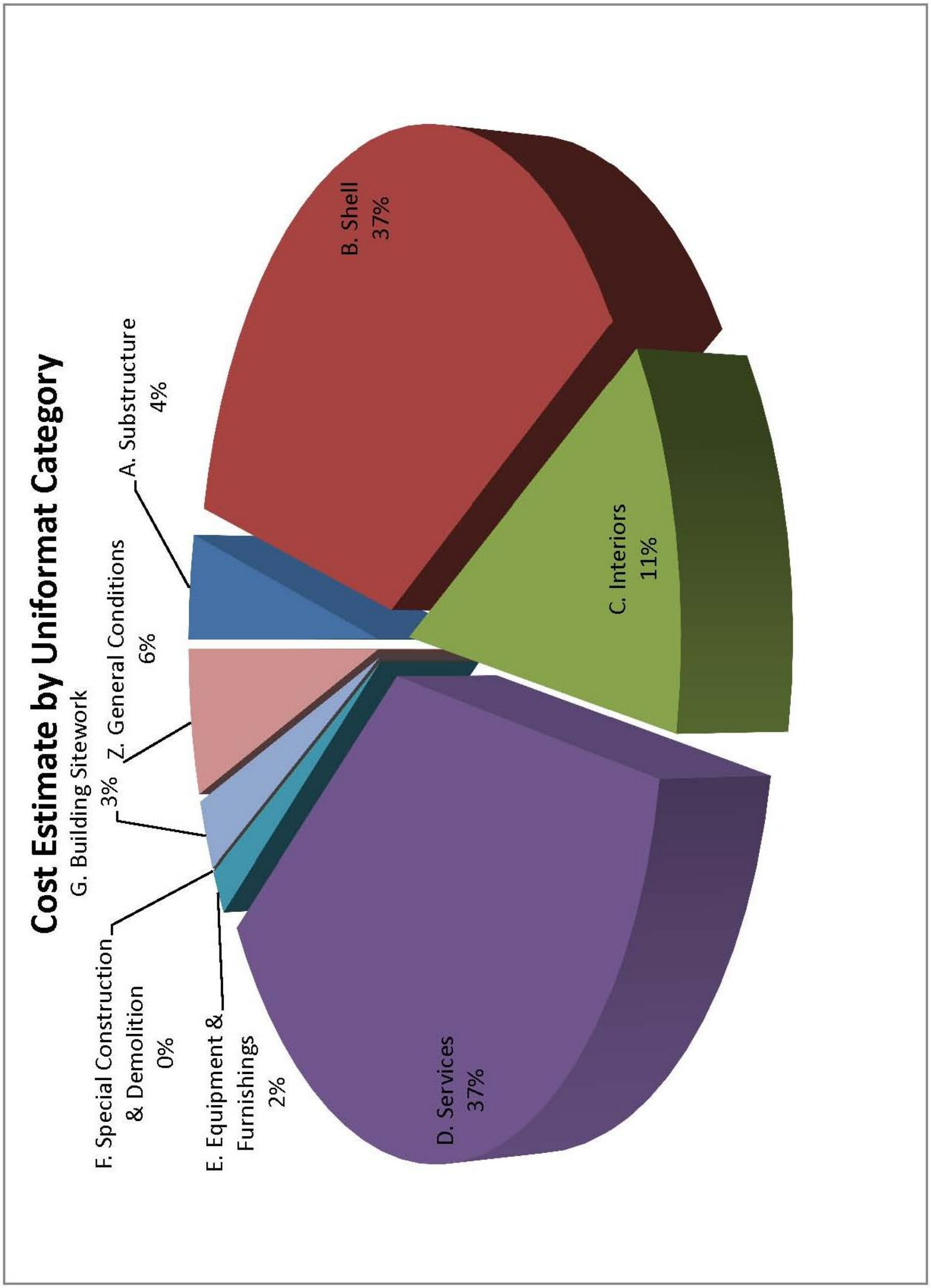
This figure depicts the existing utilities plan. Water, gas, and sanitary lines are shown in various colors. Additionally, fire hydrants are shown with red circles. It is important to note these utilities during surveys and excavation. Any new utilities must tie into the existing utilities.

UNIFORMAT DETAILED COST ESTIMATE

Uniformat Cost Estimate					
A. Substructure	$ 713,750	A10 Foundations	$ 459,750	A1010 Standard Foundations	$ 138,500
				A1020 Special Foundations	$ 200,000
				A1030 Slab on Grade	$ 121,250
		A20 Basement Construction	$ 254,000	A2010 Basement Excavation	$ 150,000
				A2020 Basement Walls	$ 104,000
B. Shell	$ 6,390,250	B10 Superstructure	$ 1,777,250	B1010 Floor Construction	$ 1,381,000
				B1020 Roof Construction	$ 396,250
		B20 Exterior Enclosures	$ 3,908,000	B2010 Exterior Walls	$ 3,239,000
				B2020 Exterior Windows	$ 629,000
				B2030 Exterior Doors	$ 40,000
		B30 Roofing	$ 705,000	B3010 Roof Coverings	$ 700,000
				B3020 Roof Openings	$ 5,000
C. Interiors	$ 1,970,000	C10 Interior Construction	$ 965,000	C1010 Partitions	$ 830,000
				C1020 Interior Doors	$ 75,000
				C1030 Fittings	$ 60,000
		C20 Stairs	$ 110,000	C2010 Stair Construction	$ 103,000
				C2020 Stair Finishes	$ 7,000
		C30 Interior Finishes	$ 895,000	C3010 Wall Finishes	$ 180,000
				C3020 Floor Finishes	$ 500,000
				C3030 Ceiling Finishes	$ 215,000
D. Services	$ 6,475,000	D10 Conveying	$ 175,000	D1010 Elevators & Lifts	$ 175,000
				D1020 Escalators & Moving Walks	$ -
				D1090 Other Conveying Systems	$ -
		D20 Plumbing	$ 1,400,000	D2010 Plumbing Fixtures	$ 100,000
				D2020 Domestic Water Distribution	$ 300,000
				D2030 Sanitary Waste	$ 240,000
				D2040 Rain Water Drainage	$ 74,000
				D2090 Other Plumbing Systems	$ 686,000
		D30 HVAC	$ 2,800,000	D3010 Energy Supply	$ -
				D3020 Heat Generating Systems	$ 140,000
				D3030 Cooling Generating Systems	$ 280,000
				D3040 Distribution Systems	$ 520,000
				D3050 Terminal & Package Units	$ 840,000
				D3060 Controls & Instrumentation	$ 360,000
				D3070 Systems Testing & Balancing	$ 200,000
				D3090 Other HVAC Systems & Equipment	$ 460,000
		D40 Fire Protection	$ 175,000	D4010 Sprinklers	$ 105,000
				D4020 Standpipes	$ 62,000
				D4030 Fire Protection Specialties	$ 8,000
				D4090 Other Fire Protection Systems	$ -
		D50 Electrical	$ 1,925,000	D5010 Electrical Service & Distribution	$ 551,250
				D5020 Lighting and Branch Wiring	$ 1,023,750
				D5030 Communications & Security	$ 350,000
				D5090 Other Electrical Systems	$ -
E. Equipment & Furnishings	$ 300,000	E10 Equipment	$ -	E1010 Commercial Equipment	$ -
				E1020 Institutional Equipment	$ -
				E1030 Vehicular Equipment	$ -
				E1090 Other Equipment	$ -
		E20 Furnishings	$ 300,000	E2010 Fixed Furnishings	$ 200,000
				E2020 Movable Furnishings	$ 100,000
F. Special Construction & Demolition	$ -	F10 Special Construction	$ -	F1010 Special Structures	$ -
				F1020 Integrated Construction	$ -
				F1030 Special Construction Systems	$ -
				F1040 Special Facilities	$ -
				F1050 Special Controls and Instrumentation	$ -
		F20 Selective Building Demolition	$ -	F2010 Building Elements Demolition	$ -
				F2020 Hazardous Components Abatement	$ -
G. Building Sitework	$ 601,000	G10 Site Preparation	$ 175,000	G1010 Site Clearing	$ -
				G1020 Site Demolition and Relocations	$ -
				G1030 Site Earthwork	$ 125,000
				G1040 Hazardous Waste Remediation	$ 50,000
		G20 Site Improvements	$ 301,000	G2010 Roadways	$ 127,500
				G2020 Parking Lots	$ 133,500
				G2030 Pedestrian Paving	$ 15,000
				G2040 Site Development	$ -
				G2050 Landscaping	$ 25,000
		G30 Site Mechanical Utilities	$ 75,000	G3010 Water Supply	$ 13,000
				G3020 Sanitary Sewer	$ 15,000
				G3030 Storm Sewer	$ 16,000
				G3040 Heating Distribution	$ 12,000
				G3050 Cooling Distribution	$ 8,000
				G3060 Fuel Distribution	$ 11,000
				G3090 Other Site Mechanical Utilities	$ -
		G40 Site Electrical Utilities	$ 50,000	G4010 Electrical Distribution	$ 10,000
				G4020 Site Lighting	$ 25,000
				G4030 Site Communications & Security	$ 15,000
				G4090 Other Site Electrical Utilities	$ -
		G90 Other Site Construction	$ -	G9010 Service and Pedestrian Tunnels	$ -
				G9090 Other Site Systems & Equipment	$ -
Z. General Conditions	$ 997,650	Z10 Design Allowance	$ -		
		Z20 Overhead & Profit	$ 997,650	Z2010 Overhead	$ 685,100
				Z2020 Profit	$ 312,550
TOTAL	$ 17,447,650				

This table is a detailed cost estimate based on Uniformat categories. These categories are divided into three levels, as shaded in purple. The levels become more descriptive based on the level of detailed required. Where there is no cost listed, that means this aspect is not included in Nexus' new elementary school.

BUILDING GENERAL CONDITIONS COST ESTIMATE



This figure is another representation of the cost estimate breakdown based on Uniformat. Each category is represented as a percentage of the total building cost analysis. General conditions are appropriately allocated at 6%, with the structure consisting of 41%, and the MEP systems as 37%.

BUILDING GENERAL CONDITIONS COST ESTIMATE

General Conditions Cost Estimate				
Personnel	Quantity	Unit	Unit Price	Total Cost
Project manager	30	Week	$ 2,125.00	$ 63,750
Engineer	30	Week	$ 1,300.00	$ 39,000
Superintendent	60	Week	$ 1,975.00	$ 118,500
Clerk	30	Week	$ 420.00	$ 12,600
				$ 233,850
Facilities	Quantity	Unit	Unit Price	Total Cost
Trailer (32'x8')	15	Month	$ 185.00	$ 2,775
Dumpster (40 CY, 1 dump/wk.)	12	Month	$ 860.00	$ 10,320
Portable toilet	15	Month	$ 180.00	$ 2,700
Storage (40' x 8')	15	Month	$ 385.00	$ 5,775
Office expenses	15	Month	$ 460.00	$ 6,900
Gravel road (8")	500	SY	$ 11.73	$ 5,865
				$ 34,335
Protection	Quantity	Unit	Unit Price	Total Cost
Site fence (6' tall)	4000	LF	$ 5.16	**$ 20,640**
Temporary Utilities	Quantity	Unit	Unit Price	Total Cost
Heat (w/ fuel, 12hrs., /wk.)	2700	CSF * wk.	$ 40.13	$ 108,351
Lighting	900	CSF	$ 14.95	$ 13,455
Power (lighting, 11.8 KWH))	3375	CSF * mn.	$ 1.65	$ 5,569
Power (job)	3375	CSF * mn.	$ 47.00	$ 158,625
Water	15	Month	$ 63.00	$ 945
				$ 286,945
Insurance, Bonds, Taxes	Quantity	Unit	Unit Price	Total Cost
Builder's risk (0.64%)	0.0064	Job		$ 105,280
				$ 105,280
Mobilization/Demobilization	Quantity	Unit	Unit Price	Total Cost
Mobilization	6	/equipment	$ 350.00	$ 2,100
Demobilization	6	/equipment	$ 325.00	$ 1,950
				$ 4,050
Fee	Quantity	Unit	Unit Price	Total Cost
1.9%	0.019	Job		**$ 312,550**
General Conditions Total				**$ 997,650**
Building Direct Cost (materials put in place)				**$ 16,450,000**
Gross Total (builidng direct cost + general conditions)				**$ 17,447,650**
Adjustment Factors	Quantity	Unit	Unit Price	Total Cost
PA Sales Tax (6%)	0.06	Job		$ 1,046,859
Available work space (-2%)	-0.02	Job		$ (348,953)
Good GC/CM management (-2%)	-0.02	Job		$ (348,953)
Location Factor (0.98)	-0.02	Job		$ (348,953)
				$ -
**all information in this table is referenced from RSMeans Building Construction Cost Data 2013*				
Building Net Total (building direct cost + general conditions)				**$ 17,447,650**

This figure illustrates the general conditions cost estimate for the project. The items included in this would be supplied by the construction manager.

