AE 481W : SENIOR THESIS

Technical Assignment 2

Cost and methods analysis

Prepared for

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Construction Management
Penn State University

By

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October 31, 2005

Executive Summary

This assignment focuses detailed analysis based on the information gathered on Tech 1. Detailed project schedule is created for the cost loading. One of the interesting features that Benner Pike Shops is that the schedules for each shop are different. Careful schedules are needed to be developed among the shops in order to avoid any safety issues or construction delays.

Site plans are then created based on the site plan developed in Tech 1. Different phases are verified in the drawings to show how the construction site is running during a specific phase. Critical phases included are: excavation, superstructure, and finish phase. These plans are useful when dealing with congestion issues, and efficiency. Problems that could not be seen from paper work could be found from the plans, and it is easy to check how efficient each process is going.

Detailed structural systems estimate was performed along with assemblies estimate. By performing estimate using different methods would be helpful to become familiar with the estimate systems and, it would give comparison between the two different methods. Structural system for the Benner Pike Shops is estimated which consists of foundation, slab on grade, columns, beams, and roof deck. Unit costs for entire system are calculated using square foot method to give general idea of material, labor, and equipment costs. For the assemblies estimate, exterior closure of the shops is estimated. The system will include exterior walls, windows, and doors. Items are lump summed in this process to get an estimate based on square foot unit. General conditions estimate is performed to give staffing costs, temporary costs, and equipment rentals through out the entire project. Any schedule savings could be proposed later based on G.C. savings calculation.

