Technical Assignment #2

Analysis of Key Construction Features

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HGS – Large Scale Manufacturing Facility
October 27, 2004

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Analysis of Key Construction Features

1. Executive Summary

This technical assignment will provide a greater understanding of the Large Scale Manufacturing Facilities primary construction features. The Project Schedule, an Assemblies Estimate of the exterior walls, the project Contracts, Gilbane's Staffing Plan, and MEP Design Coordination will be described in greater detail as this report progresses. There is also a section discussing some Critical Industry Issues which were discussed at this years PACE Roundtable Meeting.

The detailed project schedule provides a better understand of the basic processes and durations of major activities required to complete the LSM project. It is evident that a majority of the project consists of the MEP construction, which is also the most detailed sequencing phase of the project. Coordination of these phases is an integral part in completing this project on time. By early review and planning many issues with these systems can be resolved before they start construction.

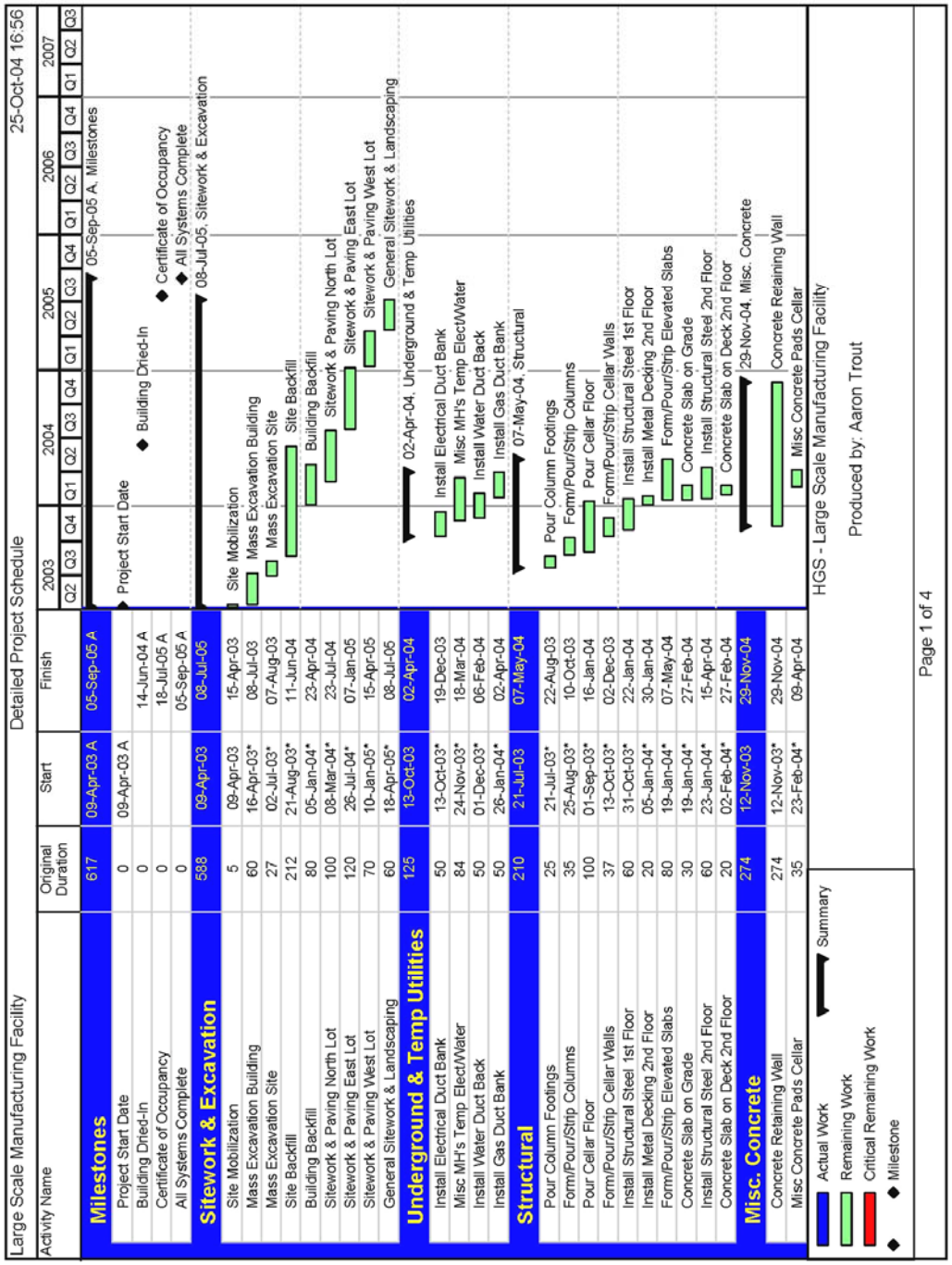
Understanding the contracts of any project is required for it to run smoothly. The contracts held between the Architect/Engineer, Owner, Construction Manager, and Subcontractors are clearly stated in the front end specifications of the construction documents. It discusses major correspondence between these entities such as changes in scope, payment requisitions, insurance, bonding, and change orders. The LSM project is a General Contractor project with Gilbane being the GC/CM; they are currently in the process of creating a GMP (Guaranteed Maximum Price) for the project which is to be accepted by HGS.

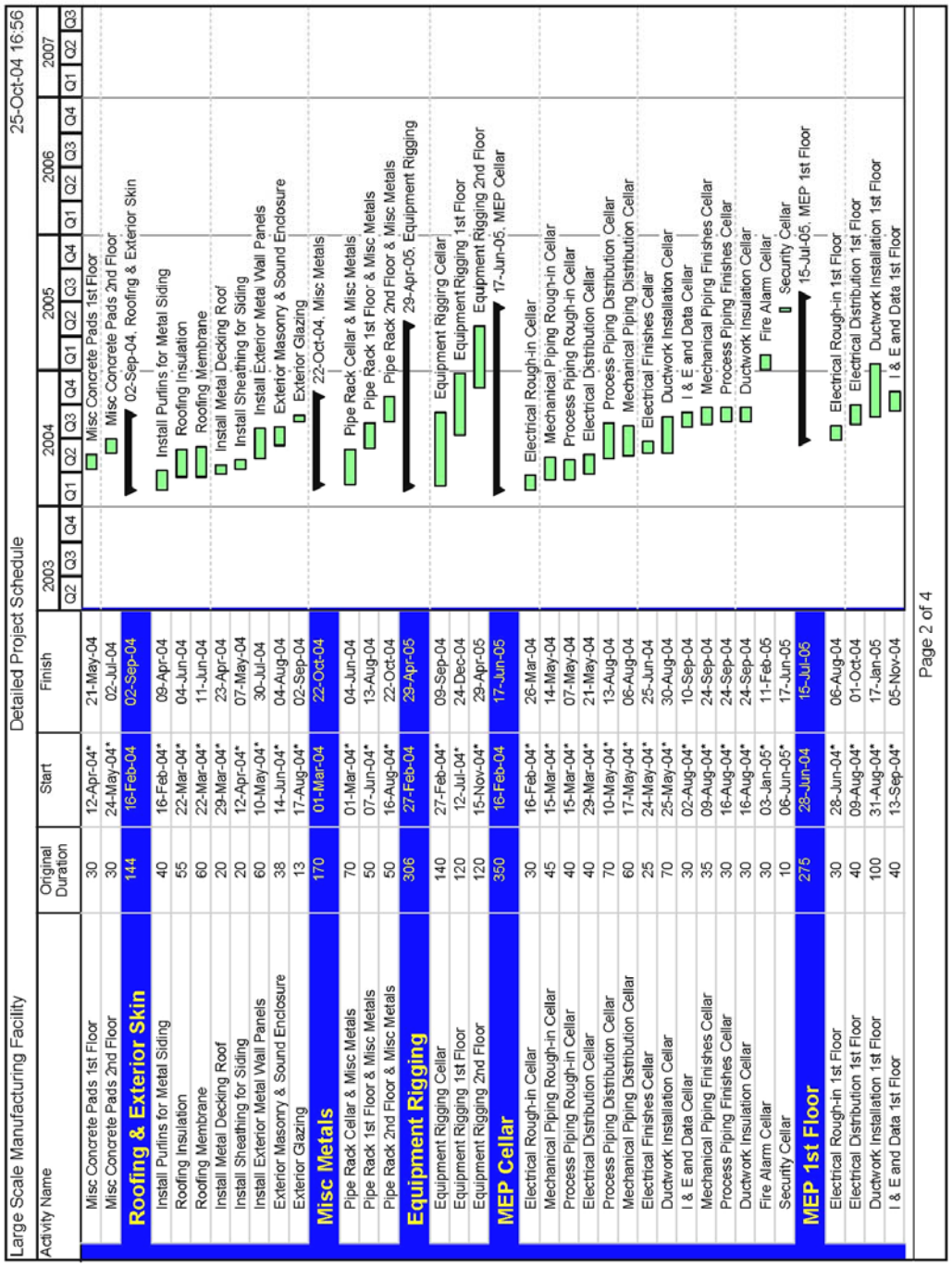
For this project Gilbane has provided an experiences staff of almost 30 employees. Each person is assigned to a specific task, which is required for a building of this size and complexity. A detailed staffing chart was designed to show the interactions between all of the staff members. This is quite important to devise in order to eliminate confusion of tasks and authority within the company.