POOL GENERAL CONDITIONS COST ESTIMATE – PHASE TWO

Phase 2 Pool Cost Estimate				
Personnel	Quantity	Unit	Unit Price	Total Cost
Project manager	12	Week	$ 2,125.00	$ 25,500
Engineer	12	Week	$ 1,300.00	$ 15,600
Superintendent	12	Week	$ 1,975.00	$ 23,700
				$ 64,800
Facilities	Quantity	Unit	Unit Price	Total Cost
Trailer (32'x8')	3	Month	$ 185.00	$ 555
Dumpster (40 CY, 1 dump/wk.)	3	Month	$ 860.00	$ 2,580
Portable toilet	3	Month	$ 180.00	$ 540
Office expenses	3	Month	$ 460.00	$ 1,380
Gravel road (8")	100	SY	$ 11.73	$ 1,173
				$ 6,228
Protection	Quantity	Unit	Unit Price	Total Cost
Site fence (6' tall)	400	LF	$ 5.16	**$ 2,064**
Temporary Utilities	Quantity	Unit	Unit Price	Total Cost
Lighting	893	CSF	$ 14.95	$ 13,350
Power (lighting, 11.8 KWH))	1340	CSF * mn.	$ 1.65	$ 2,211
Power (job)	670	CSF * mn.	$ 47.00	$ 31,490
Water	3	Month	$ 63.00	$ 189
				$ 47,240
Insurance, Bonds, Taxes	Quantity	Unit	Unit Price	Total Cost
Builder's risk (0.64%)	0.0064	Job		$ 15,974
				$ 15,974
Mobilization/Demobilization	Quantity	Unit	Unit Price	Total Cost
Mobilization	6	/equipment	$ 350.00	$ 2,100
Demobilization	6	/equipment	$ 325.00	$ 1,950
				$ 4,050
Fee	Quantity	Unit	Unit Price	Total Cost
1.9%	0.019	Job		**$ 47,422**
General Conditions Total				**$ 187,778**
Building Direct Cost (materials put in place)				**$ 2,495,876**
Gross Total (builidng direct cost + general conditions)				**$ 2,683,654**
Adjustment Factors	Quantity	Unit	Unit Price	Total Cost
PA Sales Tax (6%)	0.06	Job		$ 161,019
Available work space (-2%)	-0.02	Job		$ (53,673)
Good GC/CM management (-2%)	-0.02	Job		$ (53,673)
Location Factor (0.98)	-0.02	Job		$ (53,673)
				$ -
**all information in this table is referenced from RSMeans Building Construction Cost Data 2013*				
Building Net Total (building direct cost + general conditions)				**$ 2,683,654**

This figure displays the general conditions cost for a pool built during a second phase. The increase in cost is due to remobilizing the construction manager and subcontractors.

PLANCON COST CALCULATION

PlanCon Calculation	
Full time equivalent capacity	875 students
Conversion factor	1.3205
Rated Pupil Capacity	1155 students
Elementary legislated per pupil amount	$4,700
$4,700 x 1155 =	
Reimbursable Amount	$5,428,500
Additional Funding for LEED Silver Certification	$470
$470 x 1155 =	
Total Additional Funding for LEED Silver Certification	$542,850
$5,428,500 + $542,850 =	
Total Reimbursable Project Cost	$5,971,350
$5,428,500 / $17,500,000 =	
Reimbursable Percent	34.12%
Minus 0.5% reduction until final project accounting	33.62%
Reading School District - Market Value Aid Ratio	0.9003
$17,500,000 * 0.3362 * 0.9003 =	
State of Pennsylvania Contribution	**$5,296,915.05**

This figure shows calculations of the state funding being contributed to the new Reading Elementary school. It is important to note that the number of students was based on a typical class size. Also, based on Nexus' proposed LEED Silver Certification, the school district would be able to obtain an additional $542,850.

SCOPES OF WORK

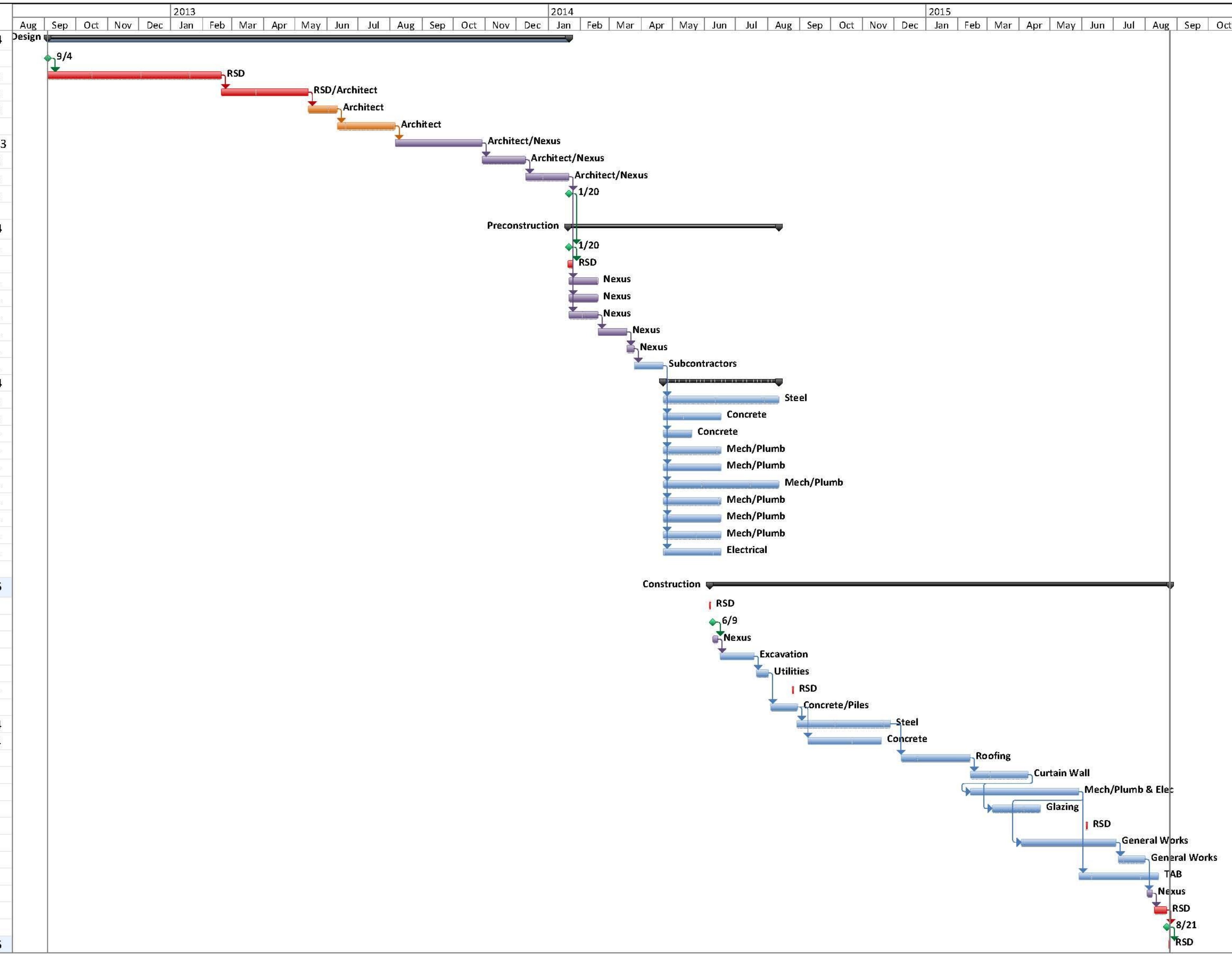
- General Works - $1,800,000
  - metal stud interior partitions; gypsum wallboard; casework; finishes; painting; exterior and interior doors; retractable wall systems in gymnasium and stage
- Concrete - $2,425,000
  - footers; pile caps / column piers; insulated concrete forms; cast-in-place concrete walls; slab-on-decks; slab-on-grades
- Mechanical and Plumbing - $4,120,000
  - mechanical equipment and units; sheetmetal; piping; domestic and sanitary piping; diffusers, registers, grilles
- Electrical - $1,575,000
  - electrical equipment; transformers; switchgear; utility connections; conduit; wiring; fixtures; luminaires
- Data - $350,000
  - cable trays; data and telecommunication wiring; data and telecommunication devices
- Excavation - $400,000
  - soil excavation; hauling offsite; disposal of contaminated soil
- Utilities - $125,000
  - Underground utility runs and connections
- Piles - $200,000
  - steel-driven piles
- Structural Steel - $1,275,000
  - structural steel members (HSS columns and lateral bracing); wide-flange girders and beams; joists; trusses; truss braces; metal decking; shear studs
- Roofing - $700,000
  - built-up white membrane roofing
- Curtain Wall - $300,000
  - curtain wall elements in classroom spaces; aluminum panel exterior cladding
- Masonry - $1,400,000
  - concrete masonry unit infill walls; face-brick exterior cladding
- Glazing - $850,000
  - glazing elements
- Carpet - $200,000
  - carpet tiles in the classroom spaces
- Flooring - $300,000
  - finished concrete flooring in corridors and auxiliary spaces; gymnasium hardwood floor; stage floor
- Elevator - $175,000
  - elevator
- Fire Protection - $175,000
  - sprinkler piping and heads
- Testing, Adjusting, Balancing - $80,000
  - mechanical, plumbing, electrical, and fire protection system commissioning

This figure lists the scopes of work as defined by Nexus. This is not meant to be interpreted as a list of subcontractors. However, this list can be used to develop packages for subcontractors to bid towards.

DESIGN, PRECONSTRUCTION, AND CONSTRUCTION MILESTONE SCHEDULE

RSD New Elementary School

ID	Task Name	Duration	Start	Finish
1	**Design**	**360 days**	**Tue 9/4/12**	**Mon 1/20/14**
2	*Notice to Proceed*	0 days	Tue 9/4/12	Tue 9/4/12
3	Feasibility Study	120 days	Tue 9/4/12	Mon 2/18/13
4	Programming	60 days	Tue 2/19/13	Mon 5/13/13
5	Conceptual Design	20 days	Tue 5/14/13	Mon 6/10/13
6	Schematic Design	40 days	Tue 6/11/13	Mon 8/5/13
7	Design Development	60 days	Tue 8/6/13	Mon 10/28/13
8	50% Construction Documents	30 days	Tue 10/29/13	Mon 12/9/13
9	Construction Documents	30 days	Tue 12/10/13	Mon 1/20/14
10	*Substantial Completion*	0 days	Mon 1/20/14	Mon 1/20/14
11				
12	**Preconstruction**	**146 days**	**Mon 1/20/14**	**Mon 8/11/14**
13	Design Complete	0 days	Mon 1/20/14	Mon 1/20/14
14	*Pool Decision Deadline*	5 days	Mon 1/20/14	Fri 1/24/14
15	Estimate Complete	20 days	Tue 1/21/14	Mon 2/17/14
16	Bid Schedule Complete	20 days	Tue 1/21/14	Mon 2/17/14
17	Scopes of Work Defined	20 days	Tue 1/21/14	Mon 2/17/14
18	Invitation to Bid	20 days	Tue 2/18/14	Mon 3/17/14
19	Subcontractor Awarding	5 days	Tue 3/18/14	Mon 3/24/14
20	Submittals	20 days	Tue 3/25/14	Mon 4/21/14
21	Lead Times - Delivery Times	**80 days**	**Tue 4/22/14**	**Mon 8/11/14**
22	Steel Mill Order	80 days	Tue 4/22/14	Mon 8/11/14
23	ICF Order	40 days	Tue 4/22/14	Mon 6/16/14
24	Concrete Order	20 days	Tue 4/22/14	Mon 5/19/14
25	Sheetmetal	40 days	Tue 4/22/14	Mon 6/16/14
26	Fans	40 days	Tue 4/22/14	Mon 6/16/14
27	AHUs	80 days	Tue 4/22/14	Mon 8/11/14
28	Pumps	40 days	Tue 4/22/14	Mon 6/16/14
29	Cooling Tower	40 days	Tue 4/22/14	Mon 6/16/14
30	Boiler	40 days	Tue 4/22/14	Mon 6/16/14
31	Feeders	40 days	Tue 4/22/14	Mon 6/16/14
32				
33	**Construction**	**317 days**	**Fri 6/6/14**	**Mon 8/24/15**
34	**Last Day of School - Spring 2014**	**1 day**	**Fri 6/6/14**	**Fri 6/6/14**
35	*Notice to Proceed*	0 days	Mon 6/9/14	Mon 6/9/14
36	*Mobilization*	5 days	Mon 6/9/14	Fri 6/13/14
37	Excavation	25 days	Mon 6/16/14	Fri 7/18/14
38	Utilities	10 days	Mon 7/21/14	Fri 8/1/14
39	**First Day of School - Fall 2014**	1 day	Mon 8/25/14	Mon 8/25/14
40	Foundation	20 days	Mon 8/4/14	Fri 8/29/14
41	Structural Steel	65 days	Fri 8/29/14	Thu 11/27/14
42	ICF Walls	51 days	Tue 9/9/14	Tue 11/18/14
43	Roofing	49 days	Mon 12/8/14	Thu 2/12/15
44	Building Façade	40 days	Fri 2/13/15	Thu 4/9/15
45	MEP Rough-Ins	75 days	Fri 2/13/15	Thu 5/28/15
46	Glazing	33 days	Fri 3/6/15	Tue 4/21/15
47	**Last Day of School - Spring 2015**	1 day	Fri 6/5/15	Fri 6/5/15
48	Interiors	66 days	Fri 4/3/15	Fri 7/3/15
49	Finishes	20 days	Mon 7/6/15	Fri 7/31/15
50	*Commissioning*	55 days	Fri 5/29/15	Thu 8/13/15
51	*Demobilization*	5 days	Mon 8/3/15	Fri 8/7/15
52	**Teacher Move-in / FF&E**	10 days	Mon 8/10/15	Fri 8/21/15
53	*Substantial Completion*	0 days	Fri 8/21/15	Fri 8/21/15
54	**First Day of School - Fall 2015**	1 day	**Mon 8/24/15**	**Mon 8/24/15**



