WORCESTER NORTH HIGH SCHOOL

TECHNICAL REPORT2 :: **ADAM TRUMBOUR** :: CONSTRUCTION MANAGEMENT

ADVISOR: DR. RILEY :: OCTOBER 28, 2009

CONTENTS

EXECUTIVE SUMMARY

Technical Report II of the Worcester North High School project covers important aspects of project execution. Herein are analyses of scheduling, site layout, estimating and industry issues.

The detailed project schedule follows WNHS from NTP to completion, organizing building construction by trade. Spanning a total of over 600 days, the schedule reflects major phases of construction. Currently, the WNHS project is close to completion of the steel superstructure. Gilbane was hired in late spring of 2009 and began mobilization of the site immediately.

In the site layout planning section, critical phases including steel erection and excavation are depicted with plans for site logistics, equipment and materials layout. Important features include steel shakeout spaces, pedestrian protection and vehicle travel. The plans are actually located in the appendix of this document on 11"x17" paper.

A detailed structural systems estimate was created for this report using MC^2 estimating software. Estimates were computed for a typical bay in each building and square foot costs were extrapolated from that data.

A general conditions estimate was compiled from data provided by Gilbane, as well as averages taken from meanscostworks.com. This section details the individual costs associated with orchestrating a major construction project.

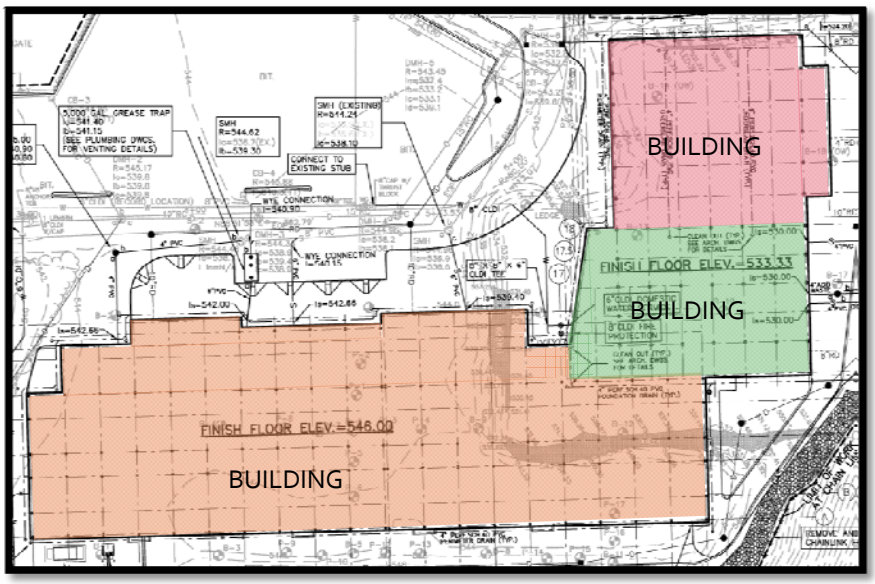
Critical industry issues covers topics discussed at the 2009 Partnership for Achieving Construction Excellence roundtable. It was an excellent opportunity to mingle with industry professionals and AE alumni to talk about our thesis projects, current market trends, and important issues in the industry today.

DETAILED PROJECT SCHEDULE

Key Project Dates:

Notice to Proceed:	April 27, 2009
Foundations Complete:	August 7, 2009
Topping Out:	November 16, 2009
Building A Dry-In:	January 22, 2010
Interior Construction Start:	March 11, 2010
Finishes Complete:	January 6, 2011
Building Turnover:	September 6, 2011

While there is not a specific phasing plan established for the WNHS, a trend of phasing the main building separately from the gymnasium and/or auditorium is evident throughout the project. The importance of completing major phases of the main building is paramount to the completion of the gymnasium; the mechanical rooms and utility tie-ins occur in the main facility. As indicated in the image below, the main building consists of classrooms and administration offices and is designated building 'A'. Building 'B' is primarily auditorium space, though music and drama classrooms are also located in that wing. Finally, the gymnasium is denoted building 'C' and is located to the northeast of the main building.



Trades begin their work on building A, progressing eastward towards building B. While buildings A and B have similar structural elements, they are phased separately. Building A is the largest and most intricate of the tree sections and has top priority for getting finished. Classrooms and offices are the heart of the school so no delay may be incurred here. Buildings B and C, however, are slightly less critical since they are auxiliary buildings housing gymnasium and auditorium space. While these are also important to finish on time, school may begin with trades finishing up work on them (should the dire event occur that there is a significant delay in the schedule). Additionally, Building C is slightly different in its construction with the load bearing walls being built of masonry and the roof support being a steel truss system. This requires slightly different trade work and more time. Delays may occur here due to the truss manufacture and delivery as well as the actual construction, therefore it is important that there be no other trade priority after this building (in other words, having steel complete building C after A and B ensures that A and B will not be affected by potential delays at C).

SITE LAYOUT PLANNING

The WNHS project is located on a parcel of land adjacent to the current facility. Advantageous to the logistics of construction, there is ample room for the construction management team to work with. A site plan of one of the more congested phases of construction, steel erection, is provided at the end of this document. Gilbane's site layout plans were not available for critique.

Site Access

Access to the site is through a gated fence bordering Harrington Way. This two-lane road is a back road servicing a small number of residences, though its main purpose is to link the High School complex with major roads Franklin Street to the north and Hamilton Street to the south. Hamilton Street also links with major highways and as such will likely be the delivery route for materials and equipment. The site entrance allows for a decent sized apron of 80 feet or more to allow for wide-turning trucks to enter (though the allotted access road is about 25 feet wide).

Parking and Offices

There are two Gilbane trailers and multiple subcontractor trailers. Gilbane has just over 1300 square feet of office space in a 24' by 56' modular trailer. Subcontractors have about 2000 square feet of office space split between three 12' x 56' modular trailers. These are located conveniently at the North side of the site. Parking for 35 cars is provided during Steel Erection, with plenty of room for more. The parking is provided along the site access road as well as next to the job trailers.

Materials Storage

During steel erection, approximately 6500 square feet of space are devoted to steel shakeout. This equates to an area about 143' x 45'. This space is located in an area convenient to delivery trucks as well as cranes. Additional is another 5200 square feet of storage space for steel, approximately 160' x 30'. This space is also located directly adjacent to the site access road and within reach of mobile cranes.

Supporting the construction are two tool storage trailers measuring 8' x 24' located at the west end of the site. These trailers will be primarily for storage of smaller tools owned by subcontractors.

Waste

Waste Management is servicing three large dumpsters located on-site, measuring 8'x 22' and 8' deep. These are located close to the west of the building as well. Four portable toilets are located on site for use throughout the duration of the project.

Equipment

A route is maintained along the inside perimeter of the complex, approximately 20' in width servicing a Grove RT9130E mobile crane. The RT9130E is a crane with a 130 ton pick capacity and a 160' full power boom, and is classified as an all-terrain crane, operating on 4 wheels. Ample space is available for other support equipment including air compressors, welding generators and aerial lifts.

DETAILED STRUCTURAL SYSTEMS ESTIMATE

The detailed cost estimate for the steel superstructure was completed using MC^2 estimating software and takeoffs from structural drawings. A typical bay for each building was estimated, including foundations, slab on grade, columns, beams/girder, composite slabs and roof systems. These specifications were input into the MC^2 software to arrive at an average cost per bay. Then, this cost was divided to create a typical cost per square foot of building space.

Building A is composed of approximately 19 bays, each measuring 21' by 126'. The largest column size is a W12x136, located along the middle of the building and extending from the slab up to floor 3. 36 of these columns create the backbone of support for the entire building A. Smaller column sizes include W12's and W8's which are distributed as supports along the exterior walls. Upper columns begin 5' above the third floor and extend to the roof deck. The cost of an average bay in building A was figured to be $716,257.00 and is a bay of approximately 2,646 square feet. This equates to **$270.70** per square foot of space. It is important to note that this is for four floors and not a single story; when calculating the total cost of building A only the footprint needs to be used as floor size. Consequently, a cost of **$13,677,388** was calculated for building A.

