



JOHNS HOPKINS UNIVERSITY
CHARLES COMMONS
BALTIMORE, MARYLAND

TECHNICAL ASSIGNMENT II
OCTOBER 31, 2005

BRYAN A. QUINN
CONSTRUCTION MANAGEMENT OPTION
ACADEMIC ADVISOR: DR. MICHAEL HORMAN

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Technical Assignment II: Cost and Methods Analysis

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Executive Summary

The schedule for Charles Commons can be divided into five sequences: site demolition, excavations/foundations, site utilities, St. Paul building, and Charles building. Site demolition of three buildings needed to be performed before excavation for the buildings. The overall schedule is 653 days and lasts from May 14, 2004 to December 11, 2006.

The site layout for Charles Commons are quite strict, especially since the lane closing permits that were initially planned with were rejected by the City of Baltimore. As part of the ensuing negotiations, a construction entrance and delivery drop-offs were allowed on 33rd Street. In addition, site use is both through laydown areas and site utility construction.

The exterior skin of the buildings consists of architectural precast panels, brick veneer, wood windows, and steel storefronts. Both buildings have a composite structure made up of two-way partially post-tensioned slabs with cast-in-place columns, cast-in-place shear walls, a composite foundation, and a steel penthouse. The assemblies estimate for the exterior skin package of both buildings totaled \$2.27 million and the detailed structural estimate totaled \$4.14 million.

The general conditions for the project amounted to \$3.23 million which is 5% of the total project cost. A significant contributor to the general conditions cost are the Owner-Controlled Insurance Program (OCIP) requirements, which comprise of 8% of the total general conditions. Approximately 52% of the General Conditions are project team salaries.

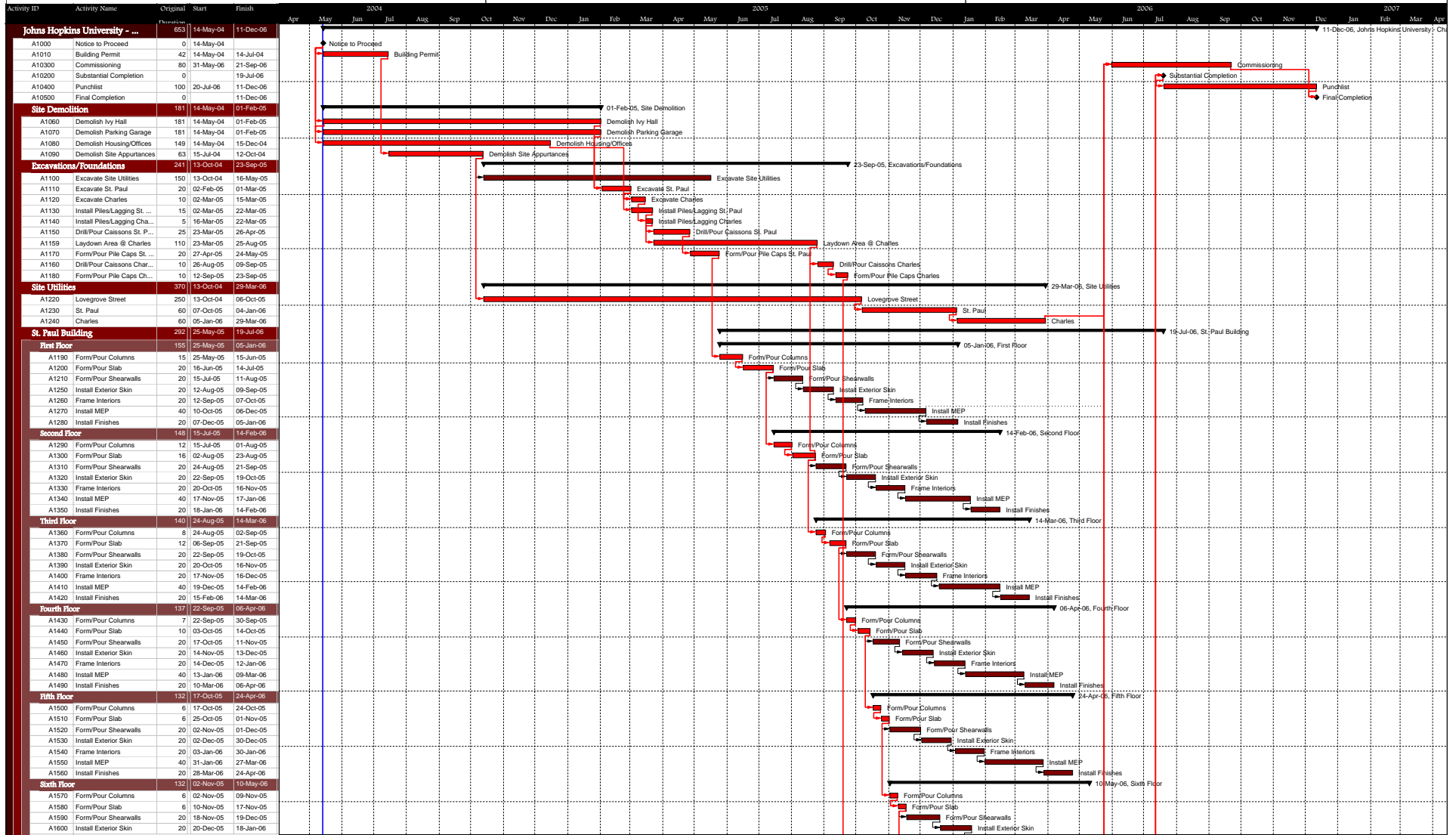
Detailed Project Schedule

The schedule for Charles Commons can be divided into five sequences: site demolition, excavations/foundations, site utilities, St. Paul building, and Charles building. Site demolition of three buildings needed to be performed before excavation for the buildings. After excavation and foundations, the buildings were constructed and site utilities were installed. The overall schedule is 653 days and lasts from May 14, 2004 to December 11, 2006.

The excavations/foundations phase was overlapped with superstructure construction in order to work inside the difficult site. The foundation and first four floors for the St. Paul building was constructed before Charles building foundations began in order to ease into the strict site layout. In addition, the first four floors of the St. Paul building required the most reinforcing and prefabrication than any other floors in the project. Site utilities occurred soon after site demolition of site signage and trees and took place throughout construction, depending on site layout space.

The construction sequence for both buildings was floor-by-floor until top-out. The activities for each floor were:

1. Form/Pour Columns – Installation of formwork for varied cast-in-place column sizes and shapes, bending rebar, pouring by crane and bucket, and stripping formwork
2. Form/Pour Slab – Installation of formwork for 4”, 6”, and 8” slabs, bending rebar and setting post-tensioning tendons, setting embeds, pouring each floor altogether, stripping the formwork, and stressing the tendons
3. Form/Pour Shearwalls – Installation formwork for varied cast-in-place shear wall sizes and shapes, bending rebar, pouring by crane and bucket, and stripping formwork
4. Install Exterior Skin – Installation of the metal stud exterior wall, architectural precast panels, face brick, wood windows, and steel storefronts.
5. Frame Interiors – Installation of interior metal stud walls
6. Install MEP – Installation of MEP branch ductwork and piping
7. Install Finishes – Installation of carpeting, drywall, and ceiling tile



█ Actual Work
 █ Critical Remaining Work
 █ Remaining Work
 ◆ Milestone
 ▶ Summary