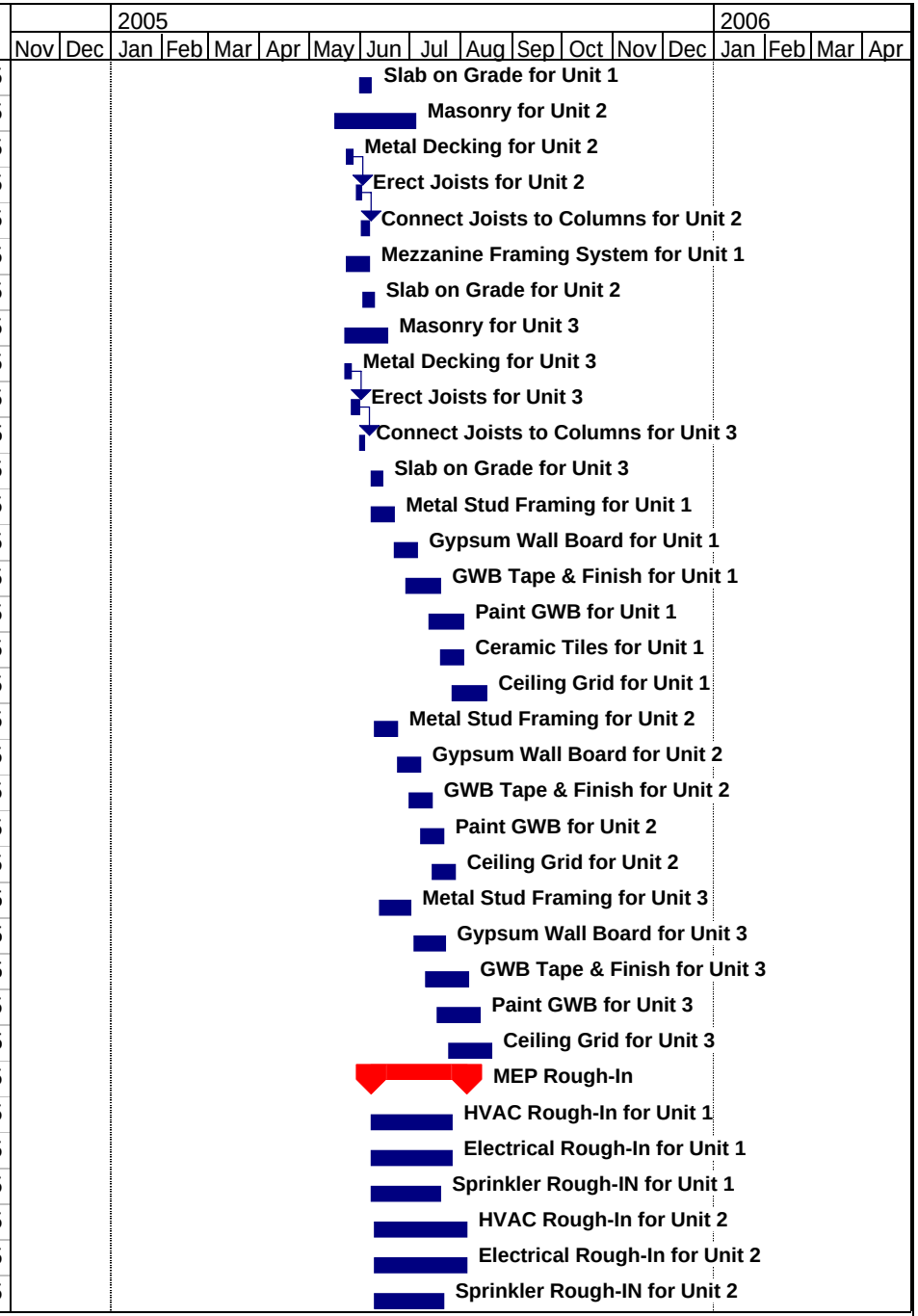
Table of Contents

Detailed Project Schedule

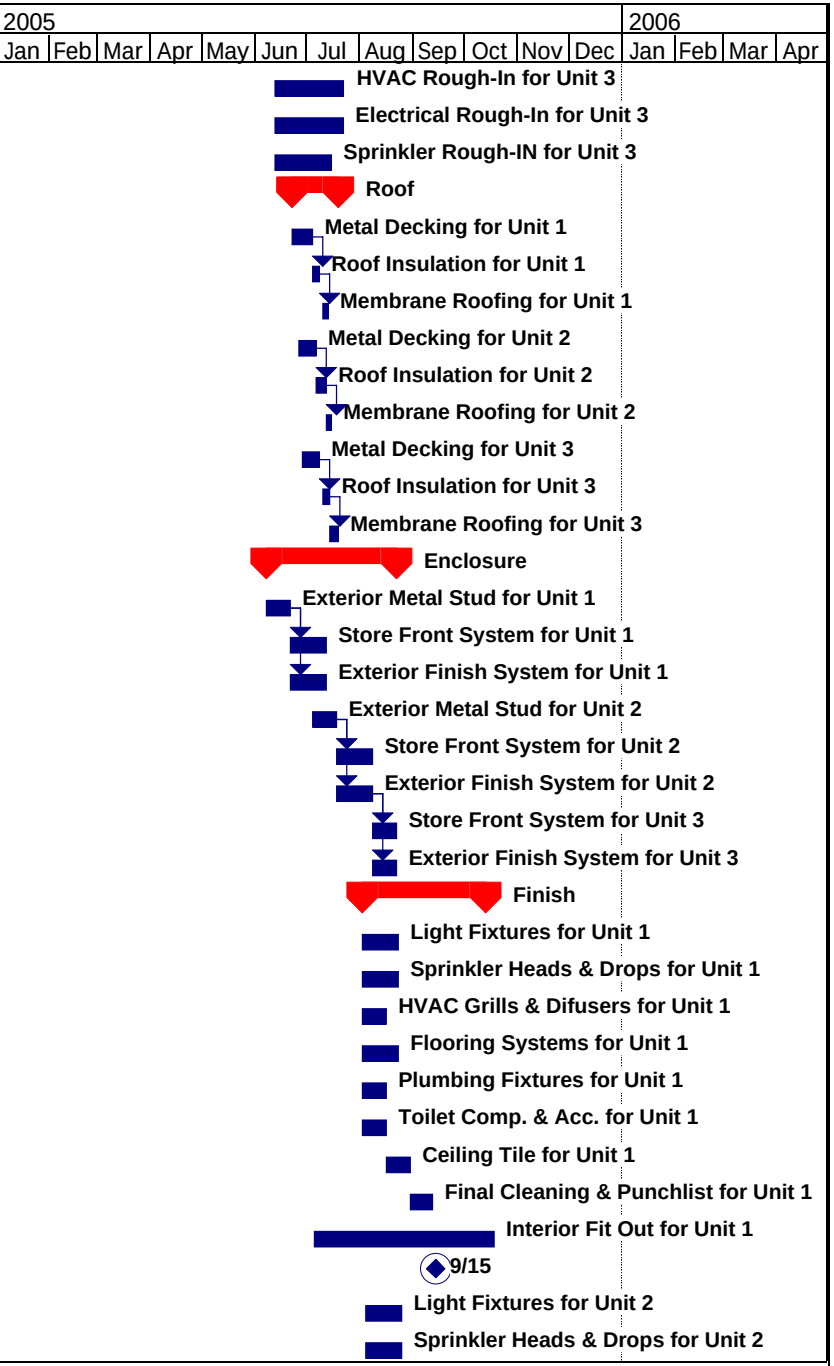
Detailed project schedule was developed based on different phases through out the construction. Phases include site work, excavation & foundation, structural system, first floor, roof, enclosure, and finish. During some of the phases, activities were described based on three major units of building; Bed Bath & Beyond. Ross Dress For Less, and the rest of the stores. Bed Bath & Beyond was referred as Unit 1, Ross Dress For Less was referred as Unit 2, and the rest as Unit 3 in the schedule.

ID	Task Name	Duration	Start	Finish
1	**Sitework**	126 days	Fri 12/17/04	Fri 6/10/05
2	Mobilization	5 days	Fri 12/17/04	Thu 12/23/04
3	E&S Systems	5 days	Fri 12/24/04	Thu 12/30/04
4	Site Clearing	10 days	Fri 12/31/04	Thu 1/13/05
5	Temporary Fences	3 days	Fri 1/14/05	Tue 1/18/05
6	Construct Haul Road	10 days	Mon 1/3/05	Fri 1/14/05
7	Site Utilities	70 days	Mon 3/7/05	Fri 6/10/05
8	Site Lighting	20 days	Thu 5/12/05	Wed 6/8/05
9	Parking Lots	50 days	Thu 6/9/05	Wed 8/17/05
10	**Excavation / Foundation**	65 days	Fri 1/14/05	Thu 4/14/05
11	Drill & Blast	30 days	Fri 1/14/05	Thu 2/24/05
12	Bulk Excavation	60 days	Fri 1/21/05	Thu 4/14/05
13	Temporary Shoring	5 days	Thu 2/10/05	Wed 2/16/05
14	Temporary Shoring	5 days	Tue 3/1/05	Mon 3/7/05
15	Footings	9 days	Mon 3/7/05	Thu 3/17/05
16	Column Footings	8 days	Tue 11/1/05	Thu 11/10/05
17	Wall Footings	8 days	Tue 11/1/05	Thu 11/10/05
18	**Structural System**	47 days	Mon 4/11/05	Tue 6/14/05
19	Steel Fabrication for Unit 1	10 days	Mon 4/11/05	Fri 4/22/05
20	Steel Fabrication for Unit 2	10 days	Mon 4/25/05	Fri 5/6/05
21	Steel Fabrication for Unit 3	8 days	Mon 5/9/05	Wed 5/18/05
22	Below Grade Rough-Ins for Unit 1	15 days	Wed 5/11/05	Tue 5/31/05
23	Below Grade Rough-Ins for Unit 2	20 days	Mon 5/9/05	Fri 6/3/05
24	Below Grade Rough-Ins for Unit 3	12 days	Mon 5/23/05	Tue 6/7/05
25	Erect Strcutural Steel for Unit 1	3 days	Mon 5/9/05	Wed 5/11/05
26	Erect Structural Steel for Unit 2	3 days	Thu 5/12/05	Mon 5/16/05
27	Erect Structural Steel for Unit 3	3 days	Tue 5/17/05	Thu 5/19/05
28	Connect Steel for Unit 1	2 days	Thu 5/12/05	Fri 5/13/05
29	Connect Steel for Unit 2	2 days	Tue 5/17/05	Wed 5/18/05
30	Connect Steel for Unit 3	2 days	Fri 5/20/05	Mon 5/23/05
31	**First Floor**	73 days	Wed 5/11/05	Fri 8/19/05
32	Masonry for Unit 1	20 days	Wed 5/11/05	Tue 6/7/05
33	Metal Decking for Unit 1	4 days	Thu 5/12/05	Tue 5/17/05
34	Erect Joists for Unit 1	3 days	Wed 5/18/05	Fri 5/20/05
35	Connect Joists to Columns for Unit 1	3 days	Mon 5/23/05	Wed 5/25/05

