



Executive Summary

This thesis assignment provides insight into the existing construction conditions for The Center for Health Research and Rural Advocacy project, which is located on the Geisinger Medical Campus in Danville, Pennsylvania. The 67,200 square foot facility will house numerous conference spaces, research offices, and a three hundred seat auditorium. The eventual client of the facility will be the Center for Health Research and Rural Advocacy division of the Geisinger Health System. The facility will be a center for healthcare research regionally, nationally, and globally in the years to come.

Geisinger Health Systems will budget the project out to their own construction division known as Geisinger Facilities which will act as a general contractor throughout the process. Geisinger Facilities will oversee the design process and manage construction through lump sum contracts with the subcontractors. The project will be delivered through a design-build structure, which will allow for the infrastructure and utility relocations to occur while the remainder of the project is designed. Geisinger Facilities' experience greatly enhances their ability to effectively manage a design build project.

Cost estimates for the Center for Health Research and Rural Advocacy using D4 Cost and R.S. Means were much lower than the actual project cost. This was due to the high quality of standards for the facility, as well as the large amount of sitework to be completed before the building project may begin. The aluminum curtain wall system is a large part of the total cost of the project and will need to be efficiently managed to ensure proper coordination and erection.

The CHRRA will be striving for sustainability through LEED certification by using energy efficient mechanical, electrical, and plumbing systems, building automation, and effective waste management. This method of construction is different than most of the other projects completed by Geisinger Facilities and will need to be closely managed to ensure that the desired rating is acquired. The aluminum curtain wall system is also radically different than the typical brick and concrete structures on the Geisinger Medical Campus.



Project Schedule Summary

To view project schedule please reference attached Appendix A.

The project schedule follows a design-build format with portions of the project going out for bid and procurement while others are still in design. The overall design and bidding processes are schedule to run from January 2005 until November 2005. The original schedule produced by Geisinger Facilities had excavation for the entire building starting August 29, 2005. The excavation was to follow the relocation of Centre Street, a main pedestrian and traffic artery through Geisinger Health Campus, as well as the moving of various other utilities including a domestic water loop, sewage, and telecommunications.

Under pressure from Geisinger Health Systems to begin construction while the utility and Centre Street relocations were occurring, Geisinger Facilities devised a new schedule. The excavation and footings for the auditorium would begin on July 11, 2005 without disturbing existing Centre Street or the utilities. This meant the ground breaking ceremony would be held in July rather than early September. Upon completion of the utility relocation, site excavation would begin in the East and work toward the West as new Centre Street is completed on September 23, 2005.

The footings, foundations, and load bearing walls for the Research Center, not including the auditorium, will be poured from August 2005 until February 2006 and will follow a similar path as the excavation.

The finishes sequencing will start in the auditorium and work upward toward the third floor. Sequencing on individual floors will start on the ends of the wings and work towards the elevators to minimize traffic on finished areas. This will hopefully minimize damage and rework to already finished materials.



Building Systems Summary

Demolition

There are two phases or areas of the Center for Health Research and Rural Advocacy project which involve the demolition and relocation of existing facilities and structure. The CHRRA building will connect directly to the Weis Research Center through a walkway on the lower level. Materials to be removed include concrete structure and core, gypsum wallboards, masonry exterior walls, fireproofing, roof membrane where piping is removed, and partitions.

Additionally, two existing exhaust fans will be relocated from the Weis Research Center's mechanical area on the roof to the new mechanical suites in the CHRRA. One cooling tower and required piping will be completely removed from the Weis Research Center since the two buildings will eventually share a mechanical system.

Electrical demolition for the project includes the removal of two automatic switch controls, 6 sixty amp control panels, and 2 thirty amp control panels and wiring. These systems are located in one electrical room in the Weis Research Center where the connection to the CHRRA will occur.

Structural Steel Frame

The structural steel frame for the Center for Health Research and Rural Advocacy employs a braced frame system with diagonal HSS steel. These are of typical sizes 7x7x1/2" or 10x6x5/8" and are connected to the structural columns and beams with 3/4" gusset plates. At the ground level, these connections are encased in concrete for additional support.

The basement floor is a 5" concrete slab on grade with the intermediate floor systems being 6" concrete slab reinforced with 6x6-W2.9xW2.9 welded wire fabricate on top of 2" 20 gauge metal decking.

Since the largest and highest pick for the crane will involve a 43' W10x100 column, a 35 ton mobile crane with a 120 foot boom will be used for the structural steel erection. The mobility of the crane will allow it to travel around the arched building



footprint to reach areas that would require an oversized tower crane. Since the lifting heights do not exceed 43' above grade, a mobile crane can be used extensively.