Bryan A. Quinn

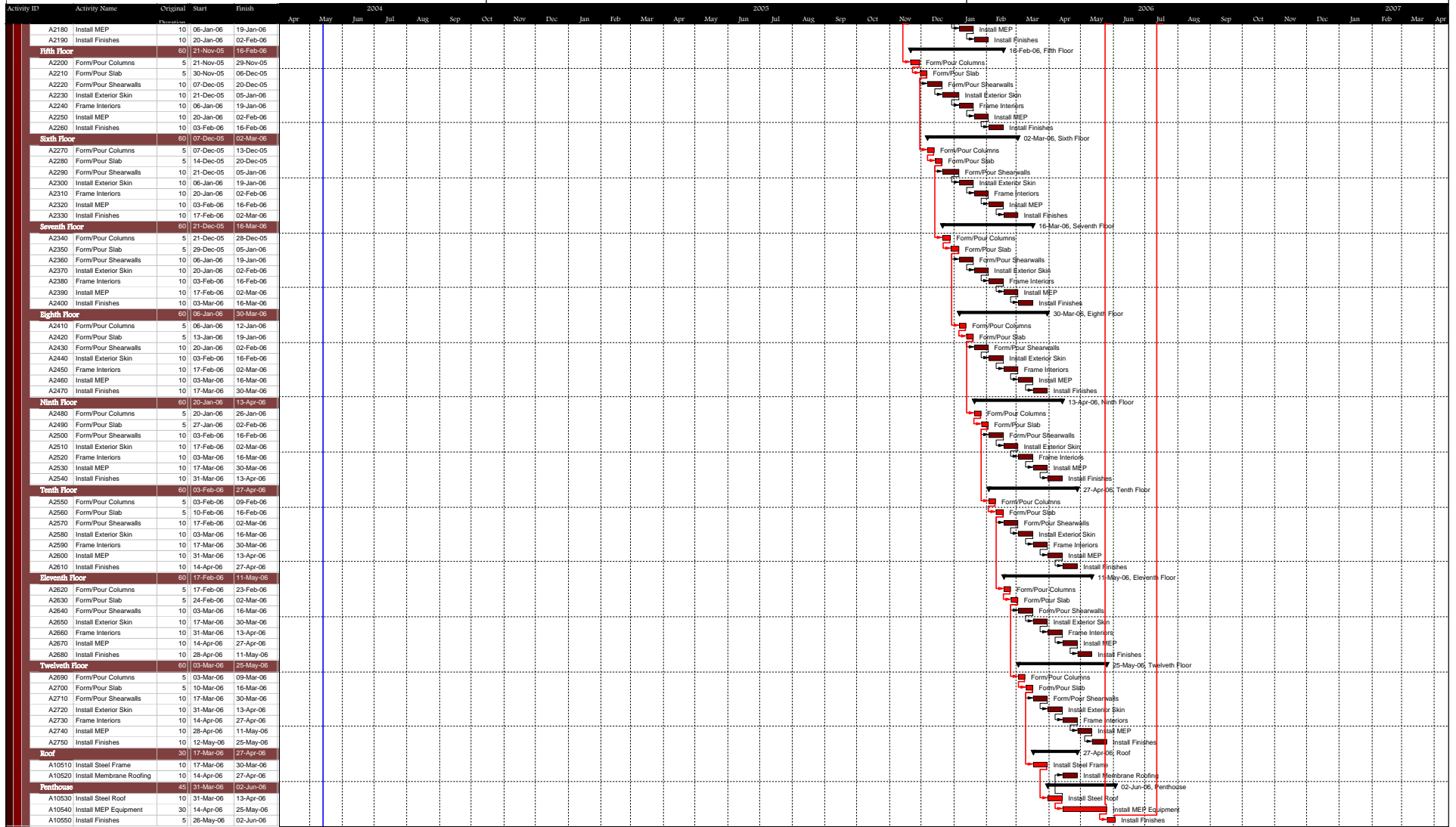
CM Advisor: Dr. Horman



█ Actual Work
 █ Critical Remaining Work
 ▼ Summary
█ Remaining Work
 ◆ Milestone

Bryan A. Quinn

CM Advisor: Dr. Horman



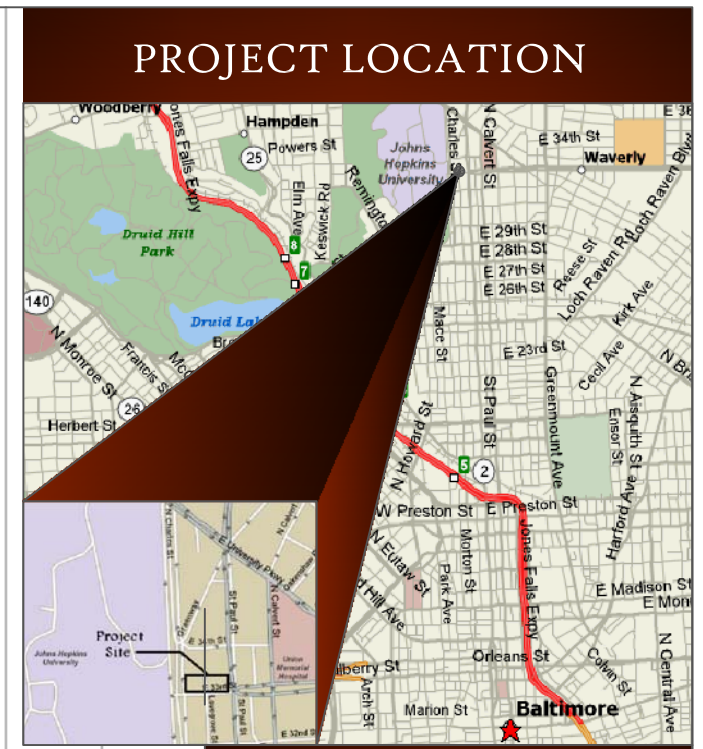
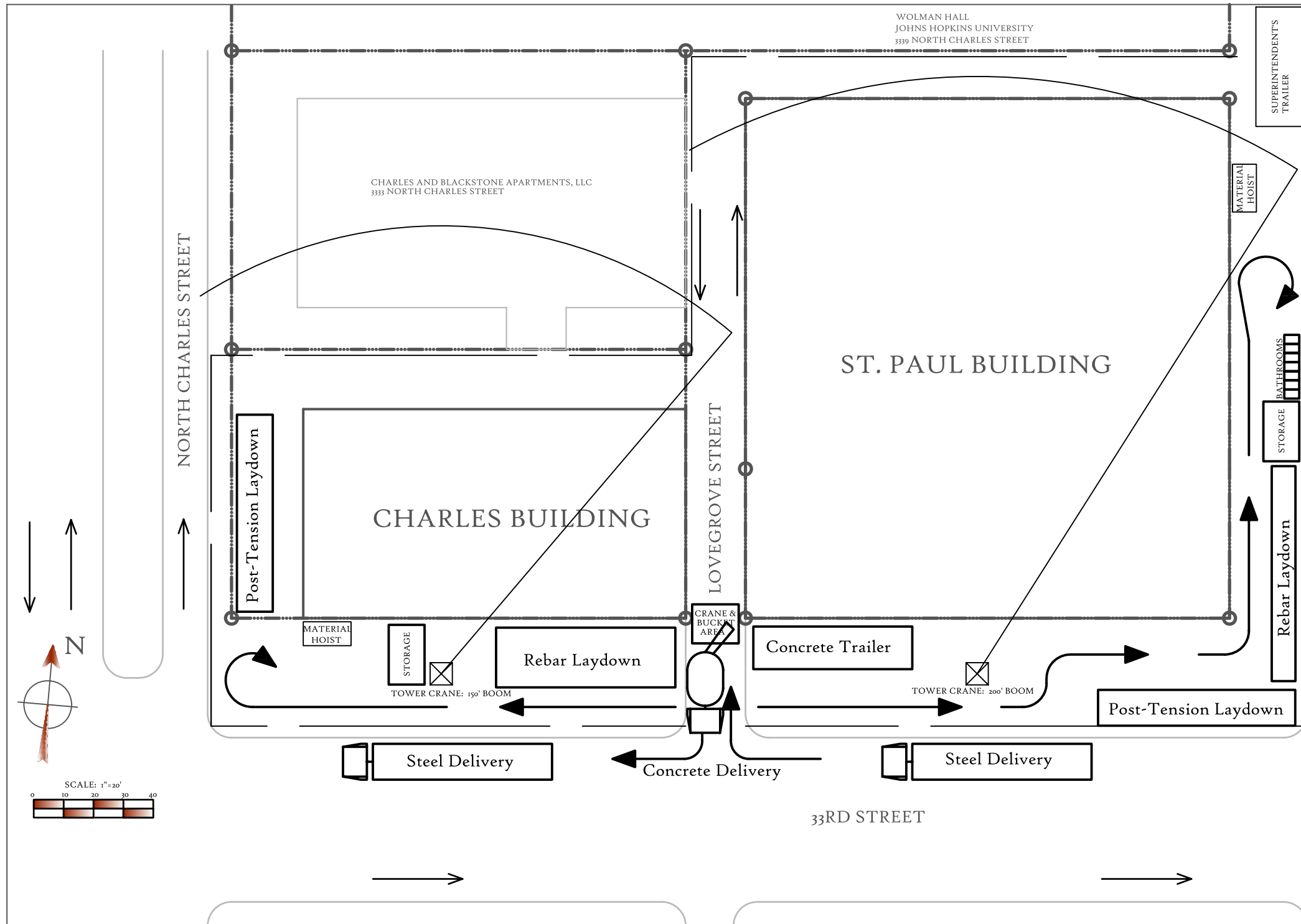
█ Actual Work
 █ Critical Remaining Work
 Summary
◆ Remaining Work
 ◆ Milestone