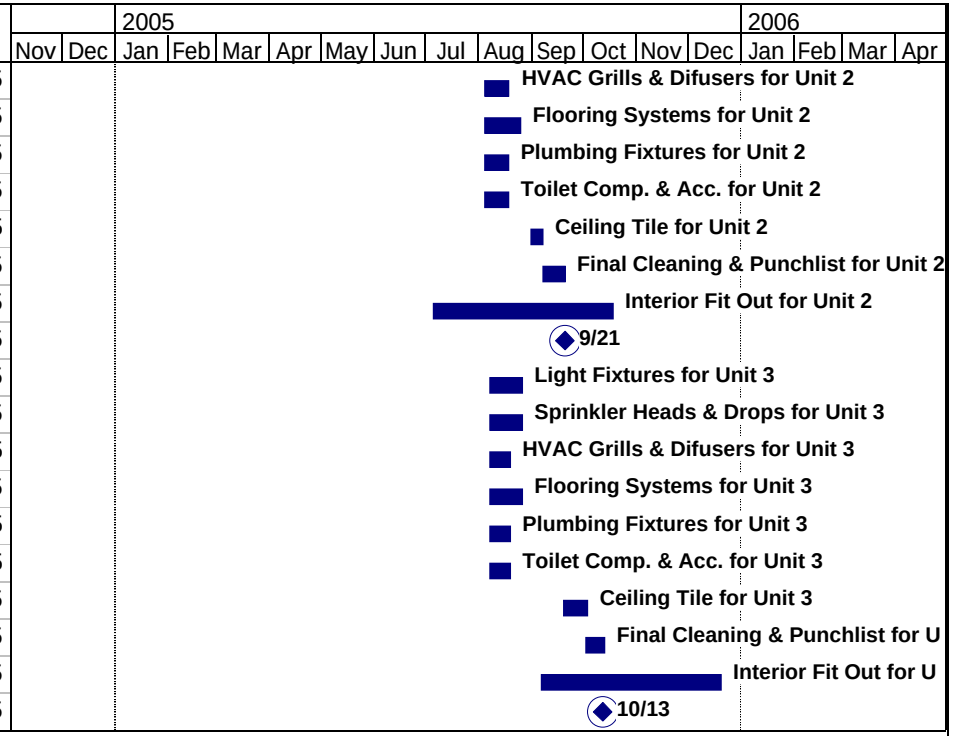
ID	Task Name	Duration	Start	Finish
36	Slab on Grade for Unit 1	5 days	Wed 6/1/05	Tue 6/7/05
37	Masonry for Unit 2	35 days	Tue 5/17/05	Mon 7/4/05
38	Metal Decking for Unit 2	4 days	Tue 5/24/05	Fri 5/27/05
39	Erect Joists for Unit 2	3 days	Mon 5/30/05	Wed 6/1/05
40	Connect Joists to Columns for Unit 2	3 days	Thu 6/2/05	Mon 6/6/05
41	Mezzanine Framing System for Unit 1	10 days	Tue 5/24/05	Mon 6/6/05
42	Slab on Grade for Unit 2	5 days	Fri 6/3/05	Thu 6/9/05
43	Masonry for Unit 3	20 days	Mon 5/23/05	Fri 6/17/05
44	Metal Decking for Unit 3	4 days	Mon 5/23/05	Thu 5/26/05
45	Erect Joists for Unit 3	3 days	Fri 5/27/05	Tue 5/31/05
46	Connect Joists to Columns for Unit 3	3 days	Wed 6/1/05	Fri 6/3/05
47	Slab on Grade for Unit 3	5 days	Wed 6/8/05	Tue 6/14/05
48	Metal Stud Framing for Unit 1	10 days	Wed 6/8/05	Tue 6/21/05
49	Gypsum Wall Board for Unit 1	10 days	Wed 6/22/05	Tue 7/5/05
50	GWB Tape & Finish for Unit 1	15 days	Wed 6/29/05	Tue 7/19/05
51	Paint GWB for Unit 1	15 days	Wed 7/13/05	Tue 8/2/05
52	Ceramic Tiles for Unit 1	10 days	Wed 7/20/05	Tue 8/2/05
53	Ceiling Grid for Unit 1	15 days	Wed 7/27/05	Tue 8/16/05
54	Metal Stud Framing for Unit 2	10 days	Fri 6/10/05	Thu 6/23/05
55	Gypsum Wall Board for Unit 2	10 days	Fri 6/24/05	Thu 7/7/05
56	GWB Tape & Finish for Unit 2	10 days	Fri 7/1/05	Thu 7/14/05
57	Paint GWB for Unit 2	10 days	Fri 7/8/05	Thu 7/21/05
58	Ceiling Grid for Unit 2	10 days	Fri 7/15/05	Thu 7/28/05
59	Metal Stud Framing for Unit 3	15 days	Mon 6/13/05	Fri 7/1/05
60	Gypsum Wall Board for Unit 3	15 days	Mon 7/4/05	Fri 7/22/05
61	GWB Tape & Finish for Unit 3	20 days	Mon 7/11/05	Fri 8/5/05
62	Paint GWB for Unit 3	20 days	Mon 7/18/05	Fri 8/12/05
63	Ceiling Grid for Unit 3	20 days	Mon 7/25/05	Fri 8/19/05
64	**MEP Rough-In**	42 days	Wed 6/8/05	Thu 8/4/05
65	HVAC Rough-In for Unit 1	35 days	Wed 6/8/05	Tue 7/26/05
66	Electrical Rough-In for Unit 1	35 days	Wed 6/8/05	Tue 7/26/05
67	Sprinkler Rough-IN for Unit 1	30 days	Wed 6/8/05	Tue 7/19/05
68	HVAC Rough-In for Unit 2	40 days	Fri 6/10/05	Thu 8/4/05
69	Electrical Rough-In for Unit 2	40 days	Fri 6/10/05	Thu 8/4/05
70	Sprinkler Rough-IN for Unit 2	30 days	Fri 6/10/05	Thu 7/21/05



ID	Task Name	Duration	Start	Finish
71	HVAC Rough-In for Unit 3	30 days	Mon 6/13/05	Fri 7/22/05
72	Electrical Rough-In for Unit 3	30 days	Mon 6/13/05	Fri 7/22/05
73	Sprinkler Rough-IN for Unit 3	25 days	Mon 6/13/05	Fri 7/15/05
74	**Roof**	19 days	Thu 6/23/05	Tue 7/19/05
75	Metal Decking for Unit 1	8 days	Thu 6/23/05	Mon 7/4/05
76	Roof Insulation for Unit 1	4 days	Tue 7/5/05	Fri 7/8/05
77	Membrane Roofing for Unit 1	3 days	Mon 7/11/05	Wed 7/13/05
78	Metal Decking for Unit 2	8 days	Mon 6/27/05	Wed 7/6/05
79	Roof Insulation for Unit 2	4 days	Thu 7/7/05	Tue 7/12/05
80	Membrane Roofing for Unit 2	3 days	Wed 7/13/05	Fri 7/15/05
81	Metal Decking for Unit 3	8 days	Wed 6/29/05	Fri 7/8/05
82	Roof Insulation for Unit 3	4 days	Mon 7/11/05	Thu 7/14/05
83	Membrane Roofing for Unit 3	3 days	Fri 7/15/05	Tue 7/19/05
84	**Enclosure**	54 days	Wed 6/8/05	Mon 8/22/05
85	Exterior Metal Stud for Unit 1	10 days	Wed 6/8/05	Tue 6/21/05
86	Store Front System for Unit 1	15 days	Wed 6/22/05	Tue 7/12/05
87	Exterior Finish System for Unit 1	15 days	Wed 6/22/05	Tue 7/12/05
88	Exterior Metal Stud for Unit 2	10 days	Tue 7/5/05	Mon 7/18/05
89	Store Front System for Unit 2	15 days	Tue 7/19/05	Mon 8/8/05
90	Exterior Finish System for Unit 2	15 days	Tue 7/19/05	Mon 8/8/05
91	Store Front System for Unit 3	10 days	Tue 8/9/05	Mon 8/22/05
92	Exterior Finish System for Unit 3	10 days	Tue 8/9/05	Mon 8/22/05
93	**Finish**	52 days	Wed 8/3/05	Thu 10/13/05
94	Light Fixtures for Unit 1	15 days	Wed 8/3/05	Tue 8/23/05
95	Sprinkler Heads & Drops for Unit 1	15 days	Wed 8/3/05	Tue 8/23/05
96	HVAC Grills & Difusers for Unit 1	10 days	Wed 8/3/05	Tue 8/16/05
97	Flooring Systems for Unit 1	15 days	Wed 8/3/05	Tue 8/23/05
98	Plumbing Fixtures for Unit 1	10 days	Wed 8/3/05	Tue 8/16/05
99	Toilet Comp. & Acc. for Unit 1	10 days	Wed 8/3/05	Tue 8/16/05
100	Ceiling Tile for Unit 1	10 days	Wed 8/17/05	Tue 8/30/05
101	Final Cleaning & Punchlist for Unit 1	9 days	Wed 8/31/05	Mon 9/12/05
102	Interior Fit Out for Unit 1	75 days	Wed 7/6/05	Tue 10/18/05
103	Unit 1 Possession	1 day	Thu 9/15/05	Thu 9/15/05
104	Light Fixtures for Unit 2	15 days	Fri 8/5/05	Thu 8/25/05
105	Sprinkler Heads & Drops for Unit 2	15 days	Fri 8/5/05	Thu 8/25/05