Cast in Place Concrete

Cast in place concrete is used for the basement walls as well as the for the floor slabs. The horizontal and vertical formwork is to be made of wood of quality related to if the surface is exposed or not. Unexposed concrete surfaces may be formed with No. 2 Common lumber or plywood while exposed concrete surfaces must be formed with New Douglas Fir B-B not less than 5-ply and at least 5/8" thick.

The cast in place work is in accordance with ACI 301, ACI 318, and ACI 347 and is to be completed in phases. The slab on grade is to be made in two pours, one being the large mechanical room space. The other composite floor systems are to be poured in two sections as well, one being the open office spaces, while the other includes the multi-use areas and supporting facilities.

Precast Concrete

The casting of the architectural precast concrete will occur at High Concrete Structures, Inc. facilities in Denver, Pennsylvania and transported to site. The architectural panels range in rectangular shapes from 18' x 4' to 12' x 2' and are all 6" thick. The panels will match the existing Weis Research Center in terms of color, texture, and finish.

The panels will be connected through the use of shear bars, 1'x4'x6" embedded to the structural steel below the finished floor elevations.

The precast panels will be lifted with a mobile crane similar to the structural steel. The mobile crane will be able to move around the site and position the precast panels as needed.

Mechanical System

The mechanical support system of the CHRRA will also serve the Weis Center. The new mechanical system will use 4 variable fan speed Air Handling Units, each with



½” coiling coils and 5/8” heating coils ranging in size from 27,000 CFM to 4,000 CFM. Three, 500 ton capacity, variable frequency drive water chillers will service the two buildings. A complex refrigerant recovery system will have the ability to monitor, test, and purge all refrigerant. There are four designated mechanical spaces servicing the two buildings, three rooms in the CHRRA and the Weis roof. Extensive re-piping work is to be done in the Weis Center for hot and cold water, high pressure steam, and condensate return. The distribution piping is made of copper type L, hard temper and of typical sizes 1” to 4”, riser piping made of black steel for sizes larger than 10”.

A hydraulically designed sprinkler system is used for fire protection at the CHRRA. Sprinklers service no more than 225 square feet in the office and open areas, and no more than 130 square feet in mechanical spaces. Concealed quick response heads are used in finished ceiling areas and are designed for use in 155^oF temperatures. Sprinkler piping is made of black steel typically 2” in distribution areas and 6” in riser piping.

Notification system includes addressable heat and smoke detectors, standard manual pull stations, and electro-magnetic door holders. There are also two LCD annunciators located at the main entrance and nurse’s station.

Electrical System

Power supply comes into the new research facility at 480/277V standard from the Plant Engineering Building. A 1500/1750KVA transformer, located in the electrical substation room, is used to feed the substation 2500A, 480/277V supply power. The substation serves nine distribution panels utilizing the three phase service. An additional four dry 300KVA transformers are to be used to step down the voltage to 208/120V for the main distribution panels. All circuit breakers and switches for the project are three-pole.

Emergency power for the facility is provided by a 1250 KW, three phase, 60 Hz emergency generator located in the emergency generator room on the lower level. The generator includes electronic metering of supply needs as well as an adjacent emergency standby motor control center.



Curtain Wall

The finished aluminum curtain wall system with glazing at the main lobby entrance, and west stairwell will consist of structurally reinforced .125" thick extruded aluminum framing with glass infill panels of typical size 4' x 9'-6". The color will be an Architectural Class 1 clear anodic coating. The remaining aluminum wall system, which is the majority of the project, is made up of a two glass system. The insulating glass is spliced by 1" thick strengthened float glass with reflective coating. These reflective glass panels are also used above the windows on the west façade.

The remaining façade consists of a 2" metal panel system fastened to 16 gauge metal framing. These metal panels will be 2" thick and typically 1' x 13' fabricated from 22 gauge G90 galvanized steel. There are seven metal wall louvers at the mechanical room which are also finished to match the aluminum anodic coating of the curtain wall system.

The design and construction responsibilities rest directly on the selected subcontractor, who must submit shop drawings and product data with a letter of certification of a registered Professional Structural Engineer in the commonwealth of Pennsylvania that the shop drawings were completed under their direction. Field testing must also be conducted to verify performance criteria of the curtain wall system. The design basis was created by Ewing Cole.

The construction of the system occurs in two phases. First, the aluminum framing will be installed, followed by the installation of the glazing and required sealing.

