

Cost and Schedule Analysis

Construction Management Breadth



Cost Comparison (Construction Management Breadth Part 1):

It seems that the main concern of most people working on a project to ensure the happiness of the owner. This happiness usually comes in the form of money. I chose to do my second breadth study based on the happiness of the owner. Since money is a major concern and time is money, I chose to analyze how my new design would affect both cost and schedule.

Cost of the Existing Design:

Taking into consideration only the aspects of the building which would change, I was able to compile a cost analysis using data from Cost Works 2005, Bill Koch of Paul Risk and Associates, and Excel. Cost Works 2005 is a computer program produced by R.S. Means and is a very efficient method of analyzing the cost of building. I utilized both assemblies' costs and unit costs. All except the spray on fireproofing was able to be found in the assemblies cost.

Cost of the New Design:

By altering the original design of masonry bearing walls and pre-cast hollow core planks to a structural steel skeleton, it was necessary to verify that the building was still constructible. These alterations included the exterior wall design, interior partitions, new steel members, new slab design, and fireproofing.

Cost Comparison:

As seen in the following diagram, there is roughly a four hundred thousand dollar savings for the construction of the new design. For the entire building, the new design is only a savings of roughly 3.3%.

Spring Run Assisted Living Willow Street, Pennsylvania
Architectural Engineering @ The Pennsylvania State University

Spring Run Assisted Living - Existing

Qty	Assembly Number	Description	Unit	Mat.	Inst.	Total	Release
17,000.000	A20101103500	Excav & f, 4000 SF, 16" d, sand, gvl, or com earth, on site storage	S.F.	0.00	110,500.00	110,500.00	2005
24,800.000	A10301202240	Slab on grade, 4" thick, non industrial, reinforced	S.F.	36,216.00	44,392.00	79,608.00	2005
39,400.000	B20101245330	Deep grv hol reinf blk wall, 8x8x16", 125 PCF wt.#5@16"vert reinf> sp	S.F.	208,820.00	244,280.00	453,100.00	2005
20,000.000	B20101245330	Deep grv hol reinf blk wall, 8x8x16", 125 PCF wt.#5@24"vert reinf> sp	S.F.	102,000.00	118,000.00	222,000.00	2005
20,000.000	B20101245320	Deep grv hol reinf blk wall, 8x8x16", 125 PCF wt.#5@32"vert reinf> sp	S.F.	98,000.00	110,000.00	208,000.00	2005
20,000.000	B20101245300	Deep grv hol reinf blk wall, 8x8x16", 125 PCF wt.#4@48"vert reinf> sp	S.F.	94,000.00	106,000.00	200,000.00	2005
0.000	C10101265500	Pins/met, 5/8"tr drwl f, none b, 3-5/8"@24" OC fmg, nothing opp f, 0 insul	S.F.	0.00	0.00	0.00	2005
0.000	C10101265400	Pins/met, 5/8"tr drwl f, none base, 3-5/8"@24" OC fmg, same opp f, 0 insul	S.F.	0.00	0.00	0.00	2005
24,800.000	B10102291300	Prst plk w/2"conc tp, 30"sp, 75PSF supimp, 8" tot d, 80PSF dl, 130PSF tot	S.F.	138,880.00	32,884.00	171,864.00	2005
74,400.000	B10102303500	Prst plk w/2"conc tp, 30"sp, 75PSF supimp, 10"tot d, 80PSF dl, 155PSF tot	S.F.	478,160.00	197,904.00	674,064.00	2005
17,000.000	B10102303500	Prst plk w/2"conc tp, 30"sp, 75PSF supimp, 10"tot d, 80PSF dl, 155PSF tot	S.F.	108,800.00	46,220.00	154,020.00	2005
0.000	B10102580950	Met dlk/conc f, 125 PSF supimp, 8" span, 20ga 1.5"v, 5" slb, 165 PSF tot	S.F.	0.00	0.00	0.00	2005
0.000		Structural Steel (price given by CM on jobsite)	TON	0.00	0.00	0.00	2005
0.000		Cementitious Fireproofing, sprayed mineral fiber or cementitious for fireproofing,	S.F.	0.00	0.00	0.00	2005
0.000	78126000400	beams, 1 hour rated, 1-3/8" thick, excl. tamping or canvas protection	S.F.	0.00	0.00	0.00	2005
Totals				\$1,261,876.00	\$1,009,280.00	\$2,273,156.00	