ID	Task Name	Duration	Start	Finish
106	HVAC Grills & Difusers for Unit 2	10 days	Fri 8/5/05	Thu 8/18/05
107	Flooring Systems for Unit 2	15 days	Fri 8/5/05	Thu 8/25/05
108	Plumbing Fixtures for Unit 2	10 days	Fri 8/5/05	Thu 8/18/05
109	Toilet Comp. & Acc. for Unit 2	10 days	Fri 8/5/05	Thu 8/18/05
110	Ceiling Tile for Unit 2	5 days	Thu 9/1/05	Wed 9/7/05
111	Final Cleaning & Punchlist for Unit 2	9 days	Thu 9/8/05	Tue 9/20/05
112	Interior Fit Out for Unit 2	75 days	Wed 7/6/05	Tue 10/18/05
113	Unit 2 Possession	1 day	Wed 9/21/05	Wed 9/21/05
114	Light Fixtures for Unit 3	15 days	Mon 8/8/05	Fri 8/26/05
115	Sprinkler Heads & Drops for Unit 3	15 days	Mon 8/8/05	Fri 8/26/05
116	HVAC Grills & Difusers for Unit 3	10 days	Mon 8/8/05	Fri 8/19/05
117	Flooring Systems for Unit 3	15 days	Mon 8/8/05	Fri 8/26/05
118	Plumbing Fixtures for Unit 3	10 days	Mon 8/8/05	Fri 8/19/05
119	Toilet Comp. & Acc. for Unit 3	10 days	Mon 8/8/05	Fri 8/19/05
120	Ceiling Tile for Unit 3	10 days	Tue 9/20/05	Mon 10/3/05
121	Final Cleaning & Punchlist for Unit 3	9 days	Mon 10/3/05	Thu 10/13/05
122	Interior Fit Out for Unit 3	75 days	Wed 9/7/05	Tue 12/20/05
123	Unit 3 Possession	1 day	Thu 10/13/05	Thu 10/13/05



Site Layout Planning

Site layout plans were divided into major phases of the construction for Better Pike Shops. Excavation phase, superstructure phase, and finish phase were created to give an idea of how each phase was done.

Excavation Phase

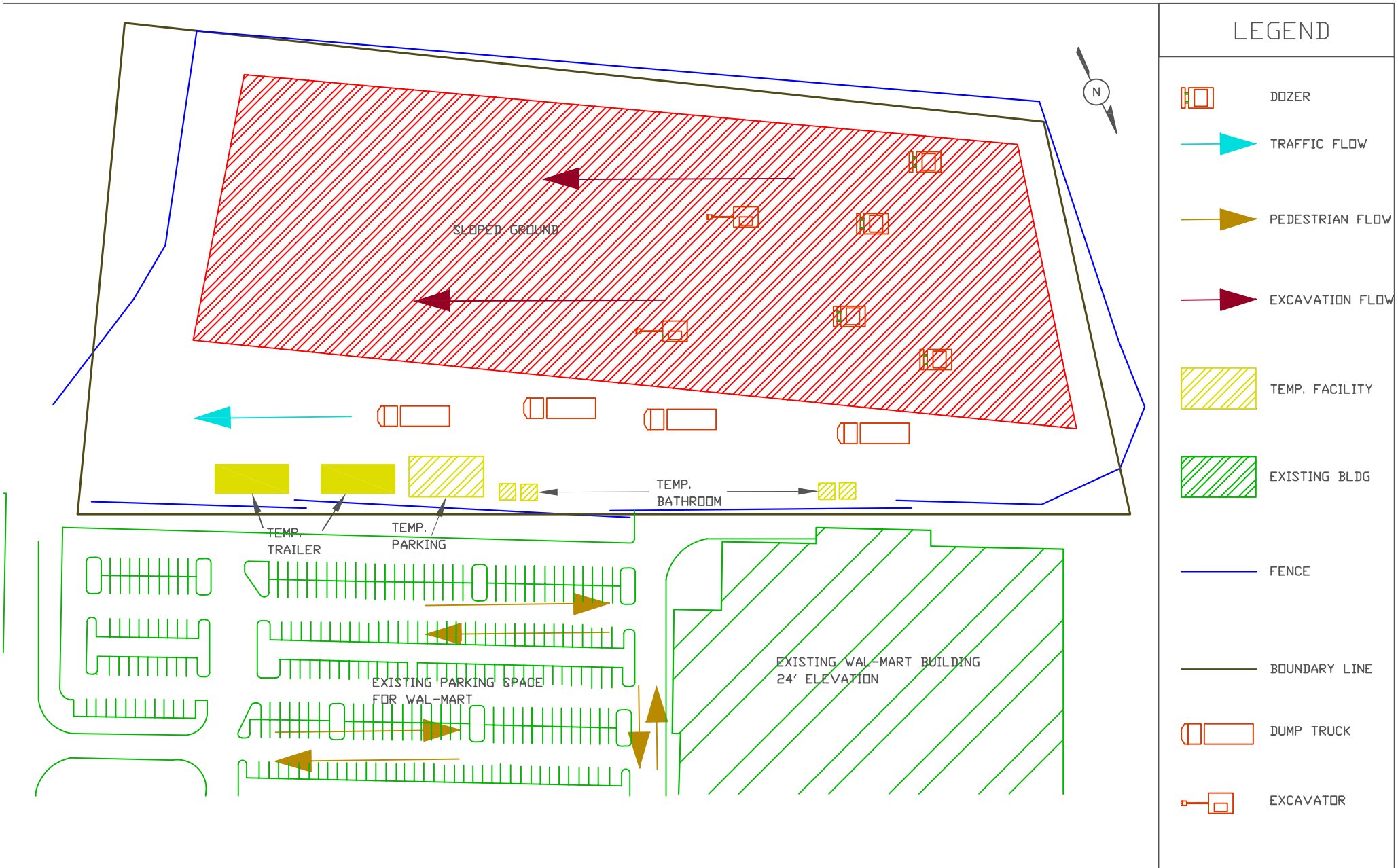
- Since there is no previous building standing, no demolition was necessary.
- The site has sloping ground in which the difference in the height between the highest point and the lowest point was 20 feet.
- The excavation was performed in the direction from high portion of the site to low portion.
- Large portion of the soil excavated from the high portion was used in filling the low portion of the site.
- Total of 14 acres were excavated with 80,000 yards being hauled after the fill.

