Peter Pan Peanut Butter

Sylvester, Georgia Processing Plant

Final Report

The Pennsylvania State University

Architectural Engineering

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ConAgra Foods - Peter Pan Peanut Butter Processing Plant

Sylvester, Georgia

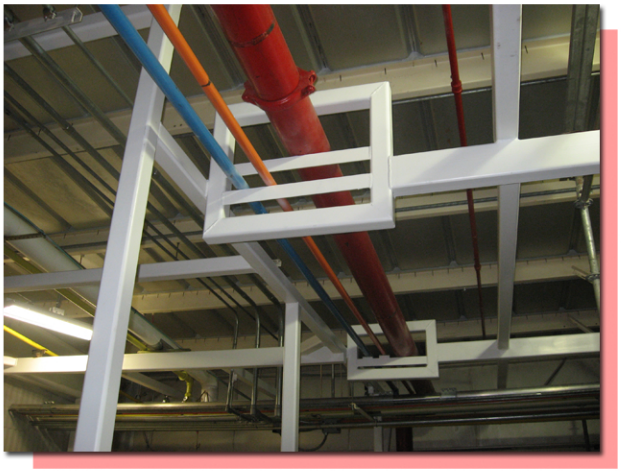
Project Team
- Owner: ConAgra Foods Inc.
- Design-Build Contractor: The Haskell Company

Project Information
- Renovation project of an existing metal building
- Dates: May, 8 to August, 9 of 2007
- Usage: Food processing and distribution
- Size: 200,100 SF
- Cost: $13.5 Million
- Project Delivery Method: Design-Build

Structural System
Structural repair to all 19 of the building's frames
- Addition of L2x2x1/8 for flange bracing every 8'0" o.c.
- Addition of PL 3x3/8x2' web stiffeners every 2'0" o.c.
- Addition of PL 3x3/8 for entire span of bottom flange
- Addition of L3x3 for entire span of frame for top flange

Addition of structural supports to transfer load from frames
- TS6x6 for vertical spans greater than 20'0" TS4x4 for other
- TS7x4 was used to transfer load from structure to columns
- Anchored into the slab with 5"x3/4" expansion bolts

Existing Slab on Grade
- Existing slab on grade is 8" 3000 psi concrete
- Reinforced by 4x4 W1.4x1.4 wire mesh



Mechanical and Electrical Systems
- 14 Make-up air units each producing 20,000-25,000 CFM
- 1 Air handling unit with cooling condenser at 2,500 CFM
- (1) 48 gallon, 45,000 BTUH water heater
- (2) 200 KW, 13 GPM @105oF rise instantaneous water heaters
- Panels: (2) 480V motor control centers, (3) 480V panels, and (2) 480V to 120/208V transformers
- Fully sprinkled wet fire system

http://www.arche.psu.edu/thesis/portfolios/2008/jmg494/

Johnathan Garlow - The Pennsylvania State University - Construction Management

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Acknowledgments

I would like to show my appreciation and thank the following. Through their unnecessary generosity, help, and support this thesis project would not have been possible.

The Haskell Company

Matthew Gulden	Director of Construction
Craig Baker	Project Manager
Michael Woods	Project Manager
Michael Stevens	Superintendent
James Ward	Mechanical Engineer

ConAgra Foods Inc.

Michael Fleming	Owner's Representative
Bill Greenwood	Owner's Representative

Industry Members Participated in my Survey and Research Interviews

The Pennsylvania State University

Dr. David Riley	Professor – Construction
Dr. John Messner	Professor – Construction
Prof. Kevin Parfitt	Professor – Structural

Finally, I would like to thank my friends and family for giving me the support I needed while attending The Pennsylvania State University.

Executive Summary

Project Stallone is a renovation project for ConAgra Foods Inc. for their long time name brand, Peter Pan Peanut Butter. The site is located in Sylvester, Georgia, a town of about 6,000 people that is known as the Peanut Capital of the World. The project took place in the summer of 2007, with an extremely tight, high risk schedule, from May to August. The contractor that took on the task of the job was The Haskell Company, a large design-build firm based out of Jacksonville Florida.

In December of 2007, I had started this project with three vague ideas of what I was going to research and work on throughout the semester. As the semester came to a close, those topics came more and more into focus. Workforce development which is a huge problem facing the industry today, is going to be a problem that needs attention before the "baby boomers" get set to retire. Over the next ten years 46.7 percent of the construction industry will be over the age of 55 years-old. Right now programs such as Pennsylvania College of Technology and The Commonwealth Workforce Development System of Pennsylvania are leading the way for find individuals and sparking their interests in programs such as the construction labor industry. Another realization that is coming into play is the number of Hispanic workers that are in the labor forces now. This is also a solution to the problem, but raises problems of its own. With a lack of communication skills, Hispanics count for 80 percent of the injuries in the field today.

In other research that I took upon myself through my thesis, I resolved a scattered structural system that took unusable floor space and made it capable of being used again, while lowering the costs dramatically and keeping the same scheduled time for completion. Finally, I focused my efforts on the mechanical system and its inefficiencies, by adding some cooling to compensate for heat producing process equipment I found a solution that was able to save the owner, by reducing the overall number of air changes per hour.

In closing, this final effort before graduation has pushed the limits of my abilities as an Architectural Engineering student to gather all of my knowledge that I have learned the past 5 years and showcase it in this report.

Project Summary

Project Information:

Located in a small town in Worth County, Georgia, Sylvester is known as the Peanut Capital of the World. The project got its name from the famous actor and from the name of the town where the building is located. Project Stallone was a project done by ConAgra Foods as a project to renovate an older building that housed the production of one of their oldest name brands, Peter Pan Peanut Butter. The renovations to the building started with the replacement of the roof on the building. This included a single-ply PVC roofing membrane with an underlying insulation layer. Structural renovations included repairs to the existing frames of the original metal building and braces that extended to carry the load of processing equipment that was attached to the original structure, rendering it close to failure. During the structural repair temporary supports in the form of scaffolding were used to ensure that the structure would not fail during the unloading, they were removed upon completion of the repairs. Epoxy flooring was added to 85 percent of the plants area. Rooms were created to section off certain areas. This allowed for the addition of air handling units that were used to pressurize the entire building for positive to negative; positive being the end, or the packaging area, and negative being the raw peanut area, where the product was brought in. along with all of this there was the addition of five different rooms that were used for Chemical storage, general storage, the production of select product, and two extensive process cleaning rooms. Through the contract there was the addition of many various scopes of work such as adding pipe bollards and some overhead doors that required the removal of some walls to be put in.

It was known to The Haskell Company coming into the project that there would be joint occupancy not only with two other contractors onsite, but with the plants own staff. This posed many scheduling and occupancy problems which required The Haskell Company to work day and night shifts. Due to the intense schedule of the project, a little over 3 months from start to finish, from May 4th to August 27th the project did not take any breaks, there were constantly workers onsite 7 days a week, 24 hours a day.

Client Information:

The owner for Project Stallone is ConAgra Foods Inc., a large producer, manufacturer, and distribuer of food. This processing plant, located in Sylvester, Georgia, is strictly for making peanut butter for one of their oldest name brands, Peter Pan. From this plant raw peanuts go in one side and finished packaged peanut butter, ready to be shipped and shelved, comes out the other. This plant produces peanut butter for not only Peter Pan, but also for the Great Value brand of peanut butter sold at Wal-Mart stores nationwide. The reasoning for the renovation on this building is for the general upkeep to a top quality level that a food processing plant should be. There were really no cost exceptions for the project, but the schedule was of the highest priority, being that every day that the plant is down peanut butter is not being produced for sale. ConAgra Foods is a very safety orientated company. Walking through the plant this becomes evident; there are safety signs posted everywhere. On the project there was a zero tolerance policy for anyone acting in an unsafe manor, any violator would be removed without question. There was joint phased occupancy in the project, due to the tight schedule. During construction of the building there was a contractor who was in charge of all furnishings as in conveyors, roasters, and pipe work. ConAgra Foods also had all of their people working in the building cleaning existing equipment.

Project Delivery:

The Haskell Company is the Design-Build contractor on this project with a GMP contract. The contract was negotiated with ConAgra Foods, which The Haskell Company has done work for in the past. This type of delivery was chosen because of the extreme amount of work that needed to be performed in such a short time period of three months. The Haskell Company had a modified GMP contract with a not to exceed cost for each of the subcontractors, with the exception of two outside structural engineering firms, who were on a cost plus fee contract. Second tier subcontractors all carried lump sum contracts with their respective contractors.

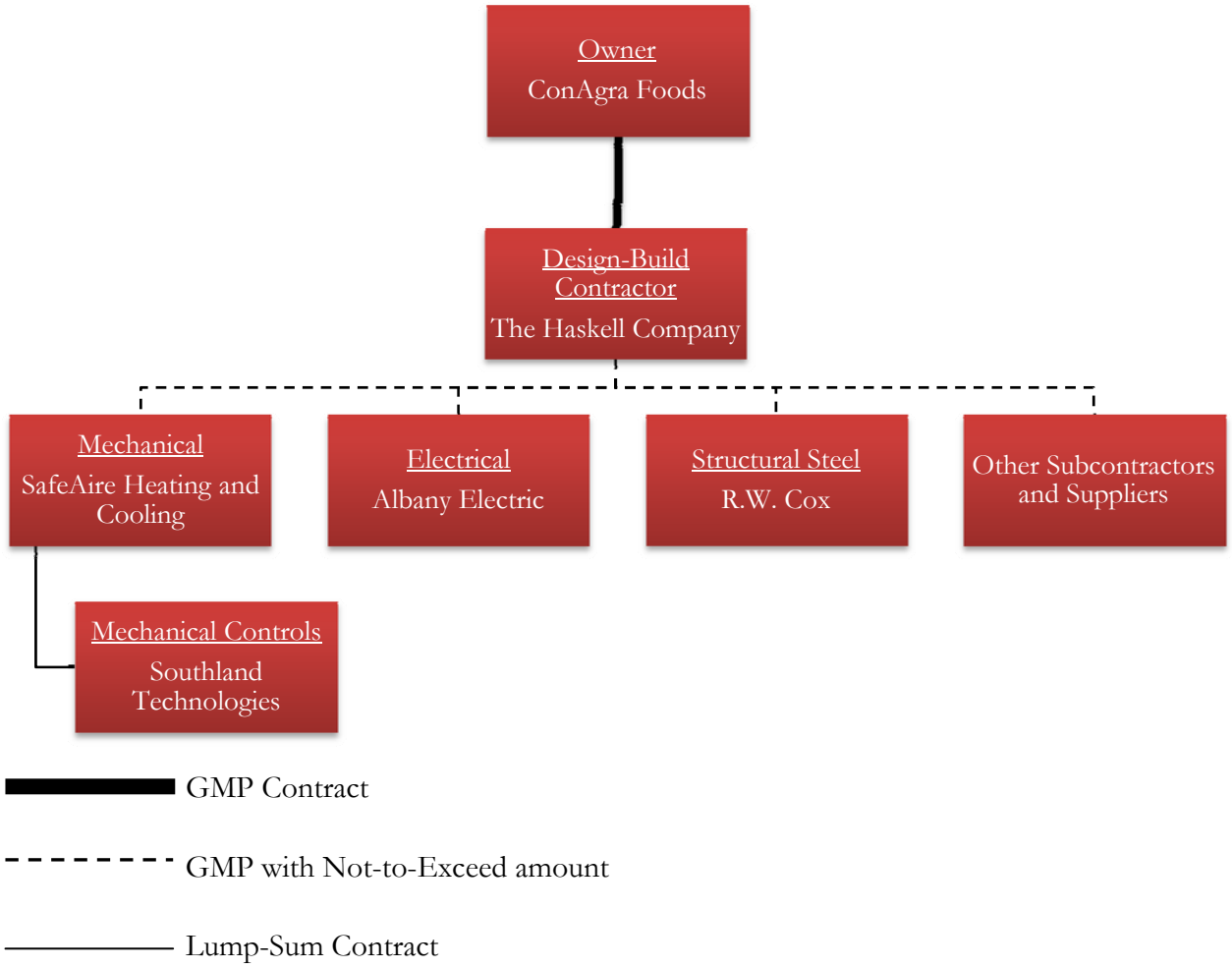


Figure 1: Organizational chart of contractors with their respective contract types.

Project Team:

The staffing for Project Stallone was organized as outlined in the following chart (below). The Director of Construction was onsite for one day in every two weeks. The Senior Project Manager and the other two Project Managers for the project were onsite for 2-3 days out of every week, usually rotating their time to ensure that there was always a Project Manager onsite at all times. The superintendents were onsite and on call for the whole duration of the project, the same is for the Assistant Project Manager and the Project Assistant. Superintendents, the Assistant PM, and the Project Assistant worked to keep a steady flow of work going on 24 hours a day and 7 days a week. The Superintendent was also responsible for a carpenter and an operator that were employed by The Haskell Company for Project Stallone.