Bryan A. Quinn

CM Advisor: Dr. Horman

Site Layout Planning

The site layout for Charles Commons is quite tight and strict, especially since the lane closing permits that were initially planned with were rejected by the City of Baltimore. As part of the ensuing negotiations, a construction entrance and delivery drop-offs were allowed on 33rd Street. Two tower cranes of 150' and 200' boom lengths were used to place concrete, set reinforcing, and unload delivery trucks. Two material hoists were used to deliver manpower, materials, and equipment to the various floors of these high-rises. Project management space was located two blocks away from the construction site because of tight site restrictions. In addition, site use is both through laydown areas and site utility construction.



**SITE LAYOUT
SUPERSTRUCTURE PHASE**

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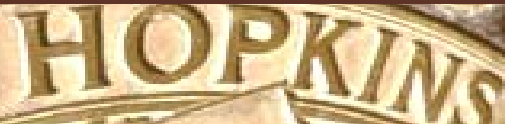
Exterior Skin Assemblies Estimate

| Assembly | Quantity | Units | Material | Installation | Total Costs |
|------------------------------------|----------|-------|----------|--------------|------------------|
| Flat Architectural Precast | 15020 | SF | \$100258 | \$30941 | \$131199 |
| Brick Veneer/Metal Stud | 46114 | SF | \$129120 | \$608704 | \$737824 |
| Wood Windows | 757 | Ea | \$197577 | \$161998 | \$359575 |
| Steel Windows | 223 | Ea | \$178400 | \$73590 | \$251990 |
| Curtain Wall Panels | 19368 | SF | \$397044 | \$280836 | \$677880 |
| Glazed Doors | 16 | Ea | \$40400 | \$28400 | \$68800 |
| | | | | | \$2227269 |
| 92.7 Location Factor 10% Markup | | | | | \$2271146 |



BRYAN QUINN

CONSTRUCTION MANAGEMENT



Detailed Structural Systems Estimate

| Structural System | Total Cost |
|------------------------------------|------------------|
| Drilled Caissons | \$471916 |
| Caisson Caps | \$33116 |
| Grade Beams | \$35626 |
| Footings | \$49649 |
| Concrete Piers | \$57453 |
| Shearwalls | \$346487 |
| Metal Decking | \$6495 |
| Steel Columns | \$78061 |
| Concrete Slabs | \$2906643 |
| Steel Beams | \$80854 |
| Total Foundation & Superstructure | \$4066300 |
| 92.7 Location Factor 10% Markup | \$4146406 |

Cost Estimate Conclusions

During the detailed estimate of the structural systems, a typical bay could not be found. On Charles Commons, there is 4000, 6000, and 8000 psi concrete on various floors. Also, the concrete slab is a two-way, partially post-tensioned slab which varies from 1 tendon and 27k stress to 34 tendons and 918k stress. In addition, elevator locations, atriums, and courtyards destroy a “typical bay size”. Columns vary in size, shape, concrete strength, and reinforcing. Finally, there are three different foundations for these two structures. Due to these complications and its length, the detailed estimate is located in Appendix I: Detailed Estimate.

These estimates are reasonable compared to the accepted bids from Miller, Long, & Arnold, Scriba Welding, Alban & Carosi Precast, and Carroll Masonry. The estimate for the exterior skin package is \$2.27 million and the bids totaled \$2.25 million for this work. In addition, the detailed structural estimate was \$4.15 million, which is comparable to the \$4.55 million in bids.



General Conditions

| Cost Code | Thru 10/15 | Unit | Quantity | Total | |
|----------------------------------|------------|------|----------|-------------|-------|
| 1 SBER PROJECT LABOR | | | | | |
| Division Manager | 0 | wks | 8 | \$43,411 | |
| Project Executive | \$68415 | wks | 64 | \$250,359 | |
| Project Manager | \$17246 | wks | 116 | \$253,402 | |
| Project Manager | \$15572 | wks | 64 | \$139,115 | |
| Superintendent | \$30826 | wks | 104 | \$277,394 | |
| Superintendent | \$36572 | wks | 116 | \$247,605 | |
| Project Engineer | \$21180 | wks | 79 | \$89,556 | |
| Administrator | \$12813 | wks | 97 | \$101,909 | |
| Accountant | 0 | wks | 18 | \$34,499 | |
| QC Manager | \$3145 | wks | 3 | \$6,124 | |
| OCIP Safety Manager | \$37913 | wks | 97 | \$226,413 | |
| IT Manager | \$3720 | wks | 6 | \$12,870 | |
| General Superintendent | \$1133 | wks | 2 | \$23,264 | |
| total | | | | \$1,705,921 | 52.8% |
| 2 SBER EQUIPMENT | | | | | |
| Delivery Service | | mos | 24 | \$15,000 | |
| Onsite Computers | | mos | 24 | \$9,000 | |
| OCIP Computer | | l/s | 1 | \$2,136 | |
| Phone Service | | mos | 20 | \$32,000 | |
| Temporary Field Office | | l/s | 1 | \$25,000 | |
| Mobilization | | l/s | 1 | \$7,500 | |
| Temporary Electric (for trailer) | | l/s | 1 | \$3,500 | |
| Security & Monitoring | | mos | 94 | \$1,000 | |
| Tool & Equipment Storage | | mos | 20 | \$4,000 | |
| Office Furniture/Equipment | | mos | 20 | \$8,000 | |
| Engineering Equipment | | mos | 12 | \$9,000 | |
| total | | | | \$116,136 | 3.6% |
| 3 SBER Material | | | | | |
| Temporary Toilets | | mos | 20 | \$25,000 | |
| Drinking Water | | mos | 20 | \$3,250 | |
| Office Supplies | | mos | 20 | \$4,000 | |
| Fire Extinguishers | | l/s | 1 | \$10,000 | |
| Signs | | l/s | 1 | \$1,000 | |
| Snow Removal | | l/s | 1 | \$2,500 | |
| OCIP Safety Materials | | l/s | 1 | \$12,476 | |
| OCIP Safety Incentive Program | | l/s | 1 | \$15,660 | |
| OCIP Training Equipment | | l/s | 1 | \$1,600 | |
| Shop Drawings/Submittals | | mos | 12 | \$20,000 | |
| Postage/Courier | | mos | 20 | \$4,800 | |
| Progress Photos | | mos | 20 | \$10,000 | |
| As-Builts | | mos | 20 | \$20,000 | |
| total | | | | \$130,286 | 4.0% |



4 **SBER COMMON LABOR**

| | | | | |
|---------------------------|-----|-----|-----------|-------|
| Laborer | mos | 2 | \$10,000 | |
| Snow Removal | wks | 8 | \$12,500 | |
| Temporary Heat/Fire Watch | wks | 36 | \$56,000 | |
| Hoist Operator | wks | 104 | \$162,000 | |
| Safety Carpenter/Foreman | wks | 156 | \$260,500 | |
| total | | | \$501,000 | 15.5% |

5 **SBER MISCELLANEOUS**

| | | | | |
|------------------------------|-------|-----|-----------|-------|
| Pest Control | mos | 20 | \$6,000 | |
| Building Permit | 1/s | 1 | \$183,000 | |
| Temporary Electric | 1/s | 1 | \$112,500 | |
| Temporary Heat | mos | 3 | \$105,000 | |
| Material Hoist | 1/s | 2 | \$75,000 | |
| Trash Chutes | 1/s | 2 | \$65,000 | |
| Dumpsters | loads | 175 | \$80,000 | |
| Temporary Fence & Gates | 1/s | 1 | \$7,500 | |
| Final Clean-up | 1/s | 1 | \$80,000 | |
| Relocation of Existing Power | 1/s | 1 | \$65,000 | |
| total | | | \$779,000 | 24.1% |

\$3,232,343

OCIP
 Requirements \$258,285 8%

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A close-up photograph of a gold coin or seal, showing the word "HOPKINS" in a serif font. The coin is slightly tilted and has a textured, metallic surface.