Figure 8: Existing Cost Analysis

Spring Run Assisted Living - New

Qty	Assembly Number	Description	Unit	Mat.	Inst.	Total	Release
24,800.000	A20101103500	Excav & f, 4000 SF, 16" d, sand, gvl, or com earth, on site storage	S.F.	0.00	161,200.00	161,200.00	2005
24,800.000	A10301202240	Slab on grade, 4" thick, non industrial, reinforced	S.F.	35,216.00	44,392.00	79,608.00	2005
21,000.000	B20101245330	Deep grv hol reinf blk wall, 8x8x16", 125 PCF wt.#5@16"vert reinf> sp	S.F.	111,300.00	130,200.00	241,500.00	2005
0.000	B20101245330	Deep grv hol reinf blk wall, 8x8x16", 125 PCF wt.#5@24"vert reinf> sp	S.F.	0.00	0.00	0.00	2005
0.000	B20101245320	Deep grv hol reinf blk wall, 8x8x16", 125 PCF wt.#5@32"vert reinf> sp	S.F.	0.00	0.00	0.00	2005
0.000	B20101245300	Deep grv hol reinf blk wall, 8x8x16", 125 PCF wt.#4@48"vert reinf> sp	S.F.	0.00	0.00	0.00	2005
49,300.000	C10101265500	Pins/met, 5/8"tr drwl f, none b, 3-5/8"@24" OC fmg, nothing opp f, 0 insul	S.F.	29,087.00	49,793.00	78,880.00	2005
38,100.000	C10101265400	Pins/met, 5/8"tr drwl f, none base, 3-5/8"@24" OC fmg, same opp f, 0 insul	S.F.	33,528.00	61,341.00	94,869.00	2005
0.000	B10102291300	Prst plk w/2"conc tp, 30"sp, 75PSF supimp, 8" tot d, 80PSF dl, 130PSF tot	S.F.	0.00	0.00	0.00	2005
0.000	B10102303500	Prst plk w/2"conc tp, 30"sp, 75PSF supimp, 10"tot d, 80PSF dl, 155PSF tot	S.F.	0.00	0.00	0.00	2005
0.000	B10102303500	Prst plk w/2"conc tp, 30"sp, 75PSF supimp, 10"tot d, 80PSF dl, 155PSF tot	S.F.	0.00	0.00	0.00	2005
99,200.000	B10102580950	Met dlk/conc f, 125 PSF supimp, 8" span, 20ga 1.5"v, 5" slb, 165 PSF tot	S.F.	237,088.00	173,600.00	410,688.00	2005
231.000		Structural Steel (price given by CM on jobsite)	TON	462,000.00	231,000.00	693,000.00	2005
100,000.000	78126000400	Cementitious Fireproofing, sprayed mineral fiber or cementitious for fireproofing,	S.F.	41,000.00	82,000.00	123,000.00	2005
Totals				\$949,219.00	\$933,526.00	\$1,882,745.00	

Figure 9: New Cost Analysis

Schedule Comparison (Construction Management Breadth Part 2):

Schedule Comparison:

Using Microsoft Project, I was able to compile a schedule of the construction process. With the help of the Bill Koch of Paul Risk and Associates, a schedule which best represented the current schedule was created. After completing a schedule of the current design, I was able to apply the changes I made through the building into a new schedule. The times for construction are a compilation of data from Cost Works 2005's assembly's costs and unit costs as well as the productivity of local contractors.

Since I was only trying to compare the actual duration of construction, I am sure there are factors I failed to incorporate. These factors include weather, fabrication time, and other items which affect the schedule.

After comparing the original schedule with the new schedule I was able to conclude that the new design would take roughly 3 months longer to complete. There are several factors which could shorten the erection time of Spring Run Assisted Living's new design. They are:

1. Enlarge the crew sizes for partitions.
2. Place concrete in less than the optimum amount.
3. Use more than one steel erection crew and crane.