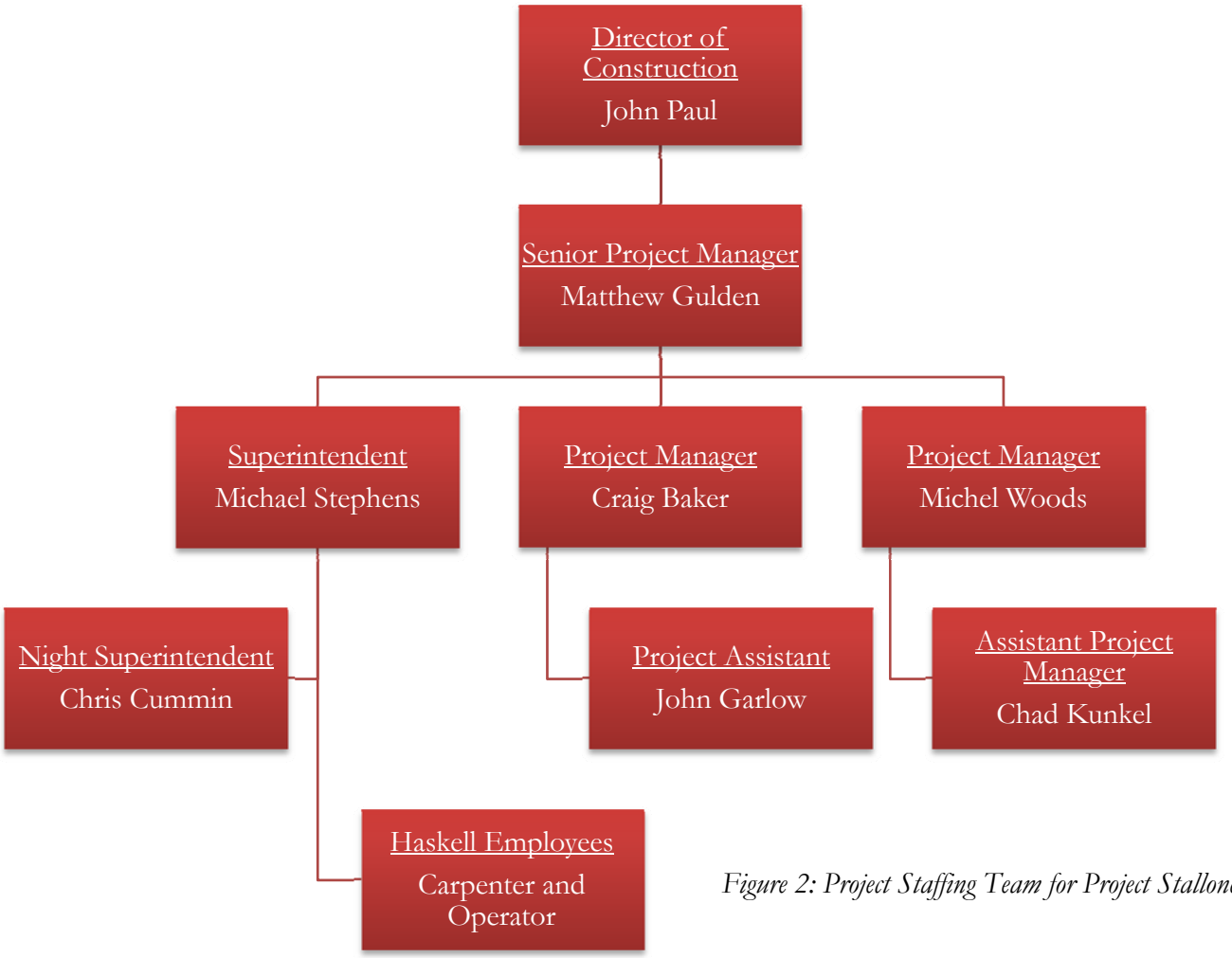


Figure 2: Project Staffing Team for Project Stallone

Project Costs:

The contract with ConAgra Foods for Project Stallone was a design-build with a GMP of $15 million. The contract had a stipulation built into it that stated that The Haskell Company would receive 40 percent of the money that was saved under the $15 million cap while ConAgra would receive the remainder. The Haskell Company finished under budget and proceeded to give a portion of their 40 percent back to the owner. The contracts for the subcontractors were awarded throughout the duration of the project and are broken down into their respected CSI divisions below. The total price of the renovation project upon completion in august 2007 was $13.1 million with a square foot cost of $65.48.

ConAgra Foods: Project Stallone Project Costs			
Package	**CSI Division**	**Total Cost ($)**	**SF Cost ($)**
General Conditions	0	$656,163.00	
Site Construction	2	$103.00	
Concrete	3	$155,069.00	
Masonry	4		
Metals	5	$4,349,997.00	
Woods and Plastics	6		
Thermal and Moisture	7	$1,678,365.00	
Doors and Windows	8	$20,440.00	
Finishes	9	$595,834.00	
Specialties	10		
Equipment	11	$80,208.00	
Mechanical	15	$3,021,857.00	
Electrical	16	$590,219.00	
Total Contract:		**$11,148,255.00**	**$55.71 / SF**
AE Design FEE	8.80%	$977,375.00	$4.88 / SF
Design-Build FEE	8.80%	$977,644.00	$4.89 / SF
Project Total:		**$13,103,274.00**	**$65.48 / SF**

Figure 3: ConAgra Foods cost breakdown in CSI order.

General Conditions Estimate:

General conditions for Project Stallone were not typical of what The Haskell Company generally deals with on a normal project. There are many things that may appear to be missing from the estimate. This is due to the fact that they were taken care of by the owner or another contractor doing work on process equipment which was onsite before The Haskell Company. The total cost for general conditions on Project Stallone is $656,163 this is 5% of the total contract with ConAgra. (See complete Breakdown of figures in Appendix A.1.)

General Conditions Summary	
Field Office Support	$23,335.00
Personell	$252,200.00
Safety	$46,800.00
Clean-up	$156,500.00
Tools and Equipment	$33,750.00
Temporary Facilities & Services	$17,600.00
Bonds & Insurance	$125,978.00
Total:	$656,163.00

Figure 4: General conditions estimate. Refer to appendix A.1 for detailed breakdown.

Detailed Project Schedule:

Key Project Durations

(All dated are in the year 2007)

HVAC System	May 11 – August 27
Steel Modifications & Unloading	May 08 – August 17
Roof	May 22 – July 01
Raw Bin & Receiving	May 08 – June 22
COP, Chem, Fines Rooms	May 11 – June 28
Isolation Area	May 08 – June 29
Wood Mezzanine	May 14 – July 17
Lower Blanching	May 04 – May 08
Grinding & Blending	May 11 – July 25
Upper Blanching	May 08 – June 22
Votator	May 08 – June 29
Tank Room	May 10 – May 16
Packaging	May 21 – June 29
Corridor	May 14 – June 27

** See Appendix A.2 for complete schedule.*

Schedule Details

The Schedule on Project Stallone was broken down in such a way that it would be easier for certain areas to get done before others. ConAgra Food's plan was that if they could get enough of the critical rooms turned over to them, they would be able to produce peanut butter or at least do initial test runs to ensure everything is working correctly. All items listed above area rooms with the exception of the HVAC System, Steel Modifications & Unloading, and the Roof. The schedule was extremely tight with a start on May 01, 2007 and a finish date of August 27, 2007.

Site Layout Plan:

The site plan attached is a general site layout plan, because throughout the project the site never changed drastically due to the fact that the project was a renovation and minima work was done to the exterior of the building. The site layout plan reflects the longest time period of the project where the site remained as shown, the structural steel modifications and repairs. There was a large amount of people that need parking during this phase of the project as well as a lot of room for laying out the steel which shows in the plan. There were no traffic problems during the project due to the fact that South Seabrook Drive is not a heavily trafficked road. The access to the site was through one gated entrance, where everybody had to sign with the security guard. For deliveries to the other side of the building, the driver would have to sign in at the security station and then the guard would escort them to the other entrance and unlock the gate to allow access. There is also parking in the front of the building where noted, but workers were not permitted to park outside of that area or in the front lot due to the fact that ConAgra Foods still had employees present during construction.

** Please see the Site Layout Plan in Appendix A.3*

Vicinity Plan

The project was located in a small town South East of Albany, GA. Located in Worth County; Sylvester, Georgia has a population of approximately 5,990, and is known to be the Peanut Capital of the World.

Image 1: Vicinity map of site and Sylvester, Georgia.

Depth Analysis

Workforce Development

Background

Workforce Development is a broad topic centering around the idea of continually finding ways to improve the work environment through employment and education. Workforce development is a key component to the success of any market in the world today, form health care to the construction industry. Without the skilled workers to continue the growth and expansion of these industries, prices will sky rocket and many will fail. The construction labor workforce is one of the many industries that are suffering from a decline in people interested in getting involved, as well as a lack of knowledge from these individuals that get involved.

From 1946 to 1964, a time known as the "baby boom," the United States experienced an unusual spike in the birth rates. Resulting from this spike, as well as an increase in the building sector, a large number of these "baby boomers" found their way into the construction workforce. As we move to current day, we are faced with an aging workforce headed for retirement and currently no resolution to the problem. Over the next ten years the 55 years and older labor workforce is projected to grow by an astonishing 46.7 percent. Coupling this fact with the number of young people, ages 16 to 24, projected to join the labor workforce at a – 6.9 percent increase, shows the severity of the issue. Currently there are some individual sectors of construction that have been facing a similar crunch as the industry will soon feel. In 2007 there was a massive shortage in the number of experienced crane operators; to meet these demands, the wages have gone up dramatically. If nothing is done about the problem it will surely continue in the same path as it did in 2007 and only worsen with time.

Problem

The looming problem with the construction industry's workforce lies in the fact that over the next ten years there will be a mass exodus of retiring "baby boomers" that current comprise about 46.7 percent of their market. There are also a various list of subtopics that contribute to the problem in whole that have been included in my research on a deeper level:

- Parents currently in the construction labor workforce steer their sons and daughters away from the industry for a variety of reasons.
- The construction industry is frowned upon by people regarded to as low paying, dangerous, and not a glamorous job.
- The construction labor workforce is not doing their part to get their voice and needs heard in high schools and technical programs.

The problem needs addressed and to be brought to a top priority in many companies. Should nothing be done about the problem it will devastate the industry and the economic markets by driving up the cost of construction due to the increase pay that workers will receive.

Solution

Increase construction companies awareness of the problem before it is too late for a solution to be set into place. By doing this companies need to alter their ways of recruiting their labor workforce and spark the interests of new young workers. An additional emphasis needs to be put into the development of trade schools and college technical programs that offer students the alternative solution to the traditional four year college. Introducing and successfully marketing these programs to youth is a necessity for their success and also the success of the industry.

Methodology

There is an overwhelming amount of data regarding the decline over the next ten years, stating that there is a problem. Various organizations such as the Bureau of Labor Statistics and topbuildingjobs.com have posted statistical figures on the decline and need but not much action has been set in place to get results. I have done initial research to figure out the problem and how serious it really is and through interviews and online surveys that I have conducted I hope to give some recommendations that will be helpful, if not the answer to finding a solution. All information from the interviews along with notes taken during the interviews is shown in appendix ## while a compilation of the material has been used to make a recommendation to the problem.

Resources

Dr. David Riley – The Pennsylvania State University

Dr. John Messner – The Pennsylvania State University

Interview Participants Listed in Table 1

Bureau of Labor Statistics (www.bls.gov)

Contacts for Workforce Development Interview		
Names	Positions	Company
Matt Gulden	Director of Construction	The Haskell Company
Michael Stevens	Project Superintendent	The Haskell Company
Clay Carr	Sales Engineer/Vice President	SafeAire Heating & Cooling
Charles Pennington	Industrial Service Technician	Mactec Engineering and Consulting, Inc.
Jonathan Dougherty	Corporate Knowledge Center Manager	James G. Davis Construction Corp.
Charles Cuppett	Union Carpenter	Carpenters Local 84
Matt Cuppett	Graduate Student	The Pennsylvania State University (ARL)
John Evans	Head of Operations	Pennsylvania CareerLink
Shelley Moore	Assistant Director of Career Services	Pennsylvania College of Technology
Harry Hintz	Professor	Pennsylvania College of Technology

Table 1: Contacts for Workforce Development information.

Evaluation

Over the past ten years the growth in the construction industry has hit record highs, despite the ups and downs of our economy through recession and growth periods. Over the next ten years there will be a retreat of those numbers in the opposite direction if nothing is done to better the current situation. Over the next ten years in the construction industry and especially focusing on the labor workforce sector, according to the Bureau of Labor Statistics (bls.gov), approximately 46.7 percent of the workforce will be over the age of 55. In the United States today the average age that people retire 65 years of age, the earliest age of retirement set by Social Security to receive benefits is 62 years of age. This becomes staggering information when you look at the big picture.