Appendix I: Detailed Estimate

BRYAN QUINN

CONSTRUCTION MANAGEMENT

| Drilled Caissons | | | Drilled Caissons | | | | | | | | | | Charles | St. Paul | | |
|--|-----------------------------------|-----|------------------------------------|-----------------|-----------------------|-------|--------------|--------|----------|---------|----------|----------|----------|----------|----------|--|
| | Quant/Dep Shaft Dia. (ft) (ft) | | Shaft Area Volume (sqft) (cuyd) | | Reinf Quar Reinf Size | | Reinf Length | | | | | | | | | |
| C26 | 88 | 2.5 | 19.625 | 63.96296 | 12 | 7 | 1056 | | | | | | | 12.5 | 75.5 | |
| C30 | 18.5 | 3 | 28.26 | 19.36333 | 14 | 8 | 259 | | | | | | | | 18.5 | |
| C30A | 22.5 | 3 | 28.26 | 23.55 | 28 | 8 | 630 | | | | | | | | 22.5 | |
| C36 | 102.5 | 3.5 | 38.465 | 146.0245 | 14 | 9 | 1435 | | | | | | | | 102.5 | |
| C36A | 44.5 | 3.5 | 38.465 | 63.39602 | 28 | 9 | 1246 | | | | | | | 25.5 | 19 | |
| C40 | 163.5 | 4 | 50.24 | 304.2311 | 20 | 9 | 3270 | | | | | | | 25 | 138.5 | |
| C40A | 0 | 4 | 50.24 | 0 | 40 | 9 | 0 | | | | | | | | | |
| C46 | 123.5 | 4.5 | 63.585 | 290.8425 | 20 | 10 | 2470 | | | | | | | 47.5 | 76 | |
| C46A | 69 | 4.5 | 63.585 | 162.495 | 40 | 10 | 2760 | | | | | | | 35.5 | 33.5 | |
| C50 | 143.5 | 5 | 78.5 | 417.213 | 20 | 11 | 2870 | | | | | | | 9.5 | 134 | |
| C50A | 23.5 | 5 | 78.5 | 68.32407 | 40 | 11 | 940 | | | | | | | | 23.5 | |
| C56 | 68.5 | 5.5 | 94.985 | 240.9805 | 22 | 11 | 1507 | | | | | | | | 68.5 | |
| C66 | 1.5 | 6.5 | 132.665 | 7.370278 | 22 | 14 | 33 | | | | | | | | 1.5 | |
| TC36 | 6 | 3.5 | 38.465 | 8.547778 | 28 | 9 | 168 | | | | | | | | 6 | |
| TC40 | 12 | 4 | 50.24 | 22.32889 | 30 | 10 | 360 | | | | | | | | 12 | |
| TC46 | 14 | 4.5 | 63.585 | 32.97 | 30 | 10 | 420 | | | | | | | | 14 | |
| TC56 | 42 | 5.5 | 94.985 | 147.7544 | 44 | 11 | 1848 | | | | | | | 42 | | |
| TC60 | 62 | 6 | 113.04 | 259.5733 | 30 | 14 | 1860 | | | | | | | 44 | 18 | |
| TC66 | 22 | 6.5 | 132.665 | 108.0974 | 33 | 14 | 726 | | | | | | | 22 | | |
| TC70 | 44 | 7 | 153.86 | 250.7348 | 50 | 14 | 2200 | | | | | | | | 44 | |
| 1071 | | | | | | | | | | | | | | | | |
| 2450 Foundation & Load Bearing Elements | | | Crew | Daily Outp/Unit | Mat | Labor | Equip | Total | Quantity | Mat | Labor | Equip | Total | | | |
| 2455 Driven Piles | | | | | | | | | | | | | | | | |
| 800 Drilled Caissons, Open style, machine drilled, | | | | | | | | | | | | | | | | |
| 300 30" dia | | | B-43 | 190 vif | 11.7 | 7.35 | 16.75 | 35.8 | 88 | 1029.6 | 646.8 | 1474 | 3150.4 | | | |
| 400 36" dia | | | | 150 | 18.35 | 9.3 | 21 | 48.65 | 188 | 3449.8 | 1748.4 | 3948 | 9146.2 | | | |
| 500 48" dia | | | | 125 | 26.5 | 11.2 | 25.5 | 63.2 | 374 | 9911 | 4188.8 | 9537 | 23636.8 | | | |
| 600 60" dia | | | | 100 | 47 | 14 | 32 | 93 | 291.5 | 13700.5 | 4081 | 9328 | 27109.5 | | | |
| 700 72" dia | | | | 90 | 73.5 | 15.55 | 35.5 | 124.55 | 129.5 | 9518.25 | 2013.725 | 4597.25 | 16129.23 | | | |
| 900 Mobilization | | | | | | | | | | | | | 79172.13 | x20% | 95006.55 | |
| 600 Drill rig, for caissons, up to 84" | | | B-43 | 1 ea | | 1400 | 3175 | 4575 | 82.38462 | 0 | 115338.5 | 261571.2 | 376909.6 | waste | | |
| | | | | | | | | | | | | | | 471916.2 | | |

| Footings | | | | | | | | | | | | | | | |
|-----------------------------|----------|--------------|-------------|----------------|------------|-------------------|--------------|---------|----------|----------|----------|----------|----------|----------|----------|
| | Quantity | Area sqft | Depth in | Volume cuyd | Reinf Quar | Reinf Size (#) | Reinf Length | Charles | St. Paul | | | | | | |
| F40 | 2 | 16 | 21 | 2.074074 | 12 | 4 | 5 | | | 2 | | | | | |
| F46 | 1 | 20.25 | 21 | 1.3125 | 8 | 5 | 5 | | | 1 | | | | | |
| F56 | 1 | 30.25 | 25 | 2.334105 | 12 | 5 | 6 | | | 1 | | | | | |
| F60 | 1 | 36 | 27 | 3 | 13 | 5 | 7 | | | 1 | | | | | |
| F70 | 6 | 49 | 31 | 28.12963 | 10 | 7 | 8 | | | 6 | | | | | |
| F76 | 2 | 56.25 | 33 | 11.45833 | 11 | 7 | 8 | | | 2 | | | | | |
| F80 | 1 | 64 | 35 | 6.91358 | 12 | 7 | 9 | | | 1 | | | | | |
| F86 | 3 | 72.25 | 37 | 24.75231 | 11 | 8 | 9 | 3 | | | | | | | |
| F90 | 6 | 81 | 39 | 58.5 | 12 | 8 | 10 | 3 | | 3 | | | | | |
| F100 | 2 | 100 | 43 | 26.54321 | 12 | 9 | 11 | | | 2 | | | | | |
| F90100 | 1 | 90 | 43 | 11.94444 | 12 | 9 | 11 | 1 | | | | | | | |
| F7080 | 1 | 56 | 35 | 6.049383 | 12 | 7 | 9 | 1 | | | | | | | |
| | | | | 183.0116 | | | | | | | | | | | |
| 3300 Cast-In-Place Concrete | | | | Crew | Daily Outp | Unit | Mat | Labor | Equip | Quantity | Mat | Labor | Equip | Total | |
| 3310 Structural Concrete | | | | | | | | | | | | | | | |
| 240 Footings, spread | | | | | | | | | | | | | | | |
| 3850 Over 5 CY | | | | C-14C | 81.04 | CY | | 226 | 45 | 0.29 | 183.0116 | 41360.62 | 8235.521 | 53.07336 | 49649.21 |