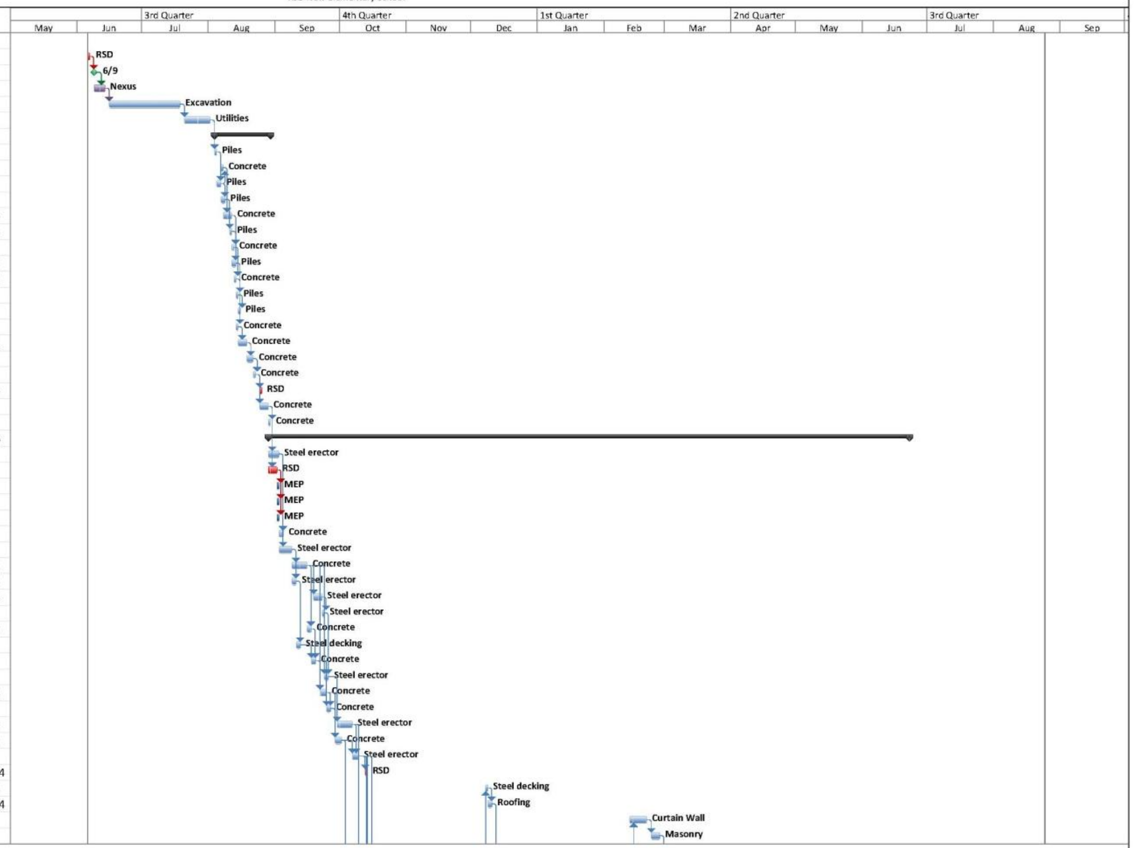
Project: RSD New Elementary School
Team: Nexus
Date: 22 February 2013

This figure displays a milestone schedule for the project. It is important to note that a design, preconstruction, and construction schedule must be developed to properly plan each phase. The design schedule is largely based on the owner-architect relationship in the planning and design phases. The preconstruction phase involves the owner-architect-construciton manager relationship and eventually the hiring of the subcontractors. Lastly, the construction milestones are listed at the bottom. Nexus has made a point to include all important school dates in their schedule to properly plan for special events both on site and at the existing elementary school.

DETAILED CONSTRUCTION SCHEDULE

RSD New Elementary School

ID	Task Name	Duration	Start	Finish
1	**Construction**			
2	**Last Day of School - Spring 2014**	1 day	Fri 6/6/14	Fri 6/6/14
3	*Notice to Proceed*	0 days	Mon 6/9/14	Mon 6/9/14
4	*Mobilization*	5 days	Mon 6/9/14	Fri 6/13/14
5	Excavation	24 days	Mon 6/16/14	Fri 7/18/14
6	Utilities	10 days	Mon 7/21/14	Fri 8/1/14
7	**Foundation**	**20 days**	**Mon 8/4/14**	**Fri 8/29/14**
8	piles - pool	1 day	Mon 8/4/14	Mon 8/4/14
9	footers - pool	1 day	Thu 8/7/14	Thu 8/7/14
10	piles - gym north	2 days	Tue 8/5/14	Wed 8/6/14
11	piles - gym south	2 days	Thu 8/7/14	Fri 8/8/14
12	footer - gym	2 days	Fri 8/8/14	Mon 8/11/14
13	piles - stair north	1 day	Mon 8/11/14	Mon 8/11/14
14	footers -stair	1 day	Tue 8/12/14	Tue 8/12/14
15	piles - classroom	2 days	Tue 8/12/14	Wed 8/13/14
16	footers -classroom	1 day	Wed 8/13/14	Wed 8/13/14
17	piles - NE corner	1 day	Thu 8/14/14	Thu 8/14/14
18	piles - east	1 day	Fri 8/15/14	Fri 8/15/14
19	footers - east	1 day	Thu 8/14/14	Thu 8/14/14
20	pool walls	2 days	Fri 8/15/14	Mon 8/18/14
21	pool slabs	3 days	Tue 8/19/14	Thu 8/21/14
22	pool deck slab	1 day	Fri 8/22/14	Fri 8/22/14
23	**First Day of School - Fall 2014**	1 day	Mon 8/25/14	Mon 8/25/14
24	basement walls	4 days	Mon 8/25/14	Thu 8/28/14
25	basement slab	1 day	Fri 8/29/14	Fri 8/29/14
26	**First Floor**	**205 days**	**Fri 8/29/14**	**Mon 6/22/15**
27	pool and gym columns	2 days	Fri 8/29/14	Tue 9/2/14
28	**No School (Labor Day Break)**	1 day	Fri 8/29/14	Mon 9/1/14
29	Chillers 1-3 Basement Delivery	1 day	Tue 9/2/14	Tue 9/2/14
30	Boilers 1-2 Basement Delivery	1 day	Tue 9/2/14	Tue 9/2/14
31	Ethylene-Glycol Basement Delivery	1 day	Tue 9/2/14	Tue 9/2/14
32	gym slab on grade 1st	2 days	Wed 9/3/14	Thu 9/4/14
33	classroom columns	4 days	Wed 9/3/14	Mon 9/8/14
34	pool and gym walls 1st lift	5 days	Tue 9/9/14	Mon 9/15/14
35	basement beams	2 days	Tue 9/9/14	Wed 9/10/14
36	pool beams	2 days	Fri 9/19/14	Mon 9/22/14
37	pool and gym girders	1 day	Tue 9/23/14	Tue 9/23/14
38	classroom slab on grade 1st	2 days	Tue 9/16/14	Wed 9/17/14
39	classroom metal decking	2 days	Thu 9/11/14	Fri 9/12/14
40	classroom slab on deck 1st	2 days	Thu 9/18/14	Fri 9/19/14
41	pool and gym beams 1st	2 days	Wed 9/24/14	Thu 9/25/14
42	classroom walls 1st lift	3 days	Mon 9/22/14	Wed 9/24/14
43	east slab on grade 1st	2 days	Thu 9/25/14	Fri 9/26/14
44	classroom beams 1st	5 days	Tue 9/30/14	Mon 10/6/14
45	east walls 1st	3 days	Mon 9/29/14	Wed 10/1/14
46	east beams 1st	3 days	Tue 10/7/14	Thu 10/9/14
47	**No School (In-Service Day)**	1 day	Mon 10/13/14	Mon 10/13/14
48	classroom 1st floor roof decking	1 day	Mon 12/8/14	Mon 12/8/14
49	classroom 1st floor roof	2 days	Tue 12/9/14	Wed 12/10/14
50	classroom curtain walls 1st	6 days	Fri 2/13/15	Fri 2/20/15
51	pool and gym brick 1st	4 days	Mon 2/23/15	Thu 2/26/15



Project: nexus2a
Date: Wed 1/23/13

Task; Split; Milestone; Summary; Project Summary; External Tasks; External Milestone; Inactive Task; Inactive Milestone; Inactive Summary; Manual Task; Duration-only; Manual Summary Rollup; Manual Summary; Start-only; Finish-only; Deadline; Progress

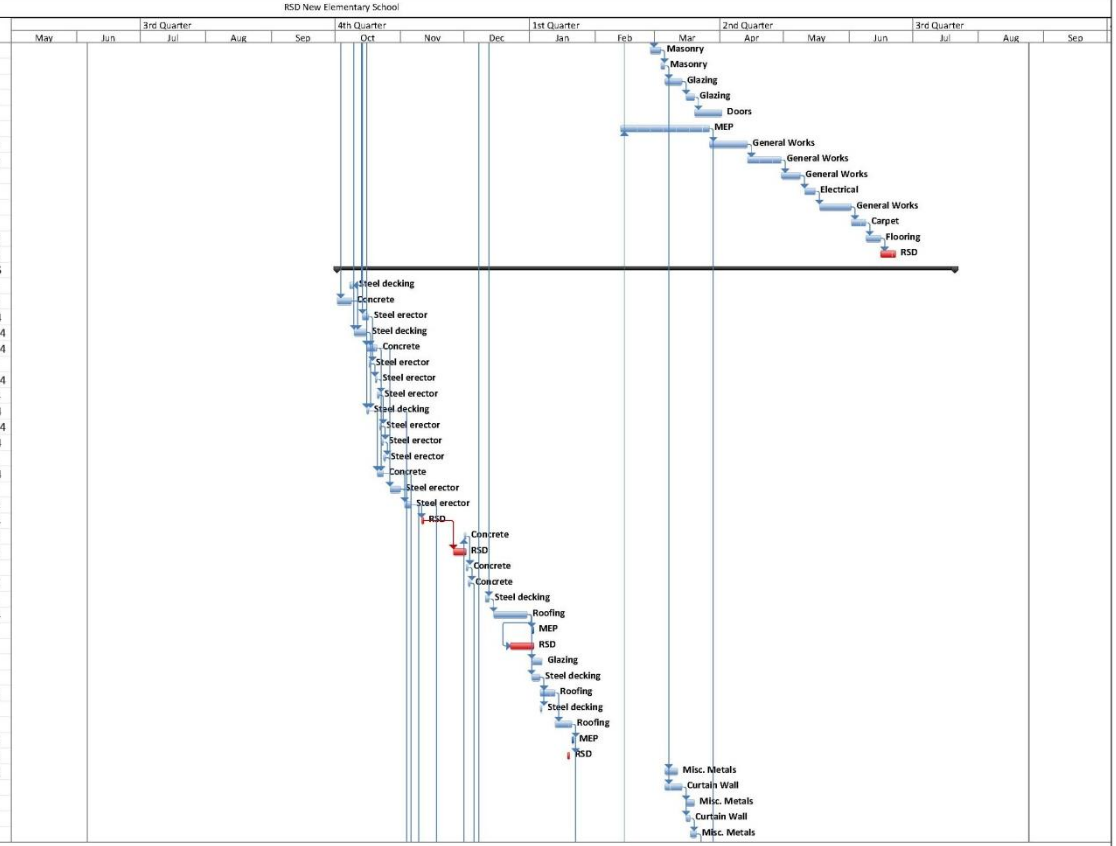
Project: RSD New Elementary School
Team: Nexus
Date: 22 February 2012

This schedule shows the first phases of construction. The excavation is followed by utility work and foundation concrete and steel work. Next, the first floor structure begins.

DETAILED COONSTRUCTION SCHEDULE CONT.

RSD New Elementary School

ID	Task Name	Duration	Start	Finish
52	classroom brick 1st	3 days	Fri 2/27/15	Tue 3/3/15
53	east brick 1st	2 days	Wed 3/4/15	Thu 3/5/15
54	windows 1st floor icf	6 days	Fri 3/6/15	Fri 3/13/15
55	windows 1st floor cw	4 days	Mon 3/16/15	Thu 3/19/15
56	exterior doors 1st floor	9 days	Fri 3/20/15	Wed 4/1/15
57	MEFP rough-ins	30 days	Fri 2/13/15	Thu 3/26/15
58	stud walls	12 days	Fri 3/27/15	Mon 4/13/15
59	gypsum wallboard	12 days	Tue 4/14/15	Wed 4/29/15
60	casework	7 days	Thu 4/30/15	Fri 5/8/15
61	fixtures	5 days	Mon 5/11/15	Fri 5/15/15
62	finishes	10 days	Mon 5/18/15	Mon 6/1/15
63	carpet tile flooring	5 days	Tue 6/2/15	Mon 6/8/15
64	concrete floor finishing	5 days	Tue 6/9/15	Mon 6/15/15
65	equipment	5 days	Tue 6/16/15	Mon 6/22/15
66	**Second Floor**	**202 days**	**Thu 10/2/14**	**Mon 7/20/15**
67	gym metal decking	2 days	Wed 10/8/14	Thu 10/9/14
68	pool and gym walls 2nd lift	5 days	Thu 10/2/14	Wed 10/8/14
69	gym beams 2nd	3 days	Tue 10/14/14	Thu 10/16/14
70	classroom metal decking	4 days	Fri 10/10/14	Wed 10/15/14
71	classroom walls 2nd lift	3 days	Thu 10/16/14	Mon 10/20/14
72	pool trusses north	1 day	Fri 10/17/14	Fri 10/17/14
73	pool trusses south	1 day	Mon 10/20/14	Mon 10/20/14
74	pool truss braces	1 day	Tue 10/21/14	Tue 10/21/14
75	east metal decking	1 day	Thu 10/16/14	Thu 10/16/14
76	gym trusses west	1 day	Wed 10/22/14	Wed 10/22/14
77	gym trusses east	1 day	Thu 10/23/14	Thu 10/23/14
78	gym truss braces	1 day	Fri 10/24/14	Fri 10/24/14
79	east walls 2nd	3 days	Tue 10/21/14	Thu 10/23/14
80	classroom beams 2nd	5 days	Mon 10/27/14	Fri 10/31/14
81	east beams roof	3 days	Mon 11/3/14	Wed 11/5/14
82	**No School (In-Service Day)**	1 day	Tue 11/11/14	Tue 11/11/14
83	gym slab on deck 2nd	1 day	Mon 12/1/14	Mon 12/1/14
84	**No School (Thanksgiving Recess)**	3 days	Wed 11/26/14	Mon 12/1/14
85	classroom slab on deck 2nd	1 day	Tue 12/2/14	Tue 12/2/14
86	east slab on deck 2nd	1 day	Wed 12/3/14	Wed 12/3/14
87	pool and gym roof decking	2 days	Thu 12/11/14	Fri 12/12/14
88	pool and gym roof	10 days	Mon 12/15/14	Tue 12/30/14
89	OAU 2&3, EAU 2&3 Deliveries	1 day	Fri 1/2/15	Fri 1/2/15
90	**No School (Holiday Break)**	**5 days**	**Tue 12/23/14**	**Fri 1/2/15**
91	pool and gym skylights	3 days	Fri 1/2/15	Tue 1/6/15
92	classroom 2nd floor roof decking	2 days	Fri 1/2/15	Mon 1/5/15
93	classroom 2nd floor roof	5 days	Tue 1/6/15	Mon 1/12/15
94	east roof decking	1 day	Tue 1/6/15	Tue 1/6/15
95	east roof	6 days	Tue 1/13/15	Tue 1/20/15
96	OAU 1 & EAU 1 Deliveries	1 day	Wed 1/21/15	Wed 1/21/15
97	**No School (MLK Jr. Day)**	1 day	Mon 1/19/15	Mon 1/19/15
98	pool and gym aluminum panel 2nd	4 days	Fri 3/6/15	Wed 3/11/15
99	classroom curtain walls 2nd	6 days	Fri 3/6/15	Fri 3/13/15
100	classroom aluminum panel 2nd	4 days	Mon 3/16/15	Thu 3/19/15
101	east curtain wall 2nd	2 days	Mon 3/16/15	Tue 3/17/15
102	east aluminum panel 2nd	3 days	Wed 3/18/15	Fri 3/20/15