Superstructure

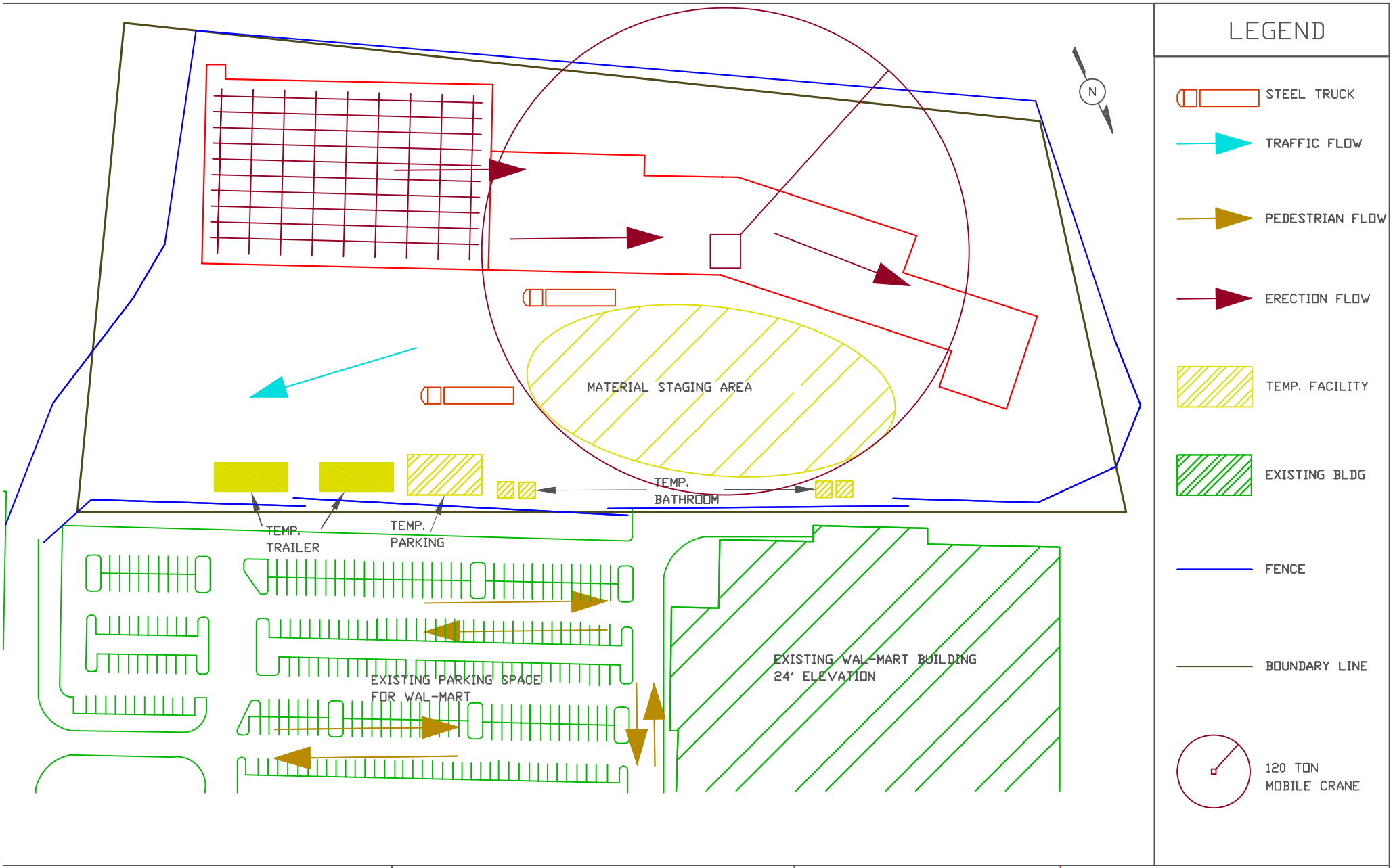
- Steel was erected in the order from East to West.
- Steel was staged in the future parking lots of the mall so the degree turn of the crane boom is minimized.
- One 120 ton mobile crane was used for the whole erection.

Finish

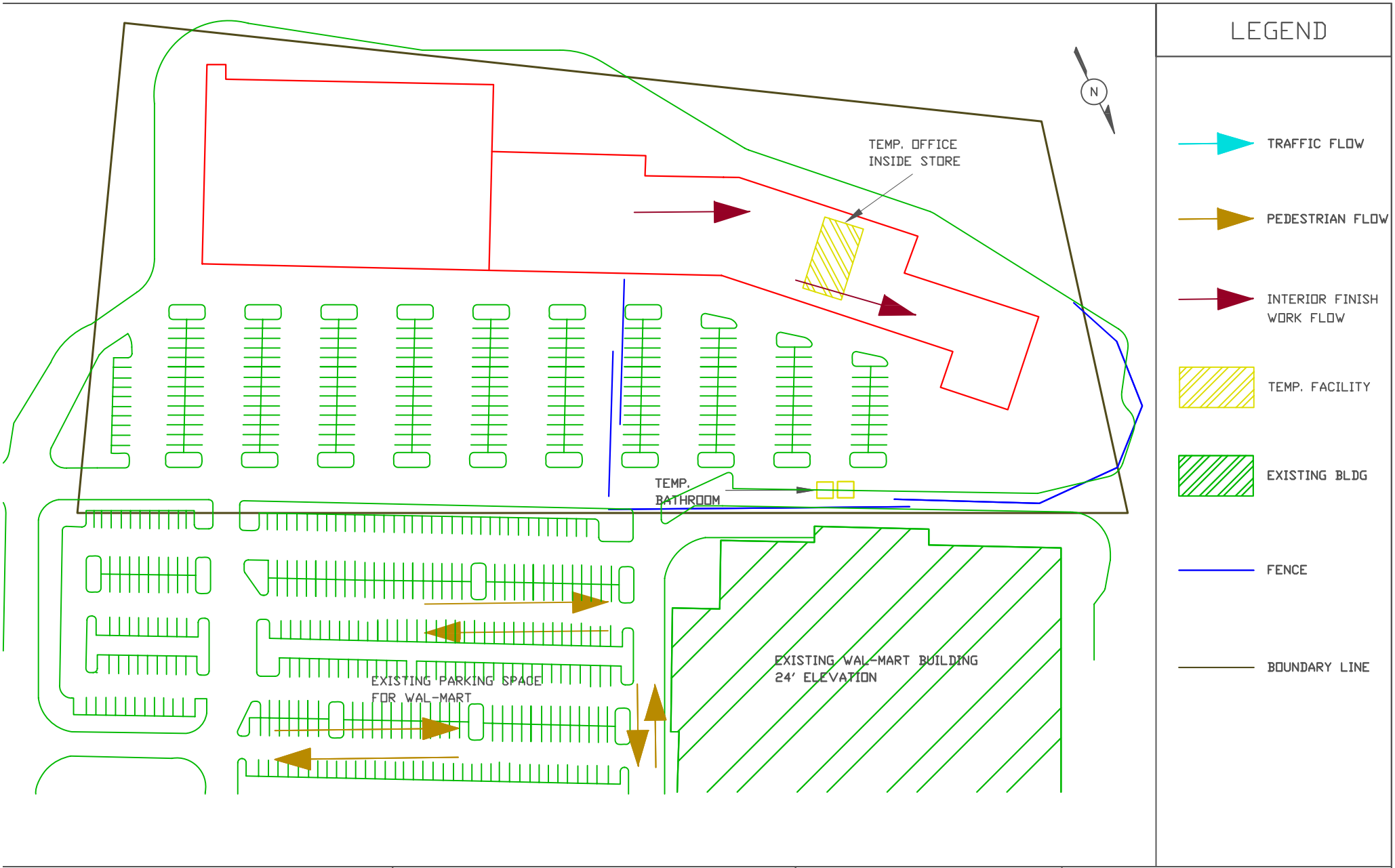
- The construction was performed in the order from East to West.
- Interior finish was performed primarily for Unit 1 (Ross Dress For Less) and Unit 2 (Bed, Bath & Beyond).
- With Unit 1 and 2 possessed by the owner, rest of the building was finished with the fences and temporary office relocated.