| Caisson Caps | | | | | | | | | | | | |
|--------------------------------------|----------|--------------|-------------|----------------|------------|-------------------|--------------|----------|----------|----------|----------|----------|
| | Quantity | Area sqft | Depth lf | Volume cuyd | Reinf Quar | Reinf Size (#) | Reinf Length | | Charles | St. Paul | | |
| CC36 | 6 | 12.25 | 3 | 8.166667 | 10 | 7 | 240 | | | 6 | | |
| CC36A | 0 | 12.25 | 3 | 0 | 16 | 7 | 0 | | | | | |
| CC40 | 0 | 16 | 3 | 0 | 12 | 7 | 0 | | | | | |
| CC40A | 1 | 16 | 3 | 1.777778 | 18 | 7 | 72 | | | 1 | | |
| CC46 | 5 | 20.25 | 3 | 11.25 | 14 | 7 | 350 | | | 5 | | |
| CC46A | 4 | 20.25 | 3 | 9 | 20 | 7 | 400 | | 3 | 1 | | |
| CC50 | 8 | 25 | 3 | 22.22222 | 16 | 7 | 640 | | 1 | 7 | | |
| CC50A | 0 | 25 | 3 | 0 | 22 | 7 | 0 | | | | | |
| CC56 | 12 | 30.25 | 3 | 40.33333 | 18 | 7 | 1296 | | 6 | 6 | | |
| CC56A | 4 | 30.25 | 3 | 13.44444 | 24 | 7 | 576 | | 2 | 2 | | |
| CC60 | 11 | 36 | 3 | 44 | 20 | 7 | 1320 | | 1 | 10 | | |
| CC60A | 2 | 36 | 3 | 8 | 26 | 7 | 312 | | | 2 | | |
| CC66 | 6 | 42.25 | 3 | 28.16667 | 22 | 7 | 924 | | | 6 | | |
| CC76 | 1 | 56.25 | 3 | 6.25 | 26 | 7 | 208 | | | 1 | | |
| | | | | 192.6111 | | | | | | | | |
| 3300 Cast-In-Place Concrete | | | | | | | | | | | | |
| 3310 Structural Concrete | | | | | | | | | | | | |
| 240 Pilecaps, incl. forms and reinf. | | | | | | | | | | | | |
| 5900 under 5 CY | | | | | | | | | | | | |
| | C-14C | | 54.14 cy | | 104 | 67.5 | 0.43 | 192.6111 | 20031.56 | 13001.25 | 82.82278 | 33115.63 |

Concrete Piers

| | | Pier "P1" | | | | | | | | | | | |
|------|---------|------------|----------|--------------|-----------------|--------------|---------|--------------|-----------------|--------------|--|--|--|
| f'c | psi | floor # | Width in | Thickness in | floor height ft | area sf | Reinf # | Reinf Size # | Reinf Leng ft | volume cu yd | | | |
| 4000 | 6,7,-12 | 12 | 12 | 12 | 71.3333 | 6 | 6 | 71.3333 | 2.641974 | | | | |
| 6000 | 3,4,5 | 18 | 12 | 12 | 34 | 8 | 9 | 34 | 1.888889 | | | | |
| 8000 | 1&2 | 24 | 12 | 12 | 24 | 8 | 11 | 24 | 1.777778 | | | | |
| | | | | | 129.3333 | 258.6666 | | | | | | | |
| | | Pier "P1a" | | | | | | | | | | | |
| f'c | psi | floor # | Width in | Thickness in | floor height ft | volume cu yd | Reinf # | Reinf Size # | Reinf Length ft | | | | |
| 4000 | 6,7,-12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| 6000 | 3,4,5 | 24 | 12 | 10 | 10 | 8 | 11 | 10 | 0.740741 | | | | |
| 8000 | 1&2 | 30 | 12 | 24 | 24 | 10 | 11 | 24 | 2.222222 | | | | |
| | | | | | 34 | 85 | | | | | | | |
| | | Pier "P2" | | | | | | | | | | | |
| f'c | psi | floor # | Width in | Thickness in | floor height ft | volume cu yd | Reinf # | Reinf Size # | Reinf Length ft | | | | |
| 4000 | 6,7,-12 | 24 | 12 | 12 | 71.3333 | 8 | 8 | 71.3333 | 5.283948 | | | | |
| 6000 | 3,4,5 | 24 | 12 | 10 | 34 | 8 | 10 | 34 | 2.518519 | | | | |
| 8000 | 1&2 | 24 | 12 | 24 | 24 | 8 | 11 | 24 | 1.777778 | | | | |
| | | | | | 129.3333 | 258.6666 | | | | | | | |
| | | Pier "P2a" | | | | | | | | | | | |
| f'c | psi | floor # | Width in | Thickness in | floor height ft | volume cu yd | Reinf # | Reinf Size # | Reinf Length ft | | | | |
| 4000 | 6,7,-12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| 6000 | 3,4,5 | 24 | 12 | 10 | 10 | 8 | 11 | 10 | 0.740741 | | | | |
| 8000 | 1&2 | 36 | 12 | 24 | 24 | 12 | 11 | 24 | 2.666667 | | | | |
| | | | | | 34 | 102 | | | | | | | |
| | | Pier "P3" | | | | | | | | | | | |
| f'c | psi | floor # | Width in | Thickness in | floor height ft | volume cu yd | Reinf # | Reinf Size # | Reinf Length ft | | | | |
| 4000 | 6,7,-12 | 12 | 12 | 12 | 71.3333 | 6 | 9 | 71.3333 | 2.641974 | | | | |
| 6000 | 3,4,5 | 24 | 12 | 10 | 34 | 8 | 11 | 34 | 2.518519 | | | | |
| 8000 | 1&2 | 30 | 12 | 24 | 24 | 10 | 11 | 24 | 2.222222 | | | | |
| | | | | | 129.3333 | 323.3333 | | | | | | | |
| | | Pier "P4" | | | | | | | | | | | |
| f'c | psi | floor # | Width in | Thickness in | floor height ft | volume cu yd | Reinf # | Reinf Size # | Reinf Length ft | | | | |
| 4000 | 6,7,-12 | 12 | 12 | 12 | 71.3333 | 8 | 7 | 71.3333 | 2.641974 | | | | |
| 6000 | 3,4,5 | 24 | 12 | 10 | 34 | 8 | 11 | 34 | 2.518519 | | | | |
| 8000 | 1&2 | 30 | 12 | 24 | 24 | 10 | 11 | 24 | 2.222222 | | | | |
| | | | | | 129.3333 | 323.3333 | | | | | | | |
| | | Pier "P5" | | | | | | | | | | | |
| f'c | psi | floor # | Width in | Thickness in | floor height ft | volume cu yd | Reinf # | Reinf Size # | Reinf Length ft | | | | |
| 4000 | 6,7,-12 | 18 | 12 | 12 | 71.3333 | 6 | 9 | 71.3333 | 3.962961 | | | | |
| 6000 | 3,4,5 | 24 | 12 | 10 | 34 | 8 | 11 | 34 | 2.518519 | | | | |
| 8000 | 1&2 | 24 | 12 | 24 | 24 | 8 | 11 | 24 | 0.740741 | | | | |
| | | | | | 115.3333 | 230.6666 | | | | | | | |
| | | Pier "P6" | | | | | | | | | | | |
| f'c | psi | floor # | Width in | Thickness in | floor height ft | volume cu yd | Reinf # | Reinf Size # | Reinf Length ft | | | | |
| 4000 | 6,7,-12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| 6000 | 3,4,5 | 18 | 12 | 14 | 14 | 6 | 6 | 14 | 0.777778 | | | | |
| 8000 | 1&2 | 18 | 12 | 24 | 24 | 6 | 6 | 24 | 1.333333 | | | | |
| | | | | | 38 | 57 | | | | | | | |
| | | Pier "P7" | | | | | | | | | | | |
| f'c | psi | floor # | Width in | Thickness in | floor height ft | volume cu yd | Reinf # | Reinf Size # | Reinf Length ft | | | | |
| 4000 | 6,7,-12 | 12 | 12 | 12 | 71.3333 | 4 | 7 | 71.3333 | 2.641974 | | | | |
| 6000 | 3,4,5 | 24 | 12 | 10 | 34 | 8 | 8 | 34 | 2.518519 | | | | |
| 8000 | 1&2 | 24 | 12 | 24 | 24 | 8 | 11 | 24 | 1.777778 | | | | |
| | | | | | 129.3333 | 258.6666 | | | | | | | |
| | | Pier "P8" | | | | | | | | | | | |
| f'c | psi | floor # | Width in | Thickness in | floor height ft | volume cu yd | Reinf # | Reinf Size # | Reinf Length ft | | | | |
| 4000 | 6,7,-12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| 6000 | 3,4,5 | 18 | 12 | 14 | 14 | 6 | 6 | 14 | 0.777778 | | | | |
| 8000 | 1&2 | 18 | 12 | 24 | 24 | 6 | 6 | 24 | 1.333333 | | | | |
| | | | | | 38 | 57 | | | | | | | |
| | | Pier "P10" | | | | | | | | | | | |
| f'c | psi | floor # | Width in | Thickness in | floor height ft | volume cu yd | Reinf # | Reinf Size # | Reinf Length ft | | | | |
| 4000 | 6,7,-12 | 12 | 12 | 12 | 71.3333 | 6 | 8 | 71.3333 | 2.641974 | | | | |
| 6000 | 3,4,5 | 18 | 12 | 10 | 34 | 6 | 11 | 34 | 1.888889 | | | | |
| 8000 | 1&2 | 24 | 12 | 24 | 24 | 8 | 11 | 24 | 1.777778 | | | | |
| | | | | | 129.3333 | 258.6666 | | | | | | | |
| | | Pier "P11" | | | | | | | | | | | |
| f'c | psi | floor # | Width in | Thickness in | floor height ft | volume cu yd | Reinf # | Reinf Size # | Reinf Length ft | | | | |
| 4000 | 6,7,-12 | 12 | 12 | 12 | 71.3333 | 4 | 7 | 71.3333 | 2.641974 | | | | |
| 6000 | 3,4,5 | 18 | 12 | 10 | 34 | 8 | 8 | 34 | 1.888889 | | | | |
| 8000 | 1&2 | 24 | 12 | 24 | 24 | 8 | 11 | 24 | 1.777778 | | | | |
| | | | | | 129.3333 | 258.6666 | | | | | | | |
| | | Pier "P12" | | | | | | | | | | | |
| f'c | psi | floor # | Width in | Thickness in | floor height ft | volume cu yd | Reinf # | Reinf Size # | Reinf Length ft | | | | |
| 4000 | 6,7,-12 | 12 | 12 | 12 | 71.3333 | 6 | 6 | 71.3333 | 2.641974 | | | | |
| 6000 | 3,4,5 | 18 | 12 | 10 | 34 | 8 | 9 | 34 | 1.888889 | | | | |
| 8000 | 1&2 | 24 | 12 | 24 | 24 | 8 | 11 | 24 | 1.777778 | | | | |
| | | | | | 129.3333 | 258.6666 | | | | | | | |