Project: nexus2a Date: Wed 1/23/13	Task / Split / Milestone	Summary / Project Summary / External Tasks	External Milestone / Inactive Task / Inactive Milestone	Inactive Summary / Manual Task / Duration-only	Manual Summary Rollup / Manual Summary / Start-only / Finish-only / Deadline / Progress

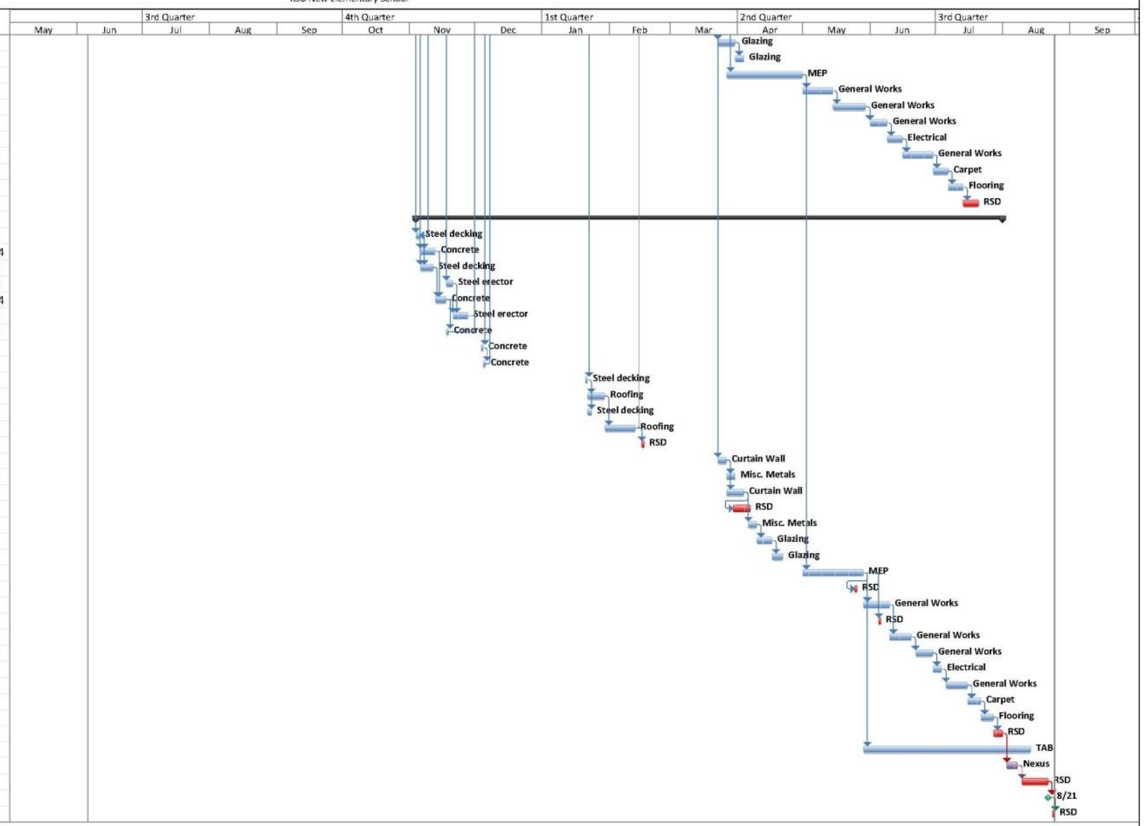
Project: RSD New Elementary School
Team: Nexus
Date: 22 February 2012

For clarity, this three page schedule is broken up by floor level. Sequencing the activity this way allows all subcontractors space to work without conflicts.

DETAILED CONSTRUCTION SCHEDULE CONT.

RSD New Elementary School

ID	Task Name	Duration	Start	Finish
103	windows 2nd floor icf	6 days	Mon 3/23/15	Mon 3/30/15
104	windows 2nd floor cw	4 days	Tue 3/31/15	Fri 4/3/15
105	MEFP rough-ins	25 days	Fri 3/27/15	Thu 4/30/15
106	stud walls	10 days	Fri 5/1/15	Thu 5/14/15
107	gypsum wallboard	10 days	Fri 5/15/15	Fri 5/29/15
108	casework	6 days	Mon 6/1/15	Mon 6/8/15
109	fixtures	5 days	Tue 6/9/15	Mon 6/15/15
110	finishes	10 days	Tue 6/16/15	Mon 6/29/15
111	carpet tile flooring	5 days	Tue 6/30/15	Mon 7/6/15
112	concrete floor finishing	5 days	Tue 7/7/15	Mon 7/13/15
113	equipment	5 days	Tue 7/14/15	Mon 7/20/15
114	**Third Floor**	**188 days**	**Tue 11/4/14**	**Fri 7/31/15**
115	gym metal decking 3rd	2 days	Tue 11/4/14	Wed 11/5/14
116	gym walls 3rd lift	5 days	Thu 11/6/14	Wed 11/12/14
117	classroom metal decking	4 days	Thu 11/6/14	Tue 11/11/14
118	gym beams roof	3 days	Tue 11/18/14	Thu 11/20/14
119	classroom walls 3rd lift	3 days	Thu 11/13/14	Mon 11/17/14
120	classroom beams roof	5 days	Fri 11/21/14	Thu 11/27/14
121	east walls 3rd lift	1 day	Tue 11/18/14	Tue 11/18/14
122	gym slab on deck 3rd	1 day	Thu 12/4/14	Thu 12/4/14
123	classroom slab on deck 3rd	1 day	Fri 12/5/14	Fri 12/5/14
124	gym roof decking	1 day	Wed 1/21/15	Wed 1/21/15
125	gym roof	6 days	Thu 1/22/15	Thu 1/29/15
126	classroom roof decking	2 days	Thu 1/22/15	Fri 1/23/15
127	classroom roof	10 days	Fri 1/30/15	Thu 2/12/15
128	**No School (In-Service Day)**	1 day	Mon 2/16/15	Mon 2/16/15
129	gym curtain walls 3rd	4 days	Mon 3/23/15	Thu 3/26/15
130	gym aluminum panel 3rd	2 days	Fri 3/27/15	Mon 3/30/15
131	clasroom curtain walls 3rd	6 days	Fri 3/27/15	Fri 4/3/15
132	**No School (Holiday Break)**	6 days	Mon 3/30/15	Mon 4/6/15
133	classroom aluminum panel 3rd	4 days	Mon 4/6/15	Thu 4/9/15
134	windows 3rd floor icf	5 days	Fri 4/10/15	Thu 4/16/15
135	windows 3rd floor cw	3 days	Fri 4/17/15	Tue 4/21/15
136	MEFP rough-ins	19 days	Fri 5/1/15	Thu 5/28/15
137	**No School (Memorial Day)**	1 day	Mon 5/25/15	Mon 5/25/15
138	stud walls	8 days	Fri 5/29/15	Tue 6/9/15
139	**Last Day of School - Spring 2015**	1 day	Fri 6/5/15	Fri 6/5/15
140	gypsum wallboard	8 days	Wed 6/10/15	Fri 6/19/15
141	casework	6 days	Mon 6/22/15	Mon 6/29/15
142	fixtures	4 days	Tue 6/30/15	Fri 7/3/15
143	finishes	8 days	Mon 7/6/15	Wed 7/15/15
144	carpet tile flooring	4 days	Thu 7/16/15	Tue 7/21/15
145	concrete floor finishing	4 days	Wed 7/22/15	Mon 7/27/15
146	equipment	4 days	Tue 7/28/15	Fri 7/31/15
147	*Commissioning*	55 days	Fri 5/29/15	Thu 8/13/15
148	*Demobilization*	5 days	Mon 8/3/15	Fri 8/7/15
149	**Teacher Move-In / FF&E**	10 days	Mon 8/10/15	Fri 8/21/15
150	*Substantial Completion*	0 days	Fri 8/21/15	Fri 8/21/15
151	**First Day of School - Fall 2015**	1 day	Mon 8/24/15	Mon 8/24/15



Project: nexus2a Date: Wed 1/23/13	Task		Summary		External Milestone		Inactive Summary		Manual Summary Rollup		Finish-only
	Split		Project Summary		Inactive Task		Manual Task		Manual Summary		Deadline
	Milestone		External Tasks		Inactive Milestone		Duration-only		Start-only		Progress

Project: RSD New Elementary School
Team: Nexus
Date: 22 February 2012

Lastly, it is important to note that there are two weeks allocated in the middle of August 2015. This time is to be used for teachers to move materials into the new classrooms and decorate before the beginning of the year.

LEED CHECKLIST

LEED 2009 for Schools New Construction and Major Renovations

Project Checklist

Project Name

Date

Sustainable Sites — Possible Points: 24

Y	?	N			
Y			Prereq 1	Construction Activity Pollution Prevention	
Y			Prereq 2	Environmental Site Assessment	
Y			Credit 1	Site Selection	1
		N	Credit 2	Development Density and Community Connectivity	4
		N	Credit 3	Brownfield Redevelopment	1
Y			Credit 4.1	Alternative Transportation—Public Transportation Access	4
Y			Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
Y			Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	2
Y			Credit 4.4	Alternative Transportation—Parking Capacity	2
Y			Credit 5.1	Site Development—Protect or Restore Habitat	1
Y			Credit 5.2	Site Development—Maximize Open Space	1
Y			Credit 6.1	Stormwater Design—Quantity Control	1
		N	Credit 6.2	Stormwater Design—Quality Control	1
Y			Credit 7.1	Heat Island Effect—Non-roof	1
Y			Credit 7.2	Heat Island Effect—Roof	1
Y			Credit 8	Light Pollution Reduction	1
Y			Credit 9	Site Master Plan	1
Y			Credit 10	Joint Use of Facilities	1

Water Efficiency — Possible Points: 11

Y	?	N			
Y			Prereq 1	Water Use Reduction—20% Reduction	
Y			Credit 1	Water Efficient Landscaping	2 to 4
Y			Credit 2	Innovative Wastewater Technologies	2
Y			Credit 3	Water Use Reduction	2 to 4
Y			Credit 3	Process Water Use Reduction	1

Energy and Atmosphere — Possible Points: 33

Y	?	N			
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	Fundamental Refrigerant Management	
Y			Credit 1	Optimize Energy Performance	1 to 19
		N	Credit 2	On-Site Renewable Energy	1 to 7
Y			Credit 3	Enhanced Commissioning	2
Y			Credit 4	Enhanced Refrigerant Management	1
Y			Credit 5	Measurement and Verification	2
		N	Credit 6	Green Power	2

Materials and Resources — Possible Points: 13

Y	?	N			
Y			Prereq 1	Storage and Collection of Recyclables	
		N	Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 2
		N	Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
Y			Credit 2	Construction Waste Management	1 to 2

Materials and Resources, Continued

Y	?	N			
		N	Credit 3	Materials Reuse	1 to 2
		N	Credit 4	Recycled Content	1 to 2
Y			Credit 5	Regional Materials	1 to 2
Y			Credit 6	Rapidly Renewable Materials	1
Y			Credit 7	Certified Wood	1

Indoor Environmental Quality — Possible Points: 19

Y	?	N			
Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
Y			Prereq 3	Minimum Acoustical Performance	
Y			Credit 1	Outdoor Air Delivery Monitoring	1
Y			Credit 2	Increased Ventilation	1
Y			Credit 3.1	Construction IAQ Management Plan—During Construction	1
Y			Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
Y			Credit 4	Low-Emitting Materials	1 to 4
Y			Credit 5	Indoor Chemical and Pollutant Source Control	1
		N	Credit 6.1	Controllability of Systems—Lighting	1
		N	Credit 6.2	Controllability of Systems—Thermal Comfort	1
Y			Credit 7.1	Thermal Comfort—Design	1
Y			Credit 7.2	Thermal Comfort—Verification	1
Y			Credit 8.1	Daylight and Views—Daylight	1 to 3
Y			Credit 8.2	Daylight and Views—Views	1
Y			Credit 9	Enhanced Acoustical Performance	1
Y			Credit 10	Mold Prevention	1