Building B is primarily an Auditorium. Seven bays at 18'-8" in width and 88'-4" in length compose the structural system. Here, the maximum column size is W12x79 and extends from the foundation to the roof deck. Hollow structural steel piping was employed to support the auditorium space, with HSS8"x1/2" X-pipe being used for eleven columns spanning from the slab to the first floor deck. The cost of an average bay in building B is calculated at $297,865. With a bay covering approximately 1650 square feet, the average square foot cost equates to about **$180.26** per square foot of building footprint. Calculating the total cost of building B yields **$2,452,044.**

Building C was slightly more difficult to estimate due to the custom made truss system for the roof. Seven trusses composed of T-shapes and hollow structural steel span the 112'-wide gymnasium. Additionally, secondary trusses span the gym providing lateral bracing and additional roof support. These are made of primarily W12 shapes and hollow strength steel. A typical bay covers approximately 2091 square feet. This costs $361,580.3 and when computed as a cost per square foot, the figure **$172.95/s.f.** . The calculated cost of the gymnasium (at 12,544 s.f.) is **$2,169,481**

The total cost estimated for the three buildings, as computed from a detailed takeoff on typical bays, is $18.3 million. Compared with the costs estimated in the previous report, via RS means and D4 cost estimation, there is a difference of about 6%. This is most likely due to the fact that the typical bays do not take into account end bays as well as peculiarities that exist throughout the building (i.e. differences in column sizing, member sizing, etc.).

GENERAL CONDITIONS ESTIMATE

Summary

The general conditions estimate was compiled based on data provided by Gilbane Building Company. At $5.14 million this is about 10% of the total project cost. The number of people on staff for this project is typical of a CM team executing a GMP contract; the Project Executive is floated between several jobs, as well as the accountant, safety director and scheduler. The full-time staff is composed of a project manager, superintendants, and project engineers. Interestingly enough, there is also an intern on the project who will aid in submittals, RFI's and other project engineering issues. The labor costs for the management team is slightly higher than national averages because of the higher cost of living in Massachusetts.

Aside from management staff, a large portion of the general conditions is reserved for insurance. Gilbane is responsible for a Contractor-Carried-Insurance-Plan, as well as bonding and liability insurance. General office expenses also account for a significant portion of the general conditions.

Significant costs on the general conditions estimate also include technology fees, safety (fall) protection and weather delays. Some of these expenses are integrated as an allowance so that the money will be there should the event arise where money is needed (as in fuel for the heating system and weather delays).

Table: General Conditions Estimate

Description	Quantity	Unit	Unit Price	Total
Protection and Safety				
Security	1	LS	$5,600	$5,600
First Aid	1	LS	$2,000	$2,000
Hardhats, Gloves, Goggles	1	LS	$5,000	$5,000
Site Signage	1	LS	$10,000	$10,000
Small Tools	1	LS	$15,000	$15,000
Safety Rails, Opening Protection	1	LS	$200,000	$200,000
Drug Testing	60	EA	$400	$24,000
Sidewalk Overhead Protection	1	LS	$25,000	$25,000
Ladders/Temp Stairs	1	LS	$30,000	$30,000
Safety Sigange/Incentives	1	LS	$15,800	$15,800
Temp. Fire Extinquishers	40	EA	$250	$10,000
Emergency Generator Fuel	1	LS	$10,000	$10,000
			Subtotal	$352,400
General Expenses				
Job Office Trailers	30	Months	$2,500	$75,000
Office Setup/Demob	1	LS	$21,000	$21,000
Advertising	1	LS	$30,000	$30,000
Office Supplies	26	Months	$300	$7,800
IT Equipment	24	Months	$2,000	$48,000
Computers	1	LS	$50,000	$50,000
Network Connection Fees	1	LS	$10,000	$10,000
Network Maintenance Fees	28096	MH	$3.60	$101,146
Telephones	26	Months	$50	$1,300
Telephone Connection	1	LS	$11,000	$11,000
Cell Phones	26	Months	$900	$23,400
Copiers/Supplies	30	Months	$1,000	$30,000
Postage/FEDEX	26	Months	$500	$13,000
Office Furniture	1	LS	$6,000	$6,000
Photography	1	LS	$18,000	$18,000
Field Engineering Svcs	12	Weeks	$6,700	$80,400
Document Reproduction	1	LS	$60,000	$60,000
Company Trucks	26	Months	$2,165	$56,290
Pest Control	30	Months	$200	$6,000
			Subtotal	$648,336
Temporary Utilities, Barricades				
Site Fencing	1	LS	$12,000	$12,000
Temp. Plumbing	1	LS	$25,000	$25,000

Temp. Sewer	1	LS	$25,000	$25,000
Temp. Heat System	1	LS	$300,000	$300,000
Temp Toilets	1	LS	$65,000	$65,000
Drinking Water	30	Months	$250	$7,500
Temp Electric Hookup	1	LS	$13,000	$13,000
Temp. Electric	26	Months	$400	$10,400
			Subtotal	$457,900
Project Staff				
Project Executive (Part-Time)	13	Months	$20,000	$260,000
Project Manager	26	Months	$16,000	$416,000
General Superintendant	26	Months	$12,000	$312,000
Sr. Project Engineer	26	Months	$9,000	$234,000
Project Engineer	26	Months	$7,000	$182,000
Superintendant	26	Months	$8,500	$221,000
Intern	26	Months	$2,500	$65,000
Accountant (Part-Time)	13	Months	$9,000	$117,000
Safety Director (Part-Time)	8	Months	$9,000	$72,000
Scheduler (Part-Time)	8	Months	$10,000	$80,000
			Subtotal	$1,959,000
Clean-Up/Waste Removal				
Snow Removal	3	Seasons	$20,000	$60,000
Weather Protection	1	LS	$200,000	$200,000
Periodic	103	Weeks	$2,600	$267,800
Road	1	LS	$2,000	$2,000
Final	1	LS	$215,000	$215,000
Chutes/Hoppers	1	LS	$7,500	$7,500
Dumpsters	144	Loads	$650	$93,600
			Subtotal	$845,900
Permits/Insurance/Fee				
Builder's Risk	1	LS	$90,000	$90,000
Liability Insurance	1	LS	$373,500	$373,500
Performance Bond	1	LS	$344,027	$344,027
Automotive Insurance	26	Months	$600	$15,600
Permits	0	LS	$0	$0
			Subtotal	$823,127
			TOTAL	$5,086,663

CRITICAL INDUSTRY ISSUES

The 2009 PACE Roundtable was a confrontation of today's leading issues in the building industry: the drive to go green, increasing application of BIM technology, procuring work in a down market and coping with generational differences in the workplace. Appropriately named were the four main discussions: Energy and the Building Industry, Business Networking, BIM Execution Planning, and the student panel: Communication Patterns of the Now Generation. While each session aimed at debating different issues, they all provided a forum for applying real scenarios to senior thesis projects.

I enjoyed the cutting edge dialogue that took place in the Energy group. Here, we attempted to list issues driving energy analysis and conservation in the building industry. Most items fell into one of three categories: energy costs/efficiency, emerging technology and marketing. Several tides of change are sweeping construction. While the motives are debatable, owners are showing increased interest in better performing buildings. Deregulation is driving energy costs up, therefore energy savings are of importance to them. Additionally, pollution/global warming is causing popular culture to value sustainability much more and some are willing to pay more to live in a green building.

Industry trades are adding to the momentum by developing newer technology that is more efficient and more intelligent. New standards are being established; between LEED, ASHRAE and the EPA, there are many new ways to qualify a building or equipment as "green". New products have hit the markets such as LED lighting, high performance insulation, intelligent controls, and hybridized equipment that decrease the footprint a structure leaves on the natural world.