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Architectural Engineering @ The Pennsylvania State University

Existing Design Schedule:

ID	Task Name	Duration	Start	Finish
1000	Rock Removal/Overdig	10 days	Mon 6/13/05	Fri 6/24/05
1010	Foundations	20 days	Mon 6/27/05	Fri 7/22/05
1020	Underground Utilities	15 days	Tue 7/12/05	Mon 8/1/05
1030	Basement Walls	20 days	Tue 7/19/05	Mon 8/15/05
1040	Slab-on-Grade Basement	5 days	Tue 8/23/05	Mon 8/29/05
1970	Water Proofing	25 days	Mon 8/1/05	Fri 9/2/05
1980	Backfill Basement	10 days	Thu 8/25/05	Wed 9/7/05
1050	First Floor Precast	10 days	Mon 8/8/05	Fri 8/19/05
1060	First Floor CMU Walls	15 days	Mon 8/15/05	Fri 9/2/05
1070	Slab-on-Grade First Floor	5 days	Mon 9/5/05	Fri 9/9/05
1080	Topping	5 days	Mon 9/19/05	Fri 9/23/05
1090	Layout	10 days	Mon 9/19/05	Fri 9/30/05
1100	Core Drill	10 days	Tue 9/26/06	Mon 10/9/06
1110	Metal Studs	20 days	Mon 10/3/05	Fri 10/28/05
1120	MEP Rough-in	30 days	Mon 10/17/05	Fri 11/25/05
1130	Kitchen Hoods	5 days	Mon 11/14/05	Fri 11/18/05
1140	Hang Drywall	20 days	Mon 11/28/05	Fri 12/23/05
1150	Drywall Finish	20 days	Mon 12/5/05	Fri 12/30/05
1160	Trim/Cabinets	15 days	Mon 12/12/05	Fri 12/30/05
1170	Prime & Ceilings	15 days	Mon 12/26/05	Fri 1/13/06
1180	Finish Paint	10 days	Mon 1/9/06	Fri 1/20/06
1190	MEP Trim/Access	10 days	Mon 1/16/06	Fri 1/27/06
1200	Flooring	15 days	Mon 1/23/06	Fri 2/10/06
1210	Kitchen Finishes	15 days	Mon 2/13/06	Fri 3/3/06
1220	Public Doors/Trim	25 days	Mon 2/27/06	Fri 3/31/06
1230	Kitchen Equipment	10 days	Mon 3/6/06	Fri 3/17/06
1240	Public Tile/MEP Trim	15 days	Mon 3/20/06	Fri 4/7/06
1250	Finish Paint	20 days	Mon 3/27/06	Fri 4/21/06
1260	Public Flooring	15 days	Mon 4/10/06	Fri 4/28/06

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ID	Task Name	Duration	Start	Finish
1270	Second Floor Precast	10 days	Mon 8/29/05	Fri 9/9/05
1280	Second Floor CMU Walls	15 days	Mon 9/5/05	Fri 9/23/05
1290	Topping	5 days	Mon 10/3/05	Fri 10/7/05
1300	Layout	10 days	Mon 10/3/05	Fri 10/14/05
1310	Core Drill	10 days	Mon 10/10/05	Fri 10/21/05
1320	Metal Studs	30 days	Mon 10/17/05	Fri 11/25/05
1330	MEP Rough-in	20 days	Mon 11/7/05	Fri 12/2/05
1340	Hang Drywall	20 days	Mon 12/12/05	Fri 1/6/06
1350	Drywall Finish	20 days	Mon 12/19/05	Fri 1/13/06
1360	Trim/Cabinets	15 days	Mon 12/26/05	Fri 1/13/06
1370	Prime & Ceilings	15 days	Mon 1/9/06	Fri 1/27/06
1380	Finish Paint	10 days	Mon 1/23/06	Fri 2/3/06
1390	MEP Trim/Access	10 days	Mon 1/30/06	Fri 2/10/06
1400	Public Doors	10 days	Mon 1/30/06	Fri 2/10/06
1410	Flooring	15 days	Mon 2/6/06	Fri 2/24/06
1420	Public Trim	10 days	Mon 2/6/06	Fri 2/17/06
1430	Public Tile	10 days	Mon 2/13/06	Fri 2/24/06
1440	Public Finish Paint	10 days	Mon 2/20/06	Fri 3/3/06
1450	Public Flooring	10 days	Mon 2/27/06	Fri 3/10/06
1460	Third Floor Precast	10 days	Mon 9/19/05	Fri 9/30/05
1470	Third Floor CMU Walls	15 days	Mon 9/26/05	Fri 10/14/05
1480	Topping	5 days	Mon 10/24/05	Fri 10/28/05
1490	Layout	10 days	Mon 10/24/05	Fri 11/4/05
1500	Core Drill	10 days	Mon 10/31/05	Fri 11/11/05
1510	Metal Studs	20 days	Mon 11/7/05	Fri 12/2/05
1520	MEP Rough-in	20 days	Mon 11/28/05	Fri 12/23/05
1530	Hang Drywall	20 days	Mon 12/26/05	Fri 1/20/06
1540	Drywall Finish	20 days	Mon 1/2/06	Fri 1/27/06
1550	Trim/Cabinets	15 days	Mon 1/9/06	Fri 1/27/06
1560	Prime & Ceilings	15 days	Mon 1/23/06	Fri 2/10/06