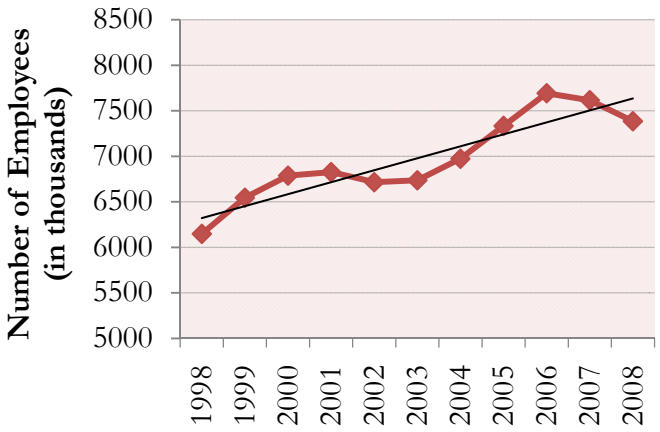


Figure 5: The 10-year trend in construction employment.

In researching the problem more in depth I turned to many different sources to try to find some answers and solutions. I found some interesting information that was never brought to my attention before this time. Reviewing the data collected as a whole there was 80 percent of the people that recognized that there was a problem and from that 80 percent only 38 percent of them had a clear plan of what they were going to do to solve it. This means that 30 percent of the whole audience that I had reached out to had no plan of action on what to do to solve this problem. Some of the most promising data that I found came from the John Evans at The Commonwealth Workforce Development System of Pennsylvania. In the state of Pennsylvania they have recognized the need for the construction industry's labor workforce and have prioritized it in their top six fields that serious attention. Included in their plan is recruiting via high schools, job fairs, and an extensive online effort. They can offer individuals up to $6,000 to get the training that they need to better themselves in the construction fields as well as after they are trained they have a active database of companies that would be interested in hiring these individuals. They also have associations with local and state wide unions for people that are interested in entering an apprenticeship program. Along with all of the positive that the state is doing, Mr. Evans had said that it was hard to get individuals

interested in the construction industry. With many of the construction industry jobs not offering any incentives, it is hard to get people interested while other more simple jobs are. Mr. Evans is also on the board of a school district around the Pittsburgh area and said that the schools don't do their parts to track the information of what students do upon graduation. They track higher education programs but students that took other routes are not accounted for.

Another alarming fact that kept coming up was the number of immigrant workers coming into the country both legally and illegally, with the majority being of Hispanic decent. This was first brought to my attention in interviewing Charles Cuppett, a union contractor from Local 84. He said that the that there is not to many young people that want to work such a labor intensive job, while there are much easier routes out there. He pushed his son to not go into the construction field wanting him to get a job that he would use his mind rather than working as hard as he has. His son is currently a graduate student at The Pennsylvania State University with a double graduate degree focus in electrical and mechanical engineering. Where the legal labor workforce lets off, the Hispanic picks up. According to Pew Hispanic Center, when you look at the overall figures from 2005 to 2006 the construction industry grew a total of 5 percent. But the number of Hispanics employed in the industry rose 14.5 percent in that same period. That means that Hispanics landed two thirds of the construction jobs in 2006, most of which are thought to be illegal immigrants. This alone could be the answer to the industries problems but it also challenges them in the fact of the workers skill levels and their language deficiencies. Hispanics currently count for 80 percent of fatal injuries on construction sites today, most of this is due to the language barrier. Should this be the solution to the construction labor workforce problem there must be some major changes before it happens.

In a final approach to find a solution to the workforce problem, a review of Pennsylvania College of Technology was done. This is a leading college that offers students the opportunity to get hands on training that will let them go into a field with actual knowledge. The college has been around since 1914 and was associated with Williamsport High School and in 1989 it became affiliated with The Pennsylvania State University. In the construction program the school offers 4 bachelor's degrees, 6 associates degrees and 3 certificate training programs. The majors range from building construction technology to heating, ventilation and air conditioning. And in talking with Shelley Moore, the Assistant Director of Career Services, mentioned that the construction had a 100 percent placement for their students, for approximately 500 students per year.

Recommendations

Based on the above outlined data and other data collected through my research I have made some recommendations on what to do about the construction industry's labor workforce development problems. There is definitely not one correct answer to the problem, all of the solutions outlined above seem like very good possible solutions. The best solution will be the one that is the easiest to implement.

Pennsylvania's Commonwealth Workforce Development System is a great idea set in place but I do not feel that it is the complete answer. Mainly due to the fact that they push all jobs, not simply construction jobs. While this is a good thing for the workforce in a whole, it is not the answer that is going to solve the construction problem. I believe teaming the efforts set in place at PA Commonwealth Workforce Development System with those of Pennsylvania College of Technology could really push for a solution. Also along the same lines, if high schools were to implement programs to push students to decide what they are going to do directly after graduation. Referring undecided students to programs like Pennsylvania College of Technology would be a possible solution. Along with the answer to the problem, as Harry Hintz from Penn College mentioned, you also know that you are getting a student that is interested in the industry as well as having the knowledge to perform. There are many reasons for the success of Pennsylvania College of Technology. This is evident upon visiting the campus, there is a traditional college feel, with onsite housing, that is inviting to high school students who are not interested in the traditional 4-year programs. (Please see more photos available in appendix ##). I believe that more programs like Pennsylvania College of Technology need to be put in place and utilized to their potential to achieve success for the labor workforce development problems.

Image 2: Inside of a classroom at Pennsylvania College of Technology

Closely related to Pennsylvania's Commonwealth Workforce Development System would be a solution that would again focus on high school students and offer them a different route of joining the union. Matt Gulden with The Haskell company had stated that young college educated individuals generally do not want to spend a lifetime in the field. Working in the field requires long hours and more travel, time that is usually spent away from family. Pushing students that feel this way to focus on a joining a union would put an end to that notion as well as providing a skilled and educated worker.

Finally, there is much emphasis placed on Hispanic workers taking over the construction labor workforce. This is definitely a solution to the problem but also raises separate problems of its own. For this to take place there needs to be an implementation plan of legalization and crossing of the language barrier.

Conclusion

The answer to the construction labor workforce issues are vast. Through much research on the subject matter I feel that the solution lies in the Hispanic workforce. There needs to be more effort set forth for the legalization of their working, whether this be through a work visa or citizenship. Also a large effort needs to be put into conquering the language barrier. There is an overwhelming number of "baby boomers" leaving the industry and with the increase of the Hispanic workforce there is more than enough to take their places. As far as programs such as Pennsylvania College of Technology should focus on producing leaders of the construction labor workforce such as foreman and superintendents to replace the "baby boomers" in these positions. Technical programs should take recognition of schools like Penn College and try to follow in their foot steps. Finally, the construction should work collectively with all organizations, Commonwealth Workforce Development Systems, technical school programs, and unions to make this transition from one workforce to another as smooth as possible.

Breadth Analysis

Structural Redesign

Background

Project Stallone was a renovation project of an older pre-engineered metal building that was transformed into the home of the processing plant for Peter Pan Peanut Butter. Upon the transition into a full blown processing plant, much of the processing and new mechanical equipment was attached from underneath of the existing frames without regard to the structural integrity. When The Haskell Company was called in to do work on replacing the roof, they said that they would do the work but they were not going to guarantee the integrity of the structure. At this point it had been loaded to the maximum limits to where there was web buckling and some of the bolts had broken due to extreme tension in the connections. When this was brought to the Attention of ConAgra they immediately wanted the problem fixed. The solution was to first come in and reinforce the existing structure with scaffolding to temporarily relieve the structure. After this pipe fitters would come in and build individual stands that would extend from the floor to right below roof level. These would be used to remove the HVAC and processing equipment loads, to which the building was never designed for in the first place. After the unloading, steel erectors came through reinforcing the existing

Image 3: Shows the structural system of a pre-engineered metal building. The frames are the larger beams that run the width, while the purlins are the smaller beams closer to the ceiling.

Image 4: Shows the extensive temporary bracing (Scaffolding) that was put in place to ensure the safety during unloading and repairs.

building frames, restoring them back to their original strength. Finally, in the end after individual inspection of each fix, the temporary scaffolding was ordered removed one frame line at a time.

Problem

The problem with the current way that the structural system is fixed is in dealing with the stands that remove the processing and HVAC equipment loads. When the problem came about there was not much lead time to organize any type of formal organized fix. Therefore, the solution was to consult a structural engineer to evaluate the loads that were initially present from the hanging equipment. From these loads he determined the equipment that required support, where ever support was needed that's where a stand would go. This caused for the random placement of pipe stands in path ways, in front of processing equipment, and in individuals offices, taking away valuable and once usable floor space. Along with loosing valuable floor space the current system does not allow for future expandability.

Image 5: Shows the original structural frame with repairs to return it to initial strength. Also shown is all of the processing equipment around it.

Image 6: Shows the newly installed stands, used to remove equipment load existing frames.

Solution

Create a uniform structural system that could utilize space more efficiently and allow for future expandability, while still providing the structural support needed to carry processing and HVAC

equipment. This can be achieved by developing a structural grid that will sit right below ceiling level, eliminating the randomness of the original fix. The grid will be comprised of structural columns and beams designed to withstand a set amount of load. Where there is a load that needs removed from the ceiling, bar joist beams can be set into the bays and utilized to remove the loads. This will allow for usability now and for expansion in the future shall ConAgra ever need it.

As stated in the problem, there was issues with the lead time on the steel. Project Stallone was started on May 4, 2007. ConAgra Foods had actually shut down the factory prior to this time, in February. In review of the situation and better planning this time could have been utilized to ensure that the steel was onsite and erected on schedule if not have finished earlier.

Methodology

First step of the process is to determine the loads that will act on the new system. After doing this I will have to use the loads to size the appropriate structural members, during this process I will use the heaviest loads in the building to size members from. By using this approach I know that the system will be capable of expansion in the future and there will be additional factors of safety built in to my calculations. Finally there will be a review of the schedule and a cost comparison to see how the new solution could have helped in the original design.

Analysis

After determining the loads that came from the equipment, calculations were done based on tributary area using factored loads of 1.2D +1.6L. There was never going to be anyone walking on any of the processing equipment so that eliminated the need for the 1.6L, live load factor of safety. Along with this, there was never going to be the potential for a wind load on the structure being that it was basically built inside of the existing building. Design for the structure was both conservative and allowable for expansion should ConAgra ever need. I used the most loaded bay as the selection criteria. The dead load on this section was 100 plf, which is relatively high for a dead load, but reasonable when figuring hanging processing equipment from. From this I found the deflection on the beam using L/360 design criteria, giving me a X-X moment of inertia, I (in^4) of 555. Using this I went into the AISC where they have he most economical W-members and chose a W18x40. I then checked this by adding the self weight and comparing the maximum moment, $152^{'\text{-kip}}$ using $Wl^2/8$

equation to the ϕM_n, or allowable moment of 274'-kip. Being that all of the passed no problem the beam was good for the design.

Column design was similar to that of the beam, again using tributary area to find the load and assuming the same as the design for the beams, no wind load, no live load, same load combinations, and a dead load of 100 plf, allowing for future expandability. Taking the tributary area plus the tributary length of the surrounding beams the unfactored weight was 501.8 kips. After adding the 1.2D factor the load came out to be 602 kips. Again using the AISC Steel Manual and taking into account the KLL value of 12' due to the bracing that the mezzanine would provide at this height the column chosen was a W12x58, with a load capacity of 603 kips < than 602. So the design is sufficient. (For full review of my calculations please refer to appendix C.)

Costs and Schedule Impacts

R.S. Means was used in the estimation of the structural system redesign for Project Stallone.

Cost Information:

The RS Means cost that I got for Project Stallone came out to be $413,365. For a typical job this is normal, but for Project Stallone because of the complexity of this renovation project it needs to be modified. Just as the schedule was increased because of complexity, I will match the number and multiply the cost by 200%. This is justified because of the extensive risk that is taken by subcontractors that would get the job. The final cost for the new structural system is $826,730.

Comparing this to the original value of $4.3 million, the savings are almost $3.5 million

Crew/Scheduling Information:

1 E-2 crew can erect 750 L.F. of W12x58 in an 8 hour work day 5 days a week. The steel columns will be erected in 5 days or a week. That same crew can erect 800 W16x40 beams in a day; at that rate the beams would be complete in 6 days. That is 11 days for the crew to finish the job. Project Stallone is a different type of building because the typical crane cannot be used because you are erecting indoors. To make up for these inefficiencies I am adding a 200% complication factor into my calculations. Therefore, doubling the duration to 22 days for steel erection. The second part to

this operation would be the removal of the roof loads and placing them onto the frames that were just built. Since this is a task that is very time consuming I am adding an additional 22 days to this unloading phase. The total duration of this phase is now 44, for simplicity 45 days, at a normal pace of work, 8 hours a day, 5 days a week. To fit in to the schedule and to keep up with the structural repairs to the existing frames, this 45 day time period will simply not work. I will use 2 crews both starting at separate ends of the building and meeting in the middle so that they are not working on top of each other. This will cut the time in half to 22 days, which is 4 and a half weeks, approximately 1 month. This is now acceptable. The above cost number is also updated to account for adding the extra crew.