This LSM project is a building consisting of numerous exterior finishes and aesthetic items. By analysis of the exterior walls using an assembly estimate, there are multiple different systems that make up the exterior skin. These consists of concrete, facing brick, a curtain wall, metal siding, and prefabricated metal wall panels.

The Partnership for Achieving Construction Excellence holds a yearly discussion at the Pennsylvania State University. At this meeting denoted the "Roundtable Meeting" industry members and Penn State faculty and students get the chance to participate in sessions where current industry issues are discussed. Some of these issues will be further discussed later in this technical assignment.

2. Detailed Project Schedule




Large Scale Manufacturing Facility
Detailed Project Schedule
25-Oct-04 16:56
Activity Name
Original Duration
Start
Finish
2003
2004
2005
2006
2007
Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3
Misc Concrete Pads 1st Floor 30 12-Apr-04* 21-May-04
Misc Concrete Pads 2nd Floor 30 24-May-04* 02-Jul-04
Roofing & Exterior Skin 144 16-Feb-04 02-Sep-04
Install Purlins for Metal Siding 40 16-Feb-04* 09-Apr-04
Roofing Insulation 55 22-Mar-04* 04-Jun-04
Roofing Membrane 60 22-Mar-04* 11-Jun-04
Install Metal Decking Roof 20 29-Mar-04* 23-Apr-04
Install Sheathing for Siding 20 12-Apr-04* 07-May-04
Install Exterior Metal Wall Panels 60 10-May-04* 30-Jul-04
Exterior Masonry & Sound Enclosure 38 14-Jun-04* 04-Aug-04
Exterior Glazing 13 17-Aug-04* 02-Sep-04
Misc Metals 170 01-Mar-04 22-Oct-04
Pipe Rack Cellar & Misc Metals 70 01-Mar-04* 04-Jun-04
Pipe Rack 1st Floor & Misc Metals 50 07-Jun-04* 13-Aug-04
Pipe Rack 2nd Floor & Misc Metals 50 16-Aug-04* 22-Oct-04
Equipment Rigging 306 27-Feb-04 29-Apr-05
Equipment Rigging Cellar 140 27-Feb-04* 09-Sep-04
Equipment Rigging 1st Floor 120 12-Jul-04* 24-Dec-04
Equipment Rigging 2nd Floor 120 15-Nov-04* 29-Apr-05
MEP Cellar 350 16-Feb-04 17-Jun-05
Electrical Rough-in Cellar 30 16-Feb-04* 26-Mar-04
Mechanical Piping Rough-in Cellar 45 15-Mar-04* 14-May-04
Process Piping Rough-in Cellar 40 15-Mar-04* 07-May-04
Electrical Distribution Cellar 40 29-Mar-04* 21-May-04
Process Piping Distribution Cellar 70 10-May-04* 13-Aug-04
Mechanical Piping Distribution Cellar 60 17-May-04* 06-Aug-04
Electrical Finishes Cellar 25 24-May-04* 25-Jun-04
Ductwork Installation Cellar 70 25-May-04* 30-Aug-04
I & E and Data Cellar 30 02-Aug-04* 10-Sep-04
Mechanical Piping Finishes Cellar 35 09-Aug-04* 24-Sep-04
Process Piping Finishes Cellar 30 16-Aug-04* 24-Sep-04
Ductwork Insulation Cellar 30 16-Aug-04* 24-Sep-04
Fire Alarm Cellar 30 03-Jan-05* 11-Feb-05
Security Cellar 10 06-Jun-05* 17-Jun-05
MEP 1st Floor 275 28-Jun-04 15-Jul-06
Electrical Rough-in 1st Floor 30 28-Jun-04* 06-Aug-04
Electrical Distribution 1st Floor 40 09-Aug-04* 01-Oct-04
Ductwork Installation 1st Floor 100 31-Aug-04* 17-Jan-05
I & E and Data 1st Floor 40 13-Sep-04* 05-Nov-04
02-Sep-04, Roofing & Exterior Skin
22-Oct-04, Misc Metals
29-Apr-05, Equipment Rigging
17-Jun-05, MEP Cellar
15-Jul-05, MEP 1st Floor
Misc Concrete Pads 1st Floor
Misc Concrete Pads 2nd Floor
Install Purlins for Metal Siding
Roofing Insulation
Roofing Membrane
Install Metal Decking Roof