Innovation and Design Process — Possible Points: 6

Y	?	N			
		N	Credit 1.1	Innovation in Design: Specific Title	1
		N	Credit 1.2	Innovation in Design: Specific Title	1
		N	Credit 1.3	Innovation in Design: Specific Title	1
		N	Credit 1.4	Innovation in Design: Specific Title	1
Y			Credit 2	LEED Accredited Professional	1
Y			Credit 3	The School as a Teaching Tool	1

Regional Priority Credits — Possible Points: 4

Y	?	N			
		N	Credit 1.1	Regional Priority: Specific Credit	1
		N	Credit 1.2	Regional Priority: Specific Credit	1
		N	Credit 1.3	Regional Priority: Specific Credit	1
		N	Credit 1.4	Regional Priority: Specific Credit	1

Total — Possible Points: 110

Y	?	N		
55			Total	110

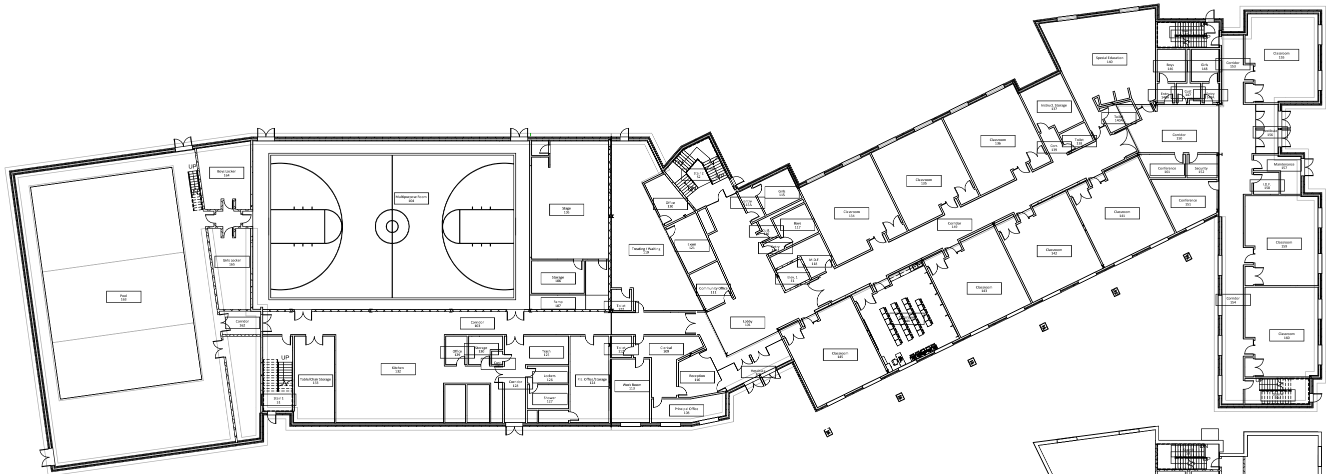
Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

This table is the LEED Checklist as developed by Nexus. It is proposed that the new school building will reach LEED Silver Certification. This is based on site analysis, materials and resources analysis, and innovation analysis by the construction managers; and, water efficiency, energy and atmosphere, and indoor environmental quality analyses by the mechanical engineers.

DETAILED STRUCTURAL STEEL QUANTITY TAKE-OFF

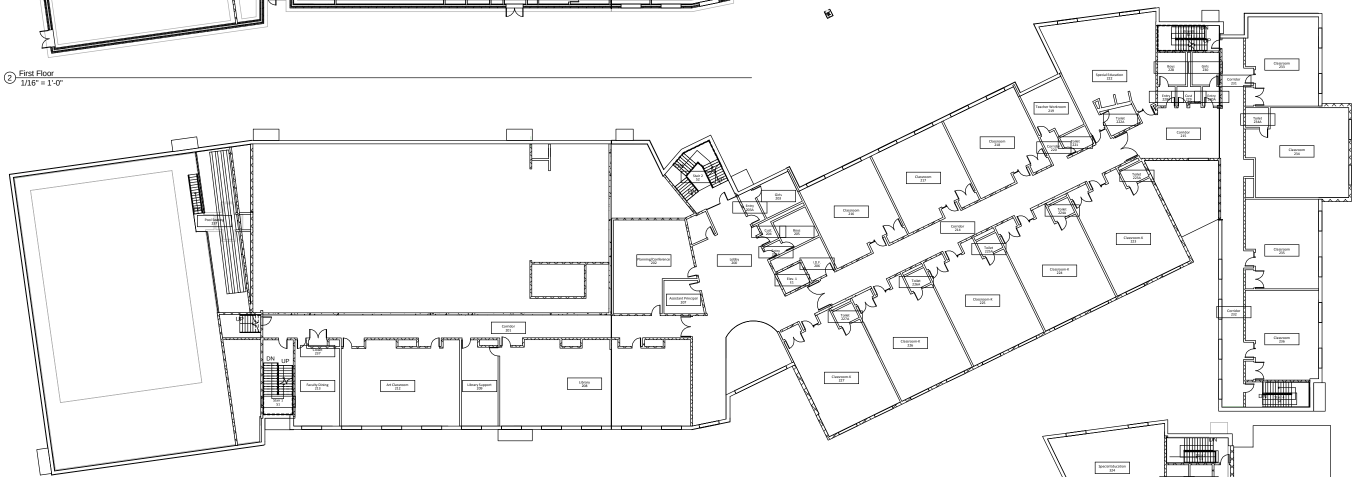
Name			
Member	*(ft)*	*(lbs)*	*Type*
60DLH18	84	1512	Pool roof truss
40LH15	60	900	Gym roof truss
W18X46	42	1932	Typical floor beam
W24x68	42	2856	Largest girder
W18X35	35	1225	Typical east wing floor beam
W18X40	42	1680	Typical roof beam
W12X87	42	3654	Typical column
HSS6X6X1/2	20.5	718	Typical brace member

This table lists the structural members utilized throughout the building. As noticed, there are eight typical steel sizes. This helps reduce complications and confusion in the field while erecting the steel.



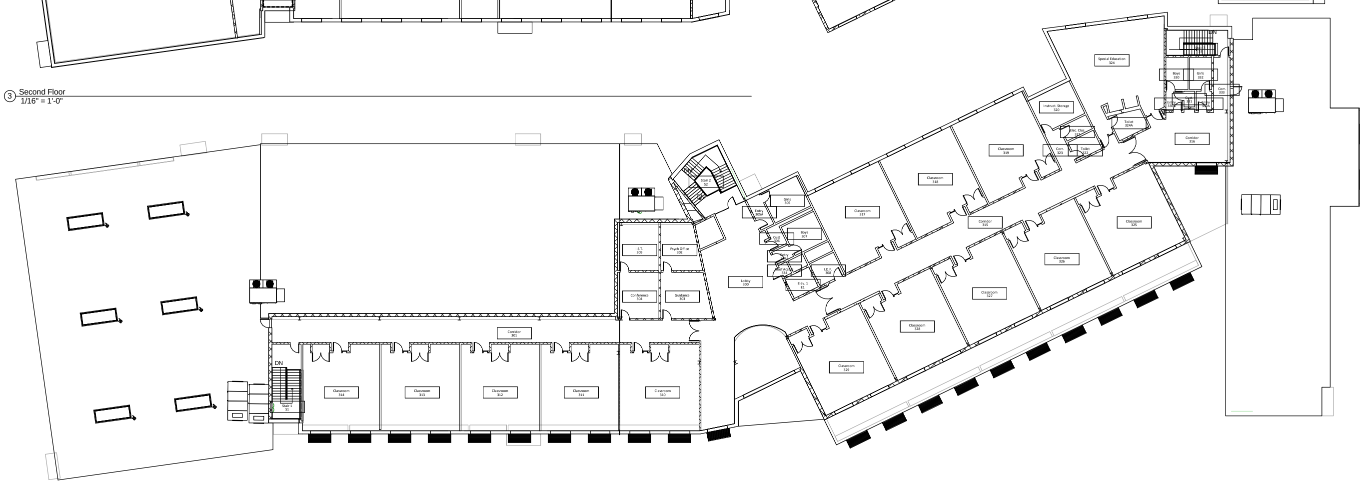
The first floor plan displays spaces for all different functions of the school. After entering the school through the main entrance on the South side of the school building, the secure main office is located to the left from the vestibule. Then, a student enters the lobby where they have access to the community spaces to the west and access to the academic spaces to the right. The 24-hour health center can also be accessed from the lobby. A typical classroom layout is shown in Room 144. Also shown on this plan is the pool and locker room layout that connects to the multipurpose room. Auxiliary spaces such as the kitchen and custodial room are on this level.

2 First Floor
1/16" = 1'-0"



The second floor plan displays more classrooms, including special education rooms. Moreover, the library and art rooms along with the teacher's lounge are located in the west wing of this level. Six kindergarten rooms are located on this level. Each of the kindergarten rooms contains an individual restroom and a larger floor area. This larger floor area cantilevers over the first floor exterior walls in each of the six kindergarten rooms.

3 Second Floor
1/16" = 1'-0"



The third floor plan shows the remainder of the classroom places. Moreover, there is roof access to the east and west roofs. Lastly, the six pool skylights are shown. These skylights enhance the daylighting aspects in the pool space.

1 Third Floor
1/16" = 1'-0"

BUILDING INTEGRATION

2013 ASCE Charles Pankow Foundation

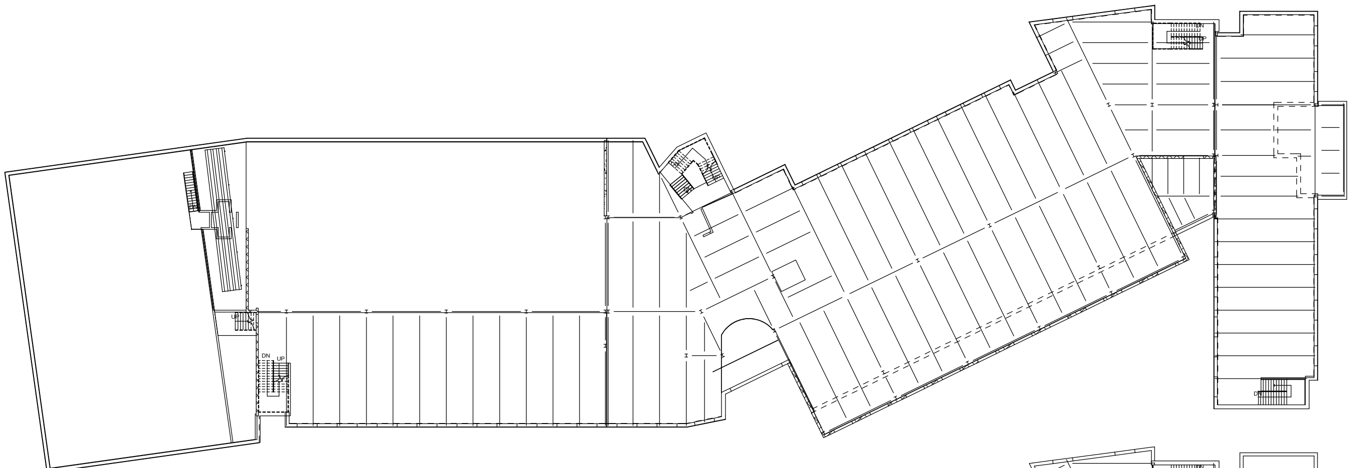
Annual Architectural Engineering Student Competition

Architectural Floor Plans

Drawings	.
Date	22 February 2013
Authors	NEXUS

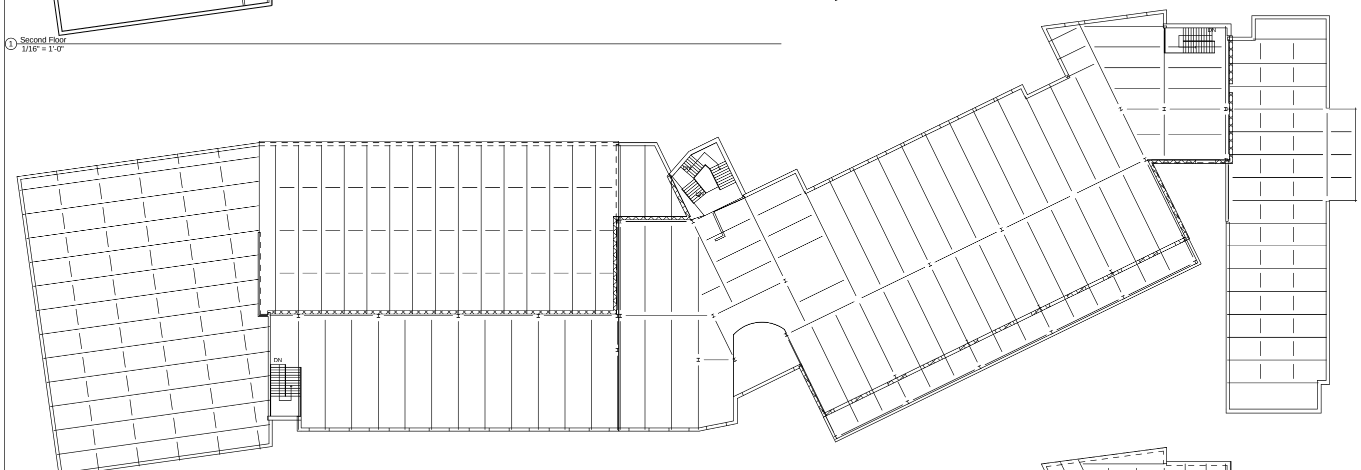
36

Scale	1/16" = 1'-0"



1 Second Floor
1/16" = 1'-0"

The second floor structural floor plan is an adequate representation of the steel structure integrated into the insulated concrete walls (ICFs). In the central classroom wing, the girder run to the exterior brick-encased columns to support the kindergarten classrooms. In nearly all cases, the beams sit in beam pockets in the ICF walls for support. There are two concrete sheer walls in the center classroom section as well, to help with lateral support.