Conclusion

In review of the structural redesign for Project Stallone it came in both under budget and would finish within the amounted time to allow other trades to work unaffected. The only down fall about this solution is the lead time issue. If ConAgra would have acted more efficiently, and contracted The Haskell Company to come in when the plant was originally shut down in mid February, this would have allowed more than sufficient lead time for the steel to arrive on time.

Breadth Analysis

Mechanical System and Life-cycle Analysis

Background

One of the main problems at Peter Pan Peanut Butter processing plant was the fact that plant was not secure for the migration of dust, this is key for any type of food processing plant. With the migration of dust going from raw product and being able to enter the packaging area, this is a recipe for disaster, especially for peanuts because they come directly form the ground. The solution to the problem came during the renovations. The Haskell Company was to come in and build airtight walls to section of certain areas of the building. In doing this pressurization of the building could take place with the additions of make-up air units and exhaust fans. The units that were chosen were AbsoluteAire 20,000 CFM units and were factory setup to run on propane that was already onsite. The units are free standing and were placed outside the building in various locations. Along with all of this they were not capable of cooling and were equipped with pre and final filtration units. In the areas where these units were added there was also a number of exhaust fans added as well to compensate for the additional air, along with keeping correct pressurization.

Image 7: Shows the exterior Make-up air units by AbsoluteAire that were used on Project Stallone.

Problem

There problems with the current mechanical system in Project Stallone all have to do with inefficiencies of the system. The current system runs on propane for heating, this in itself is not nearly as efficient as other fuel sources. The system is also extremely over designed and has far to many air changes per hour, by eliminating the excess air changes there is a huge potential for cost

savings. This is especially key when none of the inside air is being mixed and returned back into the building, causing the system to heat outside unconditioned air.

Solution

The solution to Project Stallone's mechanical problems can be solved many different ways through this analysis many of them will be outlined.

- After researching alternative fuels that could be utilized more efficiently to benefit the owner, proving propane is not the best choice.
- Look into an alternative, more green design for the system, and figure out the benefit to the owner.
- Chancing air flow rates to conserve on the fans' consumption of energy.

Methodology

Analyse the initial design and also calculating the loads associated with this. Using this information to compare it with what the ideal range of air changes per hour should be and adjusting the equipment accordingly. In doing this cooling equipment will have to be added. This is do the extra heating load that is added to certain rooms due to peanut processing equipment. There is a balance to were cooling can be added that will offset the release of hot air, thus lowering the amount of air changes required. Research and comparisons of different fuel sources will also be done to show the best solution. Finally, a life cycle cost analysis will be done for the current and the upgraded systems to see what the actual savings are.

Analysis

First aspect of this analysis was to research alternative fuels such as natural gas and see if the rates were more feasible. Around the building at Project Stallone there was the opportunity to hook in to natural gas as opposed to going with propane, which was chosen. The propane tanks were onsite prior to installation of the make-up air units and ConAgra felt that they were not going to use the heating elements on the units enough to account for any big monetary savings. There are major elements that play into the reason why propane is not the most efficient fuel for heating. First of all there is the delivery of the fuel, this ads cost that is not associated with natural gas. The overall cost

measured in $/MMbtu for propane is $28.35/MMbtu, this accounts for delivery. While the cost for natural gas is $9.90/MMbtu. These numbers are accurate for the month of April 2008. Following the current trends in the market with the rise of fuel costs, propane is surely not the option of choice today.

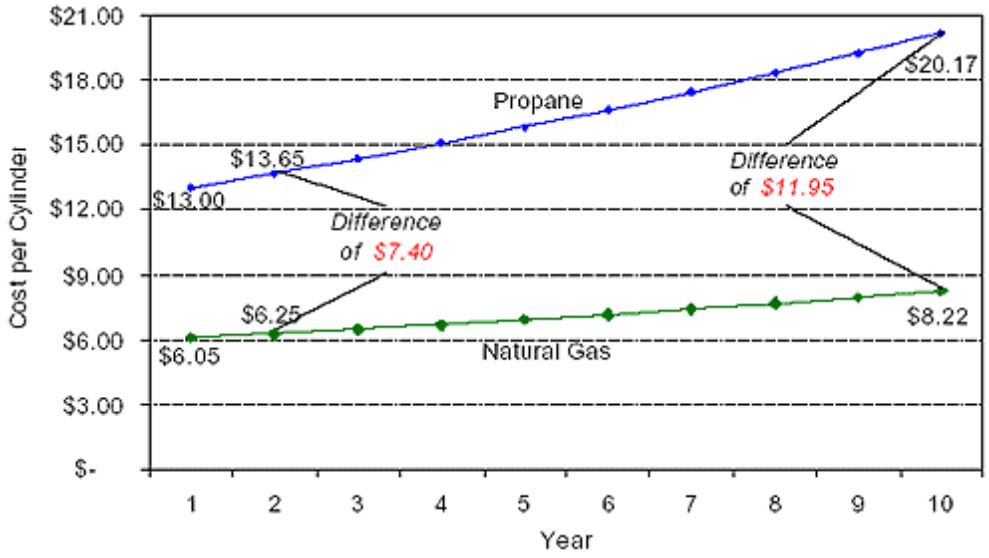


Figure 6: Overall fuel costs for Propane vs. Natural Gas.

In researching a sustainable more green design as an alternative, I spoke with the mechanical designer from The Haskell Company, James Ward. He mentioned that it is always thought of when designing mechanical systems, but it simply was not feasible for Project Stallone. This is because a number of reasons, first of all the shell of the building was nowhere near where it need to be to be considered air tight. Because of the structures design and age, being that it was a 30 year-old pre-engineered metal building, it would have been a waste of money. Secondly, the owners, ConAgra would never see a return on their investment for approximately 15 years. Due to the age of the building, they will more than likely move to a new location before this time. While green and sustainable design are great solutions, they were simply not economically feasible for Project Stallone.

The final aspect of the mechanical breadth is to determine the size of a cooling coil to add to one of the make-up air units, therefore compensating for the heat load produced by mechanical equipment.

By reducing this heat load there would not need to be such a high air change rate, which in change would result in the less usage of so many make-up air unit fans. I focused my study on one of the most critical rooms of the building, the raw product/peanut storage area. This room must remain a slight bit more pressurized then the raw peanut storage/holding tanks, but cannot be more pressurized than the roaster room, where the peanuts get cooked this process also kills bacteria. In the room there are 4 make-up air units, at 20,000 CFM each and 4 exhaust fans totaling a removal of 45,000 CFM. This gives the room a total of 20.1 air changes per hour. Knowing that the allowable is between 6 to 12 air changes per hour, this is the ideal range that I aimed for. There is roughly 10 tons of cooling that need to be compensated for, from internal and envelope loads. 2 comes from the envelope and 8 comes from the processing equipment in this area. Compensating for 80% of the tonnage would be adequate and still be in the tolerance for 6-12 ACH (Air Changes per Hour.) (Please see all load calculations in Appendix D.)

Conclusion

In review of the analysis it would have proven more efficient for ConAgra to have gone with Natural Gas as opposed to propane. It would have save them an average of $20.00/MMbtu of fuel consumption that they used. Since the Natural Gas connection was already onsite the schedule would have not have been effected. If they had to run the lines it would be a different story. Another way to save some money is through adding a cooling coil to an existing make-up air unit in the raw product area. By doing this it would compensate for the heat given off by process equipment, causing the amount of air changes per hour to reduce greatly. Doing this you would eliminate the use of the other two make-up air units cutting on energy that way while using less power to operate the cooling coils. All of this would be done while still being able to maintain neutral pressure to the outside area. The effects of adding one cooling coil would not effect the schedule by more than one or two days. If this design could be incorporated into the entire building design it would have only added a total of aproximately 5 days to the overall schedule with an up front cost of only $1,250 per unit that it would need to be attached to, 5 units in all, equaling $6,250. This return would have been seen immediately due to the less energy consumption of the excess fans that are running to keep the pressures correct and the heat in the building at the right temperature.

Conclusions and Summary

In complete review of my senior thesis project and Project Stallone, no stone was left unturned. The thesis outlined mane of the main building topics. The renovation of ConAgra Foods Peter Pan Peanut Butter processing plant was a high priority, high risk, with an extremely tight schedule. There are not many contractors in the industry that would take on this risk.

Through my final thesis project, I went in depth with 1 main depth topic and 2 separate breadth topics. My depth topic covered the topic dealing with an aging workforce, and their stunning exodus form the industry over the next ten years. Solutions included looking into a Hispanic workforce, but this also rose other problems related to the language barrier and the fact that Hispanics count for 80 percent of the construction related injuries. Secondly, my breadth topic number 1 covered the structural redesign of frames that were put into place as a permanent fix, but took away from the functionality of the building and not to mention caused a lot of onsite labor due to the fact that nothing was prefabricated. Finally, my mechanical system dabbled in to a variety of topics including alternative fuel sources and adding cooling units to equalize the heat given off by process equipment, this allowed for the fans on the make-up air units to run slower and some to not have to run at all. Doing this saves on energy costs because you are taking the air changes from 22 air changes per hour to about 8 air changes an hour, which is a more efficient way of running a system.

Concluding, serious action need to be taken in the construction industry's labor workforce within the next ten years. If no action is taken there is sure to to be a sharp sky rocket in the price of construction.

Appendix A

Included:

1. General Conditions Estimate
2. Detailed Project Schedule
3. Detailed Site Plan

General Conditions Estimate

General Conditions				
Description	**Quantity**	**Units**	**Unit Price**	**Amount**
Field Office Support				
As-Built Drawings	1	LS	$2,000	$2,000
Cell Phones	4	MO	$450	$1,800
Computers / Software	4	MO	$330	$1,320
Copier/Fax/Scanner	1	LS	$600	$600
Network Connection / Internet	4	MO	$150	$600
Office Furnature	1	LS	$2,300	$2,300
Office Supplies	4	MO	$350	$1,400
Photocopying / Drawings Out-sourced	4	MO	$450	$1,800
Postage / Expressage	4	MO	$1,000	$4,000
Substance Abuse Testing	1	EA	$75	$75
Telephone	4	MO	$850	$3,400
Telephone Setup	1	LS	$2,500	$2,500
Temporary Power (Trailer)	4	MO	$300	$1,200
Temporary Water (Trailer)	4	MO	$85	$340
			Sub-total:	$23,335
Personell				
Assistant Project Manager	15	WK	$1,400	$21,000
Project Assistant	15	WK	$1,450	$21,750
Project Managers (2)	15	WK	$5,100	$76,500
Project Managers' Cars (2)	4	MO	$1,850	$7,400
Senior Project Manager	15	WK	$3,150	$47,250
Senior Project Manager's Car	4	MO	$1,000	$4,000
Superintendent (Day)	15	WK	$2,250	$33,750
Superintendent (Night)	15	WK	$2,050	$30,750
Superintendents' Trucks (2)	4	MO	$2,450	$9,800
			Sub-total:	$252,200
Safety				
First Aid	1	LS	$3,000	$3,000
Safety Program	4	MO	$1,200	$4,800
Safety Supervisor	15	WK	$2,600	$39,000
			Sub-total:	$46,800

General Conditions Continued:

Clean-up				
Clean-up Foreman	15	WK	$1,300	$19,500
Clean-up Labor (2 Persons)	15	WK	$2,000	$30,000
Dump Carts	4	MO	$500	$2,000
Dumpsters	300	EA	$350	$105,000
			Sub-total:	$156,500
Tools and Equipment				
Fork Lift	4	MO	$2,500	$10,000
Knuckle Boom Lift	2	MO	$3,250	$6,500
Lull Forklift	2	MO	$2,900	$5,800
Sizzor Lift	3	MO	$2,650	$7,950
Small Tools	1	LS	$3,500	$3,500
			Sub-total:	$33,750
Temporary Facilities & Services				
Job Signs	1	LS	$1,200	$1,200
Temporary Toilets (20)	4	MO	$4,000	$16,000
Water Coolers / Coffee	4	MO	$100	$400
			Sub-total:	$17,600
Bonds & Insurance				
Builders Risk / General Liability Insurance		LS		$67,435
Payment / Performance Bonds		LS		$58,543
			Sub-total:	$125,978