BENNER PIKE SHOPS STATE COLLEGE, PA	INYOUNG HWANG 10/31/05	1/32" = 1'-0"	EXCAVATION PLAN



BENNER PIKE SHOPS STATE COLLEGE, PA	INYOUNG HWANG 10/31/05	1/32" = 1'-0"	STEEL ERECTION PLAN



BENNER PIKE SHOPS STATE COLLEGE, PA	INYOUNG HWANG 10/31/05	1/32" = 1'-0"	FINISH PLAN

Assemblies Estimate

Exterior Closure

The Benner Pike Shops are consisted of three major components on its exterior closure. Painted concrete blocks covered most of the side and back portions of the building. EIFS (Exterior Insulation Finish System), also known as synthetic stucco is used for the final finish of the front façade of the structure. Large portion of the front façade is covered by the combination of aluminum framing with glass windows and doors. Split faced concrete blocks are used for small portion of the façade. CMU materials are horizontally reinforced through out the exterior closure. Hollow metal doors are located in the back of the structure for each store. The estimate is based on RS Means Assemblies Estimate Cost Data.

* Exterior closure take off for the assemblies estimate can be found in Appendix A.

Assemblies Estimate (Con'd)

Concrete Block Wall	Quantity	Unit	Cost / S.F. Material	Cost / S.F. Installation		Total Cost
SYSTEM 4.1-211-1510						
Unreinforced Concrete Block Wall, 12" X 8" X 16", Styrofoam Core Fill						
Concrete block wall, 12" thick		S.F.	2.59	5.77		
Styrofoam insulation		S.F.	0.81	0.01		
Horizontal joint reinforcing, alternate courses		S.F.	0.07	0.12		
Control joint		L.F.	0.10	0.05		
Total	23808	S.F.	3.57	5.95		**$226,652.16**

Split Face Block Wall	Quantity	Unit	Cost / S.F. Material	Cost / S.F. Installation		Total Cost
SYSTEM 4.1-213-1710						
Unreinforced Split Face Block Wall, 12" X 8" X 16", 0 Scores, Styrofoam Core Fill						
Split face block wall, 12" thick		S.F.	4.05	7.22		
Styrofoam insulation		S.F.	1.03	0.01		
Horizontal joint reinforcing, alternate courses		S.F.	0.07	0.12		
Control joint		L.F.	0.10	0.05		
Total	8208	S.F.	5.25	7.40		**$103,831.20**

E.I.F.S.	Quantity	Unit	Cost / S.F. Material	Cost / S.F. Installation		Total Cost
SYSTEM 4.5-110-5180						
E.I.F.S., Cement Board Sheathing, 8" Metal Studs, 2" EPS		S.F.	4.90	8.90		
Total	13932	S.F.	4.90	8.90		**$192,261.60**

E.I.F.S.	Quantity	Unit	Cost / S.F. Material	Cost / S.F. Installation		Total Cost
SYSTEM 4.5-110-5310						
E.I.F.S., CMU Block, 8" X 10" X 16", 2" EPS		S.F.	4.43	10.30		
Total	948	S.F.	4.43	10.30		**$13,964.04**

Wood, Steel & Aluminum	Quantity	Unit	Cost / Unit Material	Cost / Unit Installation		Total Cost
SYSTEM 4.7-110-7250						
Aluminum, Single Hung, Insulating Glass, 3'-4" X 5'		S.F.	267.00	106.00		
Total	279.75	S.F.	267.00	106.00		**$104,346.75**

Assemblies Estimate (Con'd)

Wood, Steel & Aluminum	Quantity	Unit	Cost / Opening			Total Cost
			Material	Installation		
SYSTEM 4.6-100-3450						
Steel 18 GA Door, Hollow Metal, 1 Door, 3'-0" X 7'-0"		Each	845.00	206.00		
Total	18	Each	845.00	206.00		**$18,918.00**

Wood, Steel & Aluminum	Quantity	Unit	Cost / Opening			Total Cost
			Material	Installation		
SYSTEM 4.6-100-4550						
Steel 24 GA Door, Overhead, Rolling, Electric Oper. 8'-0" X 8'-0"		Each	935.00	545.00		
Total	3	Each	935.00	545.00		**$4,440.00**

Grand Total	**$664,413.75**

Detailed Structural Systems Estimate

Detailed structural systems of the Benner Pike Shops were estimated using RS Means Construction Cost Data. Estimate is based on different structural systems of the building, which are foundations, slab on grade, steel columns & beams, and metal decking. Concrete waste factor and steel connection factors are encountered as 5% and 10% respectively, of total cost for each. Knee bracing was performed for the connection among web joists, wide flange beams, and hollow steel columns.

* Take off for the detailed structural systems estimate can be found in Appendix B.