Support of Excavation

Since most of the site was made up of stiff silty clay, the excavation for the auditorium could be sloped and comply with OSHA regulations. Dewatering was necessary for ground water during auditorium excavation. Once excavation begins on the remainder of the site, a soldier beam and lagging system will be used to retain the newly positioned Centre Street. The remainder of the site will utilize a slope since there is plenty of available area to the west and south.



Project Cost Evaluation

Construction Costs: **\$11,863,594**

Construction Cost / SF: **\$176.55**

Note: Construction Costs do not include Sitework, Infrastructure, Auditorium Fit-out, Telecommunications, Green roof soil and planting, Connection to Weis Basement, & sales tax.

Total Project Costs: **\$19,206,000**

Total Project Cost / SF: **\$285.80**

Structural System Costs: **\$3,020,827**

Structural System Cost / SF: **\$44.95**

Note: Includes Structural Steel and Concrete

Electrical System Costs: **\$1,438,000**

Electrical System Cost / SF: **\$21.40**

Note: Does not Include Electrical Infrastructure Relocation

Mechanical System Costs: **\$2,778,600**

Mechanical System Cost / SF: **\$41.35**

Note: Does not Include Mechanical Infrastructure Relocation, New Chillers, or Relocation of Cooling Towers

Cladding System Costs: **\$1,735,252**

Cladding System Cost / SF: **\$25.82**

Parametric Estimate (D4 Cost Estimate)

Please refer to Appendix B for a copy of the printout from the D4 Cost Estimate

Program.

Total Building Costs: **\$12,565,987**

Total Project Costs: **\$12,565,987**

To produce the estimates shown above, four buildings were selected with similar square foot areas and number of floors. Two of the four were office buildings, one was a civic/government center for historic research, and the fourth was a medical research facility. The four buildings represented all the aspects in the design of the Center for Health Research and Rural Advocacy.



Square Foot Estimate (R.S. Means)

Assumptions:

- The Center for Health Research and Rural Advocacy is a multi-use facility with administrative offices, conference spaces, and an auditorium. Therefore, splitting the project into two separate structures was necessary.
- 65,000 SF was used for the Office calculation while the value for the auditorium was extrapolated for 2,850 SF.
- Glass metal curtain wall w/ steel frame was used since most closely resembled an aluminum glazed curtain wall system.
- Face brick and concrete w/ steel frame used for the auditorium since the interior auditorium has cast in place walls finished on the exterior.
- Since the location factor for Danville, Pennsylvania was not available, Williamsport was used as the closest available geographic region.
- Historic costs were not applicable since the R.S. Means Square Costs 26th Annual Edition: 2005 was used.

Office, 2-4 Story (64,350 SF)

Glass Metal Curtain Wall w/ Steel Frame	\$107.40 / SF
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Auditorium (2,850 SF)

Face Brick and Concrete w/ Steel Frame	\$155.82 / SF
Upholstered Seating (300)	\$234 / EA

Subtotal	\$7,425,477
Location (Williamsport)	0.88
Total	\$6,534,420

Discussion of Estimate Results & Actual Costs

The estimates produced through R.S. Means and D4 Cost were vastly different. The total building cost assembled through the D4 Cost database was off by less than \$1 million; however, the D4 Cost estimate includes general conditions and site work which not included in the actual construction costs. The accuracy was due to an adequate use of mix use buildings with similar areas and floors. The total project cost estimated through D4 was much different than the actual project cost by almost \$7 million. This is due to the intense amount of utility relocation and infrastructure required for the CHRRA project.



The R.S. Means estimate was significantly inaccurate by \$5 million or approximately half the actual cost. This was most likely due to the inability to accurately reflect a mix-use facility through R.S. Means. The Center for Health Research and Rural Advocacy is also a high quality project which may not be reflected correctly through the means calculation.



Site Plan of Existing Conditions

Please see Appendix C for site plan.

Local Conditions

The preferred method of construction for Geisinger Medical Campus projects includes a structural steel frame, with composite floor slabs, and typical tan brick and masonry facades. The Center for Health Research and Rural Advocacy is drastically different than the other projects in terms of the exterior envelope. The other Geisinger facilities do not employ large aluminum curtain wall systems or large precast concrete panels. Since infrastructure work is not an aspect that Geisinger Facilities has a lot of experience in, an MEP contractor was brought on early in the construction process to raise issues and concerns with the movement of utilities and roadways.

Construction parking is a complex issue at the Center for Health Research and Rural Advocacy site, since a large doctor parking lot sits adjacent to the property. Contractors must park in the large patient parking lots located on the opposite side of the medical campus, and then ride the Geisinger bus system to the site. Geisinger Facilities denoted an area for the contractors to park as to not take parking away from normal hospital patients.