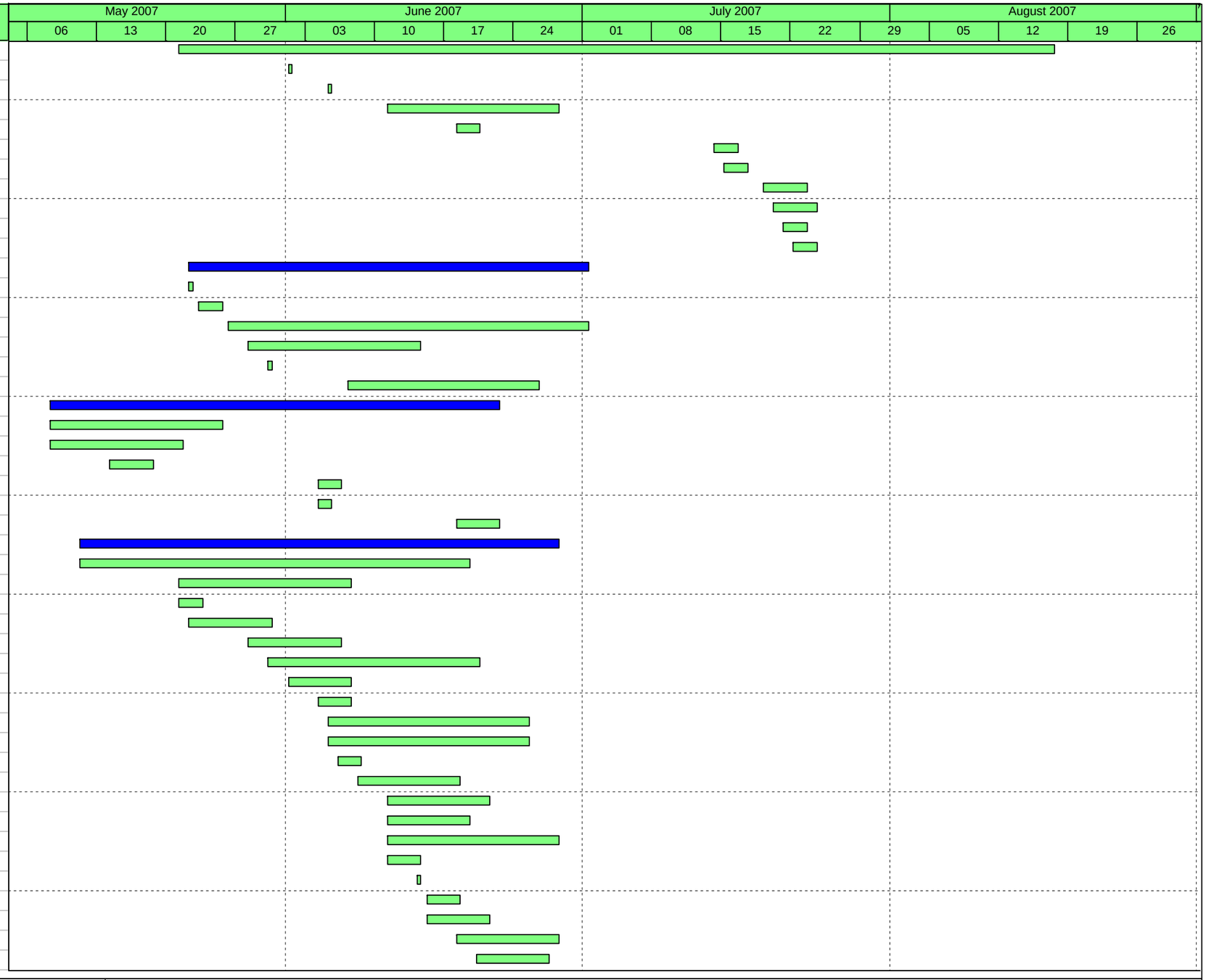
Grand Total: $656,163

General Conditions Summary	
Field Office Support	$23,335.00
Personell	$252,200.00
Safety	$46,800.00
Clean-up	$156,500.00
Tools and Equipment	$33,750.00
Temporary Facilities & Services	$17,600.00
Bonds & Insurance	$125,978.00
Total:	$656,163.00

Activity ID	Activity Name	Original Duration	Start	Finish
Project Stallone - Senior T...		82	04-May-07 A	27-Aug-07
A0999	HVAC SYSTEM	108	11-May-07 A	27-Aug-07 A
A1000	Design of Reuse Existing Eq...	1	11-May-07*	11-May-07
A1010	Design of Bid Package Draw...	1	11-May-07	11-May-07
A1020	Design Wall Requirements	1	11-May-07	11-May-07
A1030	Design Long Lead Items	1	11-May-07	11-May-07
A1040	Bid Long Lead Items	5	12-May-07	16-May-07
A1050	Design Structural HVAC Req...	28	14-May-07	20-Jun-07
A1060	Design Electrical for HVAC (f...	1	15-May-07	15-May-07
A1070	Award HVAC Work	1	17-May-07	17-May-07
A1080	Submittals / Order Equipment	15	17-May-07	06-Jun-07
A1090	Demo Packaging Ductwork	16	18-May-07	08-Jun-07
A1100	HV Ductwork	46	19-May-07	03-Jul-07
A1110	Install Condensing Units	43	21-May-07	18-Jul-07
A1120	Controls	40	21-May-07	13-Jul-07
A1130	Pads	16	24-May-07	14-Jun-07
A1140	Final Drawings HVAC	1	24-May-07	24-May-07
A1150	Final Drawings Electrical	1	25-May-07	25-May-07
A1160	Electrical for HVAC	30	26-May-07	24-Jun-07
A1170	Refurbish W.H. Units	5	28-May-07	01-Jun-07
A1180	Demo W.H. Fans	3	28-May-07	30-May-07
A1190	Set Fan Curbs	7	30-May-07	07-Jun-07
A1200	Verify Condition of Existing E...	6	31-May-07	07-Jun-07
A1210	Install Spiral Duct in Packaging	18	31-May-07	25-Jun-07
A1220	Set Fans / VFD's	16	01-Jun-07	22-Jun-07
A1230	Install Balance of Duct	26	04-Jun-07	09-Jul-07
A1240	Install CU / DF / Coils Package	17	06-Jun-07	28-Jun-07
A1250	Refurbish Readco Unit	2	09-Jun-07	10-Jun-07
A1260	Replace Sugar Mill Room	14	11-Jun-07	24-Jun-07
A1270	Start-Up	26	11-Jun-07	16-Jul-07
A1280	Test & Balance	19	18-Jun-07	12-Jul-07
A1290	Gas Piping (Interior)	21	18-Jun-07	16-Jul-07
A1300	Set HV Units	12	22-Jun-07	09-Jul-07
A1310	Gas Piping (Exterior)	36	09-Jul-07	27-Aug-07
A1319	STEEL MODIFICATIONS A...	101	08-May-07 A	17-Aug-07 A
A1320	Dansco On-site with Sunbelt	1	08-May-07	08-May-07
A1330	Install Shoring	27	08-May-07	13-Jun-07
A1340	Dansco and Sunbelt Final E...	3	09-May-07	11-May-07
A1350	Initial Design for Unloading	14	10-May-07	29-May-07
A1360	Fabricate Materials for Repairs	35	18-May-07	05-Jul-07
A1370	Structural Repairs Report	2	21-May-07	22-May-07
A1380	Grinder/Blending & Below St...	65	21-May-07	17-Aug-07
A1390	Up & Low Blanching Steel M...	65	21-May-07	17-Aug-07
A1400	Votator/ N. Packaging Steel ...	65	21-May-07	17-Aug-07
A1410	Isolation/Pre-Clean Steel Mods	65	21-May-07	17-Aug-07
A1420	S. Packaging Steel Mods	65	21-May-07	17-Aug-07
A1430	Raw & Receiving Steel Mods	65	21-May-07	17-Aug-07

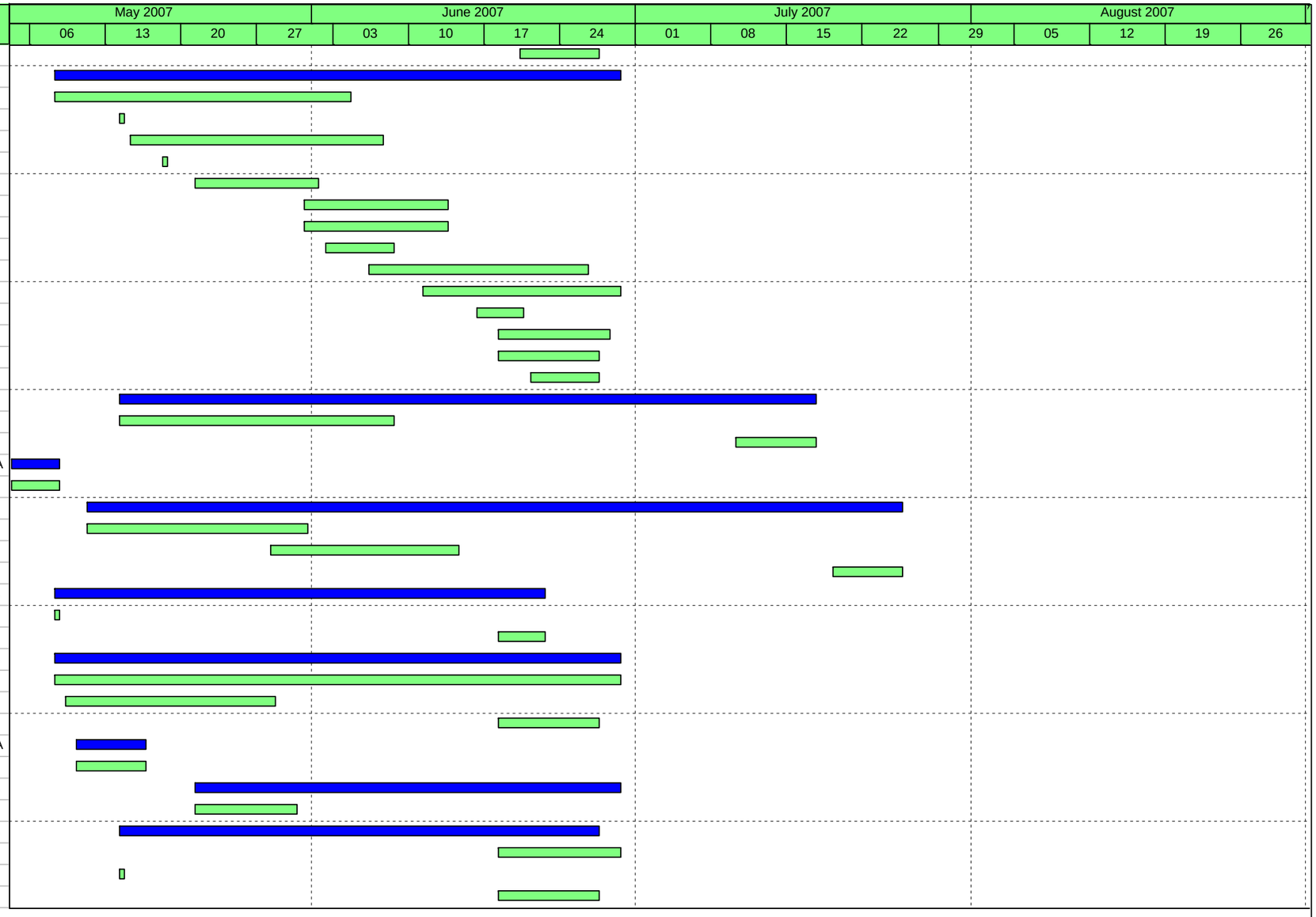
Actual Work
Remaining Work
Critical Remaining Work
Milestone
Summary

Activity ID	Activity Name	Original Duration	Start	Finish
A1440	N. & S. Rail Dock Steel Mods	65	21-May-07	17-Aug-07
A1450	Structural Repairs Design (1...	1	01-Jun-07	01-Jun-07
A1460	Begin Double Shift Work	1	05-Jun-07	05-Jun-07
A1470	Assess Progress Toward Mi...	14	11-Jun-07	28-Jun-07
A1480	Votator / N. Packaging Shori...	3	18-Jun-07	20-Jun-07
A1490	Grinder/Blending & Below S...	3	14-Jul-07	16-Jul-07
A1500	Up & Low Blanching Shoring...	3	15-Jul-07	17-Jul-07
A1510	Isolation/Pre-Clean Shoring ...	3	19-Jul-07	23-Jul-07
A1520	S. Packaging Shoring Removal	3	20-Jul-07	24-Jul-07
A1530	Raw & Receiving Shoring R...	3	21-Jul-07	23-Jul-07
A1540	N. & S. Shoring Removal	3	22-Jul-07	24-Jul-07
A1549	ROOF	41	22-May-07 A	01-Jul-07 A
A1550	Mobilize	1	22-May-07	22-May-07
A1560	Clean Roof	3	23-May-07	25-May-07
A1570	Roof Flashing	37	26-May-07	01-Jul-07
A1580	Replace Rusty Roof Panels	14	28-May-07	14-Jun-07
A1590	Roof Insulation and Membrane	1	30-May-07	30-May-07
A1600	IMP Walls at Sugar Grinding	14	07-Jun-07	26-Jun-07
A1609	RAW BIN & RECEIVING	46	08-May-07 A	22-Jun-07 A
A1610	Raw Bin Insulation Removal ...	14	08-May-07	25-May-07
A1620	IMP Walls	10	08-May-07	21-May-07
A1630	Receiving Area Insulation R...	5	14-May-07	18-May-07
A1640	Lighting	3	04-Jun-07	06-Jun-07
A1650	Re-install Peanut Bin Control...	2	04-Jun-07	05-Jun-07
A1660	Doors	5	18-Jun-07	22-Jun-07
A1669	COP, CHEM, FINES ROOMS	49	11-May-07 A	28-Jun-07 A
A1670	Roaster Replacement Drywa...	28	11-May-07	19-Jun-07
A1680	Insulation Removal / Caulking	14	21-May-07	07-Jun-07
A1690	COP Slab	3	21-May-07	23-May-07
A1700	Curbs	7	22-May-07	30-May-07
A1710	Chem, Fines IMP Walls	8	28-May-07	06-Jun-07
A1720	COP E2M Work (No Daytim...	16	30-May-07	20-Jun-07
A1730	COP Painting (Nights)	5	01-Jun-07	07-Jun-07
A1740	Demo Door Openings	4	04-Jun-07	07-Jun-07
A1750	COP Overhead Plumbing	15	05-Jun-07	25-Jun-07
A1760	COP Electrical	15	05-Jun-07	25-Jun-07
A1770	COP IMP Walls (Nights)	3	06-Jun-07	08-Jun-07
A1780	Chem, Fines Lights and Elec...	7	08-Jun-07	18-Jun-07
A1781	COP Fire Protection	9	11-Jun-07	21-Jun-07
A1782	Chem, Fines Fire Protection	7	11-Jun-07	19-Jun-07
A1790	COP Room Joint Day E2M / ...	14	11-Jun-07	28-Jun-07
A1800	COP E2M SafeAire Work (N...	4	11-Jun-07	14-Jun-07
A1810	COP IMP Ceiling	1	14-Jun-07	14-Jun-07
A1820	COP Hang Lights	2	15-Jun-07	18-Jun-07
A1830	COP Plumbing Equipment &...	5	15-Jun-07	21-Jun-07
A1840	Doors	11	18-Jun-07	28-Jun-07
A1850	COP Flooring	6	20-Jun-07	27-Jun-07