2 Third Floor
1/16" = 1'-0"

The third floor structural floor plan is also an adequate representation of the steel structure. However, the pool and multipurpose room trusses are also visibile. The pool trusses are five feet in depth and evenly spaced at 8'-6" on center. The pool trusses are between 74 and 83 feet in length and run east to west and have cross bracing in the other direction. The multipurpose room trusses are 40" deep and evenly spaced 8'-0" on center. These trusses are 60 feet in length and run north to south and also have cross bracing in the other direction. The multipurpose room roof is not just metal decking with roofing membrane; rather, it has concrete on the metal decking since the multipurpose room is able to function as a shelter in the event of an emergency.

3 Roof
1/16" = 1'-0"

The roof structural floor plan is a slight variant to the steel and ICF structure. The roof beams that run in the general north-south direction are braced to be able to support snow load. The beams mirror the floors below, one on each edge of the classrooms and two in the middle. Despite the middle two beams resting on the ICF wall above the windows, the concrete was is still able to properly distribute the load without compromising the window's integrity.

BUILDING INTEGRATION

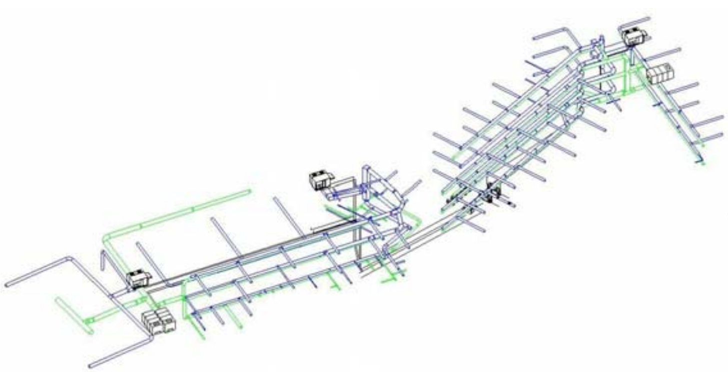
2013 ASCE Charles Pankow Foundation

Annual Architectural Engineering Student Competition

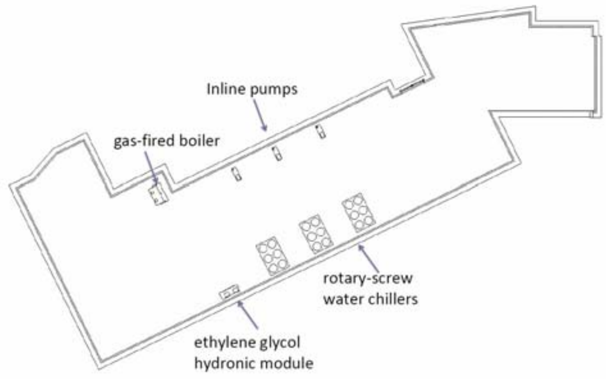
Structural Floor Plans

Drawings	.
Date	22 February 2013
Authors	Author

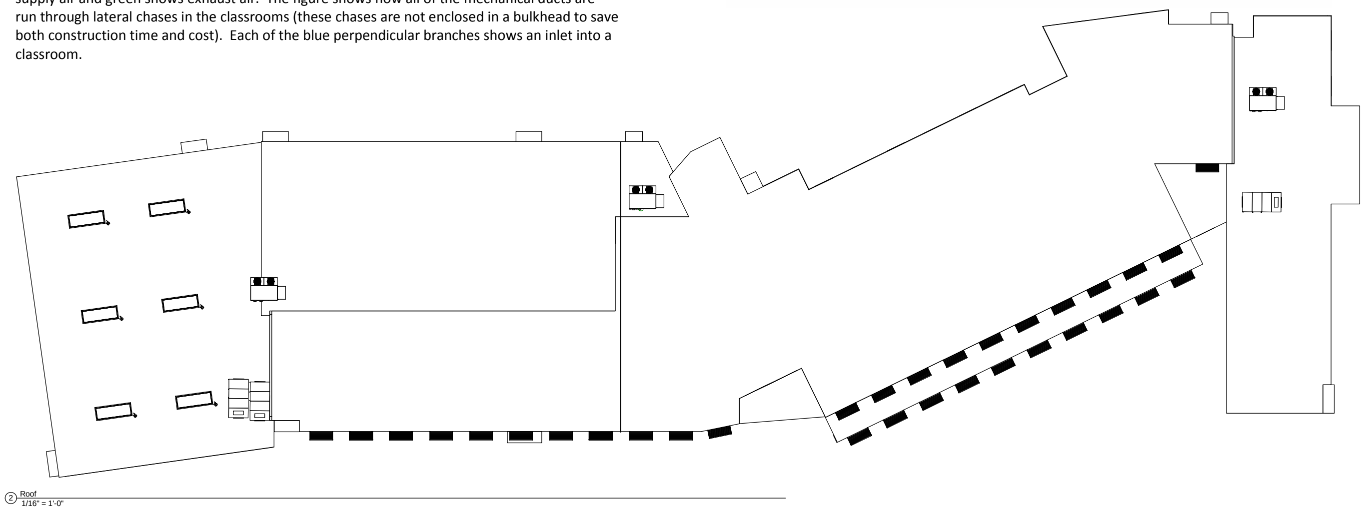
Scale	1/16" = 1'-0"



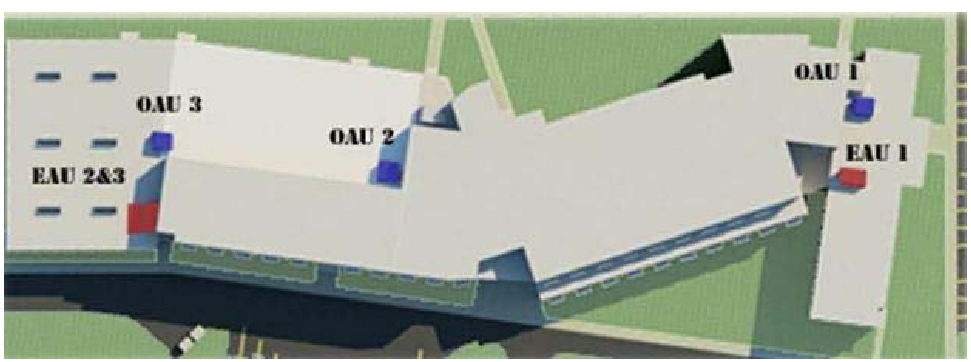
This figure above shows all of the mechanical ductwork throughout the building. Blue shows supply air and green shows exhaust air. The figure shows how all of the mechanical ducts are run through lateral chases in the classrooms (these chases are not enclosed in a bulkhead to save both construction time and cost). Each of the blue perpendicular branches shows an inlet into a classroom.



The mechanical basement floor plan shown to the left depicts what equipment is located in the basement. The gas-fired boiler, inline pumps, rotary-screw water chillers, and ethylene glycol hydronic module are all located in the basement. These pieces of equipment serve to pump domestic water throughout the building, heat and cool the air, and recover heat from exhaust air.



The mechanical roof plan shows where the outdoor air units and exhaust air units are located. As seen in the annotated rendering in the bottom left corner, the units are all labeled. A mechanical equipment schedule listing all of the units, their capacity, and weight is listed in the bottom right corner of this sheet. It is important to note the weight of the units, as compared to typical steel member weights on Drawing Sheet 39. The cooling tower will be the heaviest crane pick for the entire project.



Mechanical Equipment				
Unit #	*Equipment*	*Description*	*Capacity*	*Weight*
1	Chiller-1	Rotary-Screw Water Chiller	60 Tons	3,641 lb
2	Chiller-2	Rotary-Screw Water Chiller	60 Tons	3,641 lb
3	Chiller-3	Rotary-Screw Water Chiller	60 Tons	3,641 lb
4	Cooling Tower	Axial Fan, Induced Draft	175 Tons	4,890 lb
5	Boiler-1	Gas-Fired Boiler	800 MBh	2,774 lb
6	Boiler-2 (Pool)	Gas-Fired Boiler	350 MBh	1,411 lb
7	OAU-1	Dedicated Outdoor Air	38,000 CFM	3,830 lb
8	OAU-2	Dedicated Outdoor Air	27,000 CFM	2980 lb
9	OAU-3 (Pool)	Dedicated Outdoor Air	8,000 CFM	750 lb
10	EAU-1	Exhaust Air Unit	34,500 CFM	2,875 lb
11	EAU-2	Exhaust Air Unit	24,500 CFM	2,235 lb
12	EAU-3 (Pool)	Exhaust Air Unit	9,000 CFM	565 lb

nexus

BUILDING INTEGRATION

2013 ASCE Charles Pankow Foundation

Annual Architectural Engineering Student Competition

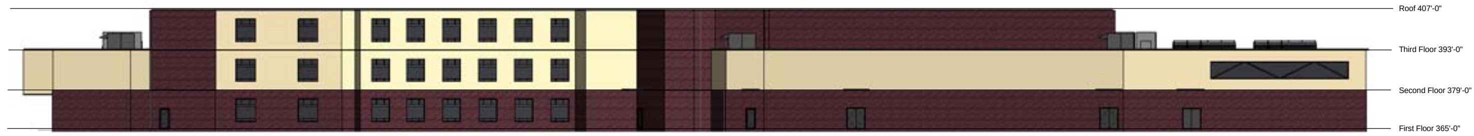
Mechanical Floor Plans

Drawings	.
Date	22 February 2013
Authors	Author

38

Scale 1/16" = 1'-0"

1 South Elevation
1/16" = 1'-0"



2 North Elevation
1/16" = 1'-0"

3 East Elevation
1/16" = 1'-0"

Figure 3 displays the East facade of the school building. The doors seen on the first floor are for emergency exit only. The door seen on the third floor leading to the roof is for access to perform maintenance on the mechanical equipment.

4 West Elevation
1/16" = 1'-0"

Figure 4 displays the West facade of the school building. The doors seen on the first floor (right side of the image) are emergency exits from the pool. The door seen on the third floor is for access to perform maintenance on the mechanical equipment above the gymnasium

Figure 1 shows the South facade of the school building. The main entrance is in the center of the image with two sets of double doors. The auxiliary doors to the left are emergency exists from the kitchen area (double doors). The door to the far left acts as an emergency exit during the school day and the visitor entrance to the gymnasium and pool after school hours.

Figure 2 shows the North facade of the school building. The main entrance used to be on this side of the school, but with safety as the top priority and a busy road along this side, the main entrance was moved to the opposie (South) facade. The left emergency exit door is from the northeast stairwell. The health center entrance is also in this view. The next two sets of double doors are emergency exits from the gymnasium. The last set of double doors is an emergency exit from the pool.

Figure 6 is from a student's perspective riding the bus to school. This is the bus lane entrance on the West side of campus. The yellow security balusters are shown in this view (however, they would be lowered during the morning and afternoon bus times). These balusters will be raised during the school day as explained in the traffic plan and safety sections of the report. The pool is behind the wall seen to the left (with an emergency exit in the foreground.

Figure 7 shows the East facade of the school building. The view looks down the bus lane from the traffic exit. Additionally, the teacher's parking lot is seen in the forefront while the existing school is in the background.

Figure 5 shows the South facade of the school building. The view is taken from the auxiliary parking lot to the West of the playing field. The main entrance is visible in the background to the left.

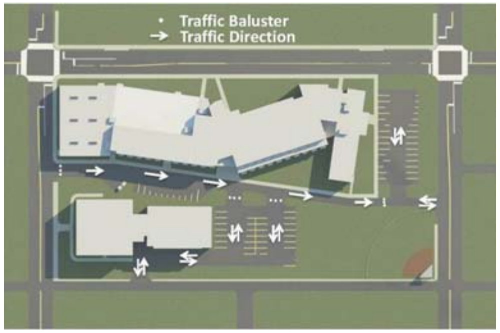
BUILDING INTEGRATION

2013 ASCE Charles Pankow Foundation

Annual Architectural Engineering Student Competition

Building Elevations and Exterior Views

Drawings	.
Date	22 February 2013
Authors	Author
	39
Scale	1/16" = 1'-0"



The safety traffic plan shown in the image above is a description of the site after construction is complete on the new Reading Elementary School. Denoted with white circles, traffic balusters help regulate the flow of traffic during the school day. For example, after school busses drop off the students in the morning and before the busses return in the afternoon, the traffic balusters will be raised. They are made of steel and rise three feet in height with a nine inch diameter. The balusters are strategically placed to prevent vehicles from approaching the school building during the day. Any visitors will have to park in the auxiliary parking lot during the school day.

The arrows on this plan denote the flow of vehicular traffic. The bus lane will be maintained as one way at all time, except at the entrance near the teacher parking lot. Maintaining a consistent flow of traffic will decrease the possibility of a traffic accident.

The image above is of the south-facing main entrance to the school building. This entrance was strategically relocated from the north facade to eliminate any possibility of a vehicle accident on the sidewalk while students were entering the school building. The other important thing to note is that all first floor glazing will be made of bullet-resistant glass. This will prevent intruder access through the windows into areas occupied by building occupants. This increase in safety measures aligns with the school district and Nexus' emphasis on building security and occupant safety.