On the Worcester North High School, an allowance was given on the original estimate for a PV system. This has been put on the back burner and there are no solid plans on the table for designs. I am interested in computing a lifecycle cost analysis on a PV system for the high school, as well as a solar hot water system. There are renewable energy credits, grant monies and tax breaks which may be available to the Worcester School Department if a system is installed. I feel that it is also important to pursue renewable technologies like these on a school since they can serve as a demonstration to students. No time is better than childhood to engrain the principles of sustainability and energy independence.

There were several professionals in attendance that could be of tremendous help on my thesis. I find Dan Kerr and Alyssa Adams of McClure Company particularly knowledgeable about the intricacies of renewable energy sources on commercial buildings, so they are excellent contacts to have. Both Dan and Alyssa work in the Energy Solutions division of the company and K-12 Educational is listed as one of their main client sectors.

I was surprised perhaps by the apparent generational differences in preferred communication methods and etiquette. It is interesting to hear what communication means to a project manager or someone who will most likely be my boss someday. It is important, evidently, to establish a standard practice for electronic communications today since it is integrated into our lives. I was surprised, too, by the lack of some people to use proper grammar and sentence structure in their emails.

My impressions of the PACE roundtable were good; I was proud to see that alumni from the AE program, as well as industry professionals, are eager to come back and share their experiences and ideas with us.

APPENDIX A: COST BREAKDOWN FOR DETAILED STRUCTURAL ESTIMATE

ItemCode	Description	Quantity	UM	Lab.Unit	Mat.Unit	Tot.UnitCost	TotalCost
02316.002	MACHINE FINE GRADE FLOOR	2499	SQFT	0.2642	0	0.279	697.72
02316.110	MACH EXCAV COLUMN FTG	60.81	CUYD	6.9549	0	7.905	480.69
02316.112	FINE GRADE @ COLUMN FTG	338	SQFT	0.4761	0	0.476	160.92
03110.520	COLUMN FOOTING EDGE FORMS	490.4	SQFT	4.4257	1.039	5.464	2679.74
03111.348	WOOD PIER FORMS	1.11	SQFT	1.0476	1.161	2.208	2.45
03110.602	Grade beam form 2-4' deep	672	SQFT	2.2909	1.226	3.517	2363.42
03110.620	GR BM FORM HARDWARE	336	SQFT	0	0.102	0.102	34.41
03110.623	PILASTER EDGE FORM @ GR BM	64	SQFT	9.1168	1.039	10.156	649.95
03111.800		84	EACH	0	0	0	0
03150.900	FORM RELEASING AGENT	1.11	SQFT	0.2095	0.023	0.233	0.26
03150.650	SCREEDS FOR SLAB	511.56	LNFT	0.9219	0.32	1.242	635.31
03150.651	CONSTRUCTION JOINTS	42	LNFT	1.8437	0.502	2.345	98.5
03150.900	FORM RELEASING AGENT	736	SQFT	0.2095	0.023	0.233	171.12
03210.155	PIER REBAR	0.01	CWT	23.7333	26.75	50.483	0.4
03210.300	GRADE BEAM REBAR	6.33	CWT	31.7857	26.75	58.536	370.61
03220.012	6x6 W2.9/W2.9 MESH	46.89	SQS	23.1663	15	38.166	1789.73
03240.011	FIBER REINFORCING (FIBERMESH)	57.85	LBS	0	4.608	4.608	266.56
03310.350	**CONC IN SLAB ON GRADE**	0	****	0	0	0	0
03310.351	3000 PSI DIRECT	38.56	CUYD	11.009	55	66.009	2545.62
03315.976	* SOG AREA *	2499	SQFT	0	0	0	0
03310.200	**CONC IN COLUMN FOOTING**	0	****	0	0	0	0
03310.218	4000 PSI W/CRANE	40.52	CUYD	13.942	56	69.942	2833.95
03310.750	**CONCRETE IN PIERS**	0	****	0	0	0	0
03310.776	4000 PSI W/CRANE	0	CUYD	19.364	56	75.364	0.16
03315.972	* NO. OF COLUMN FOOTINGS *	5	EACH	0	0	0	0
03310.250	**CONC IN GRADE BEAMS**	0	****	0	0	0	0
03310.267	4000 PSI DIRECT	39.7	CUYD	12.5817	56	68.582	2722.95
03315.975	* GRADE BEAM LENGTH *	84	LNFT	0	0	0	0
03311.700	**CONC IN SLAB OVER MTL DECK**	0	****	0	0	0	0
03311.701	3000 PSI DIRECT	75.66	CUYD	14.6787	55	69.679	5271.55
03315.991	* SLAB OVER METAL DECK AREA *	4263	SQFT	0	0	0	0
03350.132	FLOAT FINISH	2499	SQFT	0.2754	0	0.275	688.22

03350.131	POINT & PATCH	1.11	SQFT	0.1102	0.013	0.123	0.14
03350.131	POINT & PATCH	736	SQFT	0.1102	0.013	0.123	90.53
03350.132	FLOAT FINISH	4263	SQFT	0.2754	0	0.275	1174.03
03390.010	PROTECT & CURE	2499	SQFT	0.1102	0.019	0.129	323.37
03390.010	PROTECT & CURE	4263	SQFT	0.1102	0.019	0.129	551.63
05129.101	STEEL BEAMS	0	****	0	0	0	0
05129.102	I BEAMS	319.83	CWT	28.73	35	68.73	21981.92
05129.121	STEEL COLUMNS	0	****	0	0	0	0
05129.122	I SHAPES	241.01	CWT	28.73	35	68.73	16564.51
05129.141	GIRDERS	0	****	0	0	0	0
05129.142	I BEAMS	284.2	CWT	28.73	35	68.73	19533.07
05129.990	* STRUCTURAL STEEL WEIGHT *	42.25	TONS	0	0	0	0
05310.014	STD GALV CORRUFORM	4263	SQFT	0.4543	0.32	0.774	3300.84
05310.052	1-1/2X20 GA MTL DECK GALV	2499	SQFT	0.4134	0.806	1.22	3048.28
07220.035	3-7/16" URETHANE INSULATION	2499	SQFT	0.8139	2.163	2.977	7439.77
07260.012	6MIL VISQUEEN SUBGRADE PAPER	27.49	SQS	1.1018	2.9	4.002	110.01
07309.900	* ROOF AREA *	2499	SQFT	0	0	0	0
07530.020	ELASTOMERIC ROOFING	24.99	SQS	99.9429	62.72	162.663	4064.95
07810.031	CEMENTITIOUS FIREPROOFING	13535.15	BDFT	44.8066	0.448	45.335	613610.39
Total Estimate							716257.66

Cost Breakdown: Typical Bay, Building B (Auditorium)