Install Sheathing for Siding
Install Exterior Metal Wall Panels
Exterior Masonry & Sound Enclosure
Exterior Glazing
Pipe Rack Cellar & Misc Metals
Pipe Rack 1st Floor & Misc Metals
Pipe Rack 2nd Floor & Misc Metals
Equipment Rigging Cellar
Equipment Rigging 1st Floor
Equipment Rigging 2nd Floor
Electrical Rough-in Cellar
Mechanical Piping Rough-in Cellar
Process Piping Rough-in Cellar
Electrical Distribution Cellar
Process Piping Distribution Cellar
Mechanical Piping Distribution Cellar
Electrical Finishes Cellar
Ductwork Installation Cellar
I & E and Data Cellar
Mechanical Piping Finishes Cellar
Process Piping Finishes Cellar
Ductwork Insulation Cellar
Fire Alarm Cellar
Security Cellar
Electrical Rough-in 1st Floor
Electrical Distribution 1st Floor
Ductwork Installation 1st Floor
I & E and Data 1st Floor
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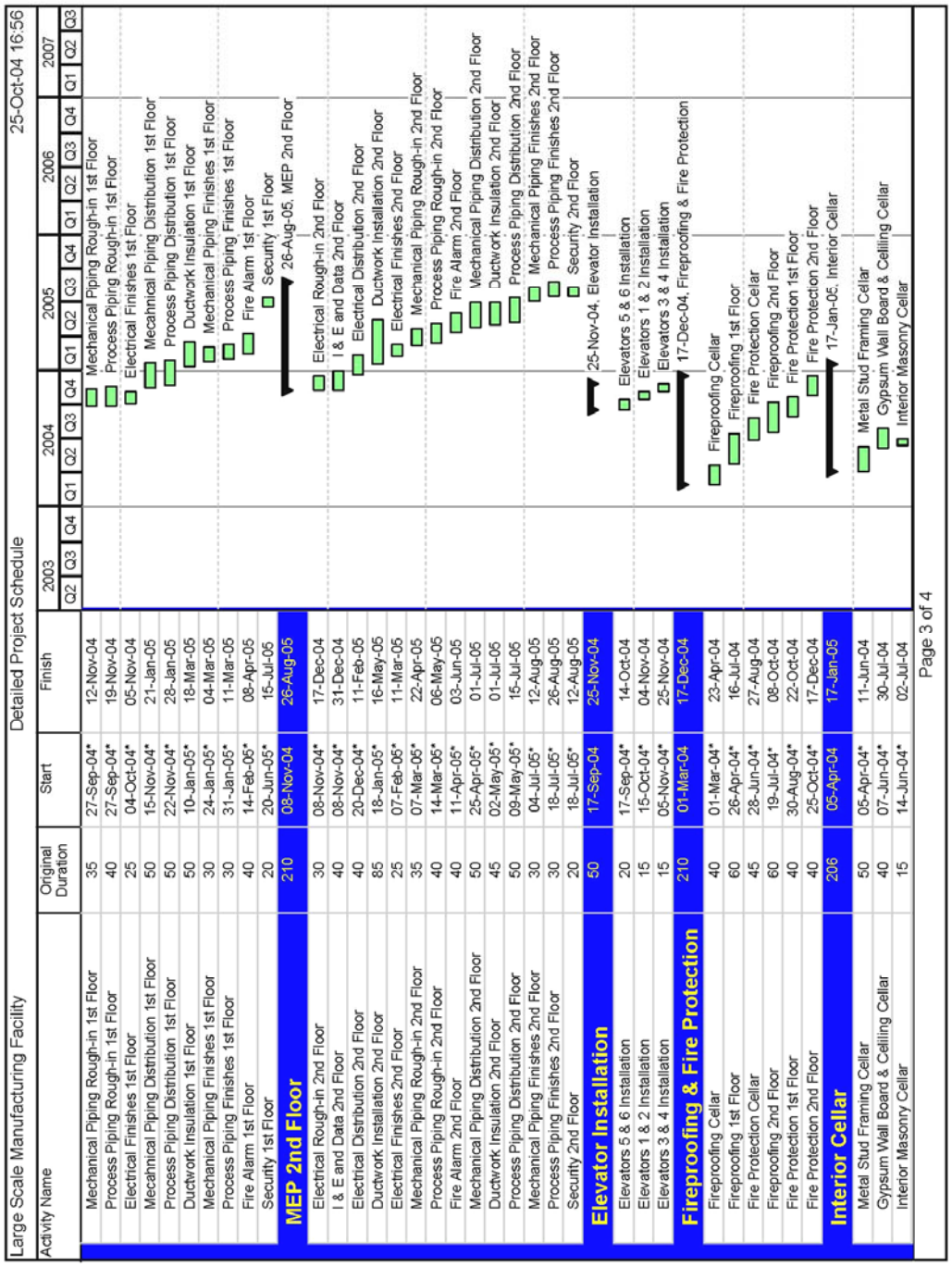
Large Scale Manufacturing Facility
Detailed Project Schedule
25-Oct-04 16:56
Activity Name
Original Duration
Start
Finish
2003
2004
2005
2006
2007
Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3
Mechanical Piping Rough-in 1st Floor 35 27-Sep-04* 12-Nov-04
Process Piping Rough-in 1st Floor 40 27-Sep-04* 19-Nov-04
Electrical Finishes 1st Floor 25 04-Oct-04* 05-Nov-04
Mecahnical Piping Distribution 1st Floor 50 15-Nov-04* 21-Jan-05
Process Piping Distribution 1st Floor 50 22-Nov-04* 28-Jan-05
Ductwork Insulation 1st Floor 50 10-Jan-05* 18-Mar-05
Mechanical Piping Finishes 1st Floor 30 24-Jan-05* 04-Mar-05
Process Piping Finishes 1st Floor 30 31-Jan-05* 11-Mar-05
Fire Alarm 1st Floor 40 14-Feb-05* 08-Apr-05
Security 1st Floor 20 20-Jun-05* 15-Jul-05
MEP 2nd Floor 210 08-Nov-04 26-Aug-05
Electrical Rough-in 2nd Floor 30 08-Nov-04* 17-Dec-04
I & E and Data 2nd Floor 40 08-Nov-04* 31-Dec-04
Electrical Distribution 2nd Floor 40 20-Dec-04* 11-Feb-05
Ductwork Installation 2nd Floor 85 18-Jan-05* 16-May-05
Electrical Finishes 2nd Floor 25 07-Feb-05* 11-Mar-05
Mechanical Piping Rough-in 2nd Floor 35 07-Mar-05* 22-Apr-05
Process Piping Rough-in 2nd Floor 40 14-Mar-05* 06-May-05
Fire Alarm 2nd Floor 40 11-Apr-05* 03-Jun-05
Mechanical Piping Distribution 2nd Floor 50 25-Apr-05* 01-Jul-05
Ductwork Insulation 2nd Floor 45 02-May-05* 01-Jul-05
Process Piping Distribution 2nd Floor 50 09-May-05* 15-Jul-05
Mechanical Piping Finishes 2nd Floor 30 04-Jul-05* 12-Aug-05
Process Piping Finishes 2nd Floor 30 18-Jul-05* 26-Aug-05
Security 2nd Floor 20 18-Jul-05* 12-Aug-05
Elevator Installation 50 17-Sep-04 25-Nov-04
Elevators 5 & 6 Installation 20 17-Sep-04* 14-Oct-04
Elevators 1 & 2 Installation 15 15-Oct-04* 04-Nov-04
Elevators 3 & 4 Installation 15 05-Nov-04* 25-Nov-04
Fireproofing & Fire Protection 210 01-Mar-04 17-Dec-04
Fireproofing Cellar 40 01-Mar-04* 23-Apr-04
Fireproofing 1st Floor 60 26-Apr-04* 16-Jul-04
Fire Protection Cellar 45 28-Jun-04* 27-Aug-04
Fireproofing 2nd Floor 60 19-Jul-04* 08-Oct-04
Fire Protection 1st Floor 40 30-Aug-04* 22-Oct-04
Fire Protection 2nd Floor 40 25-Oct-04* 17-Dec-04
Interior Cellar 206 05-Apr-04 17-Jan-05
Metal Stud Framing Cellar 50 05-Apr-04* 11-Jun-04
Gypsum Wall Board & Ceilling Cellar 40 07-Jun-04* 30-Jul-04
Interior Masonry Cellar 15 14-Jun-04* 02-Jul-04
Mechanical Piping Rough-in 1st Floor