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ID	Task Name	Duration	Start	Finish
1570	Finish Paint	10 days	Mon 2/6/06	Fri 2/17/06
1580	MEP Trim/Access	10 days	Mon 2/13/06	Fri 2/24/06
1590	Public Doors	10 days	Mon 2/13/06	Fri 2/24/06
1600	Flooring	15 days	Mon 2/20/06	Fri 3/10/06
1610	Public Trim	10 days	Mon 2/20/06	Fri 3/3/06
1620	Public Tile	10 days	Mon 2/27/06	Fri 3/10/06
1630	Public Finish Paint	10 days	Mon 3/6/06	Fri 3/17/06
1640	Public Flooring	10 days	Mon 3/13/06	Fri 3/24/06
1650	Fourth Floor Precast	10 days	Mon 10/10/05	Fri 10/21/05
1660	Fourth Floor CMU Walls	15 days	Mon 10/17/05	Fri 11/4/05
1670	Topping	5 days	Mon 11/14/05	Fri 11/18/05
1680	Layout	10 days	Mon 11/14/05	Fri 11/25/05
1690	Core Drill	10 days	Mon 11/21/05	Fri 12/2/05
1700	Metal Studs	20 days	Mon 11/28/05	Fri 12/23/05
1710	MEP Rough-in	20 days	Mon 12/19/05	Fri 1/13/06
1720	Hang Drywall	20 days	Mon 1/16/06	Fri 2/10/06
1730	Drywall Finish	20 days	Mon 1/23/06	Fri 2/17/06
1740	Trim/Cabinets	15 days	Mon 1/30/06	Fri 2/17/06
1750	Prime & Ceilings	15 days	Mon 2/13/06	Fri 3/3/06
1760	Finish Paint	10 days	Mon 2/27/06	Fri 3/10/06
1770	MEP Trim/Access	10 days	Mon 3/6/06	Fri 3/17/06
1780	Public Doors	10 days	Mon 3/6/06	Fri 3/17/06
1790	Flooring	15 days	Mon 3/13/06	Fri 3/31/06
1800	Public Trim	10 days	Mon 3/13/06	Fri 3/24/06
1810	Public Tile	10 days	Mon 3/20/06	Fri 3/31/06
1820	Public Finish Paint	10 days	Mon 3/27/06	Fri 4/7/06
1830	Public Flooring	10 days	Mon 4/3/06	Fri 4/14/06
1840	Roof Precast	10 days	Mon 10/31/05	Fri 11/11/05
1850	Roof CMU	5 days	Mon 11/7/05	Fri 11/11/05

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ID	Task Name	Duration	Start	Finish
1860	Truss/Mansard Framing	20 days	Mon 11/7/05	Fri 12/2/05
1870	Roof Membrane	20 days	Mon 11/14/05	Fri 12/9/05
1880	Roof Shingles	15 days	Mon 11/21/05	Fri 12/9/05

Spring Run Assisted Living Willow Street, Pennsylvania
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New Design Schedule:

ID	Task Name	Duration	Start	Finish
1000	Rock Removal/Overdig	10 days	Mon 6/13/05	Fri 6/24/05
1010	Foundations	25 days	Mon 6/27/05	Fri 7/29/05
1020	Underground Utilities	15 days	Tue 7/12/05	Mon 8/1/05
1030	Basement Walls	20 days	Tue 7/19/05	Mon 8/15/05
1040	Slab-on-Grade Basement	10 days	Tue 8/23/05	Mon 9/5/05
1970	Water Proofing	25 days	Mon 8/1/05	Fri 9/2/05
1980	Backfill Basement	15 days	Thu 8/25/05	Wed 9/14/05
1050	First Floor Framing	15 days	Mon 8/8/05	Fri 8/26/05
1060	First Floor Deck	3 days	Mon 9/12/05	Wed 9/14/05
1070	CIP Slab	2 days	Thu 9/15/05	Fri 9/16/05
9999	Fireproofing	10 days	Mon 11/21/05	Fri 12/2/05
1080	Topping	5 days	Mon 9/26/05	Fri 9/30/05
1090	Layout	10 days	Mon 9/26/05	Fri 10/7/05
1100	Core Drill	10 days	Mon 10/3/05	Fri 10/14/05
1110	Metal Studs	40 days	Mon 10/10/05	Fri 12/2/05
1120	MEP Rough-in	30 days	Mon 10/24/05	Fri 12/2/05
1130	Kitchen Hoods	5 days	Mon 11/21/05	Fri 11/25/05
1140	Hang Drywall	40 days	Mon 12/5/05	Fri 1/27/06
1150	Drywall Finish	40 days	Mon 1/9/06	Fri 3/3/06
1160	Trim/Cabinets	15 days	Mon 2/13/06	Fri 3/3/06
1170	Prime & Ceilings	15 days	Mon 2/27/06	Fri 3/17/06
1180	Finish Paint	10 days	Mon 3/13/06	Fri 3/24/06
1190	MEP Trim/Access	10 days	Mon 3/20/06	Fri 3/31/06
1200	Flooring	15 days	Mon 3/27/06	Fri 4/14/06
1210	Kitchen Finishes	15 days	Mon 4/17/06	Fri 5/5/06
1220	Public Doors/Trim	25 days	Mon 5/1/06	Fri 6/2/06
1230	Kitchen Equipment	10 days	Mon 5/8/06	Fri 5/19/06
1240	Public Tile/MEP Trim	15 days	Mon 5/22/06	Fri 6/9/06
1250	Finish Paint	20 days	Mon 5/29/06	Fri 6/23/06
1260	Public Flooring	15 days	Mon 6/12/06	Fri 6/30/06

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ID	Task Name	Duration	Start	Finish
1270	Second Floor Framing	10 days	Mon 8/29/05	Fri 9/9/05
1280	Second Floor Deck	3 days	Mon 9/12/05	Wed 9/14/05
1290	CIP Slab	2 days	Mon 10/3/05	Tue 10/4/05
9999	Fireproofing	10 days	Mon 12/5/05	Fri 12/16/05
1300	Layout	10 days	Mon 10/3/05	Fri 10/14/05
1310	Core Drill	10 days	Mon 10/10/05	Fri 10/21/05
1320	Metal Studs	50 days	Mon 10/17/05	Fri 12/23/05
1330	MEP Rough-in	20 days	Mon 12/5/05	Fri 12/30/05
1340	Hang Drywall	40 days	Mon 1/9/06	Fri 3/3/06
1350	Drywall Finish	40 days	Mon 2/13/06	Fri 4/7/06
1360	Trim/Cabinets	15 days	Mon 3/20/06	Fri 4/7/06
1370	Prime & Ceilings	15 days	Mon 4/3/06	Fri 4/21/06
1380	Finish Paint	10 days	Mon 4/17/06	Fri 4/28/06
1390	MEP Trim/Access	10 days	Mon 4/24/06	Fri 5/5/06
1400	Public Doors	10 days	Mon 4/24/06	Fri 5/5/06
1410	Flooring	15 days	Mon 5/1/06	Fri 5/19/06
1420	Public Trim	10 days	Mon 5/1/06	Fri 5/12/06
1430	Public Tile	10 days	Mon 5/8/06	Fri 5/19/06
1440	Public Finish Paint	10 days	Mon 5/15/06	Fri 5/26/06
1450	Public Flooring	10 days	Mon 5/22/06	Fri 6/2/06
1460	Third Floor Framing	15 days	Mon 9/19/05	Fri 10/7/05
1470	Third Floor Deck	3 days	Thu 11/3/05	Mon 11/7/05
1480	CIP Slab	2 days	Tue 11/8/05	Wed 11/9/05
9999	Fireproofing	10 days	Mon 12/19/05	Fri 12/30/05
1490	Layout	10 days	Tue 11/8/05	Mon 11/21/05
1500	Core Drill	10 days	Tue 11/15/05	Mon 11/28/05
1510	Metal Studs	50 days	Tue 11/22/05	Mon 1/30/06
1520	MEP Rough-in	20 days	Tue 1/10/06	Mon 2/6/06
1530	Hang Drywall	40 days	Tue 2/14/06	Mon 4/10/06