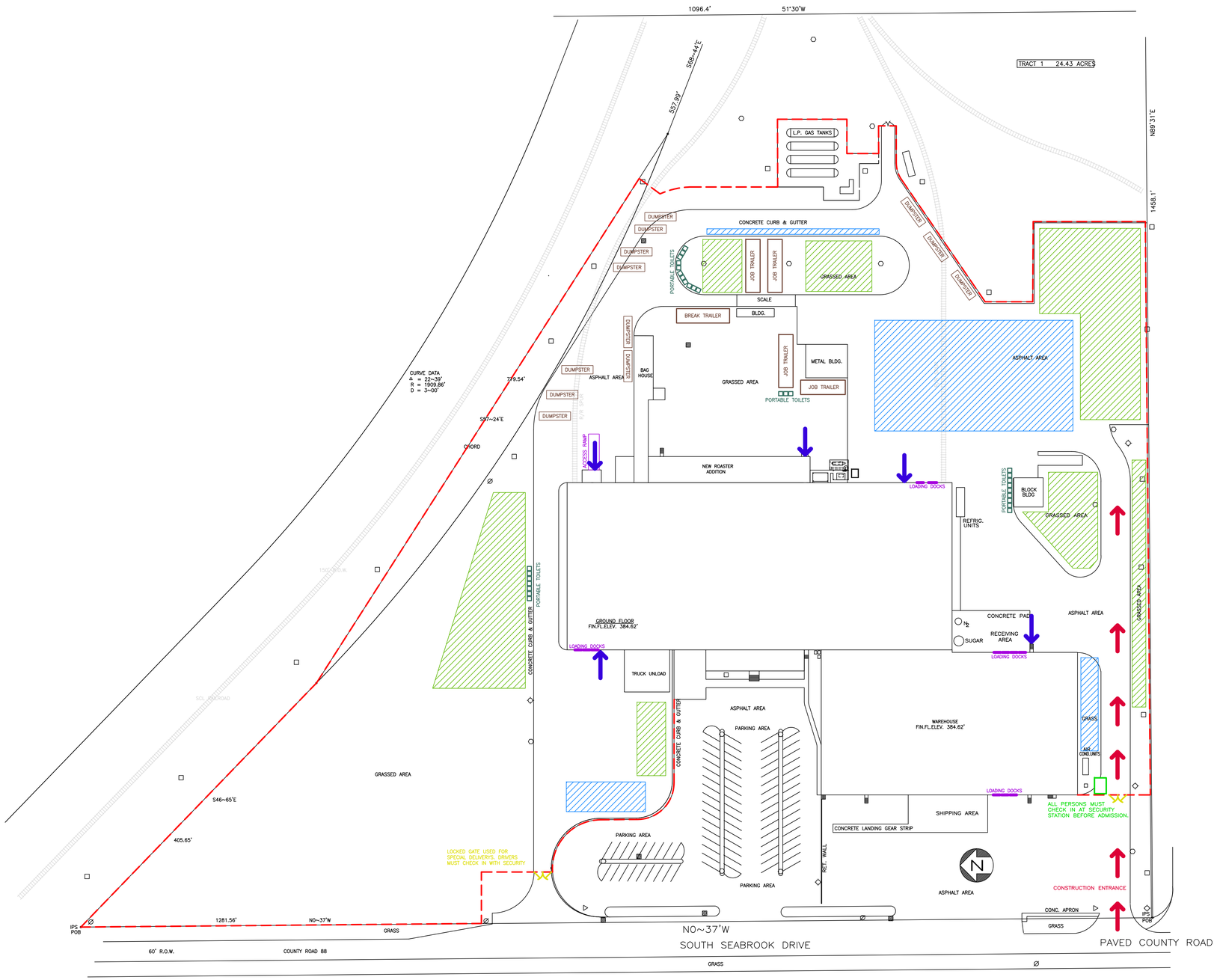


Actual Work
Remaining Work
Critical Remaining Work
Milestone
Summary

Activity ID	Activity Name	Original Duration	Start	Finish
A1860	Fines Flooring	6	20-Jun-07	27-Jun-07
A1869	ISOLATION AREA	53	08-May-07 A	29-Jun-07 A
A1870	Insulation Removal / Caulking	20	08-May-07	04-Jun-07
A1880	Complete Catwalk Steel Des...	1	14-May-07	14-May-07
A1890	Catwalk Shop Drawings/Fab...	18	15-May-07	07-Jun-07
A1900	Complete Curbs	1	18-May-07	18-May-07
A1910	Full Height IMP's	10	21-May-07	01-Jun-07
A1920	Catwalk IMP	10	31-May-07	13-Jun-07
A1930	Above Ground Plumbing	10	31-May-07	13-Jun-07
A1940	Catwalk Steel Erection	7	02-Jun-07	08-Jun-07
A1950	Lighting & Power	15	06-Jun-07	26-Jun-07
A1960	Fire Protection	15	11-Jun-07	29-Jun-07
A1970	Paint Catwalk Steel	5	16-Jun-07	20-Jun-07
A1980	Doors	11	18-Jun-07	28-Jun-07
A1990	***Non-COP Flooring-Date T...	8	18-Jun-07	27-Jun-07
A2000	COP Flooring	5	21-Jun-07	27-Jun-07
A2009	WOOD MEZZANINE	64	14-May-07 A	17-Jul-07 A
A2010	Insulation Removal / Caulking	20	14-May-07	08-Jun-07
A2020	Epoxy Paint Floors (Nights)	6	10-Jul-07	17-Jul-07
A2029	LOWER BLANCHING	5	04-May-07 A	08-May-07 A
A2030	Flooring	3	04-May-07	08-May-07
A2039	GRINDING & BLENDING	75	11-May-07 A	25-Jul-07 A
A2040	Insulation Removal / Caulking	15	11-May-07	31-May-07
A2050	Insulation Removal / Caulkin...	14	28-May-07	14-Jun-07
A2060	Flooring	5	19-Jul-07	25-Jul-07
A2069	UPPER BLANCHING	46	08-May-07 A	22-Jun-07 A
A2070	Insulation Removal / Caulking	1	08-May-07	08-May-07
A2080	***Flooring - Date TBD***	5	18-Jun-07	22-Jun-07
A2089	VOTATOR	53	08-May-07 A	29-Jun-07 A
A2090	Insulation Removal / Caulking	39	08-May-07	29-Jun-07
A2100	Votator Mezzanine IMP Walls	14	09-May-07	28-May-07
A2110	***Flooring - Date TBD***	8	18-Jun-07	27-Jun-07
A2119	TANK ROOM	7	10-May-07 A	16-May-07 A
A2120	***Flooring - Date TBD***	5	10-May-07	16-May-07
A2129	PACKAGING	40	21-May-07 A	29-Jun-07 A
A2130	Insulation Removal / Caulking	8	21-May-07	30-May-07
A2149	CORRIDOR	45	14-May-07 A	27-Jun-07 A
A2140	***Flooring - Date TBD***	10	18-Jun-07	29-Jun-07
A2150	Insulation Removal / Caulking	1	14-May-07	14-May-07
A2160	***Flooring - Date TBD***	8	18-Jun-07	27-Jun-07



Actual Work
Remaining Work
Critical Remaining Work
Milestone
Summary



Legend

- Site Fence
- Gate Access
- Security Station
- Building Access Points
- Construction Site Traffic
- Material Access Points
- Site Parking
- Material Laydown Areas

16' 64'
8' 32' 128'

The Haskell Company
111 Riverside Avenue
Jacksonville, Florida 32202
Phone # (904) 791-4500

HASKELL®
America's Design-Build Leader®
AA C002281 EB0000906 IB0000849 LC26000242

PROJECT STALLONE
ConAgra Foods®
SYLVESTER, GA

Senior Thesis

Johnathan Garlow

Technical Assignment 2

Scale: 1/64" = 1'-0"

Site Plan

A-001

Appendix B

Included:

1. Online Survey
2. Interview Notes
3. Photos of Penn College

Workforce Development Surveys and Interviews

Survey Questions:

Page 1

1. What is your name?
2. What is the name of your company?
3. What type of firm?
    a. General Contractor
    b. Design-Build
    c. Construction Manager
    d. Architect
    e. Subcontractor
    f. Other (Please specify)
4. What is the size of your company?

Page 2

1. Are you a union contractor? Yes No

Page 3: Non-Union Contractors

1. How many field workers were hired by your company in 2006? 2007?
2. How many field workers left your company in 2006? 2007?
3. Out of those who left the company how many retired in 2006 and 2007 respectively?
4. How many field workers are set to retire from your company in 2008?
5. How many field laborers do you anticipate hiring for 2008?
6. What is the average age of people hired?
7. What is the average age of people that have left the company?
8. Does your company offer training programs for incoming field worker employees? If so please elaborate.
9. What is the average starting pay for field workers? Are there any other benefits/incentives that come with this pay?

Page 4: Union Contractors

1. On average how many field workers are on a typical project for your company?
2. What is the average age of field workers on a typical construction project?
3. Do you think that the age of a worker benefits or hinders their productivity? Please explain.
4. Does your company have any union members that are also full time employees? (Example: a Foreman) If so, Please state their age and pay, including benefits/incentives.

Page 5: Workforce Questions

1. Do you feel that there is currently a shortage in the workforce? Yes No

According to studies there is a large number of "Baby Boomers" in the construction workforce today, people born between 1946 and 1964. The problem being as they continue to get older there is an insufficient number of young people to replace them.

2. What do you think about the problem?
3. What action does your company plan taking so they can continue normal operation?
4. Within the next 10 years do you feel that there will be a shortage in the workforce?

   Yes No

Page 6

Thank you for your time. If you or your company has any additional information on the topic, your help would be greatly appreciated. Feel free to contact me at (724) ###-#### or by email at jmg494@psu.edu.

1. Any additional information can be added below.

[Survey End]

Workforce Development Interview Notes

Charles Cuppett – Union Carpenter *3/22/2008*

- Born – March 16, 1958, in the "Baby boomers"
- Union – Carpenters Local 84
- Size of Local – approximately 2250 in southwestern PA, approximately 150 in his Local
- What is the age of the people in your local – recently there has been a lot of younger people joining, the average age is 33, with the majority of the younger people entering the local between 25 to 30 into the apprenticeship.
- Current job – Self-employed residential contractor.
- Do you have pride in your work – Takes very much pride in the work that he does.
- Do you do work for other contractors – through the unions only, approximately 2-3 different contractors in a year depending on the market. Works approximately 10 months a year depending.
- What is your pay – union rates are $/hr, plus benefits which include savings annuity, all health insurance.
- What complaints do you have with the construction industry – Employers not paying into the benefit programs. This affects him because the company will not pay the union so he cannot collect the benefits.
- Explained the programs – for learning and getting started package, for the young the apprenticeship programs are very good. The rank goes: apprentice, journeyman, foreman, and general foreman. The apprentice gets paid while he/she is learning a little over $12/hr plus benefits, great job if you are coming out of high school. General foreman can take ten years or longer to get there, makes $30/hr and up plus benefits and generally does no physical labor.
- Raising a son while working – He included his son in his activities to the extent that his son was interested. He did not want his son to follow in the same direction as he did, there is a good living in it but he wanted him to do more. They had him tested to see what he would be good at and the test said an engineer, so that was the direction that they pushed him. It was a combined effort between Mr. Cuppett and his wife.
- Any plans on retiring – no plans on retiring any time soon. The cost of health care is too expensive for him to afford on his own.
- Do you feel that the current workforce is knowledgeable – some are knowledgeable, in his local they are knowledgeable.
- Do you feel that the labor workforce will strengthen or weaken over the next ten years – Weaken, there is not too many people out there that want to work, he feels that the market is weakening. Feels that there is going to be a Hispanic workforce that is going to take over. Within the past 5 years they have added Spanish to the union guides. Some workmanship will be compromised by the change, the quality of the work will suffer over the next ten years.
- What do you think can be done to solve the workforce deficiencies in the construction industry – the Hispanic workforce is the answer. By 2050 it is projected that the white American will be less than 50 percent of the population. Hispanics are getting their citizenships and getting certified in the unions. He feels that the same thing that is happening with the "baby boomers" will happen with this generation of Hispanic workforce in time. All of the trades need people.