| f'c psi | Pier # | floor # | Width in | Thickness in | floor ft | height ft | volume cu yd | Reinf # # | Reinf Size # | Reinf Length ft | | |
|------------|------------|------------|-------------|-----------------|-------------|--------------|-----------------|--------------|-----------------|--------------------|----------|----------|
| | Pier "P13" | | | | | | | | | | | |
| | 4000 | 6,7,-12 | 12 | 12 | 71.3333 | | | 6 | 7 | 71.3333 | 2.641974 | |
| | 6000 | 3,4,5 | 18 | 12 | 34 | | | 8 | 9 | 34 | | 1.888889 |
| | 8000 | 1&2 | 24 | 12 | 24 | | | 12 | 11 | 24 | | 1.777778 |
| | | | | | 129.3333 | 258.6666 | | | | | | |
| | Pier "P14" | | | | | | | | | | | |
| | 4000 | 6,7,-12 | 12 | 12 | 71.3333 | | | 6 | 8 | 71.3333 | 2.641974 | |
| | 6000 | 3,4,5 | 18 | 12 | 34 | | | 6 | 11 | 34 | | 1.888889 |
| | 8000 | 1&2 | 24 | 12 | 24 | | | 10 | 11 | 24 | | 1.777778 |
| | | | | | 129.3333 | 258.6666 | | | | | | |
| | Pier "P15" | | | | | | | | | | | |
| | 4000 | 6,7,-12 | 18 | 12 | 71.3333 | | | 6 | 8 | 71.3333 | 3.962961 | |
| | 6000 | 3,4,5 | 18 | 12 | 34 | | | 6 | 11 | 34 | | 1.888889 |
| | 8000 | 1&2 | 18 | 12 | 24 | | | 6 | 11 | 24 | | 1.333333 |
| | | | | | 129.3333 | 194 | | | | | | |
| | Pier "P16" | | | | | | | | | | | |
| | 4000 | 6,7,-12 | 12 | 12 | 71.3333 | | | 6 | 8 | 71.3333 | 2.641974 | |
| | 6000 | 3,4,5 | 18 | 12 | 34 | | | 6 | 11 | 34 | | 1.888889 |
| | 8000 | 1&2 | 18 | 12 | 24 | | | 6 | 11 | 24 | | 1.333333 |
| | | | | | 129.3333 | 194 | | | | | | |
| | Pier "P21" | | | | | | | | | | | |
| | 4000 | 6,7,-12 | 30 | 12 | 51.3333 | | | 10 | 10 | 51.3333 | 4.753083 | |
| | 6000 | 3,4,5 | 30 | 12 | 34 | | | 16 | 11 | 34 | | 3.148148 |
| | 8000 | 1&2 | 30 | 12 | 24 | | | 30 | 11 | 24 | | 2.222222 |
| | | | | | 109.3333 | 273.3333 | | | | | | |
| | Pier "P22" | | | | | | | | | | | |
| | 4000 | 6,7,-12 | 12 | 12 | 51.3333 | | | 8 | 10 | 51.3333 | 1.901233 | |
| | 6000 | 3,4,5 | 18 | 12 | 34 | | | 12 | 14 | 34 | | 1.888889 |
| | 8000 | 1&2 | 24 | 12 | 24 | | | 16 | 14 | 24 | | 1.777778 |
| | | | | | 109.3333 | 218.6666 | | | | | | |
| | Pier "P23" | | | | | | | | | | | |
| | 4000 | 6,7,-12 | 18 | 12 | 51.3333 | | | 10 | 8 | 51.3333 | 2.85185 | |
| | 6000 | 3,4,5 | 18 | 12 | 34 | | | 20 | 11 | 34 | | 1.888889 |
| | 8000 | 1&2 | 24 | 12 | 24 | | | 31 | 11 | 24 | | 1.777778 |
| | | | | | 109.3333 | 218.6666 | | | | | | |
| | Pier "P24" | | | | | | | | | | | |
| | 4000 | 6,7,-12 | 24 | 12 | 51.3333 | | | 8 | 9 | 51.3333 | 3.802467 | |
| | 6000 | 3,4,5 | 24 | 12 | 34 | | | 12 | 11 | 34 | | 2.518519 |
| | 8000 | 1&2 | 24 | 12 | 24 | | | 20 | 11 | 24 | | 1.777778 |
| | | | | | 109.3333 | 218.6666 | | | | | | |
| | Pier "P25" | | | | | | | | | | | |
| | 4000 | 6,7,-12 | 18 | 12 | 51.3333 | | | 6 | 7 | 51.3333 | 2.85185 | |
| | 6000 | 3,4,5 | 24 | 12 | 34 | | | 8 | 9 | 34 | | 2.518519 |
| | 8000 | 1&2 | 24 | 12 | 24 | | | 8 | 10 | 24 | | 1.777778 |
| | | | | | 109.3333 | 218.6666 | | | | | | |
| | Pier "P28" | | | | | | | | | | | |
| | 4000 | 6,7,-12 | 12 | 12 | 51.3333 | | | 10 | 9 | 51.3333 | 1.901233 | |
| | 6000 | 3,4,5 | 24 | 12 | 34 | | | 20 | 11 | 34 | | 2.518519 |
| | 8000 | 1&2 | 30 | 12 | 24 | | | 31 | 11 | 24 | | 2.222222 |
| | | | | | 109.3333 | 273.3333 | | | | | | |
| | Pier "P29" | | | | | | | | | | | |
| | 4000 | 6,7,-12 | 18 | 12 | 51.3333 | | | 8 | 9 | 51.3333 | 2.85185 | |
| | 6000 | 3,4,5 | 24 | 12 | 34 | | | 16 | 11 | 34 | | 2.518519 |
| | 8000 | 1&2 | 30 | 12 | 24 | | | 20 | 11 | 24 | | 2.222222 |
| | | | | | 109.3333 | 273.3333 | | | | | | |
| | Pier "P30" | | | | | | | | | | | |
| | 4000 | 6,7,-12 | 24 | 12 | 51.3333 | | | 10 | 10 | 51.3333 | 3.802467 | |
| | 6000 | 3,4,5 | 30 | 12 | 34 | | | 20 | 11 | 34 | | 3.148148 |
| | 8000 | 1&2 | 30 | 12 | 24 | | | 30 | 11 | 24 | | 2.222222 |
| | | | | | 109.3333 | 273.3333 | | | | | | |
| | Pier "P31" | | | | | | | | | | | |
| | 4000 | 6,7,-12 | 18 | 12 | 51.3333 | | | 8 | 10 | 51.3333 | 2.85185 | |
| | 6000 | 3,4,5 | 24 | 12 | 34 | | | 12 | 11 | 34 | | 2.518519 |
| | 8000 | 1&2 | 30 | 12 | 24 | | | 18 | 11 | 24 | | 2.222222 |
| | | | | | 109.3333 | 273.3333 | | | | | | |
| | Pier "P34" | | | | | | | | | | | |
| | 4000 | 6,7,-12 | 18 | 12 | 51.3333 | | | 8 | 10 | 51.3333 | 2.85185 | |
| | 6000 | 3,4,5 | 24 | 12 | 34 | | | 12 | 11 | 34 | | 2.518519 |
| | 8000 | 1&2 | 30 | 12 | 24 | | | 18 | 11 | 24 | | 2.222222 |
| | | | | | 109.3333 | 273.3333 | | | | | | |