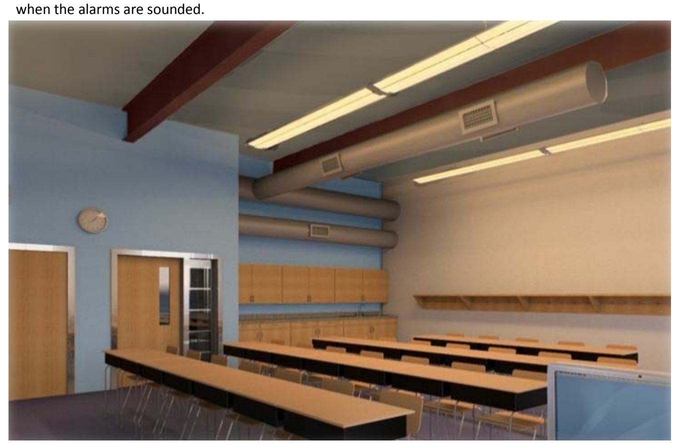
Priority #1

safety & security

The above image is a typical representation of the construction site during the superstructure erection sequences. While under construction, in order to maintain the safety of students and other school members currently in the existing three story elementary school, sidewalks will need to be closed around the construction site. These sidewalks will be closed to protect bystanders from debris, dust, and any other site hazards. Moreover, a crane swing is displayed on this plan to illustrate that the crane will never swing over the existing school boundary, preventing any possibility of an accident. The next important thing to note is the concrete truck and steel delivery truck turns. These turns will be made to increase traffic flow and safety throughout a regular day. The concrete trucks, will shorter lengths, can make right turns in and out of the site; while the steel delivery trucks will need to make left turns across two lanes of traffic due to their larger turning radii.

The floor plan shown to the left depicts the secure perimeter established when the intrusion detection system is activated. Should an intruder make it past the two sets of bullet-resistant doors in the vestibule, the three access points to the remainder of the school will be automatically locked (as shaded in blue). Video surveillance will be maintained at the main entrance, with controls being operated in the reception office. Thus, in the event of a security breach, all students will remain in their classrooms since the intruder will be locked into the first floor lobby until authorities arrive.

The interior rendering of a typical classroom below is included with the safety and security items to demonstrate the incorporation of several measures Nexus provides for occupant safety and building security. FIrst, the public address system will have an integral speaker with the classroom clock to voice-alert the teacher and student of an security breach. Security alarms in the corridors will double as an alert system. The intrusion detection system located at all exterior doors will trigger the security alarms and public address system. Lastly, manual window shades will be installed on the classroom door window and sidelight to prevent views into the classrooms from the corridors. Teachers will pull these shades when the alarms are sounded.



BUILDING INTEGRATION

2013 ASCE Charles Pankow Foundation

Annual Architectural Engineering Student Competition

Safety and Security

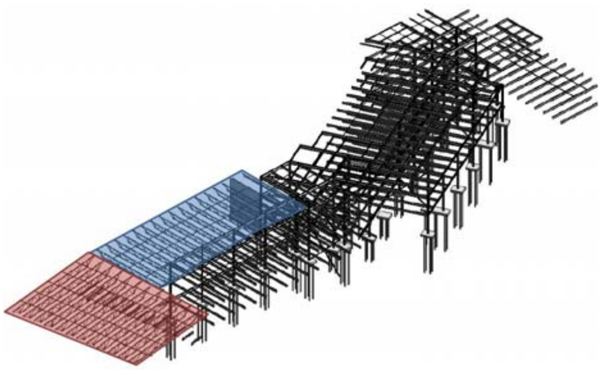
Drawings	.
Date	22 February 2013
Authors	Author

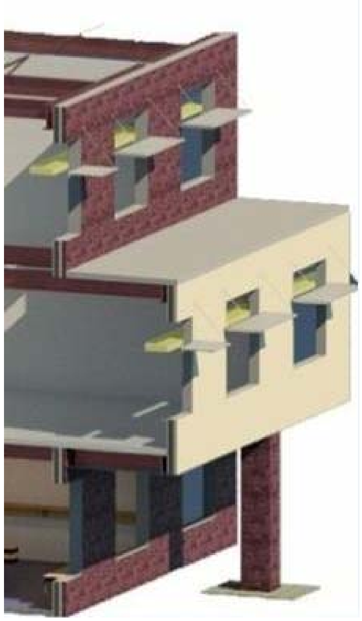
40

Scale

Name			
Member	*(ft)*	*(lbs)*	*Type*
60DLH18	84	1512	Pool roof truss
40LH15	60	900	Gym roof truss
W18X46	42	1932	Typical floor beam
W24x68	42	2856	Largest girder
W18X35	35	1225	Typical east wing floor beam
W18X40	42	1680	Typical roof beam
W12X87	42	3654	Typical column
HSS6X6X1/2	20.5	718	Typical brace member

The table above lists the typical sizes of steel members throughout the school building. These members are typical girders, floor and roof beams, and pool and multipurpose room trusses. The heaviest members are the interior columns, while the longest crane picks will be for the northern pool trusses and multipurpose room trusses. The pool trusses are highlighted in red and the multipurpose room trusses are highlighted in blue.



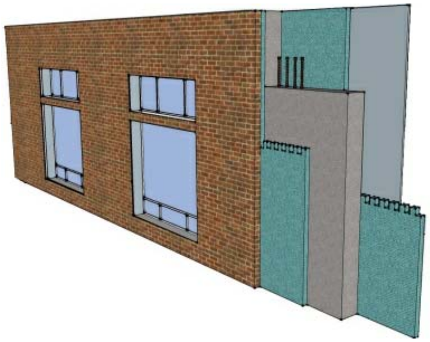


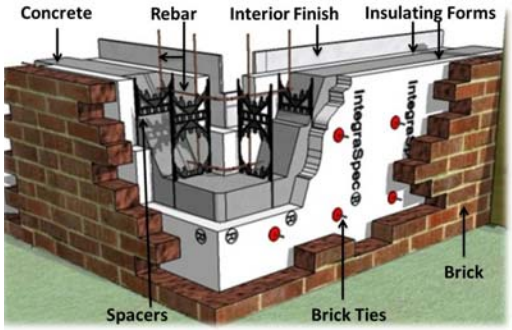
The figure to the left illustrates the exterior window louvers and interior lightshelves. The exterior window louvers will have two dowels that attach (bolt into) to the brick or metal panel facade after the exterior envelope is installed. This process will begin immediately after the brick and metal panels are installed to maintain the construction schedule. Scaffolding will be required for this process. Next, the interior lightshelves will be installed while the interior walls are being framed with metal studs. These lightshelves help direct sunlight that enters the top one foot of the window into deeper interior spaces of the classrooms. Then, the lightshelves will be cladded with gypsum wallboard and painted with a reflective paint to help direct the sunlight. These exterior louvers and lightshelves are only placed on the south facade as that will be the only direction in which direct sunlight enters the school builidng while it is regularly occupied by students, faculty, and staff members.

The two images below are depictions of the insulated concrete form walls (ICFs). The ICFs act as exterior bearing walls for the structural system. As discussed on Drawing Sheet 38, the steel structure is integral into the ICFs where the beams sit in beam pockets in the exterior walls.

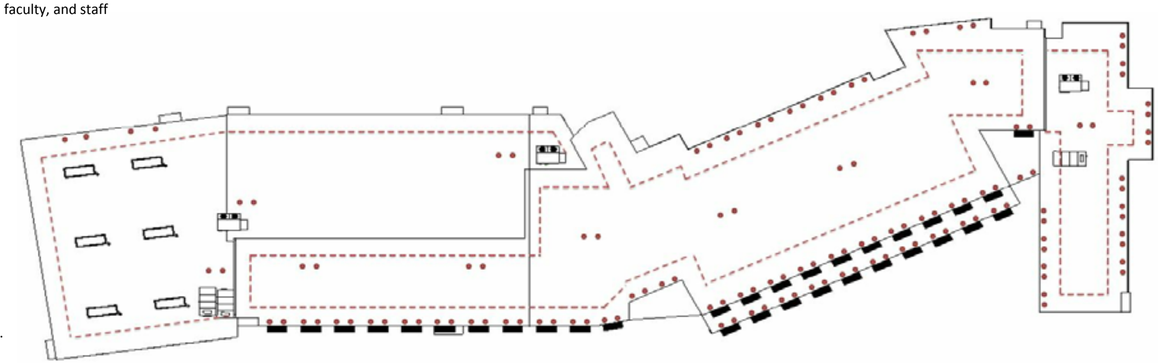
These concrete walls will be constructed ahead of the steel erection sequence to maintain the construction schedule. The walls will first need to be formed with the insulated panels, braced, and then concrete poured. The walls will be poured in one-floor lifts to allow the crane to easily reach over and place steel members that connect to the interior columns and rest on the ICF walls.

To maintain structural integrity, the walls are reinforced as shown in the middle right figure. Moreover, the insulated panels remain in place to provide thermal insulation that helps with the mechanical system efficiency.





The roof plan shown to the right has red circles on it that represent the roof davits. Roof davits are tie-off anchoring points for workers on the roof when they come within 15 feet of the edge (indicated with red dotted line). When outside the fifteen foot perimeter, all maintenace workers must be tied-off in case they were to fall off of the roof, their harness would prevent them from falling to the ground. These davits will mainly be used while window washing. The davits also have the capacity to anchor window washing equipment hoists. There are also intermediate interior davits for tie-off points when workers determine the workspace is unsafe to not be tied-off. There are davits located next to all mechanical equipment pieces for worker safety during maintenance procedures.



BUILDING INTEGRATION

2013 ASCE Charles Pankow Foundation

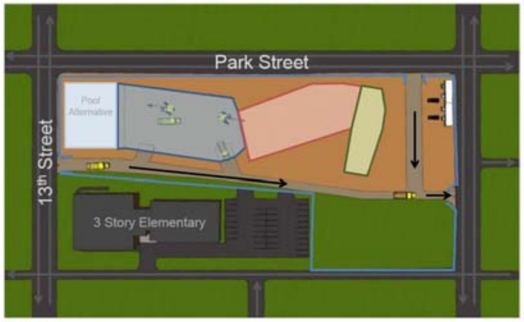
Annual Architectural Engineering Student Competition

Constructability

Drawings	.
Date	22 February 2013
Authors	Author

41

Scale



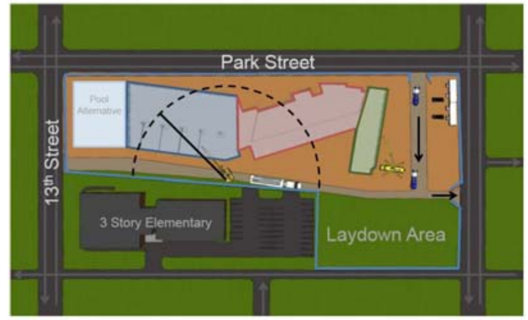
Zone 1
Zone 2
Zone 3

Excavation - 6/16/14 to 7/18/14

N

The excavation site plan on the left (as seen on page 9 of the report) displays the sequencing of the excavation phase of construction. The two 3-dimensional views of the excavation site plan are show in the right two middle figures. Excavators and dump trucks are show in Zone 1 of the building footprint in View 1. View 2 is taken from the site trailors perspective.

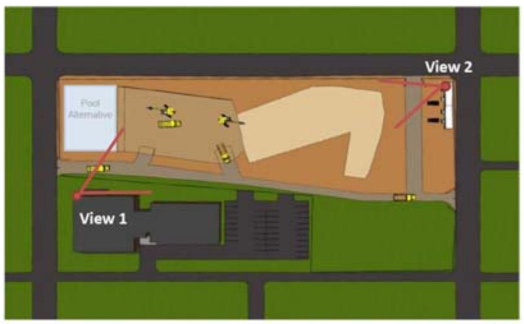
The superstructure site plan to the right (as seen on page 15 of the report) displays the sequencing of the steel and concrete structure. In general, the steel erection sequences will follow the concrete erection sequences. This is due to the steel being intgral into the exterior ICF bearing walls. As the walls are cast in one floor (14 foot) lifts, the steel will follow behind as the concrete cures. The two right bottom figures display these processes. View 1, from the west side of the site, shows the crane erecting first floor beams in the administration area (with the yellow concrete pump in the background). View 2, from the site trailor perspective, shows the concrete pump placing concrete in the first floor east wing classrooms.