Since the Center for Health Research and Rural Advocacy will be a LEED certified building, recycling is huge issue. Danville, Pennsylvania offers free recycling for all residents; however, the commercial building industry is not as lucky. The lack of a local recycling plant makes tipping fees upward of \$20 per ton.

Ground water locations for the project site were encountered at 25 feet below finished grade, however; only three of the eleven bore samples found any water when drilled to 30 feet. The vast majority of the boring logs found reddish brown silty clay which was moist and stiff. This clay material was found throughout the entire range of the boring logs, with the exception of some sporadic brown clay with rock fragments.



Client Information

Heal. Teach. Discover. Serve.

Geisinger Health System is a physician-led health care system, providing health care, education, research, and service to almost two million people across Pennsylvania. The 437-bed Geisinger Medical Center houses doctors, nurses, researchers, and other healthcare specialists dedicated to providing exceptional service through state-of-the-art facilities. The Geisinger Health System contains a division known as Geisinger Facilities which manages all aspects of the buildings and infrastructure on the Geisinger Health Campus located in Danville, Pennsylvania. The Geisinger Facilities division is essentially a General Contractor employed during the design phases their projects. Once the Geisinger Health System Foundation Board of Directors approves the construction of a project, the Geisinger Facilities managers act as the owners and general contractor for that specific project.

The Center for Health Research and Rural Advocacy (CHRRRA) needed a new high tech facility to cope with ever changing demands in healthcare research. The relocation of one hundred and twenty staff members from the Weis Research Center to the CHRRRA building will allow for improvements in the effectiveness of health services and medical treatments research. The three hundred seat auditorium and numerous other conference rooms will fulfill CHRRRA's need for educational spaces where professionals from across the country may present research findings.

The Geisinger Facilities' goals for the project include a timely and cost efficient management of the relocation, construction, and infrastructure work required for the Center for Health Research and Rural Advocacy. Safety standards are extremely high, which includes the laborers on-site, as well as protection for the doctors, nurses, and other healthcare specialists who drive and walk by the construction site everyday. Waste management, emissions control, and other health risks are of high concern due to the close proximity to the existing Weis Research Center and the main patient care compound. The Geisinger Health System always employs a high quality of construction



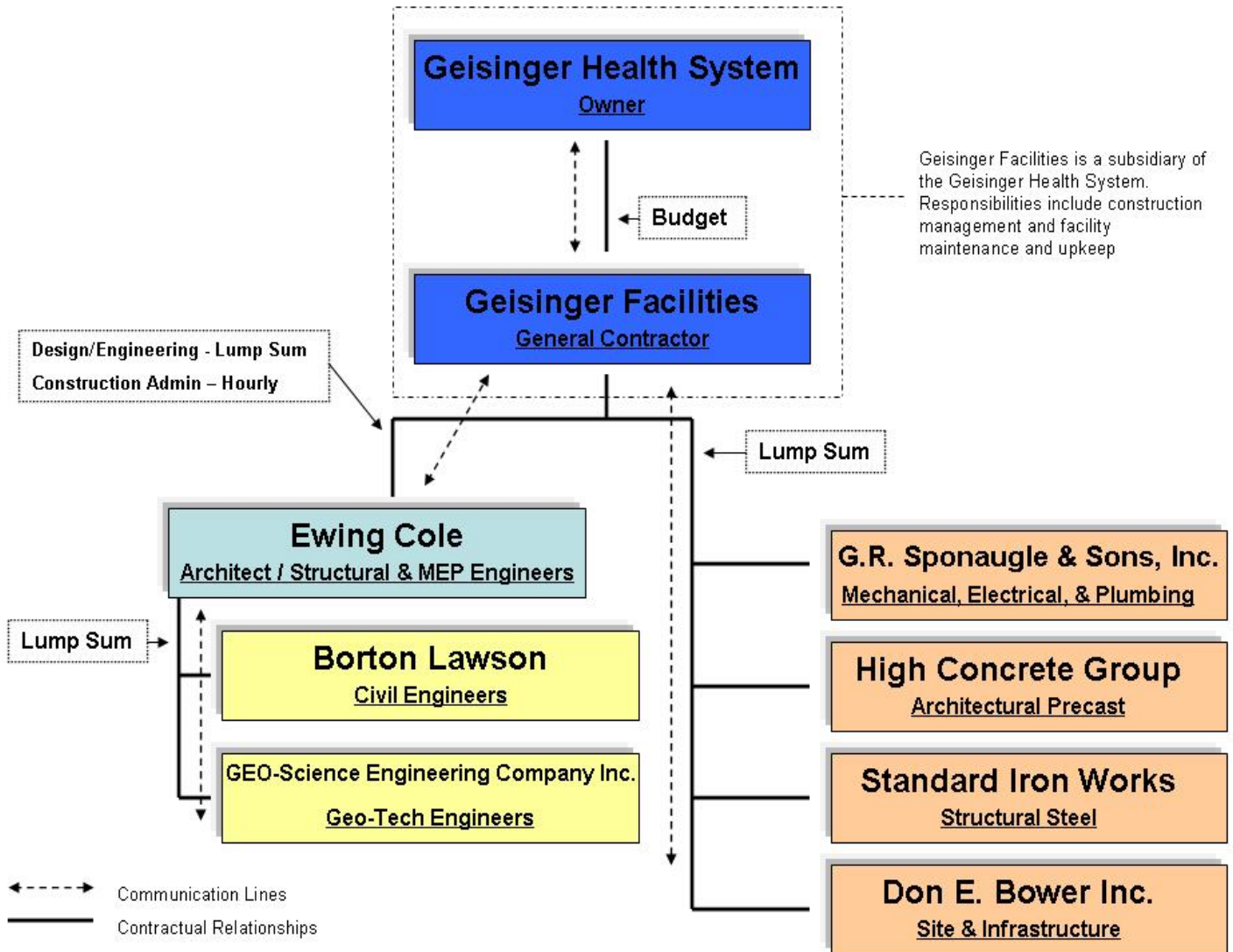
for all their healthcare projects which is evident in all the facilities on the Geisinger Medical Campus.