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ID	Task Name	Duration	Start	Finish
1540	Drywall Finish	40 days	Tue 3/21/06	Mon 5/15/06
1550	Trim/Cabinets	15 days	Tue 4/25/06	Mon 5/15/06
1560	Prime & Ceilings	15 days	Tue 5/9/06	Mon 5/29/06
1570	Finish Paint	10 days	Tue 5/23/06	Mon 6/5/06
1580	MEP Trim/Access	10 days	Tue 5/30/06	Mon 6/12/06
1590	Public Doors	10 days	Tue 5/30/06	Mon 6/12/06
1600	Flooring	15 days	Tue 6/6/06	Mon 6/26/06
1610	Public Trim	10 days	Tue 6/6/06	Mon 6/19/06
1620	Public Tile	10 days	Tue 6/13/06	Mon 6/26/06
1630	Public Finish Paint	10 days	Tue 6/20/06	Mon 7/3/06
1640	Public Flooring	10 days	Tue 6/27/06	Mon 7/10/06
		1 day?	Mon 6/13/05	Mon 6/13/05
1650	Fourth Floor Framing	15 days	Mon 10/10/05	Fri 10/28/05
1660	Fourth Floor Deck	3 days	Mon 10/31/05	Wed 11/2/05
1670	CIP Slab	2 days	Thu 11/3/05	Fri 11/4/05
9999	Fireproofing	10 days	Mon 1/2/06	Fri 1/13/06
1680	Layout	10 days	Thu 11/3/05	Wed 11/16/05
1690	Core Drill	10 days	Thu 11/10/05	Wed 11/23/05
1700	Metal Studs	50 days	Thu 11/17/05	Wed 1/25/06
1710	MEP Rough-in	20 days	Thu 1/5/06	Wed 2/1/06
1720	Hang Drywall	40 days	Thu 2/9/06	Wed 4/5/06
1730	Drywall Finish	40 days	Thu 3/16/06	Wed 5/10/06
1740	Trim/Cabinets	15 days	Thu 4/20/06	Wed 5/10/06
1750	Prime & Ceilings	15 days	Thu 5/4/06	Wed 5/24/06
1760	Finish Paint	10 days	Thu 5/18/06	Wed 5/31/06
1770	MEP Trim/Access	10 days	Thu 5/25/06	Wed 6/7/06
1780	Public Doors	10 days	Thu 5/25/06	Wed 6/7/06
1790	Flooring	15 days	Thu 6/1/06	Wed 6/21/06
1800	Public Trim	10 days	Thu 6/1/06	Wed 6/14/06
1810	Public Tile	10 days	Thu 6/8/06	Wed 6/21/06
1820	Public Finish Paint	10 days	Thu 6/15/06	Wed 6/28/06

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ID	Task Name	Duration	Start	Finish
1830	Public Flooring	10 days	Thu 6/22/06	Wed 7/5/06
1840	Roof Framing	10 days	Mon 10/31/05	Fri 11/11/05
1850	Roof Deck	3 days	Mon 11/14/05	Wed 11/16/05
1990	CIP Slab	2 days	Thu 11/17/05	Fri 11/18/05
9999	Fireproofing	10 days	Mon 1/16/06	Fri 1/27/06
1860	Truss/Mansard Framing	20 days	Mon 11/7/05	Fri 12/2/05
1870	Roof Membrane	20 days	Mon 11/14/05	Fri 12/9/05
1880	Roof Shingles	15 days	Mon 11/21/05	Fri 12/9/05

Construction Management Breadth Conclusion:

The owner of the building would have a decision to make. His options are

- A. Spend 3.3% more for construction costs but wait roughly 3 months longer for completion
- B. Save the extra money, have the building done sooner and make money off of the tenants earlier.

It is my belief that the later of the two options is a better choice financially. This means that the current structural design of a masonry building with pre-cast hollow core planks is best suited for the owner.