ItemCode	Description	Quantity	UM	Lab.Unit	Mat.Unit	Tot.UnitCost	TotalCost
02316.110	MACH EXCAV COLUMN FTG	24.96	CUYD	6.9549	0	7.905	197.33
02316.112	FINE GRADE @ COLUMN FTG	193	SQFT	0.4761	0	0.476	91.89
02316.100	MACH EXCAV CONTINUOUS FTG	3.26	CUYD	6.9549	0	7.905	25.76
02316.101	HAND EXCAV CONTINUOUS FTG	0.81	CUYD	32.3728	0	32.373	26.37
02316.002	MACHINE FINE GRADE FLOOR	1649.12	SQFT	0.2642	0	0.279	460.43
02316.022	WASHED GRAVEL SLAB FILL	30.54	CUYD	16.1864	5.12	21.306	650.68
03111.114	WALL FORM 16'-18' HIGH	1226.25	SQFT	3.4221	1.45	4.873	5974.88
03111.141	WALL KEY FORMS	37.34	LNFT	0.8231	0.235	1.058	39.49
03111.189	WALL FORM HARDWARE	613.12	SQFT	0	0.102	0.102	62.78
03110.520	COLUMN FOOTING EDGE FORMS	248	SQFT	4.4257	1.039	5.464	1355.17
03111.348	WOOD PIER FORMS	120	SQFT	1.0476	1.161	2.208	264.97
03150.900	FORM RELEASING AGENT	1226.25	SQFT	0.2095	0.023	0.233	285.1
03150.900	FORM RELEASING AGENT	120	SQFT	0.2095	0.023	0.233	27.9
03150.650	SCREEDS FOR SLAB	197.89	LNFT	0.9219	0.32	1.242	245.77
03210.160	WALL REBAR	27.54	CWT	32.9629	26.75	59.713	1644.79
03210.155	PIER REBAR	10.42	CWT	23.7333	26.75	50.483	525.87
03210.210	COLUMN FOOTING REBAR	10.3	CWT	31.7857	26.75	58.536	602.74
03220.012	6x6 W2.9/W2.9 MESH	18.14	SQS	23.1663	15	38.166	692.35
03240.011	FIBER REINFORCING (FIBERMESH)	38.17	LBS	0	4.608	4.608	175.91
03310.550	**CONCRETE IN WALLS**	0	****	0	0	0	0
03310.575	4000 PSI DIRECT	34.06	CUYD	14.6787	56	70.679	2407.48
03315.982	* CONCRETE WALL AREA *	613.12	SQFT	0	0	0	0
03310.200	**CONC IN COLUMN FOOTING**	0	****	0	0	0	0
03310.218	4000 PSI W/CRANE	14.3	CUYD	13.942	56	69.942	999.91
03310.750	**CONCRETE IN PIERS**	0	****	0	0	0	0
03310.776	4000 PSI W/CRANE	2.78	CUYD	19.364	56	75.364	209.34
03315.972	* NO. OF COLUMN FOOTINGS *	5	EACH	0	0	0	0
03310.150	**CONC IN CONTINUOUS	0	****	0	0	0	0

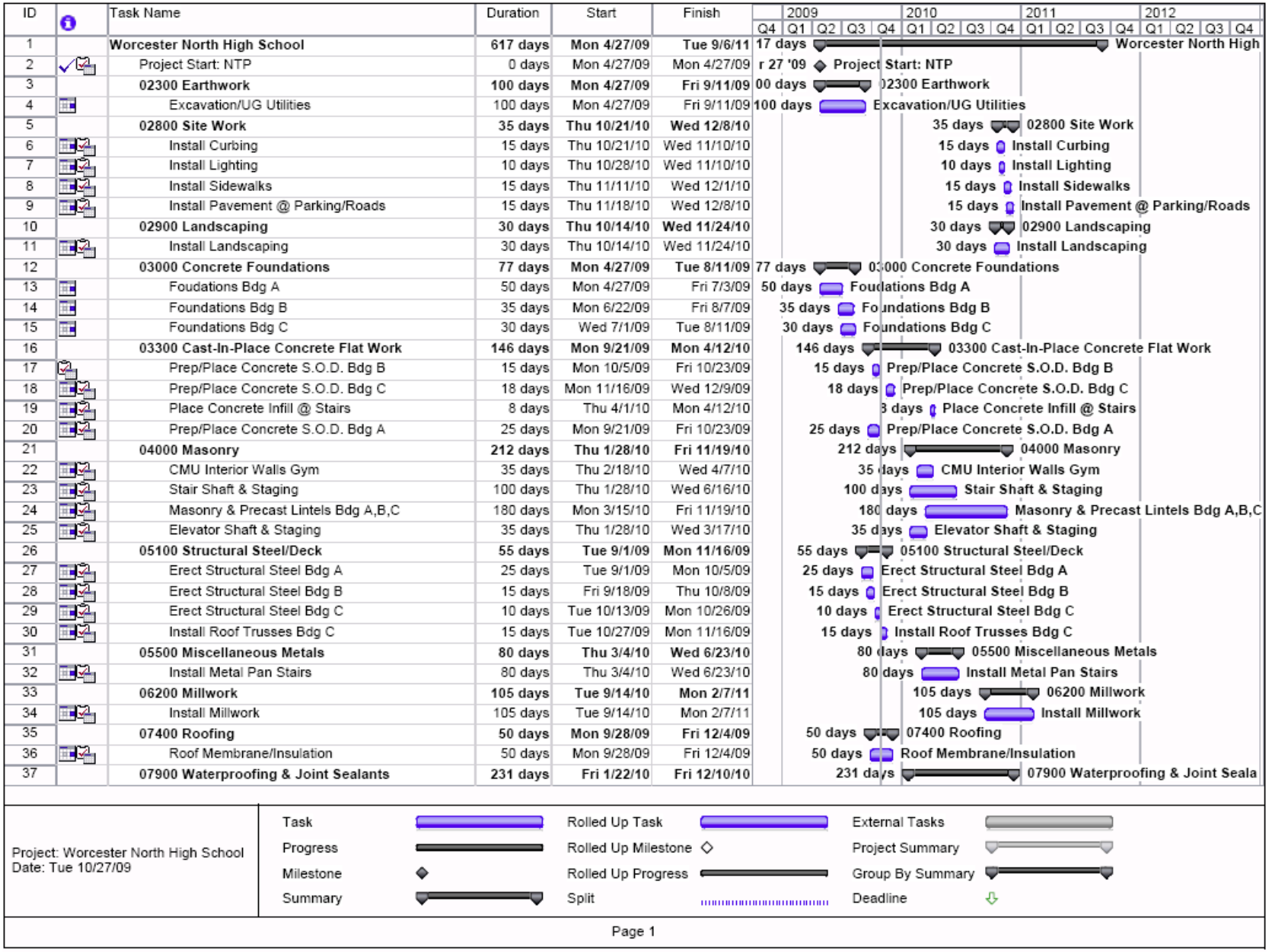
	FOOTING**						
03310.167	4000 PSI DIRECT	4.07	CUYD	11.009	56	67.009	272.95
03315.971	* CONTINUOUS FOOTING LENGTH *	18.33	LNFT	0	0	0	0
03310.350	**CONC IN SLAB ON GRADE**	0	****	0	0	0	0
03310.351	3000 PSI DIRECT	25.45	CUYD	11.009	55	66.009	1679.89
03315.976	* SOG AREA *	1649.12	SQFT	0	0	0	0
03311.700	**CONC IN SLAB OVER MTL DECK**	0	****	0	0	0	0
03311.701	3000 PSI DIRECT	11.45	CUYD	14.6787	55	69.679	797.98
03315.991	* SLAB OVER METAL DECK AREA *	1649.12	SQFT	0	0	0	0
03350.131	POINT & PATCH	1226.25	SQFT	0.1102	0.013	0.123	150.83
03350.131	POINT & PATCH	120	SQFT	0.1102	0.013	0.123	14.76
03350.132	FLOAT FINISH	1649.12	SQFT	0.2754	0	0.275	454.17
03350.132	FLOAT FINISH	1649.12	SQFT	0.2754	0	0.275	454.17
03390.010	PROTECT & CURE	1649.12	SQFT	0.1102	0.019	0.129	213.4
03390.010	PROTECT & CURE	1649.12	SQFT	0.1102	0.019	0.129	213.4
05129.101	STEEL BEAMS	0	****	0	0	0	0
05129.102	I BEAMS	62.7	CWT	28.73	35	68.73	4309.37
05129.121	STEEL COLUMNS	0	****	0	0	0	0
05129.122	I SHAPES	48.02	CWT	28.73	35	68.73	3300.25
05129.141	GIRDERS	0	****	0	0	0	0
05129.142	I BEAMS	48.73	CWT	28.73	35	68.73	3349.12
05129.990	* STRUCTURAL STEEL WEIGHT *	7.97	TONS	0	0	0	0
05129.101	STEEL BEAMS	0	****	0	0	0	0
05129.102	I BEAMS	38.46	CWT	28.73	35	68.73	2643.37
05129.141	GIRDERS	0	****	0	0	0	0
05129.142	I BEAMS	81.82	CWT	28.73	35	68.73	5623.57
05129.181	BRACING	0	****	0	0	0	0
05129.184	ANGLES	1.34	CWT	45.968	35	90.968	121.98
05129.185	TEES	3.66	CWT	45.968	35	90.968	333.39
05129.990	* STRUCTURAL STEEL WEIGHT *	6.26	TONS	0	0	0	0
05310.052	1-1/2X20 GA MTL DECK GALV	1481.09	SQFT	0.4134	0.806	1.22	1806.63
05310.014	STD GALV CORRUFORM	1649.12	SQFT	0.4543	0.32	0.774	1276.91