Process Piping Rough-in 1st Floor
Electrical Finishes 1st Floor
Mecahnical Piping Distribution 1st Floor
Process Piping Distribution 1st Floor
Ductwork Insulation 1st Floor
Mechanical Piping Finishes 1st Floor
Process Piping Finishes 1st Floor
Fire Alarm 1st Floor
Security 1st Floor
26-Aug-05, MEP 2nd Floor
Electrical Rough-in 2nd Floor
I & E and Data 2nd Floor
Electrical Distribution 2nd Floor
Ductwork Installation 2nd Floor
Electrical Finishes 2nd Floor
Mechanical Piping Rough-in 2nd Floor
Process Piping Rough-in 2nd Floor
Fire Alarm 2nd Floor
Mechanical Piping Distribution 2nd Floor
Ductwork Insulation 2nd Floor
Process Piping Distribution 2nd Floor
Mechanical Piping Finishes 2nd Floor
Process Piping Finishes 2nd Floor
Security 2nd Floor
25-Nov-04, Elevator Installation
Elevators 5 & 6 Installation
Elevators 1 & 2 Installation
Elevators 3 & 4 Installation
17-Dec-04, Fireproofing & Fire Protection
Fireproofing Cellar
Fireproofing 1st Floor
Fire Protection Cellar
Fireproofing 2nd Floor
Fire Protection 1st Floor
Fire Protection 2nd Floor
17-Jan-05, Interior Cellar
Metal Stud Framing Cellar
Gypsum Wall Board & Ceilling Cellar
Interior Masonry Cellar
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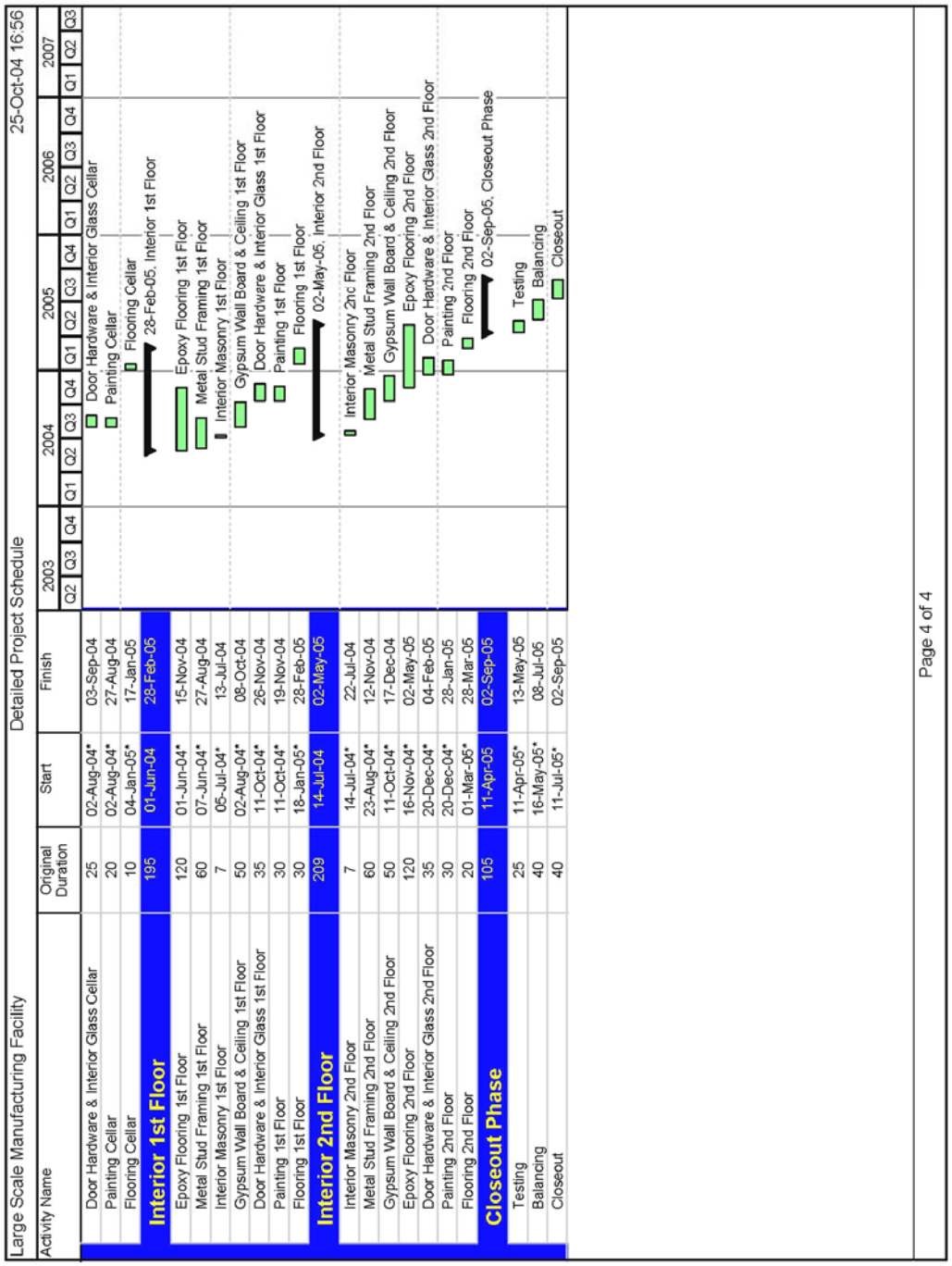
Large Scale Manufacturing Facility
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25-Oct-04 16:56
Activity Name
Original Duration
Start
Finish
2003
2004
2005
2006
2007
Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3
Door Hardware & Interior Glass Cellar 25 02-Aug-04* 03-Sep-04
Painting Cellar 20 02-Aug-04* 27-Aug-04
Flooring Cellar 10 04-Jan-05* 17-Jan-05
Interior 1st Floor 195 01-Jun-04 28-Feb-05
Epoxy Flooring 1st Floor 120 01-Jun-04* 15-Nov-04
Metal Stud Framing 1st Floor 60 07-Jun-04* 27-Aug-04
Interior Masonry 1st Floor 7 05-Jul-04* 13-Jul-04
Gypsum Wall Board & Ceiling 1st Floor 50 02-Aug-04* 08-Oct-04
Door Hardware & Interior Glass 1st Floor 35 11-Oct-04* 26-Nov-04
Painting 1st Floor 30 11-Oct-04* 19-Nov-04
Flooring 1st Floor 30 18-Jan-05* 28-Feb-05
Interior 2nd Floor 209 14-Jul-04 02-May-05
Interior Masonry 2nd Floor 7 14-Jul-04* 22-Jul-04
Metal Stud Framing 2nd Floor 60 23-Aug-04* 12-Nov-04
Gypsum Wall Board & Ceiling 2nd Floor 50 11-Oct-04* 17-Dec-04
Epoxy Flooring 2nd Floor 120 16-Nov-04* 02-May-05
Door Hardware & Interior Glass 2nd Floor 35 20-Dec-04* 04-Feb-05
Painting 2nd Floor 30 20-Dec-04* 28-Jan-05
Flooring 2nd Floor 20 01-Mar-05* 28-Mar-05
Closeout Phase 105 11-Apr-05 02-Sep-05
Testing 25 11-Apr-05* 13-May-05
Balancing 40 16-May-05* 08-Jul-05
Closeout 40 11-Jul-05* 02-Sep-05
Door Hardware & Interior Glass Cellar
Painting Cellar
Flooring Cellar
28-Feb-05, Interior 1st Floor
Epoxy Flooring 1st Floor
Metal Stud Framing 1st Floor
Interior Masonry 1st Floor
Gypsum Wall Board & Ceiling 1st Floor
Door Hardware & Interior Glass 1st Floor
Painting 1st Floor
Flooring 1st Floor
02-May-05, Interior 2nd Floor
Interior Masonry 2nc Floor
Metal Stud Framing 2nd Floor
Gypsum Wall Board & Ceiling 2nd Floor
Epoxy Flooring 2nd Floor
Door Hardware & Interior Glass 2nd Floor
Painting 2nd Floor
Flooring 2nd Floor
02-Sep-05, Closeout Phase
Testing
Balancing
Closeout
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3. Assemblies Estimate