Detailed Structural Systems Estimate (Con'd)

Description	Size	Quantity	Unit	Unit Cost			Total Cost
				Material	Labor	Equipment	
Foundations							
Footings w/ formwork	3' x 3' x 1'	22	C.Y.	226.00	45.00	0.29	$5,878
	5' x 5' x 1'	24	C.Y.	226.00	45.00	0.29	$6,531
	5'-6" x 5'-6" x 1'-6"	25	C.Y.	226.00	45.00	0.29	$6,839
	6'-6" x 6'-6" x 1'-10"	78	C.Y.	226.00	45.00	0.29	$21,226
	7'-6" x 7'-6" x 1'-4"	15	C.Y.	226.00	45.00	0.29	$3,956
	7'-6" x 7'-6" x 2'	50	C.Y.	226.00	45.00	0.29	$13,565
Wall Footings w/ formwork	12" x 24" x 1700'	126	C.Y.	226.00	45.00	0.29	$34,162
Reinforcing	#4 bars	0.34	Ton	760.00	580.00		$454
	#6 bars	1.27	Ton	760.00	580.00		$1,706
	#7 bars	1.23	Ton	760.00	580.00		$1,643
	#8 bars	0.90	Ton	720.00	335.00		$946
Footing Columns	TS 8" x 8" x 5/16"	4	Each	610.00	43.50	29.20	$2,536
	TS 8" x 8" x 1/4"	2	Each	580.00	42.25	27.50	$1,609
	TS 8" x 6" x 3/8"	2	Each	320.00	38.50	24.50	$802
	TS 10" x 8" x 3/8"	2	Each	680.00	45.70	32.30	$1,805
	TS 10" x 8" x 1/2"	1	Each	710.00	47.16	33.20	$903
	4" Dia. Standard Pipe	2	Each	200.00	36.25	24.75	$646
Concrete Waste	5% of concrete cost						$4,608
Assumption	All footing columns have height of 16 inches All footing columns are estimated with unit costs based on 14 feet long structural tubing Concrete waste factor is assumed to be 5% of total concrete cost						
Slab on Grade							
Slab on Grade w/ finish	4" thick	109122	S.F.	1.07	0.65	0.01	$188,781
Reinforcing Welded Wire Fabric	6 x 6 - W2.1 x W2.1	1091	100 S.F.	25.50	19.60		$49,204
Formwork Bulkhead forms	6" high with 4 uses	1700	L.F.	0.26	2.96		$5,474
Gravel Fill	4" deep	109122	S.F.	0.16	0.13	0.01	$32,737
Concrete Waste	5% of concrete cost						$9,439
Assumption	Concrete waste factor is assumed to be 5% of total concrete cost						

Detailed Structural Systems Estimate (Con'd)

Columns & Beams							
Structural Tubing	TS 10" x 8" x 3/8"	21	Each	680.00	45.70	32.30	$15,918
	TS 8" x 6" x 3/8"	32	Each	320.00	38.50	24.50	$12,256
Beam	W 24 x 68	552	L.F.	65.50	2.70	1.27	$38,347
	W 24 x 76	900	L.F.	73.00	2.70	1.27	$69,273
	W 24 x 55	60	L.F.	53.00	2.70	1.27	$3,418
	W 24 x 94	90	L.F.	90.50	2.78	1.30	$8,512
	W 24 x 62	117	L.F.	59.50	2.70	1.27	$7,426
	W 18 x 35	1161	L.F.	33.50	3.13	1.46	$44,222
	W 18 x 40	368	L.F.	38.50	3.13	1.46	$15,857
	W 16 x 26	667	L.F.	25.00	2.07	1.33	$18,943
	W 16 x 45	29	L.F.	43.00	2.59	1.66	$1,370
	W 16 x 36	125	L.F.	34.00	2.42	1.55	$4,746
	W 12 x 26	350	L.F.	25.00	2.35	1.51	$10,101
	W 21 x 57	175	L.F.	56.00	2.87	1.35	$10,539
	W 21 x 50	385	L.F.	48.00	2.82	1.32	$20,074
	W 21 x 44	490	L.F.	42.50	2.82	1.32	$22,854
	W 30 x 99	122	L.F.	95.50	2.50	1.17	$12,099
	W 30 x 108	46	L.F.	104.00	2.50	1.17	$4,953
	W 27 x 84	54	L.F.	81.00	2.52	1.18	$4,574
	W 10 x 22	567	L.F.	21.00	3.45	2.21	$15,116
	W 8 x 18	18	L.F.	17.00	3.45	2.21	$408
	W 8 x 31	54	L.F.	30.00	3.76	2.41	$1,953
Open Web Joist	26K9	43827	L.F.	8.15	1.36	0.68	$446,599
	26K12	241	L.F.	8.45	1.36	0.68	$2,526
	26K10	258	L.F.	8.30	1.36	0.68	$2,664
	28K10	7702	L.F.	8.80	1.25	0.62	$82,185
	28K9	1056	L.F.	8.00	1.25	0.62	$10,423
	28K7	1488	L.F.	7.20	1.25	0.62	$13,496
	20K4	893	L.F.	4.50	1.50	0.74	$6,017
	20K5	5894	L.F.	4.92	1.50	0.74	$42,204
	22K7	8308	L.F.	6.00	1.50	0.74	$68,458
	22K4	2016	L.F.	5.10	1.50	0.74	$14,797
	22K6	707	L.F.	5.45	1.50	0.74	$5,438
	22K9	190	L.F.	6.80	1.50	0.74	$1,721
	30K9	1008	L.F.	8.10	1.25	0.62	$10,050
	16K9	576	L.F.	6.00	1.67	1.67	$5,380
	12K1	72	L.F.	3.25	2.00	0.99	$449
	10K1	29	L.F.	3.05	2.50	1.24	$196
Steel Connection	10% of steel cost						$105,556
Assumption	All footing columns are estimated with unit costs based on 14 feet long structural tubing Steel connections are assumed to be 10% of total steel cost						

Detailed Structural Systems Estimate (Con'd)

Metal Decking							
Metal Roof Deck	1-1/2" deep 22 GA	109122	S.F.	1.06	0.24	0.02	$144,041
Steel Connection	10 % of steel cost						$14,404
Assumption	Steel connections are assumed to be 10% of total steel cost						
Grand Total							**$1,715,014**

Description	Size	Quantity	Unit	Unit Cost			Total Cost
				Material	Labor	Equipment	
Square Foot Method (Entire System)		109122	S.F.	11.95	3.44	0.33	$1,715,014