07220.035	3-7/16" URETHANE INSULATION	1487.44	SQFT	0.8139	2.163	2.977	4428.25
07260.012	6MIL VISQUEEN SUBGRADE PAPER	18.14	SQS	1.1018	2.9	4.002	72.59
07309.900	* ROOF AREA *	1487.44	SQFT	0	0	0	0
07530.020	ELASTOMERIC ROOFING	14.87	SQS	99.9429	62.72	162.663	2419.51
07810.031	CEMENTITIOUS FIREPROOFING	3165.29	BDFT	44.8066	0.448	45.335	143497
07810.031	CEMENTITIOUS FIREPROOFING	2282.24	BDFT	44.8066	0.448	45.335	103464.5
Total Estimate							297864.9

Cost Breakdown: Typical Bay, Building C

ItemCode	Description	Quantity	UM	Lab.Unit	Mat.Unit	Eqp.Unit	Tot.UnitCost	TotalCost
02260.034	BRACE FTG TRENCH W/JACKS	1160	SQFT	3.0574	0.64	0	3.697	4288.98
02316.100	MACH EXCAV CONTINUOUS FTG	165.93	CUYD	6.9549	0	0.95	7.905	1311.63
02316.101	HAND EXCAV CONTINUOUS FTG	41.48	CUYD	32.3728	0	0	32.373	1342.87
03310.150	**CONC IN CONTINUOUS FOOTING**	0	****	0	0	0	0	0
03310.167	4000 PSI DIRECT	207.41	CUYD	11.009	56	0	67.009	13898.16
03315.971	* CONTINUOUS FOOTING LENGTH *	280	LNFT	0	0	0	0	0
04210.011	MORTAR	33.97	CUYD	0	50	0	50	1698.67
04210.201	STANDARD SIZE FACE BRICK	71.89	M	566.9517	135	0	701.952	50465.27
04210.507	ADD FOR FLEMISH DBL STRCHR BND	7840	SQFT	0.8431	0	0	0.843	6609.9
04210.580	ADD FOR FLUSH CUT	7840	SQFT	0.2316	0	0	0.232	1815.74
04219.990	* MASONRY WALL AREA *	7840	SQFT	0	0	0	0	0
04220.102	FILL VOIDS W/ CONCRETE	98.73	CUYD	20.552	55	0	75.552	7458.94
04220.502	8X8X16 CONC BLOCK	8820	PCS	1.9929	0.63	0	2.623	23133.98
04224.122	MASONRY REBAR	39.28	CWT	20.552	26.75	0	47.302	1857.95
04224.222	8" TRUSS REINFG, REG GALV	5600	LNFT	0	0.874	0	0.874	4892.16
04930.011	CLEAN FACE BRICK	7840	SQFT	0.406	0	0	0.406	3183.04
05129.101	STEEL BEAMS	0	****	0	0	0	0	0
05129.102	I BEAMS	28.01	CWT	28.73	35	5	68.73	1924.78
05129.161	TRUSSES	0	****	0	0	0	0	0
05129.162	I BEAMS	97.81	CWT	28.73	35	5	68.73	6722.7
05129.165	TEES	147.35	CWT	38.3067	35	5	78.307	11538.72
05129.990	* STRUCTURAL STEEL WEIGHT *	13.66	TONS	0	0	0	0	0
07140.011	WATERPROOFING ON MASONRY	7840	SQFT	0.4983	0.358	0	0.857	6716.53
07810.031	CEMENTITIOUS FIREPROOFING	4689.88	BDFT	44.8066	0.448	0.08	45.335	212613.7
09970.101	FIELD PAINT	0	****	0	0	0	0	0
09970.102	RED OXIDE	545.16	SQFT	0.1188	0.077	0	0.196	106.63
Total Estimate								361580.3

APPENDIX B: DETAILED PROJECT SCHEDULE



ID	Task Name	Duration	Start	Finish
1	**Worcester North High School**	**617 days**	**Mon 4/27/09**	**Tue 9/6/11**
2	Project Start: NTP	0 days	Mon 4/27/09	Mon 4/27/09
3	**02300 Earthwork**	**100 days**	**Mon 4/27/09**	**Fri 9/11/09**
4	Excavation/UG Utilities	100 days	Mon 4/27/09	Fri 9/11/09
5	**02800 Site Work**	**35 days**	**Thu 10/21/10**	**Wed 12/8/10**
6	Install Curbing	15 days	Thu 10/21/10	Wed 11/10/10
7	Install Lighting	10 days	Thu 10/28/10	Wed 11/10/10
8	Install Sidewalks	15 days	Thu 11/11/10	Wed 12/1/10
9	Install Pavement @ Parking/Roads	15 days	Thu 11/18/10	Wed 12/8/10
10	**02900 Landscaping**	**30 days**	**Thu 10/14/10**	**Wed 11/24/10**
11	Install Landscaping	30 days	Thu 10/14/10	Wed 11/24/10
12	**03000 Concrete Foundations**	**77 days**	**Mon 4/27/09**	**Tue 8/11/09**
13	Foudations Bdg A	50 days	Mon 4/27/09	Fri 7/3/09
14	Foundations Bdg B	35 days	Mon 6/22/09	Fri 8/7/09
15	Foundations Bdg C	30 days	Wed 7/1/09	Tue 8/11/09
16	**03300 Cast-In-Place Concrete Flat Work**	**146 days**	**Mon 9/21/09**	**Mon 4/12/10**
17	Prep/Place Concrete S.O.D. Bdg B	15 days	Mon 10/5/09	Fri 10/23/09
18	Prep/Place Concrete S.O.D. Bdg C	18 days	Mon 11/16/09	Wed 12/9/09
19	Place Concrete Infill @ Stairs	8 days	Thu 4/1/10	Mon 4/12/10
20	Prep/Place Concrete S.O.D. Bdg A	25 days	Mon 9/21/09	Fri 10/23/09
21	**04000 Masonry**	**212 days**	**Thu 1/28/10**	**Fri 11/19/10**
22	CMU Interior Walls Gym	35 days	Thu 2/18/10	Wed 4/7/10
23	Stair Shaft & Staging	100 days	Thu 1/28/10	Wed 6/16/10
24	Masonry & Precast Lintels Bdg A,B,C	180 days	Mon 3/15/10	Fri 11/19/10
25	Elevator Shaft & Staging	35 days	Thu 1/28/10	Wed 3/17/10
26	**05100 Structural Steel/Deck**	**55 days**	**Tue 9/1/09**	**Mon 11/16/09**
27	Erect Structural Steel Bdg A	25 days	Tue 9/1/09	Mon 10/5/09
28	Erect Structural Steel Bdg B	15 days	Fri 9/18/09	Thu 10/8/09
29	Erect Structural Steel Bdg C	10 days	Tue 10/13/09	Mon 10/26/09
30	Install Roof Trusses Bdg C	15 days	Tue 10/27/09	Mon 11/16/09
31	**05500 Miscellaneous Metals**	**80 days**	**Thu 3/4/10**	**Wed 6/23/10**
32	Install Metal Pan Stairs	80 days	Thu 3/4/10	Wed 6/23/10
33	**06200 Millwork**	**105 days**	**Tue 9/14/10**	**Mon 2/7/11**
34	Install Millwork	105 days	Tue 9/14/10	Mon 2/7/11
35	**07400 Roofing**	**50 days**	**Mon 9/28/09**	**Fri 12/4/09**
36	Roof Membrane/Insulation	50 days	Mon 9/28/09	Fri 12/4/09
37	**07900 Waterproofing & Joint Sealants**	**231 days**	**Fri 1/22/10**	**Fri 12/10/10**