3.1. Description / Assumptions

Description

The chart below shows an assemblies estimate for the LSM Facility. In order to devise an estimate, the 2004 R.S. Means Cost Works program was used which is an electronic version of the Assembly Cost book. The Assembly costs are broken up into substructure, shell, interiors, services, equipment & furnishings, special construction, and building sitework.

The chart above lists the items located in the shell of the building, in specific the exterior walls. This includes exterior walls, exterior doors, and exterior windows. A location is first needed to be obtained so that appropriate costs for the LSM building are used. Rockville, MD was not listed in the database; College Park, MD which is the closest location to Rockville, MD was selected. From this the exterior walls were split up according to the CSI Uniformat II.

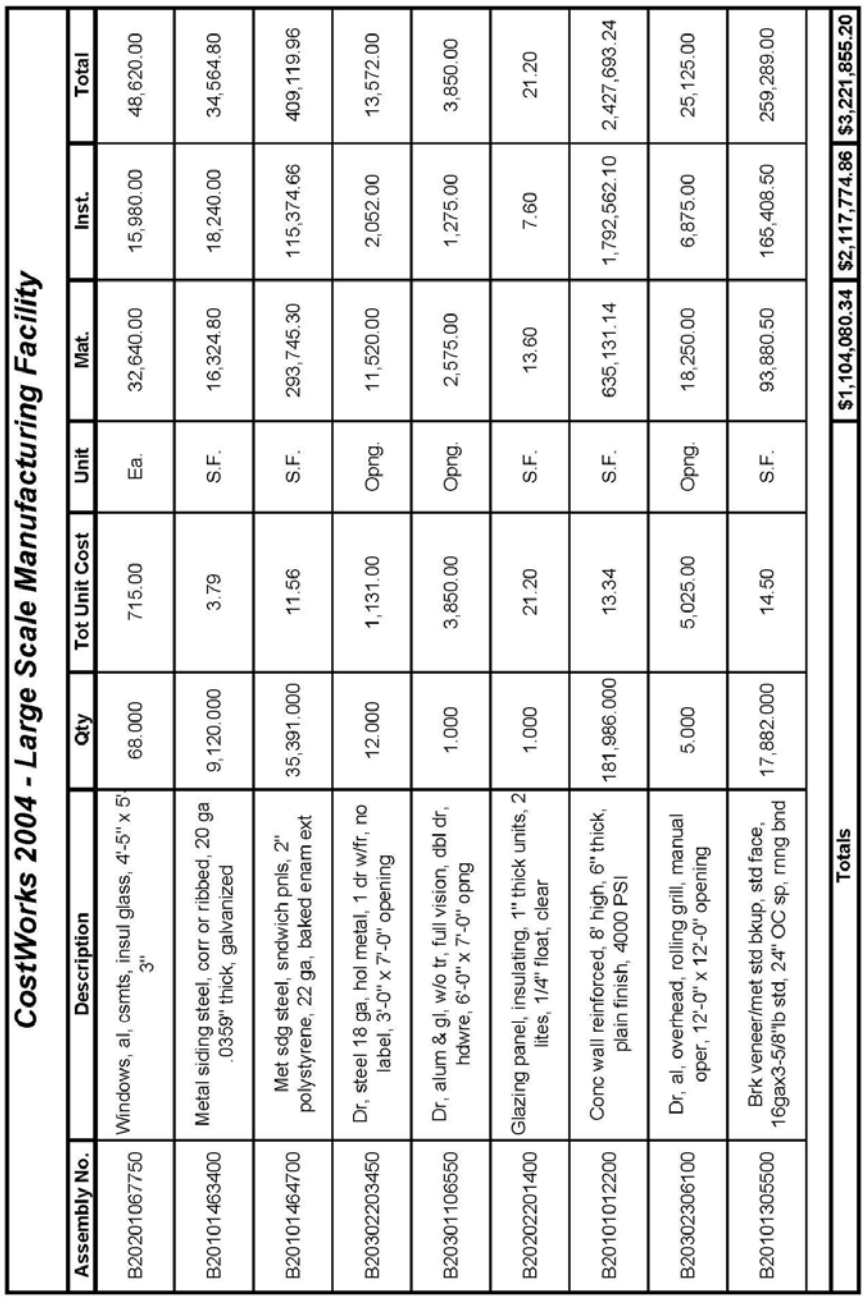
The LSM building consists of three main exterior wall systems: 2in. preformed metal wall panels, 4in. facing brick, and an 18in. cast in place concrete wall. The southern façade consists of the 4in. facing brick with a curtain wall system on the western side with windows punched throughout the elevation. The other three faces of the building consist of the 2in. preformed metal wall panels with ribbed metal siding towards the top of the building. The cellar walls are base up of a 22ft. high 18in. thick reinforced cast-in-place concrete wall. The northern section is 100% visible and on the western and eastern sides is visible on most of the face. On the southern face of the building the concrete wall is underground. This entire wall was used in the assemblies estimate since it is visible throughout most of the exterior of the building.

All take-offs will be attached to the end of this technical assignment.

Assumptions

- Since actual location was not listed a location that closely resembled market costs was used
- If items were not specified exactly in the Assembly Costs, an alternative was chosen that would closely resemble the specified product
- If correct dimensions were not listed, alterations to total unit cost or quantity were made to make up the difference
- Due to exterior grading certain areas of the concrete are located underground, and this area was taken into account for exterior walls
- Metal stud spacing was assumed to be 24 in. since no distance was specified
- Retaining walls and wall surrounding generator pad were not included in estimate
- Additional time for helix pattern in brick was not taken into account

3.2. Cost Works Chart



CostWorks 2004 - Large Scale Manufacturing Facility

Assembly No.	Description	Qty	Tot Unit Cost	Unit	Mat.	Inst.	Total
B20201067750	Windows, al, csmts, insul glass, 4'-5" x 5' 3"	68.000	715.00	Ea.	32,640.00	15,980.00	48,620.00
B20101463400	Metal siding steel, corr or ribbed, 20 ga .0359" thick, galvanized	9,120.000	3.79	S.F.	16,324.80	18,240.00	34,564.80
B20101464700	Met sdg steel, sndwich pnls, 2" polystyrene, 22 ga, baked enam ext	35,391.000	11.56	S.F.	293,745.30	115,374.66	409,119.96
B20302203450	Dr, steel 18 ga, hol metal, 1 dr w/fr, no label, 3'-0" x 7'-0" opening	12.000	1,131.00	Opng.	11,520.00	2,052.00	13,572.00
B20301106550	Dr, alum & gl, w/o tr, full vision, dbl dr, hdwre, 6'-0" x 7'-0" opng	1.000	3,850.00	Opng.	2,575.00	1,275.00	3,850.00
B20202201400	Glazing panel, insulating, 1" thick units, 2 lites, 1/4" float, clear	1.000	21.20	S.F.	13.60	7.60	21.20
B20101012200	Conc wall reinforced, 8' high, 6" thick, plain finish, 4000 PSI	181,986.000	13.34	S.F.	635,131.14	1,792,562.10	2,427,693.24
B20302306100	Dr, al, overhead, rolling grill, manual oper, 12'-0" x 12'-0" opening	5.000	5,025.00	Opng.	18,250.00	6,875.00	25,125.00
B20101305500	Brk veneer/met std bkup, std face, 16gax3-5/8"lb std, 24" OC sp, rnng bnd	17,882.000	14.50	S.F.	93,880.50	165,408.50	259,289.00
	Totals				**$1,104,080.34**	**$2,117,774.86**	**$3,221,855.20**

3.3. Proposal for Detailed Estimate

For technical assignment three we are required to complete a detailed estimate on a system of our choice. Instead of going into more detail on the exterior walls of the LSM building, I plan on doing an estimate on the superstructure.