Minorities should have no problems getting jobs especially in the unions, the doors are wide open to them

John Evans – Team PA CareerLink *3/24/2008*

- What industries do you provide jobs for – there is a cluster of 6 main areas that we really push to get jobs for. Construction industry is in the top 6.
- What is the most common industry that you provide jobs for – there is a serious demand for welders here in Fayette County. There are two companies that are in desperate need of welders, one of the companies has an onsite training program. The hot job for the time and the area right now is truck driving. Construction has been lagging behind other industries in training and pay.
- If an individual was coming in without direction, and no past work experience what direction would they be pushed – there is assessments that are given to individuals to see what they are good at. From there the state is capable of giving up to $6,000 for people to get training that they need. The training has to come from a list of places that are affiliated with the state, called an approved vendors list.
- Is there more of a demand for a technical field of work as opposed to a more labor intensive job – technical field of work are definitely more in demand.
- What is the average age of workers that come in looking for a job – overall it is about 30 years-old, for the construction industry in particular it is about the mid 20's.
- He is on the board for Brownsville Area School District and they don't have reporting for young people that go on to technical programs. This needs to be implemented. People that attend trade schools find jobs right away afterwards. While a lot of companies take on training themselves.
- Do you work closely with labor unions – they do work with them. They have a close association with union apprenticeship programs. The unions are still in a bind for a workforce as well.
- What type of jobs are most in demand from a company's stand point – there is a website, PA CareerLink's website if you go under the employers section, there is a list of construction companies.
- What type of incentives are offered to individuals interested in starting a career in the construction industry – there are not any real incentives for people coming into the market.
- What do you think is a solution to the construction industry's labor workforce problems – the solution lies in the vo-tech programs associated with high schools. Technical programs are trying to spark more of an interest in the construction industry. They need to start emphasizing trade schools to get people more training in the construction management fields.
- What do you think about the Hispanic workforce – they are filling the gaps that we currently cannot. For instance, in Lancaster PA the market is booming. The quality of work is good.

Shelley Moore – Pennsylvania College of Technology *3/31/2008*

- How long has Penn College been around – 1989 is when Penn College started its affiliation with The Pennsylvania State University. Before that they were affiliated with Penn College. All information available at www.pct.edu/about/history. Used to be the old Williamsport High School. The current enrolment is 6,682 students. You can find this information by looking up

"Fast Facts" on Google and also in the Sourcebook. 60 percent of the students come from the 15 closest counties to the school.

- What is the average age of your students – also found on "Fast Facts" 60 percent are traditional students, that means 25 years of age or younger.
- What percentage of students goes on to find a job – it varies by major. The college promotes their 96 percent placement rate. In construction there is 100 percent placement. They have a variety of companies that are active with the school and account for a lot of their placement. They have no affiliations with the unions.
- The hands-on experience is what attracts students as well as employers later on. Employers like this because it eliminates or shortens the training curve. It also helps the student because they have been working in the industry for the past two years so they will know if they like it or not. And until last year they didn't allow people that were undecided to enter the college. Now they do with intense one-on-one counseling to help them find direction.
- The school does offer scholarships as well as the traditional scholarships, loans and grants offered through the government.
- They also have a workforce development and continuing education to the school that is associated with a variety of companies. The companies offer the school on things that they are looking for in potential employees and the school works these things into their curriculum. This is located at www.pct.edu/wdce.
- There are 1500 housing units on campus, with eventual expansion for an additional 500 units.

Harry Hintz – Pennsylvania College of Technology *3/31/2008*

- Mr. Hintz is a professor at the college. Was working in the field for a long portion of his life until it took a toll on his body. He decided to get his master's in education and go on to teach at Penn College.
- He teaches general carpentry and wood classes. His students do a lot of different activities such as have to build a unit entirely on their own as seen in image ##. They also do roof structure, such as trusses and focus on exterior weatherproofing.
- He stated that he doesn't work closely with any unions but the masons did.
- Said that he has a daughter that was interested in coming to school there. was interested in the construction industry but he thinks that she is going to end up going into another field.
- He said that he thinks that the answer to the construction industry's labor workforce problems lies in the high schools. He feels that if the students get to a point to where they are studying at Penn College they already know what they want. If there was more of an interest sparked in kids in high school there would be a greater turn out here and in the industry.

Photos from Pennsylvania College of Technology

Image B.1: Shows Pennsylvania College of Technology from outside the campus.

Image B.2: Student and Administrative Services Building.

Image B.3: Madigan Library completed in August 2006.

Image B.4: Displays of craftsmanship from carpentry classes.

Image B.5: Hands on construction, interior finishing.

Image B.6: Inside view of interior finishing units.

Image B.7: Interior hands-on arch work.

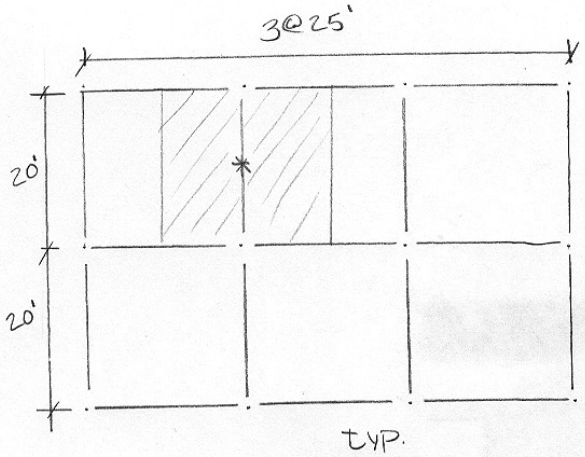
Image B.8: Hands-on fireplace stone work

Image B.9: Exterior masonry finishing class.

Image B.10: Hands-on plumbing class with water heaters on bottom and units on top.

Appendix C

Structural Calculations



NO LIVE LOAD

LOAD combo: 1.2D + 1.6L

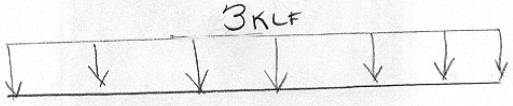
* - beam selected

Assumptions: the greatest loaded bay in the building would come from the exaust Peanut Duct. This is what I am Designing From This will Allow for Future Expansions in other bays.

The Most loaded bay will experience A load of 100 psf

Weight:

100 psf x 25' = 2500 plf x 1.2 = 3 klf ← factored



$\Delta_{all} = \frac{L}{360} = \frac{20 \times 12}{360} = .67"$

$\Delta = \frac{5 w \ell^4}{384 EI} = \frac{5 \times (3)(20)^4 \times 1728}{384 (29{,}000) I} = \frac{372}{I}$

$.67" = \frac{372}{I} \Rightarrow I = 555 \text{ in}^4$

Check Steel Manual

Pg 3-21 → Most Economical Choice

W18 x 40 with $I = 612$

$I = 612 in^4 > I = 555 in^4$

Good!

Check beam with added self weight.

3 KLF + 40 PSF self wt.

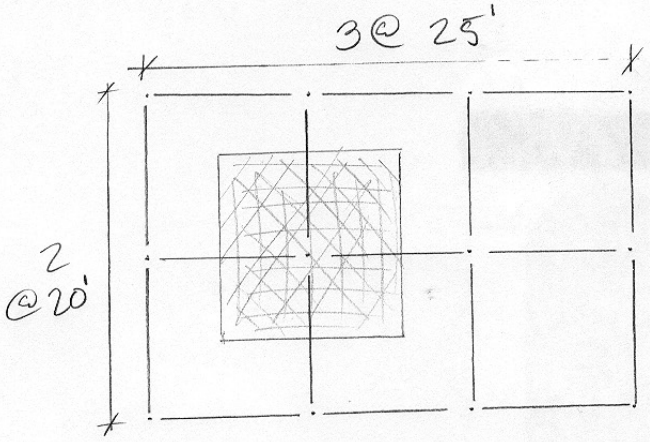
$$.67'' = \frac{5(3.04)(20)^4 \times 1728}{384(29{,}000)\, I} \Rightarrow I = 563 < 612$$

BEAMS = W18 x 40

Check Moment

$$\frac{wl^2}{8} = M = \frac{3.04(20)^2}{8} = 152\ 'K < \text{Allowable} = 274\ 'K$$

Column Design



Design of Columns Follows Same Assumptions As Design of beams.

100 PSF x (20' x 25') ← trib Area = 500 K

+

beam self wt: $2 \times \frac{20'}{2} \times .04^{KLF}$ = .8 K

$2 \times \frac{25'}{2} \times .04^{KLF}$ = 1 K

501.8 K

LOAD Combo: 1.2D + 1.6L

1.2 (501.8) = 602 K KLL = 12'

Choose W 12 x 58 603 = ϕP_n > 602

GOOD!

R.S. Means Estimating

3.75 Structural Steel Members	Crew	Daily Output	Labor-Hours	Unit	2008 Bare Costs Material	Labor	Equipment	Total	Total Incl O&P
x 26	E-2	600	.093	L.F.	31.50	3.91	2.61	38.02	44
x 33		550	.102		40	4.26	2.85	47.11	54.50
x 49		550	.102		59.50	4.26	2.85	66.61	75.50
W 12 x 14		880	.064		16.95	2.66	1.78	21.39	25
x 22		880	.064		26.50	2.66	1.78	30.94	36
x 26		880	.064		31.50	2.66	1.78	35.94	41
x 35		810	.069		42.50	2.89	1.93	47.32	53.50
x 50		750	.075		60.50	3.13	2.09	65.72	74
x 58		750	.075		70	3.13	2.09	75.22	84.50
x 72		640	.088		87	3.66	2.45	93.11	105
x 87		640	.088		105	3.66	2.45	111.11	125
W 14 x 26		990	.057		31.50	2.37	1.58	35.45	40.50
x 30		900	.062		36.50	2.60	1.74	40.84	46.50
x 34		810	.069		41	2.89	1.93	45.82	52.50
x 43		810	.069		52	2.89	1.93	56.82	64
x 53		800	.070		64	2.93	1.96	68.89	77.50
x 74		760	.074		89.50	3.08	2.06	94.64	106
x 90		740	.076		109	3.17	2.12	114.29	128
x 120		720	.078		145	3.26	2.18	150.44	168
W 16 x 26		1000	.056		31.50	2.34	1.57	35.41	40.50
x 31		900	.062		37.50	2.60	1.74	41.84	48
x 40		800	.070		48.50	2.93	1.96	53.39	60
x 50		800	.070		60.50	2.93	1.96	65.39	73.50
x 67		760	.074		81	3.08	2.06	86.14	96.50
W 18 x 35	E-5	960	.083		42.50	3.53	1.77	47.80	54.50
x 40		960	.083		48.50	3.53	1.77	53.80	61
x 46		960	.083		55.50	3.53	1.77	60.80	69
x 50		912	.088		60.50	3.72	1.86	66.08	75
x 55		912	.088		66.50	3.72	1.86	72.08	81.50
x 65		900	.089		78.50	3.77	1.89	84.16	95
x 76		900	.089		92	3.77	1.89	97.66	110
x 86		900	.089		104	3.77	1.89	109.66	123

Beams:

W18x40 (81) – 20’ sections = 1620 L.F.

(111) – 25’ sections = 2775 L.F.

Columns:

W12x58 (122) – 25’ sections = 3050 L.F.

	W18×40			W12×58		
	Unit	quantity	Price	Unit	quantity	Price
Total Material Cost :	48.50	(1620+ 2775)	$213,158	70	3050	$213,500
Labor :	2.93	4395	$12,877	3.13	"	$9547
Equipment :	1.96	4395	$8,614	209	"	$6,375
total :			$234,649			$229,422

Costs: $464,071

\+ Sales tax 4% GA: +$18563

\+ Location Factor : −$84925

↳ 81.7

$397,709

R012909-80 Sales Tax by State

State sales tax on materials is tabulated below (5 state
Many states allow local jurisdictions, such as a count
additional sales tax.