Sequencing issues for the Facilities' project management team are important, but not critical for the CHRRA building. It is more important that the project is completed when scheduled to allow a smooth transition for the researchers rather than monetary concerns as in most other construction projects. Some key sequencing issues the owner cares about include integrating the MEP systems for the two research facilities during normal operating hours, as well as the eventual connection of the two facilities.

At completion of the Center for Health Research and Rural Advocacy project, the Geisinger Facilities' team would like to see a state-of-the-art facility completed as scheduled and at a cost equal to or less than the allotted budget. The CHRRA will be a jewel on the Geisinger Medical Campus and will hopefully be a center for healthcare research regionally, nationally, and globally in the years to come.



Project Delivery System



As seen in the diagram above, Geisinger Facilities holds a budgetary type contract with the parent organization. Once the budget is accepted through a lengthy approval process, the Geisinger Facilities begins management of the allocations of funds to their subcontractors. Subcontracts are selected on a low-bid basis and typically employ a lump sum contractual agreement on all Geisinger Medical Campus projects. Change orders are directed through Geisinger Facilities as the acting General Contractor where they have the authority to approve or reject the change orders.



Geisinger Facilities also holds the lump sum contract with the Ewing Cole, the architect; however, once design and engineering phases of the project have been completed, Geisinger Facilities will pay Ewing Cole hourly for construction administration.

Performance and payment bonds are not required for the subcontractors by Geisinger Facilities; however, comprehensive insurance programs are necessary. The insurance policies are as follows:

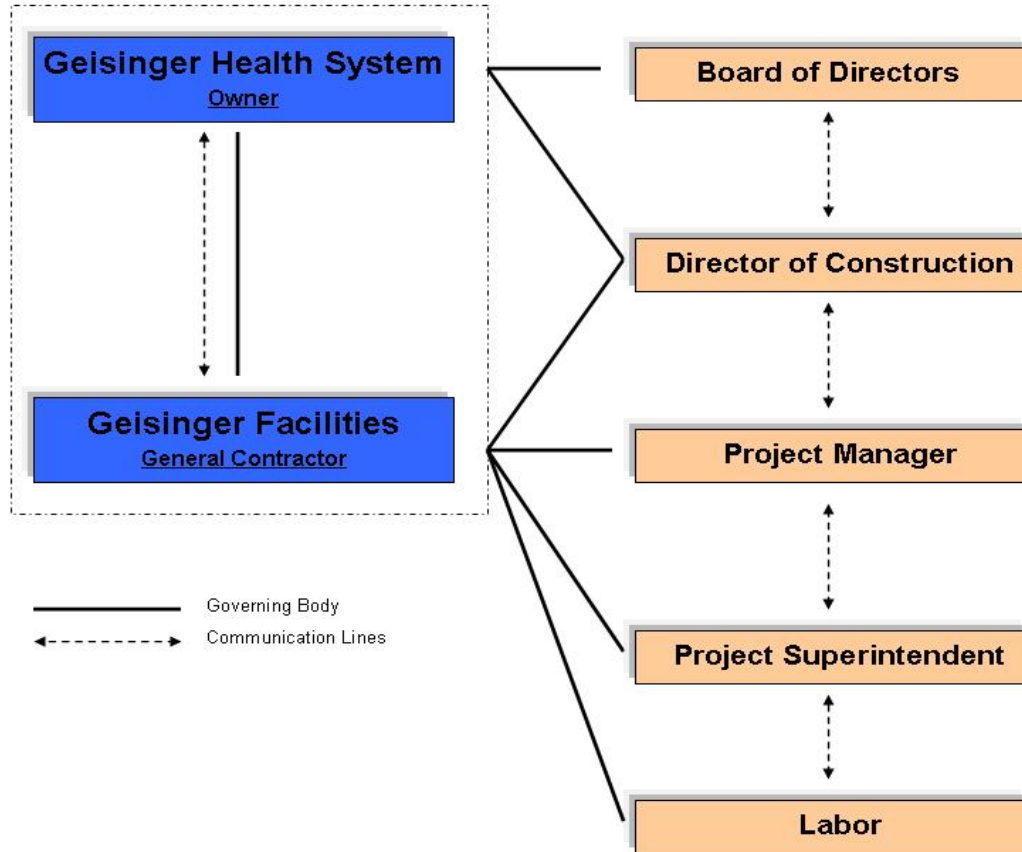
- Workmen's Compensation, Employer's Liability, Temporary Disability Benefits with Limit of Liability for Employer's Liability coverage not less than \$1,000,000.
- Comprehensive General Liability and Comprehensive Automobile Liability
- Bodily Injury Liability (minimum limits of \$1,000,000 each person and \$3,000,000 each occurrence.
- Property Damage Liability
- Contractual Liability

Projects completed on Geisinger Medical Campus typically are delivered in a design-build format. Since Geisinger Facilities is a very experienced owner, a design-build type delivery system is feasible and often times can greatly accelerate the schedule of their projects. For this type of project, the design-build allows for the extensive infrastructure and existing utilities work to begin before the entire design is complete.

Geisinger Facilities employs an appropriate delivery system for the amount of experience they have for construction projects on the Geisinger Medical Campus. The contract types allow them to control the budgetary requirements of the job closely and keep change orders and other additional costs closely monitored.



Staffing Plan



The Director of Construction for the Geisinger Health System is responsible for determining the feasibility of projects, cost analysis, and other preconstruction concerns the Board of Directors may have. This position is similar to a Project Executive at a large Construction Management firm and his responsibilities; however, his responsibilities are often to more than one project. He is technically an employee of the Geisinger Health System, but the director of construction is in close coordination with Geisinger Facilities, since the project manager will report directly to him.

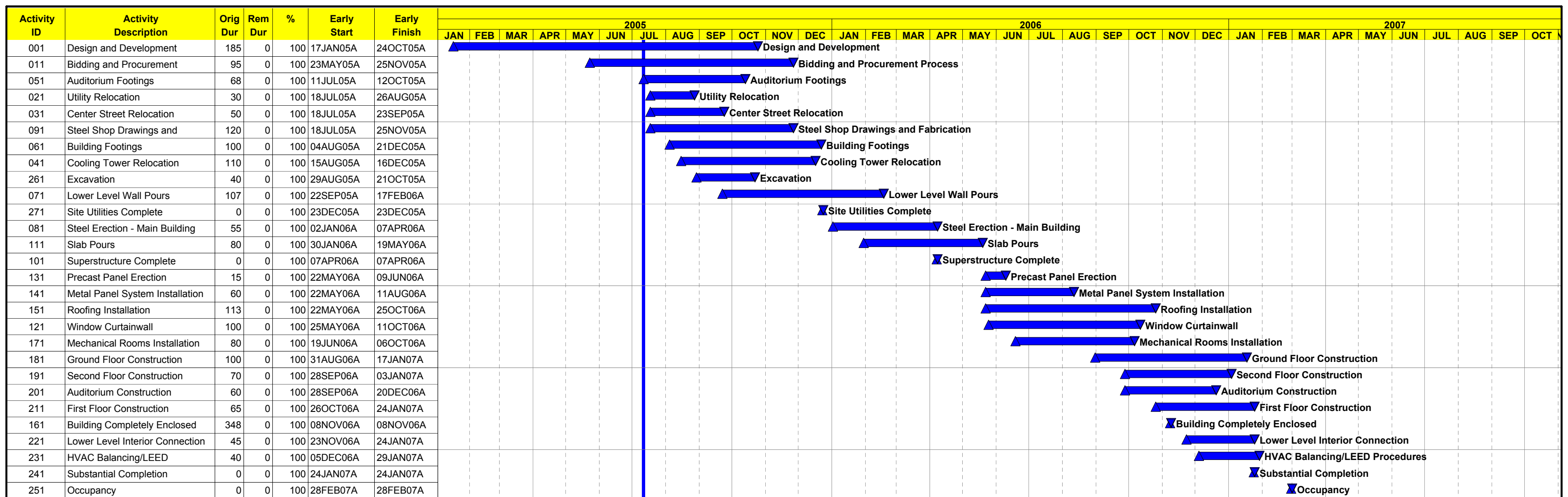
Geisinger Facilities assigns at least one of their project managers to every project. The project manager is responsible for preconstruction activities, such as procuring of materials and subcontractors as well as cost control and value engineering ideas. Since all the construction is on the Geisinger Medical Campus, he is technically on site every