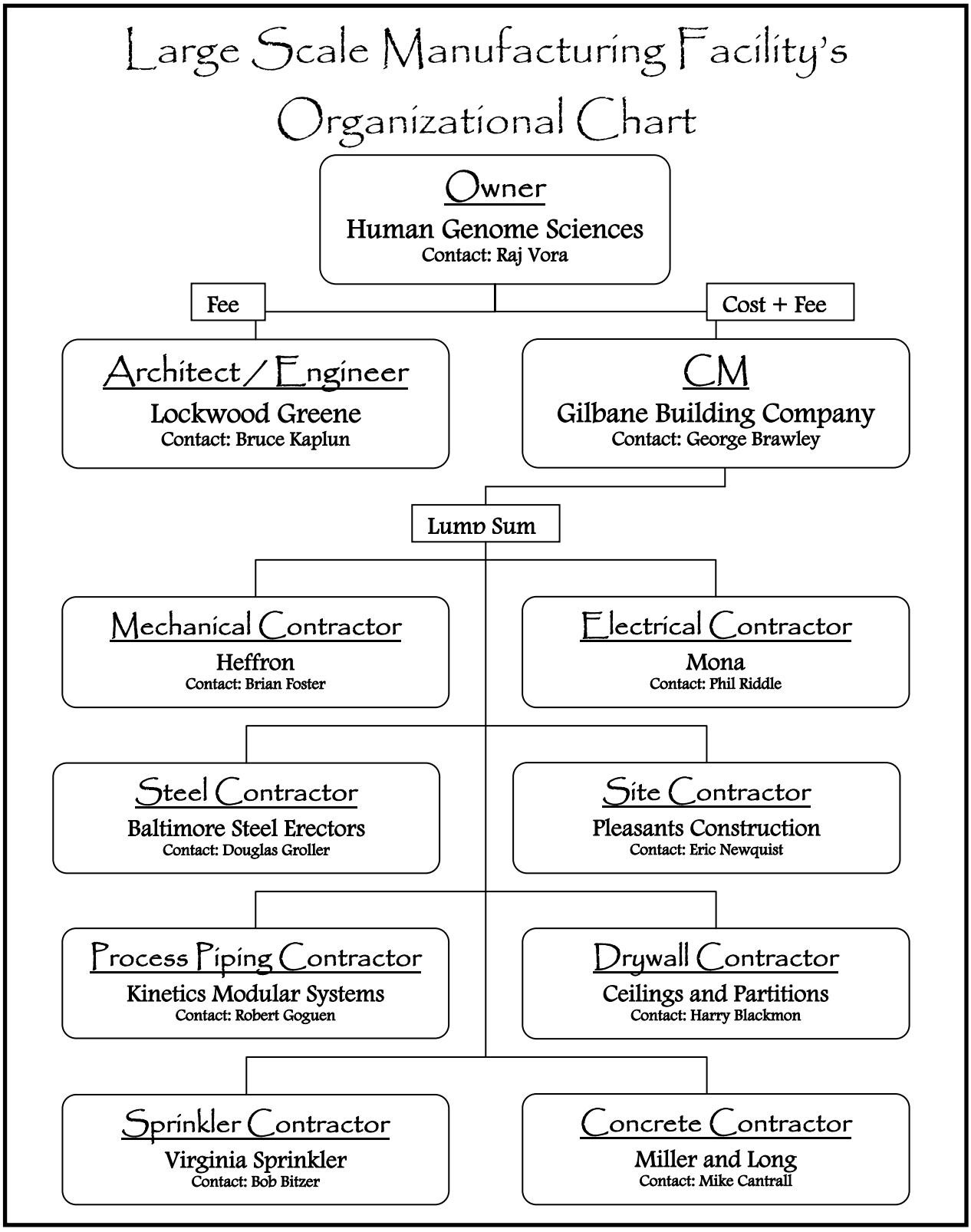
There are several reasons why I choose to do this. To give some more background on the LSM project, Value Engineering was performed on the structural system. From this, the first and second floors were changed from concrete to structural steel; the cellar was to remain concrete. By doing a take-off and estimate of these systems I will be able to determine the cost of changing from concrete to steel. This is an important issue because at the time the Value Engineering was performed; steel prices were not as high as they are now.

I will then be able to determine if there were cost savings or losses from changing the structural system. I will also be able to determine if more money would have been saved or lost by not changing the cellar to structural steel.

I plan on doing more research on this subject as I continue with my senior thesis. I will soon begin research for Dr. Horman here at Penn State on the effects of when a steel fabricator is brought onto the project. This could have also had some effects on the overall cost of the project.

4. Contracts

4.1. Project Organization Chart



4.2. Contract Description

Owner – A/E

Lockwood Greene was hired on by HGS as the architect and engineer with whom they hold a fee based contract. Lockwood Greene does not hold any contracts with the subcontractors or the equipment suppliers.

As per HGS's request; I am not able to discuss any further details of the contract held between HGS and Lockwood Greene.

Owner – CM

Gilbane Building Company was hired on as the Construction Manager for the LSM project. They hold all of the contracts with the subcontractors and some equipment suppliers. Though Gilbane is considered the General Contractor, they do not self perform any construction.

In respects to the contract held between the CM and the Owner, the Pre-GMax phase of the project is similar to a cost plus fee where everything is considered in scope. When the project is 60% complete Gilbane is to submit a GMP which is to be approved by HGS. Once they approve the GMP any change in scope will be an out-of-scope change.

In order to select subcontractors for the project, Gilbane has a procedure they must follow. First a bid list is prepared by Gilbane and then sent to HGS for approval with a minimum of three subcontractors. After the bid list is approved by HGS, Gilbane will prepare a Request for Proposal for the approved bidders and send it out for bids. There is a form that the contractors must return to Gilbane to acknowledge that they received all of the bid documents (i.e. drawings, specifications, safety plan, quality plan, etc.). If the subcontractors have any questions during the bidding process, Gilbane will answer and distribute the answers/solutions in the form of a Supplement.

CM – Subcontractors

As stated earlier, Gilbane holds contracts with all of the subcontractors. Like most projects the contract type is a lump sum contract, where all of the work is placed under a given budget.

In reference to payment, all subcontractors are required to send Gilbane a pencil copy of what they intend to bill by the 25th of the month, which is submitted on AIA Document A703. This pencil copy is reviewed by the Project Executive and the General Superintendent for percent complete, and if the value is correct the Requisition for Payment is sent to the owner for approval. The Trade Contractor then resubmits the notarized Requisition for Payment, which is due back to Gilbane on the 5th of the following month. Gilbane then submits their bill to the Owner by the 8th of the following month. Within five days of receiving payment from HGS, Gilbane will pay their subcontractors.

Changes in the work are handled by each discipline Engineer within Gilbane. As they are received, the documents are disseminated to the

Engineer who will then open a Change Request in JDE assigning a number to the change. A RFQ (Request for Quotation) is then prepared and sent to the appropriate subcontractor with any drawings or specs which resulted in the Change Order. The Trade Contractor has 10 days to quote the work and if they ask for a time extension, their request must be accompanied with a schedule showing the impact the extra work has on the job. Gilbane will then process each quotation within 35 days.

Insurance and Bonds

On this specific project, the Owner has chosen to have an O.C.I.P. insurance program where HGS will carry the insurance for all of the subcontractors. In order for this to work, all of the subcontractors must give back a credit from their bid which would have covered their own insurance for the project. The O.C.I.P. covers everything except automotive liability for the subcontractors, and they have to provide this coverage which is stated in the General Conditions for the project.

Gilbane includes a copy of their boilerplate contract in their Request for Proposal. This allows the subcontractors to review the commercial terms and conditions to help decide if they want to enter into a contract with Gilbane based upon the requirements of the document. It is very rare that a subcontractor will want to alter the document presented to them.

Gilbane is required to obtain a bond waiver from Gilbane Legal in order to cover the cost of Labor, Payment, and Performance Bonds. Sometimes the Owner will also request that certain subcontractors be bonded considering the scope of work they will be performing, and that cost needs to be included in the total bid price. The purpose of the Payment Bond is to ensure that Gilbane will pay all of the subcontractors the full amount required, and that payments will be received on time. The Performance Bond ensures that Gilbane will complete the project in accordance with the contractual documents and HGS's standards.