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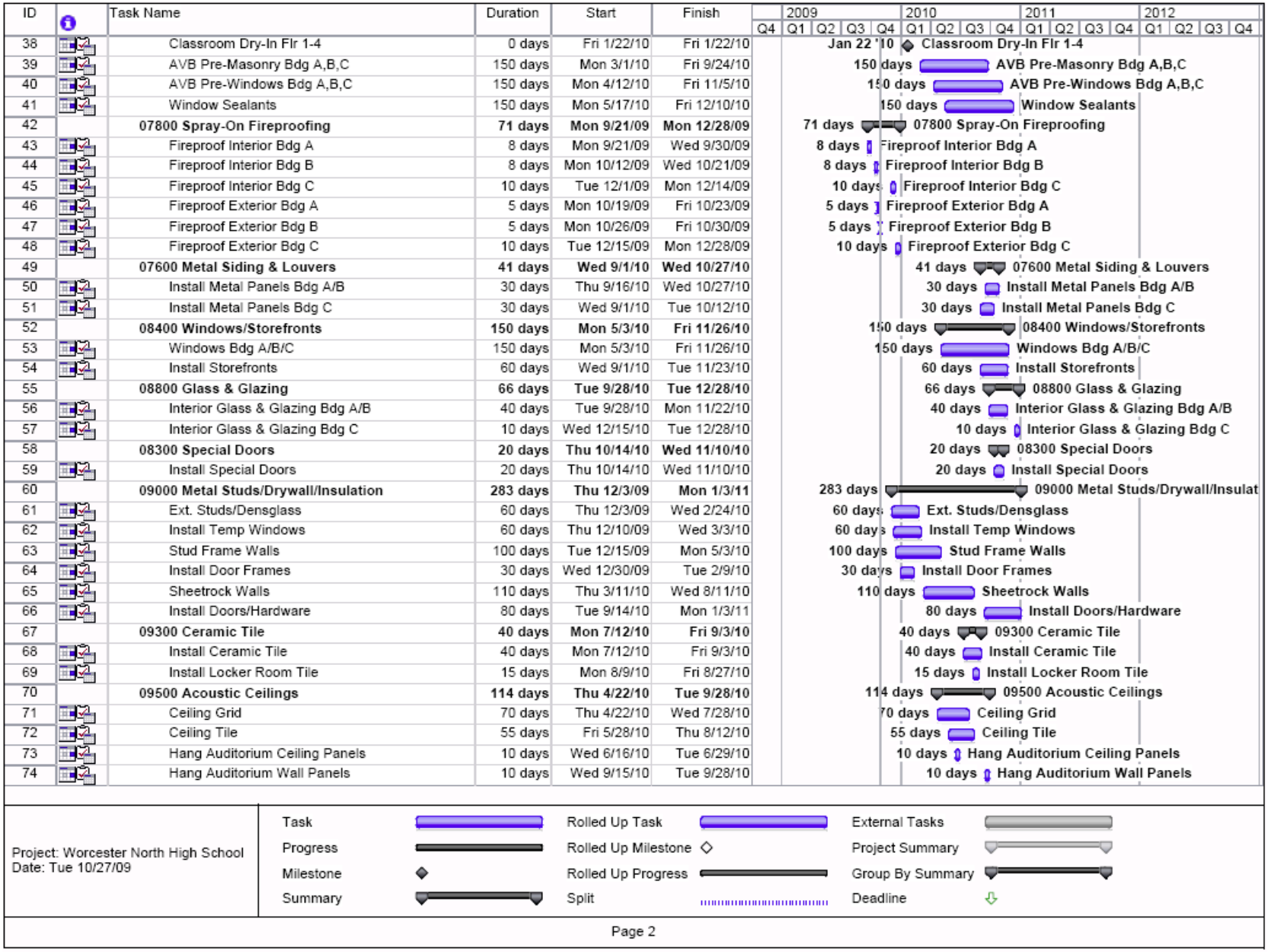
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Task Name
Duration
Start
Finish
2009
2010
2011
2012
Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4
38 Classroom Dry-In Flr 1-4 0 days Fri 1/22/10 Fri 1/22/10
39 AVB Pre-Masonry Bdg A,B,C 150 days Mon 3/1/10 Fri 9/24/10
40 AVB Pre-Windows Bdg A,B,C 150 days Mon 4/12/10 Fri 11/5/10
41 Window Sealants 150 days Mon 5/17/10 Fri 12/10/10
42 07800 Spray-On Fireproofing 71 days Mon 9/21/09 Mon 12/28/09
43 Fireproof Interior Bdg A 8 days Mon 9/21/09 Wed 9/30/09
44 Fireproof Interior Bdg B 8 days Mon 10/12/09 Wed 10/21/09
45 Fireproof Interior Bdg C 10 days Tue 12/1/09 Mon 12/14/09
46 Fireproof Exterior Bdg A 5 days Mon 10/19/09 Fri 10/23/09
47 Fireproof Exterior Bdg B 5 days Mon 10/26/09 Fri 10/30/09
48 Fireproof Exterior Bdg C 10 days Tue 12/15/09 Mon 12/28/09
49 07600 Metal Siding & Louvers 41 days Wed 9/1/10 Wed 10/27/10
50 Install Metal Panels Bdg A/B 30 days Thu 9/16/10 Wed 10/27/10
51 Install Metal Panels Bdg C 30 days Wed 9/1/10 Tue 10/12/10
52 08400 Windows/Storefronts 150 days Mon 5/3/10 Fri 11/26/10
53 Windows Bdg A/B/C 150 days Mon 5/3/10 Fri 11/26/10
54 Install Storefronts 60 days Wed 9/1/10 Tue 11/23/10
55 08800 Glass & Glazing 66 days Tue 9/28/10 Tue 12/28/10
56 Interior Glass & Glazing Bdg A/B 40 days Tue 9/28/10 Mon 11/22/10
57 Interior Glass & Glazing Bdg C 10 days Wed 12/15/10 Tue 12/28/10
58 08300 Special Doors 20 days Thu 10/14/10 Wed 11/10/10
59 Install Special Doors 20 days Thu 10/14/10 Wed 11/10/10
60 09000 Metal Studs/Drywall/Insulation 283 days Thu 12/3/09 Mon 1/3/11
61 Ext. Studs/Densglass 60 days Thu 12/3/09 Wed 2/24/10
62 Install Temp Windows 60 days Thu 12/10/09 Wed 3/3/10
63 Stud Frame Walls 100 days Tue 12/15/09 Mon 5/3/10
64 Install Door Frames 30 days Wed 12/30/09 Tue 2/9/10
65 Sheetrock Walls 110 days Thu 3/11/10 Wed 8/11/10
66 Install Doors/Hardware 80 days Tue 9/14/10 Mon 1/3/11
67 09300 Ceramic Tile 40 days Mon 7/12/10 Fri 9/3/10
68 Install Ceramic Tile 40 days Mon 7/12/10 Fri 9/3/10
69 Install Locker Room Tile 15 days Mon 8/9/10 Fri 8/27/10
70 09500 Acoustic Ceilings 114 days Thu 4/22/10 Tue 9/28/10
71 Ceiling Grid 70 days Thu 4/22/10 Wed 7/28/10
72 Ceiling Tile 55 days Fri 5/28/10 Thu 8/12/10
73 Hang Auditorium Ceiling Panels 10 days Wed 6/16/10 Tue 6/29/10
74 Hang Auditorium Wall Panels 10 days Wed 9/15/10 Tue 9/28/10
Jan 22 '10 Classroom Dry-In Flr 1-4
150 days AVB Pre-Masonry Bdg A,B,C
150 days AVB Pre-Windows Bdg A,B,C
150 days Window Sealants
71 days 07800 Spray-On Fireproofing
8 days Fireproof Interior Bdg A
8 days Fireproof Interior Bdg B
10 days Fireproof Interior Bdg C
5 days Fireproof Exterior Bdg A
5 days Fireproof Exterior Bdg B
10 days Fireproof Exterior Bdg C
41 days 07600 Metal Siding & Louvers
30 days Install Metal Panels Bdg A/B
30 days Install Metal Panels Bdg C
150 days 08400 Windows/Storefronts
150 days Windows Bdg A/B/C
60 days Install Storefronts
66 days 08800 Glass & Glazing
40 days Interior Glass & Glazing Bdg A/B
10 days Interior Glass & Glazing Bdg C
20 days 08300 Special Doors
20 days Install Special Doors
283 days 09000 Metal Studs/Drywall/Insulat
60 days Ext. Studs/Densglass
60 days Install Temp Windows
100 days Stud Frame Walls
30 days Install Door Frames
110 days Sheetrock Walls
80 days Install Doors/Hardware
40 days 09300 Ceramic Tile
40 days Install Ceramic Tile
15 days Install Locker Room Tile
114 days 09500 Acoustic Ceilings
70 days Ceiling Grid
55 days Ceiling Tile
10 days Hang Auditorium Ceiling Panels
10 days Hang Auditorium Wall Panels
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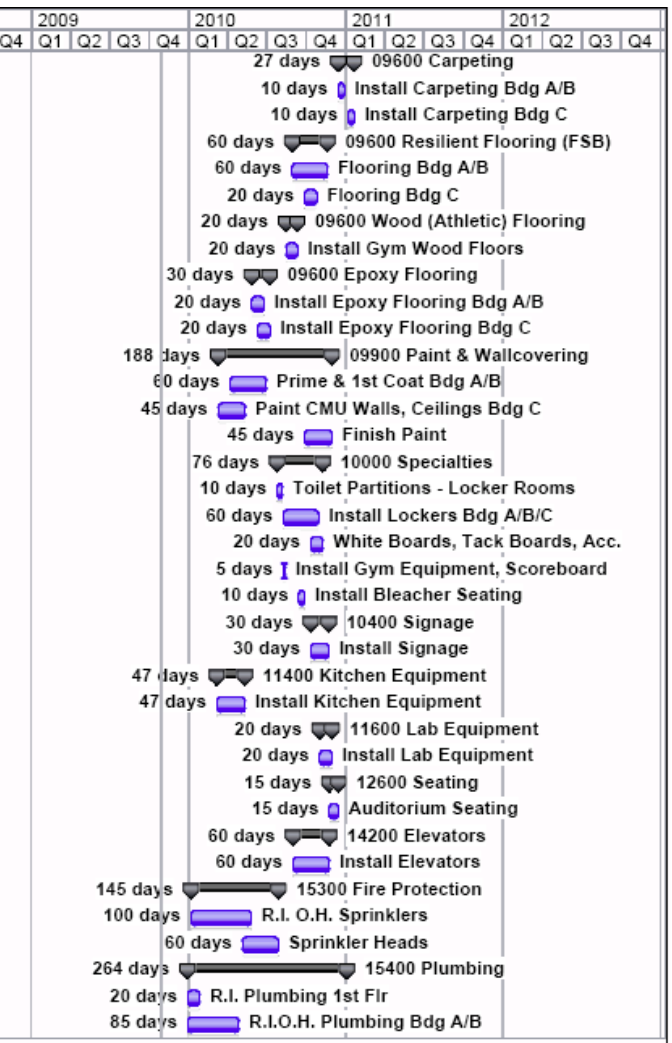
ID	Task Name	Duration	Start	Finish
75	**09600 Carpeting**	**27 days**	**Wed 12/15/10**	**Thu 1/20/11**
76	Install Carpeting Bdg A/B	10 days	Wed 12/15/10	Tue 12/28/10
77	Install Carpeting Bdg C	10 days	Fri 1/7/11	Thu 1/20/11
78	**09600 Resilient Flooring (FSB)**	**60 days**	**Mon 8/30/10**	**Fri 11/19/10**
79	Flooring Bdg A/B	60 days	Mon 8/30/10	Fri 11/19/10
80	Flooring Bdg C	20 days	Tue 9/28/10	Mon 10/25/10
81	**09600 Wood (Athletic) Flooring**	**20 days**	**Mon 8/16/10**	**Fri 9/10/10**
82	Install Gym Wood Floors	20 days	Mon 8/16/10	Fri 9/10/10
83	**09600 Epoxy Flooring**	**30 days**	**Fri 5/28/10**	**Thu 7/8/10**
84	Install Epoxy Flooring Bdg A/B	20 days	Fri 5/28/10	Thu 6/24/10
85	Install Epoxy Flooring Bdg C	20 days	Fri 6/11/10	Thu 7/8/10
86	**09900 Paint & Wallcovering**	**188 days**	**Thu 3/11/10**	**Mon 11/29/10**
87	Prime & 1st Coat Bdg A/B	60 days	Thu 4/8/10	Wed 6/30/10
88	Paint CMU Walls, Ceilings Bdg C	45 days	Thu 3/11/10	Wed 5/12/10
89	Finish Paint	45 days	Tue 9/28/10	Mon 11/29/10
90	**10000 Specialties**	**76 days**	**Mon 7/26/10**	**Mon 11/8/10**
91	Toilet Partitions - Locker Rooms	10 days	Mon 7/26/10	Fri 8/6/10
92	Install Lockers Bdg A/B/C	60 days	Mon 8/9/10	Fri 10/29/10
93	White Boards, Tack Boards, Acc.	20 days	Tue 10/12/10	Mon 11/8/10
94	Install Gym Equipment, Scoreboard	5 days	Mon 8/9/10	Fri 8/13/10
95	Install Bleacher Seating	10 days	Tue 9/14/10	Mon 9/27/10
96	**10400 Signage**	**30 days**	**Tue 10/12/10**	**Mon 11/22/10**
97	Install Signage	30 days	Tue 10/12/10	Mon 11/22/10
98	**11400 Kitchen Equipment**	**47 days**	**Mon 3/8/10**	**Tue 5/11/10**
99	Install Kitchen Equipment	47 days	Mon 3/8/10	Tue 5/11/10
100	**11600 Lab Equipment**	**20 days**	**Tue 11/2/10**	**Mon 11/29/10**
101	Install Lab Equipment	20 days	Tue 11/2/10	Mon 11/29/10
102	**12600 Seating**	**15 days**	**Wed 11/24/10**	**Tue 12/14/10**
103	Auditorium Seating	15 days	Wed 11/24/10	Tue 12/14/10
104	**14200 Elevators**	**60 days**	**Wed 9/1/10**	**Tue 11/23/10**
105	Install Elevators	60 days	Wed 9/1/10	Tue 11/23/10
106	**15300 Fire Protection**	**145 days**	**Thu 1/7/10**	**Wed 7/28/10**
107	R.I. O.H. Sprinklers	100 days	Thu 1/7/10	Wed 5/26/10
108	Sprinkler Heads	60 days	Thu 5/6/10	Wed 7/28/10
109	**15400 Plumbing**	**264 days**	**Wed 12/30/09**	**Mon 1/3/11**
110	R.I. Plumbing 1st Flr	20 days	Wed 12/30/09	Tue 1/26/10
111	R.I.O.H. Plumbing Bdg A/B	85 days	Wed 12/30/09	Tue 4/27/10