| Concrete Slabs | | | | | | | | | | | |
|----------------|---------|--------|----------|----------|----------|----------|-----------|------|------|------|-----|
| Load | Tendons | Length | Weight | Mat | Labor | Equip | Total | | | | |
| Kips | # | ft | lbs | | | | | | | | |
| 27 | 1 | 90 | 45.9 | 51.867 | 84.915 | 4.59 | 141.372 | 1.13 | 1.85 | 0.1 | 27 |
| 54 | 2 | 3286 | 3351.72 | 3787.444 | 6200.682 | 335.172 | 10323.298 | 1.13 | 1.85 | 0.1 | 54 |
| 81 | 3 | 1394 | 2132.82 | 2410.087 | 3945.717 | 213.282 | 6569.0856 | 1.13 | 1.85 | 0.1 | 81 |
| 108 | 4 | 2488 | 5075.52 | 5735.338 | 9389.712 | 507.552 | 15632.602 | 1.13 | 1.85 | 0.1 | 108 |
| 135 | 5 | 1622 | 4136.1 | 4673.793 | 7651.785 | 413.61 | 12739.188 | 1.13 | 1.85 | 0.1 | 135 |
| 162 | 6 | 3620 | 11077.2 | 12517.24 | 20492.82 | 1107.72 | 34117.776 | 1.13 | 1.85 | 0.1 | 162 |
| 189 | 7 | 1612 | 5754.84 | 6502.969 | 10646.45 | 575.484 | 17724.907 | 1.13 | 1.85 | 0.1 | 189 |
| 216 | 8 | 2294 | 9359.52 | 10576.26 | 17315.11 | 935.952 | 28827.322 | 1.13 | 1.85 | 0.1 | 216 |
| 243 | 9 | 1008 | 4626.72 | 5228.194 | 8559.432 | 462.672 | 14250.298 | 1.13 | 1.85 | 0.1 | 243 |
| 270 | 10 | 3230 | 16473 | 18614.49 | 30475.05 | 1647.3 | 50736.84 | 1.13 | 1.85 | 0.1 | 270 |
| 297 | 11 | 674 | 3781.14 | 4272.688 | 6995.109 | 378.114 | 11645.911 | 1.13 | 1.85 | 0.1 | 297 |
| 324 | 12 | 2985 | 18268.2 | 11508.97 | 14979.92 | 730.728 | 27219.618 | 0.63 | 0.82 | 0.04 | 324 |
| 351 | 13 | 1812 | 12013.56 | 7568.543 | 9851.119 | 480.5424 | 17900.204 | 0.63 | 0.82 | 0.04 | 351 |
| 378 | 14 | 1494 | 10667.16 | 6720.311 | 8747.071 | 426.6864 | 15894.068 | 0.63 | 0.82 | 0.04 | 378 |
| 405 | 15 | 952 | 7282.8 | 4588.164 | 5971.896 | 291.312 | 10851.372 | 0.63 | 0.82 | 0.04 | 405 |
| 432 | 16 | 1530 | 12484.8 | 7865.424 | 10237.54 | 499.392 | 18602.352 | 0.63 | 0.82 | 0.04 | 432 |
| 459 | 17 | 1400 | 12138 | 7646.94 | 9953.16 | 485.52 | 18085.62 | 0.63 | 0.82 | 0.04 | 459 |
| 486 | 18 | 2190 | 20104.2 | 12665.65 | 16485.44 | 804.168 | 29955.258 | 0.63 | 0.82 | 0.04 | 486 |
| 513 | 19 | 810 | 7848.9 | 4944.807 | 6436.098 | 313.956 | 11694.861 | 0.63 | 0.82 | 0.04 | 513 |
| 540 | 20 | 2000 | 20400 | 12852 | 16728 | 816 | 30396 | 0.63 | 0.82 | 0.04 | 540 |
| 567 | 21 | 328 | 3512.88 | 2213.114 | 2880.562 | 140.5152 | 5234.1912 | 0.63 | 0.82 | 0.04 | 567 |
| 594 | 22 | 616 | 6911.52 | 4354.258 | 5667.446 | 276.4608 | 10298.165 | 0.63 | 0.82 | 0.04 | 594 |
| 621 | 23 | 516 | 6052.68 | 3813.188 | 4963.198 | 242.1072 | 9018.4932 | 0.63 | 0.82 | 0.04 | 621 |
| 648 | 24 | 262 | 3206.88 | 2020.334 | 2629.642 | 128.2752 | 4778.2512 | 0.63 | 0.82 | 0.04 | 648 |
| 675 | 25 | 526 | 6706.5 | 4225.095 | 5499.33 | 268.26 | 9992.685 | 0.63 | 0.82 | 0.04 | 675 |
| 702 | 26 | 442 | 5860.92 | 3692.38 | 4805.954 | 234.4368 | 8732.7708 | 0.63 | 0.82 | 0.04 | 702 |
| 727 | 27 | 40 | 550.8 | 347.004 | 451.656 | 22.032 | 820.692 | 0.63 | 0.82 | 0.04 | 727 |
| 756 | 28 | 160 | 2284.8 | 1439.424 | 1873.536 | 91.392 | 3404.352 | 0.63 | 0.82 | 0.04 | 756 |
| 783 | 29 | 76 | 1124.04 | 708.1452 | 921.7128 | 44.9616 | 1674.8196 | 0.63 | 0.82 | 0.04 | 783 |
| 810 | 30 | 28 | 428.4 | 269.892 | 351.288 | 17.136 | 638.316 | 0.63 | 0.82 | 0.04 | 810 |
| 837 | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0.63 | 0.82 | 0.04 | 837 |
| 864 | 32 | 30 | 489.6 | 308.448 | 401.472 | 19.584 | 729.504 | 0.63 | 0.82 | 0.04 | 864 |
| 891 | 33 | 24 | 403.92 | 254.4696 | 331.2144 | 16.1568 | 601.8408 | 0.63 | 0.82 | 0.04 | 891 |
| 918 | 34 | 26 | 450.84 | 284.0292 | 369.6888 | 18.0336 | 671.7516 | 0.63 | 0.82 | 0.04 | 918 |