Assessment of Findings

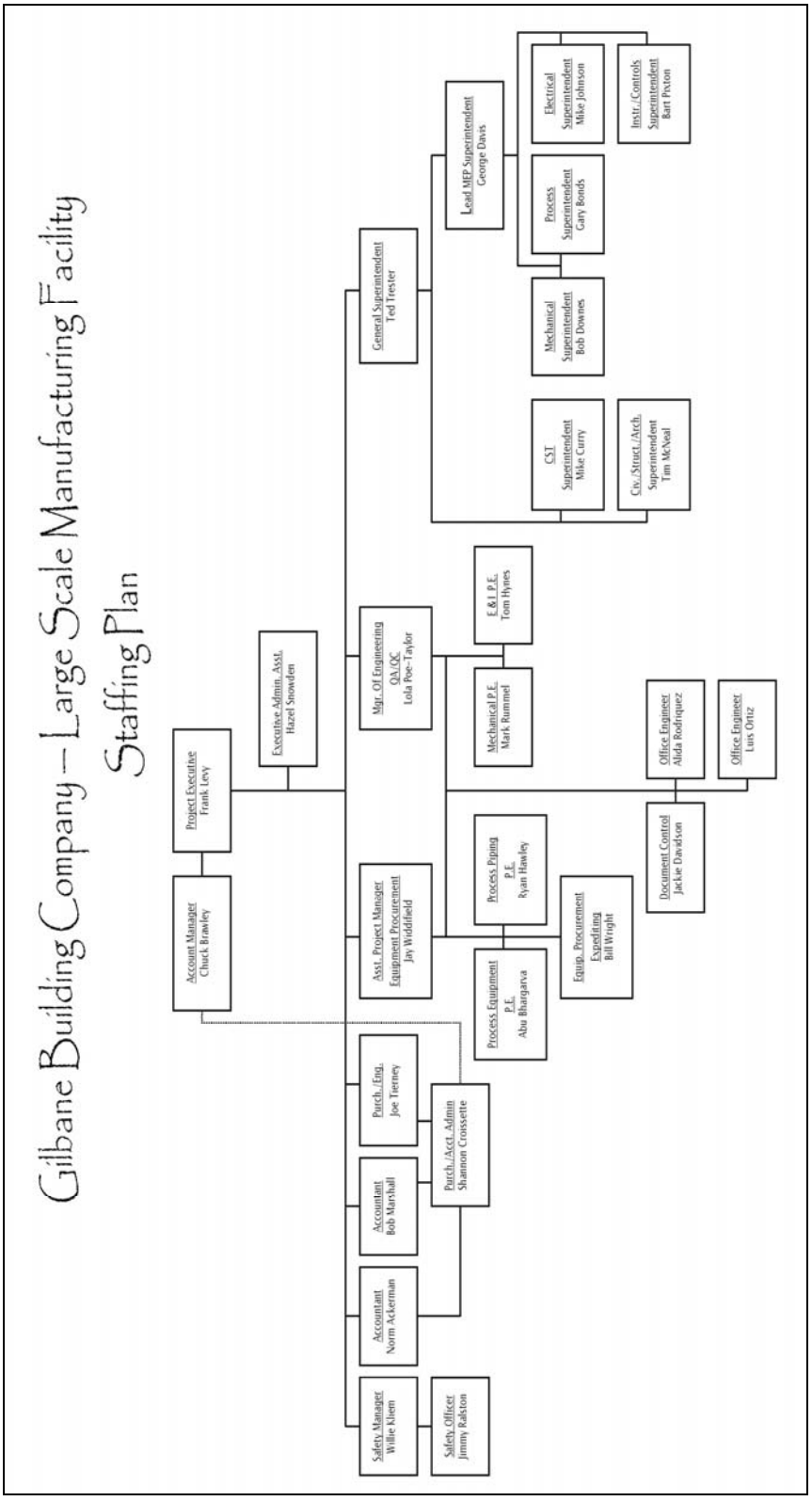
I feel that the approach HGS took with the contract type they selected and the insurance program is best suited for the project. This is a very large scale project and a GMP contract is the safest way to build this building with minimal cost issues.

By having Gilbane as the Construction Manager this helps out with coordination and scheduling of the project. If HGS would have chosen a Multiple Prime system there could be issues with trade contractors conforming together to coordinate early possibly pointing out issues early in the construction process. Also, by having a Construction Manager the Owner only needs to consult with one firm instead of multiple which can make the process much easier on the owner.

HGS also chose the O.C.I.P. Insurance Program, which provides cost savings for them. An owner can reduce the total cost of the project by 1–2% as compared to traditional, fragmented insurance programs.

5. Staffing Plan

5.1. Staff Organizational Chart



5.2. Description

By looking at the Gilbane's staffing chart it is evident that there is a lot of manpower that was assigned to the project (27 staff members). This project requires such a large staff due to the specialized equipment, construction techniques, and quality of construction required. Due to the restrictions of available space on the site, Gilbane has rented out a section of an office building to take the place of a site trailer.

At the top of the chart are the Account Manager and Project Executive whom work in close correlation. The Account Manager deals primarily with the accounting portion of the project and the Project Executive deals mainly with the site issues.

Below the Project Executive the staff is split up into smaller sections dealing with: Safety, Accounting, Equipment, Quality Control, and Site work. There are eight superintendents on site and each one has a specific trade that they work along side with. This is essential because the building is so specialized that a high level of detail needs to be placed on each specific trade. This does cause some issues with coordination within the company since each superintendent deals only with their area of expertise.

There are also two safety managers on site. Gilbane strives to have a safe workplace, and due to the size of the building and amount of workers in the field it is necessary to have this much management available.

Unlike most job sites, Gilbane has provided a document control section of the office. All incoming and outgoing paperwork passes through document control where it is entered into Prologue and then dispersed to the appropriate people. This is essential because without this intermediate stage, many processes such as change orders, submittals, and payment requisitions would be delayed due to confusion with their current state and where they are to be sent next.

There is a large staff that is assigned specifically to the equipment on the project. This is a very concise process due to the nature of the equipment; much of it is being delivered from long distances and also has a long lead time. It is up to this group to coordinate the delivery of the equipment with all of the field staff. On top of they have to ensure that the equipment ordered is exactly what the owner requires, and that it will physically fit inside the space designated.

Quality control is an important issue on this project due to all of the "clean" spaces. On top of that the building is to be validated to proper paperwork needs to be organized and kept on file. This person is responsible for multiple on site inspections, equipment delivery inspections, and equipment-in-place inspections.

As the project progresses less staff will be required on the project, and some people will move on to other projects that are just beginning construction.

6. Design Coordination

Scope of Coordination

The LSM project incorporates a large highly detailed MEP system that requires an extensive amount of coordination. There is a large amount of ductwork located on all three floors which is located primarily in the plenum paces. Throughout the rest of the plenum space a majority of the sprinkler lines, electrical raceways, plumbing lines, and some process pipes that have to be coordinated properly so that they can be placed within the plenum space. There are mechanical chases located throughout the building that service the "clean rooms" where mainly process piping, conduit, and other mechanical piping exist.

There are primarily three main MEP systems that require this extensive coordination to alleviate as many issues as possible.

1) Mechanical systems and all branches for the "dirty " sections of the building. This includes mechanical equipment and piping for utilities, chilled water, condensing water from the cooling towers, and HVAC heating & cooling duct.
2) Power distribution required for the mechanical equipment to support all of the utilities. This also includes the power requirements for the Building Automation System that controls the operation of the mechanical equipment.
3) Process systems and branches which include the same systems as the "dirty" sections. The installation of the equipment and piping for this system is more stringent due to the fact that it has to be installed in a clean state and kept clean during all of the construction activities. A different control system, the Mechanical Execution Controls) is installed for the Process Operation which is required for manufacturing a pharmaceutical product.