Zone 1
Zone 2
Zone 3

Superstructure Erection - 8/29/14 to 1/23/15

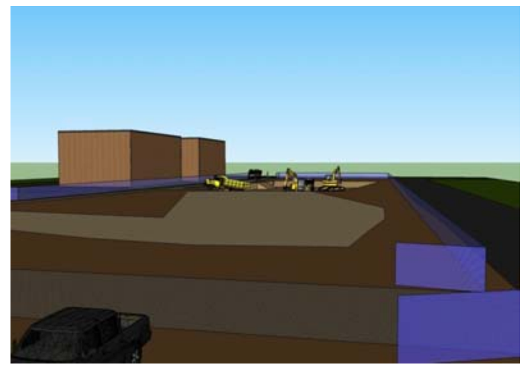
N



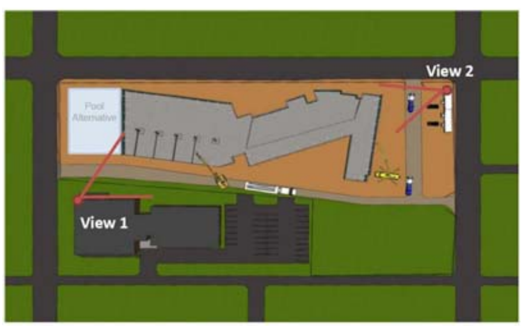
Excavation Site Plan

N

View 1

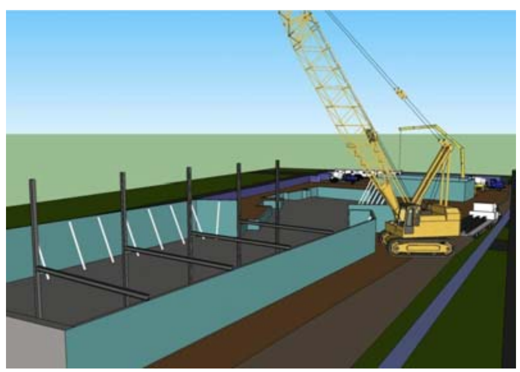


View 2

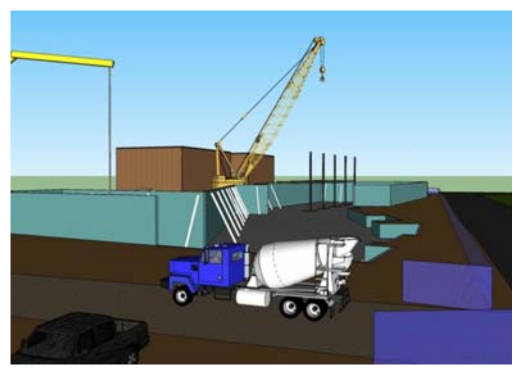


Superstructure Site Plan

N



View 1



View 2

nexus

BUILDING INTEGRATION

2013 ASCE Charles Pankow Foundation

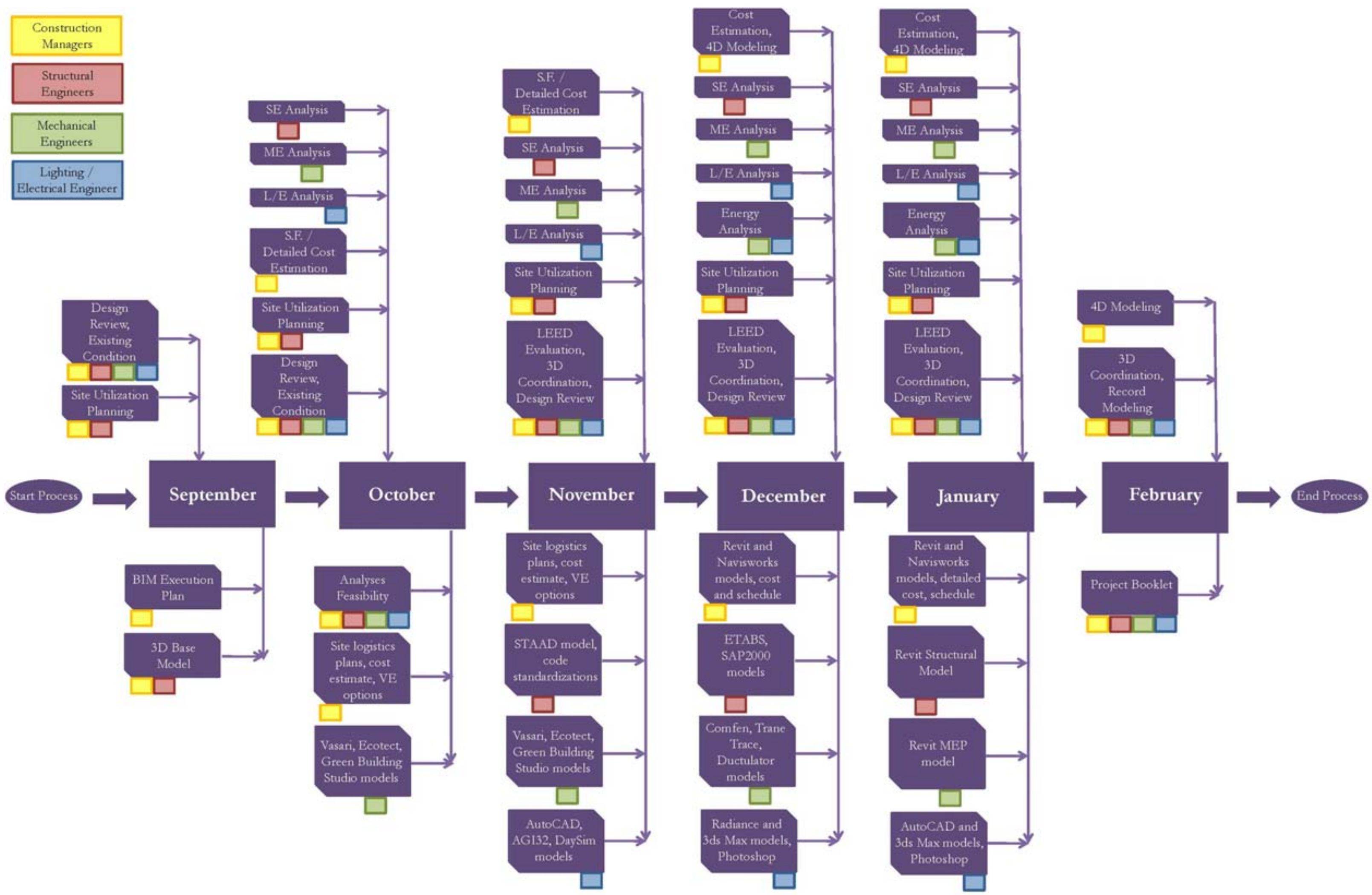
Annual Architectural Engineering Student Competition

Site Plans

Drawings	.
Date	22 February 2013
Authors	Author

42

Scale



The team overall process map depicts all of the teams process for the entire project. The team overall process map is a level one process map that is then further defined by level two process maps developed for each discipline.

Each phase of the project is divided into months (September - February).

The purple shaded boxes above the months represent Building Information Modeling (BIM) uses that each Nexus team member performed. The shaded (yellow, red, green, and blue) smaller boxes below each BIM use is which team members are performing those uses.

The purple boxes below the months are the outputs (or results) of the BIM processes performed by Nexus. The smaller colored boxes below these outputs represent which team members contributed to that deliverable. Many of these deliverables involved sophisticated technology applications to produce analytical models that helped the team integrate and collaborate.

nexus

BUILDING INTEGRATION

2013 ASCE Charles Pankow Foundation

Annual Architectural Engineering Student Competition

Team Overall Process Map

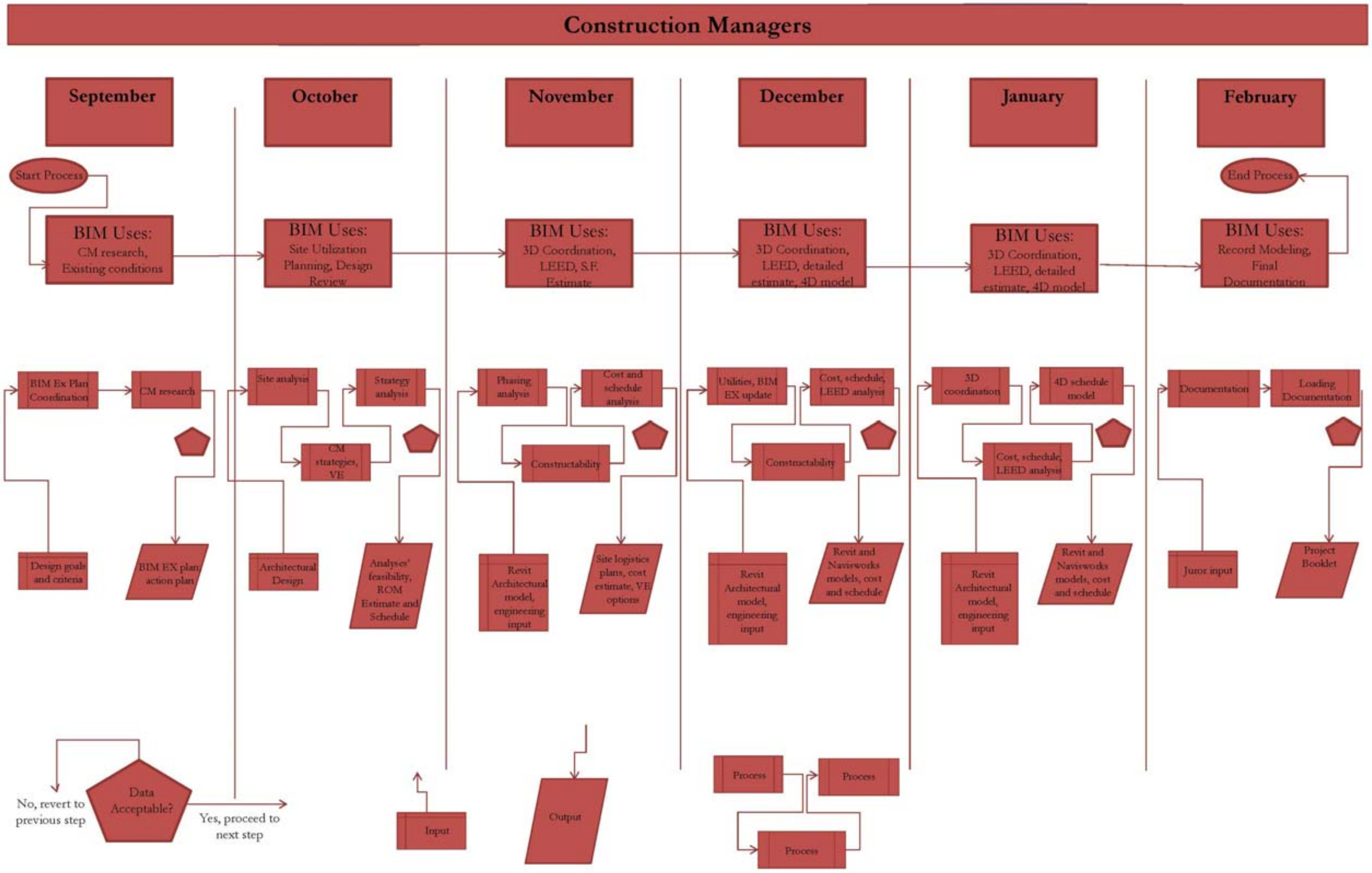
Drawings .

Date 22 February 2013

Authors Author

43

Scale



The Construction Management Process Map is a level two map to the Team Overall Process Map. This process map is organized in a similar fashion.

The BIM uses are listed below the months and flow from one to the next. Below that are inputs that go into three processes with an output coming out of that. However, if the output is not satisfactory, the pentagon shape tells the users to go back, reconfigure the input, perform the three processes again, and then the output should be acceptable.

As seen throughout this process map, there are several technologies listed including: Revit, Navisworks, and Microsoft Project.

nexus

BUILDING INTEGRATION

2013 ASCE Charles Pankow Foundation

Annual Architectural Engineering Student Competition

Construction Management Process Map

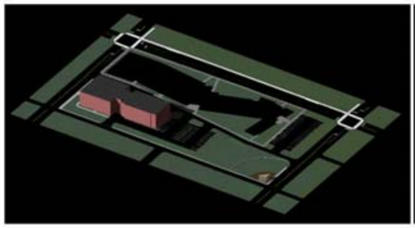
Drawings .

Date 22 February 2013

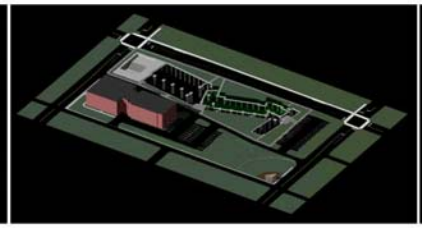
Authors Author

44

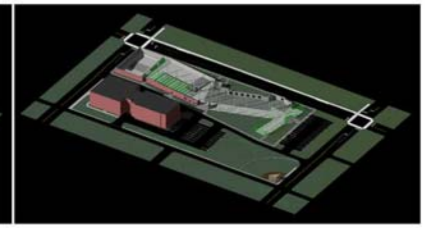
Scale



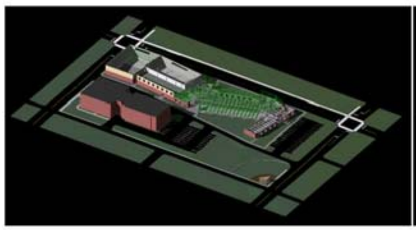
06/09/14 - Mobilization



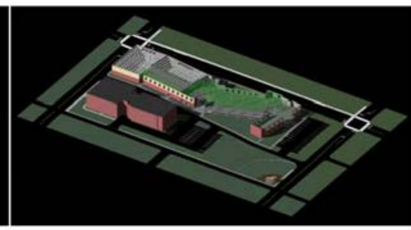
08/05/14 - 08/25/14 - Foundation



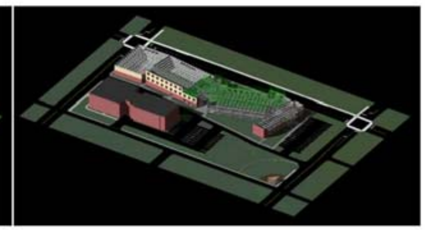
08/29/14 - 09/17/14 - First Floor Structure



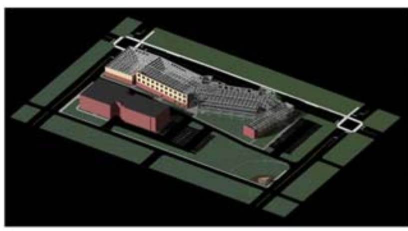
09/17/14 - 10/02/14 - First and Second Floor Structure



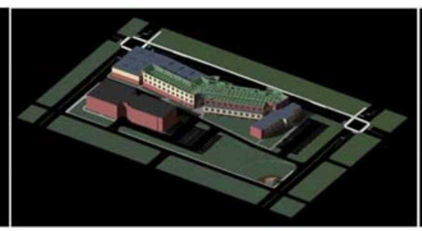
10/02/14 - 10/31/14 - Second Floor Structure



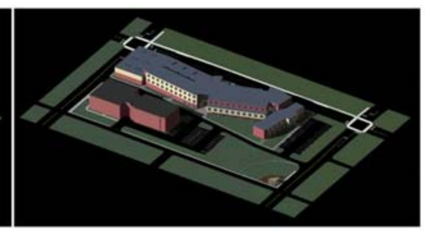
10/31/14 - 11/27/14 - Third Floor Structure



11/27/14 - 01/21/15 - Structure Complete



01/21/15 - 02/12/15 Roofing and Glazing



02/12/15 - 04/21/15 - Building Enclosed

nexus

BUILDING INTEGRATION

2013 ASCE Charles Pankow Foundation

Annual Architectural Engineering Student Competition

Navisworks

Drawings	.
Date	22 February 2013
Authors	Author

45

Scale