225005.9 174660.9 399666.8 12949.1 439903.78

.153 in^2 0.001063
 assume 480pcf for steel tendons
 480
 total sqft 313000

| 3230 Stressing Tendons | Crew | Daily Output | Units | Mat | Labor | Equip | Total |
|-------------------------------------|--------|--------------|----------|------|-------|-------|-------|
| 600 Prestressing Steel | | | | | | | |
| 10 Post-tensioned in field | | | | | | | |
| 100 Grouted strand, 50' span, 100k | C-3 | | 1200 lbs | 1.13 | 1.85 | 0.1 | 3.08 |
| 150 300k | C-3 | | 1200 lbs | 0.63 | 0.82 | 0.04 | 1.49 |
| 3110 Structural C.I.P. Forms | | | | | | | |
| 420 Forms In Place, Elevated Slabs | | | | | | | |
| 10 Flat slab, drop panels, plywood, | | | | | | | |
| 2150 to 15' high, 4 use | C-2 | | 544 sf | 1.44 | 2.94 | 0 | 4.38 |
| 445 Forms In Place, Slab On Grade | | | | | | | |
| 3050 Edge forms, 4 use, 7"-12" high | C-1 | | 435 SFCA | 0.74 | 2.38 | 0 | 3.12 |
| 3310 Structural Concrete | | | | | | | |
| 220 Concrete, Ready Mix, Normal Wt | | | | | | | |
| 300 4000 psi | | | | | 84 | | 84 |
| 411 6000psi | | | | | 103 | | 103 |
| 412 8000psi | | | | | 167 | | 167 |
| 1000 For high early strength, add | | | | | 10% | | |
| 700 Placing Concrete and vibrating, | | | | | | | |
| 10 Elevated slabs, 6" to 10" thick, | | | | | | | |
| 1550 With crane and bucket | C-7 | | 110 cy | | 18.9 | 8.75 | |
| 3350 Concrete Finishing | | | | | | | |
| 300 Finishing Floors | | | | | | | |
| 200 Screed, float, hand trowel | 1 Cefi | | 600 sf | 0 | 0.44 | 0 | 0.44 |

| | | | | | | | | | | |
|----------------|-------|----------|----------|----------|----------|-----|-------------|----------------------------------|--------|-------|
| | | | | | 439903.8 | 10% | \$483,894 | Reinforcing | 199182 | |
| Slab Formwork | | | | | waste | | | | | 56909 |
| Quantity | Units | Mat | Labor | Equip | Total | | | | | |
| 284545.5 | sf | 409745.5 | 836563.8 | 0 | 1246309 | | | | | |
| 28454 | sf | 21055.96 | 67720.52 | 0 | 88776.48 | | | | | |
| | | | | | 1335086 | 10% | \$1,468,594 | Formwork | 56909 | |
| Slab Pouring | | | | | waste | | | | | |
| Quantity | Units | Mat | Labor | Equip | Total | | | | | |
| 2459.012 | cy | 227212.8 | 46475.34 | 21516.36 | 295204.4 | | | | | |
| 1053.87 | cy | 119403.5 | 19918.15 | 9221.366 | 148543 | | | | | |
| 1412.186 | cy | 259418.6 | 26690.32 | 12356.63 | 298465.6 | | | | | |
| | | | | | 742213 | 10% | \$816,434 | Concrete | | |
| Slab Finishing | | | | | waste | | | | | |
| Quantity | Units | Mat | Labor | Equip | Total | | | | | |
| 313000 | sf | 0 | 137720 | 0 | 137720 | | | | | |
| | | | | | | | \$137,720 | Finishing | | |
| | | | | | | | \$2,906,643 | Slab-on-grade and Elevated slabs | | |

| Steel Columns | | | | | | | | | | | | |
|--------------------------------|----------|-------|-------|------------|--------|--|----------|----------|----------|----------|----------|----------|
| | quantity | width | width | thick | length | | quantity | Mat | Labor | Equip | Total | |
| HSS | 49 | 4 | 4 | 5/16 | 16 | | 784 | 65.33333 | 9408 | 2319.333 | 53344.67 | 65072 |
| HSS | 4 | 6 | 6 | 5/16 | 32 | | 128 | 10.66667 | 2517.333 | 410.6667 | 10061.33 | 12989.33 |
| 05100 Structural Metal Framing | | | Crew | Daily Outp | Mat | | Labor | Equip | Total | | | 78061.33 |
| 05120 Structural Steel | | | | | | | | | | | | |
| 260 Columns, Structural | | | | | | | | | | | | |
| 4500 4"x4"x1/4"x12' | | | | | | | 144 | 35.5 | 23 | 202.5 | | |
| 4550 6"x6"x1/4"x12' | | | | | | | 236 | 38.5 | 24.5 | 299 | | |

Steel Beams

| | Quantity | Unit | Mat | Labor | Equip | Total | Charles | St. Paul |
|---------|----------|------|--------|----------|--------|----------|---------|----------|
| W 8x10 | 40 | lf | 579 | 172.5 | 88.4 | 839.9 | 40 | |
| W 10x12 | 130 | lf | 4095 | 560.625 | 287.3 | 4942.925 | 30 | 100 |
| W 12x14 | 134 | lf | 2713.5 | 393.625 | 202.34 | 5782.825 | 134 | |
| W 14x22 | 550 | lf | 20625 | 1436.875 | 737 | 22798.88 | | 550 |
| W 16x26 | 286 | lf | 10725 | 740.025 | 380.38 | 11845.41 | 136 | 150 |
| W 18x35 | 480 | lf | 24120 | 1878 | 700.8 | 34644.28 | | 480 |
| | | | | | | 80854.21 | | |

480 pcf
40172 20.086

| 5120 Structural Steel | Crew | Daily Output | Unit | Mat | Labor | Equip | Total |
|---------------------------------|------|--------------|------|------|-------|-------|-------|
| 640 Structural Steel Members | | | | | | | |
| 10 Shop fab-d for bolted conn's | | | | | | | |
| 302 W8x10 | E-2 | 880 | lf | 9.65 | 3.45 | 2.21 | 15.31 |
| 702 W10x22 | | 880 | | 21 | 3.45 | 2.21 | 26.66 |
| 1102 W12x14 | | 990 | | 13.5 | 2.35 | 1.51 | 17.36 |
| 1902 W14x26 | | 990 | | 25 | 2.09 | 1.34 | 28.43 |
| 2702 W16x26 | | 1000 | | 25 | 2.07 | 1.33 | 28.4 |
| 3302 W18x35 | | 960 | | 33.5 | 3.13 | 1.46 | 38.09 |
| 8496 10 to 24 tons, add | | | | 50% | 25% | | |