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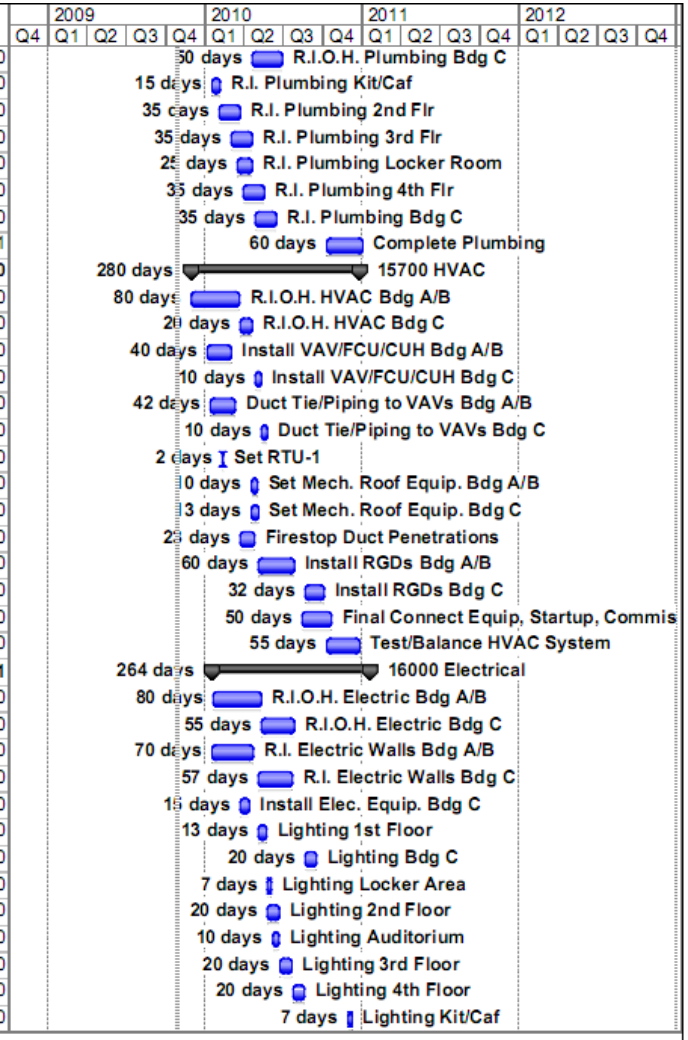
ID	Task Name	Duration	Start	Finish
112	R.I.O.H. Plumbing Bdg C	50 days	Thu 4/22/10	Wed 6/30/10
113	R.I. Plumbing Kit/Caf	15 days	Mon 1/18/10	Fri 2/5/10
114	R.I. Plumbing 2nd Flr	35 days	Thu 2/4/10	Wed 3/24/10
115	R.I. Plumbing 3rd Flr	35 days	Thu 3/4/10	Wed 4/21/10
116	R.I. Plumbing Locker Room	25 days	Thu 3/18/10	Wed 4/21/10
117	R.I. Plumbing 4th Flr	35 days	Thu 4/1/10	Wed 5/19/10
118	R.I. Plumbing Bdg C	35 days	Thu 4/29/10	Wed 6/16/10
119	Complete Plumbing	60 days	Tue 10/12/10	Mon 1/3/11
120	**15700 HVAC**	**280 days**	**Tue 12/1/09**	**Mon 12/27/10**
121	R.I.O.H. HVAC Bdg A/B	80 days	Tue 12/1/09	Mon 3/22/10
122	R.I.O.H. HVAC Bdg C	20 days	Thu 3/25/10	Wed 4/21/10
123	Install VAV/FCU/CUH Bdg A/B	40 days	Thu 1/7/10	Wed 3/3/10
124	Install VAV/FCU/CUH Bdg C	10 days	Thu 4/29/10	Wed 5/12/10
125	Duct Tie/Piping to VAVs Bdg A/B	42 days	Thu 1/14/10	Fri 3/12/10
126	Duct Tie/Piping to VAVs Bdg C	10 days	Thu 5/13/10	Wed 5/26/10
127	Set RTU-1	2 days	Thu 2/11/10	Fri 2/12/10
128	Set Mech. Roof Equip. Bdg A/B	10 days	Tue 4/20/10	Mon 5/3/10
129	Set Mech. Roof Equip. Bdg C	13 days	Tue 4/20/10	Thu 5/6/10
130	Firestop Duct Penetrations	23 days	Thu 3/25/10	Mon 4/26/10
131	Install RGDs Bdg A/B	60 days	Thu 5/6/10	Wed 7/28/10
132	Install RGDs Bdg C	32 days	Mon 8/23/10	Tue 10/5/10
133	Final Connect Equip, Startup, Commissioning	50 days	Mon 8/16/10	Fri 10/22/10
134	Test/Balance HVAC System	55 days	Tue 10/12/10	Mon 12/27/10
135	**16000 Electrical**	**264 days**	**Mon 1/18/10**	**Thu 1/20/11**
136	R.I.O.H. Electric Bdg A/B	80 days	Thu 1/21/10	Wed 5/12/10
137	R.I.O.H. Electric Bdg C	55 days	Thu 5/13/10	Wed 7/28/10
138	R.I. Electric Walls Bdg A/B	70 days	Mon 1/18/10	Fri 4/23/10
139	R.I. Electric Walls Bdg C	57 days	Thu 5/6/10	Fri 7/23/10
140	Install Elec. Equip. Bdg C	15 days	Thu 3/25/10	Wed 4/14/10
141	Lighting 1st Floor	13 days	Thu 5/6/10	Mon 5/24/10
142	Lighting Bdg C	20 days	Mon 8/23/10	Fri 9/17/10
143	Lighting Locker Area	7 days	Thu 5/27/10	Fri 6/4/10
144	Lighting 2nd Floor	20 days	Thu 5/27/10	Wed 6/23/10
145	Lighting Auditorium	10 days	Wed 6/9/10	Tue 6/22/10
146	Lighting 3rd Floor	20 days	Fri 6/25/10	Thu 7/22/10
147	Lighting 4th Floor	20 days	Mon 7/26/10	Fri 8/20/10
148	Lighting Kit/Caf	7 days	Wed 12/1/10	Thu 12/9/10