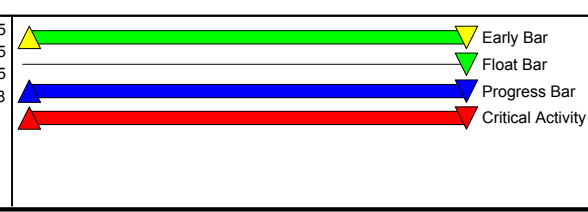
day. The plan is to have the project manager working on the project from the very early design stages up until the final inspections and occupancy.

Since the Center for Health Research and Rural Advocacy is a fairly small project for the Geisinger Facilities, only one superintendent was assigned to it. The superintendent is brought onto the management team once subcontractors as well as the Geisinger labor force have been determined. He is not involved in preconstruction services and his responsibilities last throughout the entire phase of the construction process. His assignments include coordinating and managing sitework as well as supervising construction activities.

As mentioned before, Geisinger Facilities is like a general contractor, which means they have their own labor force to do certain aspects of construction. For the CHRRA, Geisinger employed the remainder of their workforce. Their responsibilities include pouring and forming concrete, masonry, and other various general trades portions of the project.



Start Date	17JAN05	▶
Finish Date	10JUL05	▼
Data Date	11JUL05	▶
Run Date	28SEP05 18:18	▶



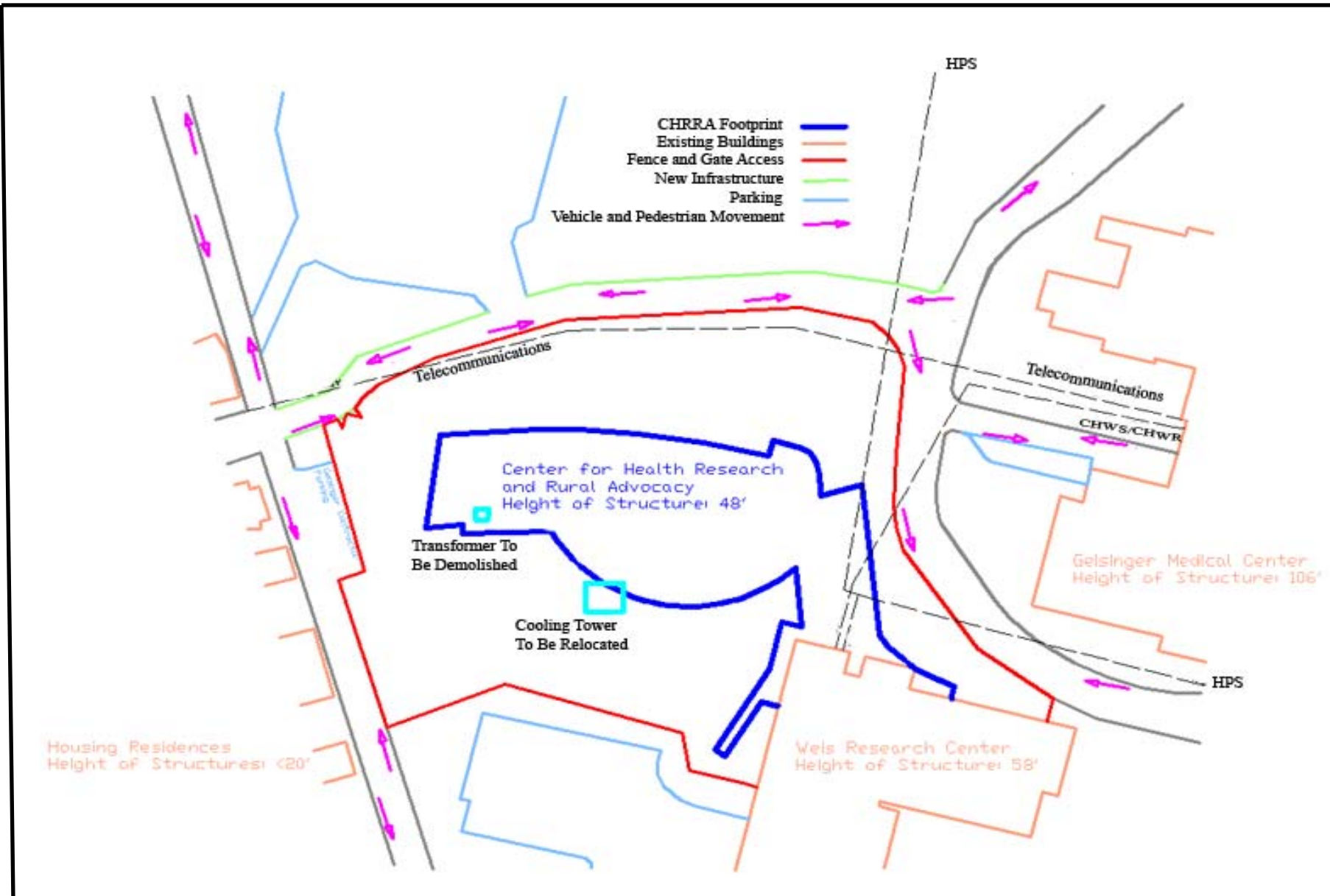
CHRR
 Geisinger Health Systems
 Center for Health Research
 Classic Schedule Layout