General Conditions Estimate

Description	Quantity	Unit	Unit Cost	Total Cost	% of Total GC Cost
Project Staff					
Project manager	40	Week	$1,625	$65,000	5.74%
Superintendent	40	Week	$1,500	$60,000	5.30%
Superintendent	24	Week	$1,500	$36,000	3.18%
Field engineer	48	Week	$995	$47,760	4.22%
Field engineer	48	Week	$995	$47,760	4.22%
Field engineer	48	Week	$995	$47,760	4.22%
Administrative Requirements					
Permits	1	L.S.	$75,000	$75,000	6.63%
Bonds	1	L.S.	$90,000	$90,000	7.95%
Insurances	1	L.S.	$60,000	$60,000	5.30%
Field office expense	12	Month	$140	$1,680	0.15%
Construction photos	1	L.S.	$292	$292	0.03%
Temporary Facilities & Jobs					
Temporary heat	1	L.S.	$9,863	$9,863	0.87%
Temporary lighting	1	L.S.	$13,005	$13,005	1.15%
Temporary power	1	L.S.	$13,092	$13,092	1.16%
Trailer	8	Month	$150	$2,400	0.21%
Surveying	1	L.S.	$1,818	$1,818	0.16%
Telephone bill	12	Month	$204	$2,448	0.22%
Scaffolding	12	Month	$59	$708	0.06%
Temporary fencing		L.F.	$4	$0	0.00%
Temporary signs	200	S.F.	$16	$3,280	0.29%
Daily clean up	190	1000 S.F.	$23	$4,378	0.39%
Final clean up	190	1000 S.F.	$47	$9,016	0.80%
Equipment Rental					
Concrete cart (1 week rental)	6	Each	$165	$990	0.09%
Vibrators (1 week rental)	3	Each	$32	$96	0.01%
Concrete mixer (1 week rental)	2	Each	$2,010	$4,020	0.36%
Excavator (1 month rental)	2	Each	$4,175	$8,350	0.74%
Tractor (2 weeks rental)	4	Each	$1,770	$14,160	1.25%
Vibratory compactor (2 weeks rental)	2	Each	$1,680	$6,720	0.59%
Dump truck (1 month rental)	4	Each	$1,175	$4,700	0.42%
Generator (1 month rental)	2	Each	$195	$780	0.07%
Tracktor loader (2 weeks rental)	1	Each	$835	$1,670	0.15%
120 ton mobile crane (1 week rental)	1	Each	$7,550	$7,550	0.67%
40 C.Y. Dumpster (2 weeks rental)	20	Each	$805	$32,200	2.84%
Temporary Toilets (12 months rental)	4	Each	$195	$9,360	0.83%
GC Fees				$450,000	39.76%
Grand Total				**$1,131,854**	**100.00%**

Appendix A

Concrete Block			
Split faced concrete block		Painted concrete block	
Size	S.F.	Size	S.F.
12" x 8" x 16"	392	12" x 8" x 16"	1600
12" x 8" x 16"	128	12" x 8" x 16"	1260
12" x 8" x 16"	48	12" x 8" x 16"	384
12" x 8" x 16"	224	12" x 8" x 16"	320
12" x 8" x 16"	528	12" x 8" x 16"	400
12" x 8" x 16"	204	12" x 8" x 16"	640
12" x 8" x 16"	384	12" x 8" x 16"	608
12" x 8" x 16"	152	12" x 8" x 16"	352
12" x 8" x 16"	540	12" x 8" x 16"	720
12" x 8" x 16"	1080	12" x 8" x 16"	320
12" x 8" x 16"	100	12" x 8" x 16"	1600
12" x 8" x 16"	48	12" x 8" x 16"	2088
12" x 8" x 16"	280	12" x 8" x 16"	304
12" x 8" x 16"	280	12" x 8" x 16"	640
		12" x 8" x 16"	1008
		12" x 8" x 16"	960
		12" x 8" x 16"	736
		12" x 8" x 16"	5500
		12" x 8" x 16"	1464
		12" x 8" x 16"	1488
		12" x 8" x 16"	1920
Sum	4388		24312
		subtract doors	24(3'x7')
Total	8208		23808

E.I.F.S.	
On 8" Metal Stud	On 10" Conc. Block
S.F.	S.F.
1536	448
400	500
1536	
4480	
1120	
916	
180	
120	
940	
240	
112	
1200	
320	
832	
Total 13932	948

Window		Door	
Aum. Framing		Insul. flush type	
Size	S.F.	Size	S.F.
64' x 12'	768	(3' x 7')18	378
38' x 18'	684		
(7' x 16')27	3024		
Total	4476		378

Appendix B

Description	Size	# of material	Span	Quantity	Unit
Foundations					
Footings	3' x 3' x 1'			22	C.Y.
w/ formwork	5' x 5' x 1'			24	C.Y.
	5'-6" x 5'-6" x 1'-6"			25	C.Y.
	6'-6" x 6'-6" x 1'-10"			78	C.Y.
	7'-6" x 7'-6" x 1'-4"			15	C.Y.
	7'-6" x 7'-6" x 2'			50	C.Y.
Wall Footings	12" x 24" x 1700'			126	C.Y.
w/ formwork					
Reinforcing	#4 bars			0.34	Ton
	#6 bars			1.27	Ton
	#7 bars			1.23	Ton
	#8 bars			0.90	Ton
Footing Columns	TS 8" x 8" x 5/16"	39	16 in	14	L.F.
	TS 8" x 8" x 1/4"	26	16 in	14	L.F.
	TS 8" x 6" x 3/8"	22	16 in	14	L.F.
	TS 10" x 8" x 3/8"	25	16 in	14	L.F.
	TS 10" x 8" x 1/2"	12	16 in	14	L.F.
	4" Dia. Standard Pipe	26	16 in	14	L.F.
Slab on Grade					
Slab on Grade	4" thick			109122	S.F.
w/ finish					
Reinforcing	6 x 6 - W2.1 x W2.1			1091	100 S.F.
Welded Wire Fabric					
Formwork	6" high with 4 uses			1700	L.F.
Bulkhead forms					
Gravel Fill	4" deep			109122	S.F.

Appendix B (Con'd)

Columns & Beams					
Structural Tubing	TS 10" x 8" x 3/8"	21		14	L.F.
	TS 8" x 6" x 3/8"	32		14	L.F.
Beam	W 24 x 68	12		46	L.F.
	W 24 x 76	10		90	L.F.
	W 24 x 55	2		30	L.F.
	W 24 x 94	2		45	L.F.
	W 24 x 62	3		39	L.F.
	W 18 x 35	23		43	L.F.
	W 18 x 40	8		46	L.F.
	W 18 x 35	4		43	L.F.
	W 16 x 26	29		23	L.F.
	W 16 x 45	1		29	L.F.
	W 16 x 36	5		25	L.F.
	W 12 x 26	25		14	L.F.
	W 21 x 57	5		35	L.F.
	W 21 x 50	11		35	L.F.
	W 21 x 44	14		35	L.F.
	W 30 x 99	2		61	L.F.
	W 30 x 108	1		46	L.F.
	W 27 x 84	1		54	L.F.
	W 10 x 22	27		21	L.F.
	W 8 x 18	2		9	L.F.
	W 8 x 31	6		9	L.F.
Open Web Joist	26K9	8	128	214	L.F.
	26K12	1	43	28	L.F.
	26K10	1	46	28	L.F.
	28K10	8	83	58	L.F.
	28K9	4	44	30	L.F.
	28K7	1	40	186	L.F.
	20K4	1	24	186	L.F.
	20K5	2	48	307	L.F.
	22K7	5	134	62	L.F.
	22K4	12	30	28	L.F.
	22K6	1	34	104	L.F.
	22K9	1	34	28	L.F.
	30K9	4	45	28	L.F.
	16K9	4	24	30	L.F.
	12K1	3	12	10	L.F.
	10K1	1	16	9	L.F.