State	Tax (%)	Sta
Alabama	4	Illinois
Alaska	0	Indiana
Arizona	5.6	Iowa
Arkansas	6	Kansas
California	7.25	Kentucky
Colorado	2.9	Louisiana
Connecticut	6	Maine
Delaware	0	Maryland
District of Columbia	5.75	Massachusetts
Florida	6	Michigan
		Minnesota
Hawaii	4	Mississippi

Location Factors

STATE/ZIP	CITY	MAT.	INST.	TOTAL
GEORGIA				
300-303,399	Atlanta	98.1	78.2	89.6
304	Statesboro	98.0	48.3	76.8
305	Gainesville	96.8	64.6	83.0
306	Athens	96.2	67.3	83.8
307	Dalton	98.2	53.3	79.0
308-309	Augusta	96.8	65.0	83.2
310-312	Macon	95.6	66.3	83.0
313-314	Savannah	97.7	61.9	82.4
315	Waycross	97.0	57.9	80.3
316	Valdosta	96.8	50.8	77.1
318-319	Columbus	96.9	67.5	84.3

Price escalation due to adding the extra crew Calculations:

$464,071 + $12,877 + $9547 = $486,495 * 1.04(Tax) * .817(Location) = $413,365

Cost Information:

The RS Means cost that I got for Project Stallone came out to be $413,365. For a typical job this is normal, but for Project Stallone because of the complexity of this renovation project it needs to be modified. Just as the schedule was increased because of complexity, I will match the number and multiply the cost by 200%. This is justified because of the extensive risk that is taken by subcontractors that would get the job. . The final cost for the new structural system is $826,730.

Crew/Scheduling Information:

1 E-2 crew can erect 750 L.F. of W12x58 in an 8 hour work day 5 days a week. The steel columns will be erected in 5 days or a week. That same crew can erect 800 W16x40 beams in a day; at that rate the beams would be complete in 6 days. That is 11 days for the crew to finish the job. Project Stallone is a different type of building because the typical crane cannot be used because you are erecting indoors. To make up for these inefficiencies I am adding a 200% complication factor into my calculations. Therefore, doubling the duration to 22 days for steel erection. The second part to this operation would be the removal of the roof loads and placing them onto the frames that were just built. Since this is a task that is very time consuming I am adding an additional 22 days to this unloading phase. The total duration of this phase is now 44, for simplicity 45 days, at a normal pace of work, 8 hours a day, 5 days a week. To fit in to the schedule and to keep up with the structural repairs to the existing frames, this 45 day time period will simply not work. I will use 2 crews both starting at separate ends of the building and meeting in the middle so that they are not working on top of each other. This will cut the time in half to 22 days, which is 4 and a half weeks, approximately 1 month. This is now acceptable. The above cost number is also updated to account for adding the extra crew.

Days per Week	Hours per Day	Production Efficiency					Payroll Cost Factors	
		1 Week	2 Weeks	3 Weeks	4 Weeks	Average 4 Weeks	@ 1-1/2 Times	@ 2 Times
5	8	100%	100%	100%	100%	100%	100%	100%
	9	100	100	95	90	96.25	105.6	111.1
	10	100	95	90	85	91.25	110.0	120.0
	11	95	90	75	65	81.25	113.6	127.3
	12	90	85	70	60	76.25	116.7	133.3
6	8	100	100	95	90	96.25	108.3	116.7
	9	100	95	90	85	92.50	113.0	125.9
	10	95	90	85	80	87.50	116.7	133.3
	11	95	85	70	65	78.75	119.7	139.4
	12	90	80	65	60	73.75	122.2	144.4
7	8	100	95	85	75	88.75	114.3	128.6
	9	95	90	80	70	83.75	118.3	136.5
	10	90	85	75	65	78.75	121.4	142.9
	11	85	80	65	60	72.50	124.0	148.1
	12	85	75	60	55	68.75	126.2	152.4

Overtime tables: there is no need for these in this project if following scheduling outlined above

Crew E-2	Hr.	Daily	Hr.	Daily	Bare Costs	Incl. O&P
1 Struc. Steel Foreman	$45.00	$360.00	$81.20	$649.60	$41.86	$72.30
4 Struc. Steel Workers	43.00	1376.00	77.55	2481.60		
1 Equip. Oper. (crane)	40.95	327.60	61.75	494.00		
1 Equip. Oper. Oiler	35.10	280.80	52.95	423.60		
1 Lattice Boom Crane, 90 Ton		1567.00		1723.70	27.98	30.78
56 L.H., Daily Totals		$3911.40		$5772.50	$69.85	$103.08

Appendix D

Mechanical Calculations

Mechanical Unit Sizing Information Table 1 of 2

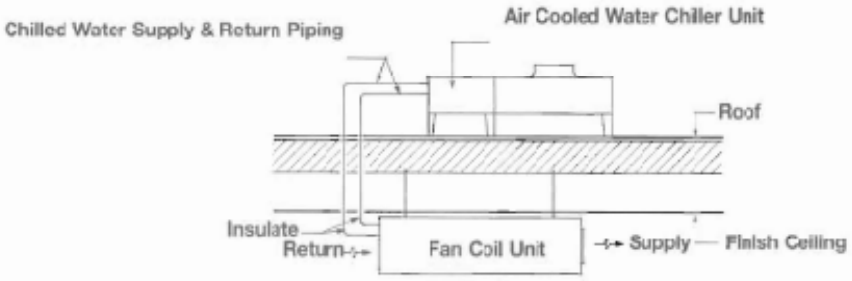
					ENVELOPE LOAD		INTERNAL LOADS		OUTSIDE AIR LOAD			
ZONE		Rel. Press.	Area (sf)	Avg. Height (ft)	sf/ton	tons	w/sf	tons	Perimeter Wall (lf)	% Open	Press. Diff. ("w.g.)	Velocity (fpm)
MINOR INGREDIENTS STORAGE ROOM	A/C	+1	386	16	600	1	9	1	84	1%	0.00001	13
GRINDING KITCHEN 2ND FLOOR	H&V	+1	2232	16	2400	1	7	4	212	1%	0.00001	13
PROCESS COOLING AREA/VOTATORS	H&V	+1	15500	16	2400	6	10	44	580	1%	0.00001	13
RAW PRODUCT/PEANUT STORAGE AREA	H&V	+1	10110	16	2400	4	7	20	443	8%	0.00001	13
UPPER LEVEL COLOR SORT AREA	H&V	+1	5880	16	2400	2	5	8	153	10%	0.00001	13
GRINDING KITCHEN 1ST FLOOR	H&V	+1	4425	13	2400	2	7	9	272	5%	0.00001	13
PACKAGING	A/C	+2	28580	28	600	48	7	57	674	3%	0.00005	28
NEW ROASTER AREA	H&V	+1	7180	26	400	18	17	35	525	3%	0.00001	13
LOWER LEVEL COLOR SORT	H&V	+1	12360	13	2400	5	7	25	647	3%	0.00001	13
READCO ROOM	A/C	+1	2137	13	600	4	5	3	232	1%	0.00001	13
RAW PEANUT/BULK STORAGE	H&V	0	9450	24	2400	4	4	11	510	1%	0.00001	13
RAW PRODUCT WAREHOUSE	H&V	+1	13365	32	2400	6	9	34	607	1%	0.00001	13
FINISHED PRODUCT WAREHOUSE	A/C	+1	37500	32	600	63	2	21	864	3%	0.00001	13
READCO PENTHOUSE	A/C	+1	6000	16	600	10	2	3	250	1%	0.00001	13
SUGAR MILL ROOM	A/C	+1	1600	16	600	3	5	2	250	1%	0.00001	13

Mechanical Unit Sizing Information Table 2 of 2

						A/C	H&V		LEVEL OF FILTRATION	
ZONE	Airflow Req'd for Press. (cfm)	Airflow transfr'd from Adj. Zone (cfm)	Outside Airflow Req'd fopr Press. (cfm)	cfm/ton	tons	Total Load (tons)	Cooling w/ Outside Air 5F above Ambient (cfm)	Equiv. Air Changes per Hour	Pre-Filtration Minimum Efficiency Reporting Value (MERV)	Final Filtration Minimum Efficiency Reporting Value (MERV)
MINOR INGREDIENTS STORAGE ROOM	170	0	170	350	0	2	N/A	N/A	7	13
GRINDING KITCHEN 2ND FLOOR	430	0	430	600	1	N/A	11942	20.1	7	13
PROCESS COOLING AREA/VOTATORS	1175	5000	-3825	600	-6	N/A	112318	27.2	7	13
RAW PRODUCT/PEANUT STORAGE AREA	6733	500	6233	600	10	N/A	54090	20.1	7	13
UPPER LEVEL COLOR SORT AREA	3100	0	3100	600	5	N/A	24026	15.3	7	13
GRINDING KITCHEN 1ST FLOOR	2239	700	1539	600	3	N/A	23675	24.7	7	13
PACKAGING	16033	0	16033	400	40	145	N/A	N/A	7	14
NEW ROASTER AREA	5186	0	5186	600	9	N/A	117035	37.6	7	13
LOWER LEVEL COLOR SORT	2663	1000	1663	600	3	N/A	66128	24.7	7	13
READCO ROOM	382	0	382	350	1	8	N/A	N/A	7	13
RAW PEANUT/BULK STORAGE	1550	3250	-1700	600	-3	N/A	32641	8.6	7	13
RAW PRODUCT WAREHOUSE	2460	0	2460	600	4	N/A	88400	12.4	7	13
FINISHED PRODUCT WAREHOUSE	10505	4500	6005	350	17	101	N/A	N/A	7	13
READCO PENTHOUSE	507	0	507	350	1	15	N/A	N/A	7	13
SUGAR MILL ROOM	507	0	507	600	1	6	N/A	N/A	7	13
					86	276	530255			

0 HVAC

030 Cooling Generating Systems



sign Assumptions: The chilled water, cooled systems priced, utilize iprocating hermetic compressors and peller-type condenser fans. Piping n pumps and expansion tanks is included based on a two pipe system. No ducting is includec and the fan-coil units are cooling only. Water treatment and balancing are not included. Chilled water piping is insulated. Area distribution is through the use of multiple fan coil units. Fewer but larger fan coil units with duct distribution would be approximately the same S.F. cost.

tem Components	QUANTITY	UNIT	COST EACH MAT.	COST EACH INST.	COST EACH TOTAL
SYSTEM D3030 110 1200					
PACKAGED CHILLER, AIR COOLED, WITH FAN COIL UNIT					
APARTMENT CORRIDORS, 3,000 S.F., 5.50 TON					
Fan coil air conditioning unit, cabinet mounted & filters chilled water	1.000	Ea.	3,207.75	467.42	3,675.17
Water chiller,ar conditioning unit, reciprocating, air cooled,	1.000	Ea.	6,435	1,746.25	8,181.25
Chilled water unit coil connections	1.000	Ea.	910	1,275	2,185
Chilled water distribution piping	440.000	L.F.	8,514	17,380	25,894
TOTAL			19,066.75	20,868.67	39,935.42
COST PER S.F.			6.36	6.96	13.32
*Cooling requirements would lead to choosing a water cooled unit					

030 110 Chilled Water, Air Cooled Condenser Systems	COST PER S.F. MAT.	COST PER S.F. INST.	COST PER S.F. TOTAL
Packaged chiler, air cooled, with fan coil unit			
Apartment corridors, 3,000 S.F., 5.50 ton	6.37	6.97	13.34
6,000 S.F., 11.00 ton	5.30	5.55	10.85
10,000 S.F., 18.33 ton	4.59	4.23	8.82
20,000 S.F., 36.66 ton	3.42	3.06	6.48
40,000 S.F., 73.33 ton	3.96	3.06	7.02
Banks and libraries, 3,000 S.F., 12.50 ton	9.80	8.15	17.95
6,000 S.F., 25.00 ton	9	6.65	15.65
10,000 S.F., 41.66 ton	6.65	4.65	11.30
20,000 S.F., 83.33 ton	7	4.18	11.18
40,000 S.F., 167 ton*			
Bars and taverns, 3,000 S.F., 33.25 ton	16.30	9.70	26
6,000 S.F., 66.50 ton	14.85	7.50	22.35
10,000 S.F., 110.83 ton	12.15	2.40	14.55
20,000 S.F., 220 ton*			
40,000 S.F., 440 ton*			
Bowling alleys, 3,000 S.F., 17.00 ton	12.30	9.20	21.50
6,000 S.F., 34.00 ton	9.05	6.45	15.50
10,000 S.F., 56.66 ton	8	4.70	12.70
20,000 S.F., 113.33 ton	8.05	4.23	12.28
40,000 S.F., 227 ton*			
Department stores, 3,000 S.F., 8.75 ton	8.75	7.75	16.50
6,000 S.F., 17.50 ton	6.90	6	12.90
10,000 S.F., 29.17 ton	5.30	4.33	9.63
20,000 S.F., 58.33 ton	4.55	3.20	7.75
40,000 S.F., 116.66 ton	5.20	3.15	8.35

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