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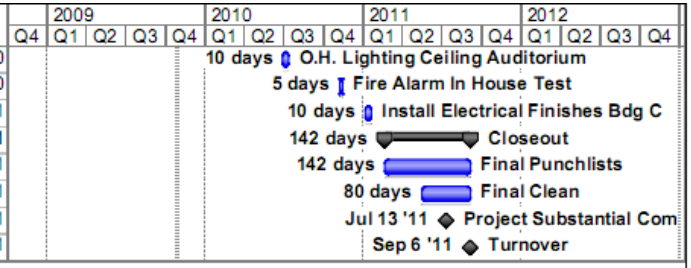
149	O.H. Lighting Ceiling Auditorium	10 days	Wed 6/30/10	Tue 7/13/10
150	Fire Alarm In House Test	5 days	Tue 11/9/10	Mon 11/15/10
151	Install Electrical Finishes Bdg C	10 days	Fri 1/7/11	Thu 1/20/11
152	**Closeout**	**142 days**	**Mon 2/21/11**	**Tue 9/6/11**
153	Final Punchlists	142 days	Mon 2/21/11	Tue 9/6/11
154	Final Clean	80 days	Wed 5/18/11	Tue 9/6/11
155	Project Substantial Completion	0 days	Wed 7/13/11	Wed 7/13/11
156	Turnover	0 days	Tue 9/6/11	Tue 9/6/11



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Milestone	Rolled Up Progress	Group By Summary
Summary	Split	Deadline

EXISTING SCHOOL

CM Trailers

Sub Trailers

Parking

LIMIT OF WORK

Parking

Site Access Road

Site Access Road

Temporary
Soil Stockpile

Soil Stockpile

Building 'C'
Gymnasium

Parking

Toilets

Building 'B'
Auditorium

NEW HIGH SCHOOL

Building 'A'

LIMIT OF WORK

N

Adam Trumbour	Worcester North High School	Site Plan: Logistics Plan for Excavation Phase	40' 0' 20' 40' 80' 160' GRAPHIC SCALE

EXISTING SCHOOL

CM Trailers

Sub Trailers

Sub Trailers

Sub Trailers

Steel Storage

Sidewalk Overhead Protection

LIMIT OF WORK

Parking

Parking

Site Access Road

Site Access Road

Steel Shakeout

Building 'C'
Gymnasium

Parking

Tool Storage

Dumpsters

Toilets

Crane Travel Route

Crane Reach
Grove RT9130E

Building 'B'
Auditorium

Crane Reach
Grove RT9130E

NEW HIGH SCHOOL

Building 'A'

LIMIT OF WORK

N

Adam Trumbour	Worcester North High School	Site Plan: Logistics Plan for Steel Erection Phase	40' 0' 20' 40' 80' 160' GRAPHIC SCALE