All contractors involved in there three main MEP systems have to perform coordination with each other and all of the other trades, including the designers, detailers, and the field workers. This is to ensure that all of the equipment, piping, and ductwork installation do not conflict with systems being installed by other trade contractors. As stated in the specifications: Each contractor is required to coordinate their work of systems installation with all other trades as to not impact or conflict with the installation of the other contractors.

Development of Coordination Plan

In order to create a coordinated MEP construction plan, a constructability review for the project was performed. For this, the architectural and equipment arrangement drawings were used to create a sequence of events that showed the move in path for all of the equipment. This also included placing piping and ductwork to a general location that was near its respective piece of equipment. In the field the piping and ductwork would stop in this

general location until the equipment was set in place, and then the systems final connections can be made.

The use of 3D CAD was also incorporated into the design coordination process. These 3D models were developed for areas consisting of a large amount of equipment and piping. By using these models, they were able to determine equipment move-in pathways as well as determining sections of piping or ductwork that needed to be left uninstalled until the equipment was set in place.

Challenging Areas & Field Conflicts

The largest challenge that Gilbane experienced on the project was the process of moving all of the equipment into the building. This had to be coordinated with all of the architectural activities (i.e. flooring, concrete pouring, metal studwork, etc.). For example, certain walls could not be erected until a piece of equipment was received and set in its respective place. There is a section of prefabricated metal wall panels that cannot be installed until some heat exchangers are received, which will leave roughly a 20 ft. by 20 ft. section of the building open to the environment. This causes issues with keeping the building clean and also with temporary heat for the winter months the building will be left open. Another given challenge is with all of the mechanical chases. There is a large amount of work and to be completes that requires multiple trades to be involved at once.

There were some instances where structural members, mainly steel, had impacts on the actual setting of the equipment. Certain elevations on the equipment arrangement drawing were unable to be attained, so the elevations needed to be modified. This also resulted in modifications to the mechanical piping connections.

7. Critical Industry Issues

This year I attended the 12th Annual PACE Roundtable Meeting. This event is held for PACE members and Penn State faculty and students to interact in a learning environment on current issues in the industry. There are multiple sessions pertaining to different issues and topics in the construction that are held to allow industry members and students to interact and gain some new information and concepts prevalent today.

This year at the PACE Roundtable Meeting I was able to attend three discussion groups with industry members and student peers. The three I chose to attend were: Integrating Distributed Teams, Constructability and VE in Design, and Leadership Jump-Start for Entry Level/Undergraduates.

Integrating Distributed Teams

Summary

In this session we discussed the issues/difficulties with project teams that are located in different areas, and what can be done to make it less detrimental to a project. Some of the main issues that were brought up concerned the trust and accountability that come hand in hand with personal interaction. It is more difficult to trust someone that you only speak with over the phone or through the internet. There is a lot more reassurance when you get answers and details on a subject by talking face to face with a person.

Some other issues deal with time consumption and knowledge of local conditions. If you have an architect that is located in another country, getting information answered in a timely fashion is usually not the case. At times the A/E will come on site to solve a major issue, and by being in another country that can make that process difficult or unattainable. Also, they might not be familiar with local codes and conditions which can definitely lead to problems when suggestions and changes are made to the project.

Interesting Topics

I was most surprised by the globalization issues. I knew that some fabrication and design is sent overseas for others to perform; I was just astonished by how often this is happening and how much more the industry is shifting towards sending work to other countries.

Applications to Thesis

There is not a lot that I can apply to my thesis research concerning this discussion. The only thing I would be able to emphasize is how beneficial it is to have an Architect close by that can come to the job site when needed. The architect for the LSM project has some personnel on site at all times to deal with any issues and questions that arise. I spoke a little with Nick Weaver from Holder Construction whom I would be able to contact if I require any further information.

Constructability and VE in Design

Summary

Constructability reviews and Value Engineering are prevalent throughout the construction industry; every company performs these to some extent. We discussed these two topics in detail during our session; pertaining to when these are performed and the benefits.

Constructability reviews are the most simple for of a drawing check. They are typically performed when a new set of drawings are released. The basic function of a constructability review is to see if the building can actually be built the way it is designed.

Value Engineering is a tool used for two purposes: to reduce the overall cost of the project or to add value to the building. Before any suggestions should be made it is important to take the owner's needs and wants into account.

The most beneficial way to apply value engineering would be to reduce the initial cost of the building while improving the long term performance of the building (hence reducing life cost). This is what the Green Value Engineering hopes to incorporate with all aspects of "Building Green". Some helpful hints to promote good Constructability reviews and Value Engineering methods are to simply ask questions, get the CM involved early, and always have the owners needs taken into account.

Interesting Topics

I was very interested in the discussion on how much excess cost is incurred on numerous projects on simple items such as cable trays, facing brick, and carpeting. On many projects oversized cable trays are designed, and on larger projects where there are hundreds of thousands of linear feet of cable tray a lot of money can be saved by reducing the size or using a different system. Another example is in reference to carpet tile and broadloom. It costs more to install carpet tile, but if the carpeting is in an area where it will undergo a lot of wear or damage by using carpet tile small sections can be replaced instead of the entire carpet. This will reduce the life cost of the building and also help keep the aesthetic appeal of the building in tact longer.

Application to Thesis

During the session the comparison of VCT and terrazzo flooring came up concerning initial cost to life cost. This subject fostered the idea of changing a certain floor type in the LSM project to terrazzo flooring. A large portion of the flooring on the first and second floors is epoxy flooring, and by taking into account the initial cost and life cost of these two flooring systems the terrazzo flooring could prove to be more beneficial. On top of being more durable and possibly cheaper, it provides a smoother and more aesthetically appealing finish.

If I chose to research this topic more I will be in touch with Mike Arnold from the Foreman Group, whom I interned for last summer. They perform a lot of school work, and flooring is a major part in that type of construction.

Leadership Jump-Start for Entry Level/Undergraduates

Summary

This session I feel was the most interactive between the industry members and the students. We primarily discussed what attributes and experiences will form a person into a good leader, and along those lines the comparison between what students expect and what the industry is expecting of them.

It was evident that in order for us as students to become successful we need to show initiative, take any opportunities that are presented, not be afraid to make mistakes, take as much responsibility as we are capable of, and always ask questions. These are just the basic attributes and actions that one must take in order to become successful in what they want to pursue.

The students also brought up some suggestions for the industry to take into account concerning rewards and incentives. It is important for us as new employees to know we are performing up to their expectations and that we are an integral part of the company. All incentives do not have to be in the form of money. Simply by providing positive verbal feedback, giving that person more responsibility, or providing the opportunity for promotion lets us know that we are doing a good job. That is the most beneficial way to utilize our knowledge and our eagerness to do the best job possible.

Interesting Topics

Many topics discussed in this session were of great interest to me. From interviewing with multiple companies within my past four years in college I have obtained much of the knowledge discussed in the session. I greatly enjoyed hearing about what certain companies expect and provide for their new employees, such as the Foreman Group, James G. Davis Construction, and Holder Construction.

Application to Thesis

The idea of incentive programs seems to be a hot topic within the construction industry. Whether it is for providing exceptional work or by working safely, incentives prove to be beneficial for the overall project. I have not yet decided what I will be doing my extensive research on exactly, but the idea on incentives in the workforce could be an interesting topic to research.

There must be an appropriate time and manner in which these incentive programs are incorporated, and by performing some surveys and researching some projects a specific plan could be devised to incorporate incentive plans to all construction projects.

Appendix

A. Assemblies Estimate Takeoff