Sheet 1 of 1

Date	Revision	Checked	Approved

Center For Health Research and Rural Advocacy D4 Cost Estimate

<u>Code</u>	<u>Division Name</u>	<u>%</u>	<u>Sq. Cost</u>	<u>Projected</u>
00	Bidding Requirements	2.58	\$4.82	\$324,191
	Bidding Requirements	2.58	\$4.82	\$324,191
	Untitled	0.00	\$0.00	\$0
01	General Requirements	4.09	\$7.65	\$514,324
	General Requirements	4.09	\$7.65	\$514,324
02	Site Work	10.45	\$19.54	\$1,313,207
	Site Work	10.45	\$19.54	\$1,313,207
03	Concrete	12.07	\$22.57	\$1,516,753
	Concrete	12.07	\$22.57	\$1,516,753
04	Masonry	8.57	\$16.02	\$1,076,320
	Masonry	8.57	\$16.02	\$1,076,320
05	Metals	5.91	\$11.05	\$742,665
	Metals	5.91	\$11.05	\$742,665
06	Wood & Plastics	7.15	\$13.37	\$898,314
	Wood & Plastics	7.15	\$13.37	\$898,314
07	Thermal & Moisture Protection	3.95	\$7.39	\$496,542
	Thermal & Moisture Protection	3.95	\$7.39	\$496,542
08	Doors & Windows	4.16	\$7.78	\$523,016
	Doors & Windows	4.16	\$7.78	\$523,016
09	Finishes	7.27	\$13.59	\$913,112
	Finishes	7.27	\$13.59	\$913,112
10	Specialties	0.94	\$1.77	\$118,690
	Specialties	0.94	\$1.77	\$118,690
11	Equipment	0.79	\$1.48	\$99,542
	Equipment	0.79	\$1.48	\$99,542
12	Furnishings	0.67	\$1.26	\$84,418
	Furnishings	0.67	\$1.26	\$84,418
13	Special Construction	0.45	\$0.84	\$56,388
	Special Construction	0.45	\$0.84	\$56,388
14	Conveying Systems	1.00	\$1.87	\$125,470
	Conveying Systems	1.00	\$1.87	\$125,470
15	Mechanical	17.77	\$33.23	\$2,232,776
	Mechanical	17.77	\$33.23	\$2,232,776
16	Electrical	12.18	\$22.77	\$1,530,261
	Electrical	12.18	\$22.77	\$1,530,261
	Total Building Costs	100	\$186.99	\$12,565,987



EXISTING CONDITIONS
SITE PLAN

CENTER FOR HEALTH RESEARCH AND RURAL ADVOCACY
GEISINGER MEDICAL CAMPUS
DANVILLE, PENNSYLVANIA

