A.3 Project Background

A project background has been assembled in order to understand the research methodology behind the Wellington Condominiums Project. The following sections that will detail the Wellington Condominiums Project Background are as followed:

A.3.1 General Building Data

Building Name: Wellington Condominiums

Location and Site: 614 Wharton Boulevard Exton, PA 19341 at the Eagleview Town Square

Building Occupant Name: Wellington Condominiums

Occupancy: Separated Mixed Use Groups of R-2 Residential (Specifically 48 Luxury Condominiums) and S-2 Parking Garage

Size: 147,069 SF (Including Parking Garage)

Number of stories above grade/ total levels: 4 Stories / 5 Levels w/ Parking Garage

Primary Project Team:

Owner:	***The Hankin Group***
General Contractor:	***Wellington Commercial Construction***
Construction Manager:	***Wellington Commercial Construction***
Architect:	***Minno & Wasko Architects and Planner***
Engineers:	***Liberty Engineering***

Chester Valley Engineers

Earth Engineering Inc.

Swirnow Structures LLC

American Panel Tec

Dates of Construction:
Start: 9/26/05
Finish: 5/04/07

Actual Cost: $18,105,952 (Overall Project Cost w/ General Conditions. Not including costs of consultants/services/designs for Architectural/Structural, Civil, Geotechnical, and MEP of the Project.)

Project Delivery Method: Design-Build

Major National Codes:
- 2003 International Building Code
- 2003 International Mechanical Code
- 2003 International Fuel Gas Code
- 2002 National Electric Code
- 2003 National Standard Plumbing Code
- National Fire Protection Agency (NFPA 13, NFPA 13R)
- Americans with Disabilities Accessibility Guidelines (ADDAG)

Residential Zoning Requirements: Uwchlan Township Zoning Ordinance 12 of 1997:

Maximum Building Height: 65 feet
Actual Building Height: 58 feet 4 inches

Building Coverage: 50%

Maximum Building Length: 300 feet
Actual Building Length: 267 feet

Building Setbacks: 25 feet

Maximum Occupant Load: 735 persons

Parking Requirements: 120 peak demand (2.5 / unit)

Maximum Allowable Residential Egress Travel Distance: 250 feet
Actual Maximum Residential Egress Travel Distance: 160 feet

Accessible Means of Stair Egress Capacity: 240 people

Maximum Allowable Garage Egress Travel Distance: 400 feet
Actual Maximum Allowable Garage Egress Travel Distance: 164 feet

A.3.2 Architecture

"Extraordinary Residences Exceptional Lifestyle" is the quote that architects tried to convey and bring to life in the design of the Wellington Condominiums Project. Wellington Condominiums or Wellington Estates is a 4 story luxury condominium located at the heart of the award winning community town center of Eagleview. Wellington is a limited collection of extraordinary condominium homes styled to give the effect of a grand estate homestead. The condominiums have 48 residences which can be up to 2300 square feet in each living space. The 8 designs Willow, Sequoia, Juniper, Cypress, Aspen, Magnolia, Palmetto, and Holy are the floor plans that future homeowners have to choose from with a choice of décor being "traditional" or "contemporary."

The architectural style and philosophy took into account the surrounding nature and environments that encompasses the building. As the name of the eight floor plan designs suggest, Wellington tries to connect nature by introducing huge windows and private balconies to view the luscious forests and strategically laid out parks to the condominiums. This natural and environmental connection with the building and its surroundings was so important to the design that the mechanical units at the last minute were redesigned to be on top of the roof so that future homeowners would encapsulate the entire atmosphere that the owner wanted.

The architectural design also focused on the location and amenities that Wellington Condominiums would offer to the home owners. Being that Wellington was located right at Wellington Square Park, home owners have access to many areas of recreation, concerts, shopping, dining and entertaining right at their door step. No need to drive to go to the mall or stores because everything is within 10 – 15 minutes of casual walking distance. In order to ensure full customer satisfaction, the amenities that where architecturally designed with serious consideration were the underground and indoor parking, building controls and security, and recycling and trash receptions on each floor.

A.3.3 Building System Summary

Building Systems Summary		
Yes	No	Work Scope
	X	Demolition Required
X		Cast in Place Concrete
X		Structural Steel
	X	Precast Concrete
X		Mechanical System
X		Electrical System
X		Masonry
X		Curtain Wall
X		Support of Excavation

Figure 1: Building Systems Summary

A.3.3.1 Cast in Place Concrete

The foundation and first floor consists of a large part of the cast in place concrete that was done on the construction site. The structural engineer has specified in the construction documents that all concrete work except the slab on grade shall have a minimum compressive strength of 6,000 PSI. The type of horizontal and vertical formworks and concrete placement methods of the foundation and first floor elements are described in more detail as followed:

Footings:

- Normal weight concrete with a minimum compressive strength of 6,000 PSI at 28 days
- Reinforcing will consist of A615, Grade 60
- Average size of column footing 15'L X 15'W X 18"D
- Minimum of 3 feet below finished surface where exposed to frost
- Minimum allowable bearing pressure of 3,500 PSF

Slab on Grade:

- 5 inches of normal weight concrete with a minimum compressive strength of 3,000 PSI at 28 days
- Reinforced with 6 X 6 – W2.1 X W2.1 welded wire fabric, over a 14 inch crushed stone sub base and vapor barrier

Foundation Bearing and Shear Wall Construction: (includes exterior and stair and tower walls)

- 8" and 12" normal weight reinforced concrete with a minimum compressive strength of 6,000 PSI at 28 days

First Floor:

- 12" of normal weight reinforced concrete with a minimum compressive strength of 6,000 PSI at 28 days

Since the soil at the time had enough cohesion to stay in place, the foundation strip and column footings did not require any horizontal or vertical formwork. The only task left was to situate the footing rebar and place the concrete with a concrete pump at the locations required. Once the footings were to the strength required, the foundation's exterior walls and columns took form with large gang forms. These large forms took shape very quickly with a 120 ton AmQuip crane tipping up each one into position. The formwork was connected and reinforced into place with lateral bracing. After the formwork was set and properly supported, the rebar was placed in the foundation walls and columns. Following inspection from the project management team, the concrete was placed with a concrete pump and allowed time to gain strength.

After pouring the slab on grade with the concrete pump the next focus was on the first floor. The first floor would be the first encounter and need for horizontal formwork. The formwork consisted of setting up metal shores, stringers, and joists with plywood as the sheathing. The first floor's vertical formwork would also make use of plywood as the ease of handling and construction. The rebar and roughins were situated and the concrete was placed using the concrete pump truck.

A.3.3.2 Structural Steel

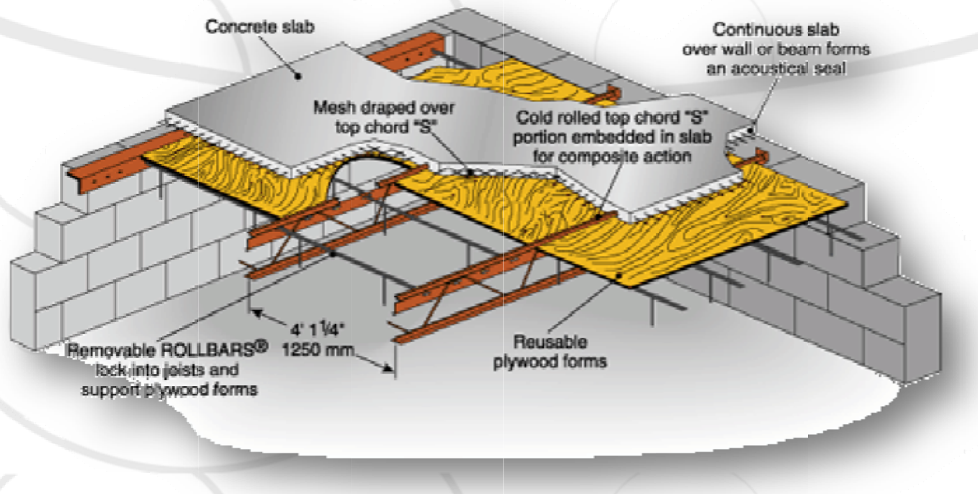


Figure 2: Typical Usage of Hambros Joist System Prescribed by Manufacturer
Reference: www.swirnow.com

The Wellington Condominiums Project did not make use of large structural steel components but is using a very innovative system called the Hambro's joist 3" slab on deck composite system. The second, third, and penthouse floor make use of this system. This floor's bearing and shear wall components were designed into the Wellington Condominiums project by the stud engineer and made use of 4" and 6" metal stud walls at 16" o.c. These walls are capable of carrying the loads directly and therefore make it very easy to lay up this composite system. The general steps with advantages to this system are laid out as prescribed by the manufacturer Swirnow Structures.

1. **Spreading Joists:** Spread Hambro joist at 4'-1 ¼" on load bearing walls
2. **Placing Roll bars:** Roll bars are to keep uniform spacing while providing lateral and tensional stability
3. **Installing Plywood Forms:** Installing the plywood creates a working surface and forms a rigid diaphragm during construction
4. **Mesh In Place:** Mesh over top chord of joist creates a way of reinforcing concrete
5. **Pouring Concrete:** No shoring is required with this system when pouring concrete. The minimum thickness requirement is 2 ½". The Wellington Condominiums project makes use of 3" slab thickness.
6. **Stripping Formwork:** When concrete reaches strength of 500 PSI (usually the day after the pour) the plywood forms can be taken out. When the concrete

reaches strength of 1000 PSI (usually within 48 hours) the deck is ready for other trades and the formwork can be removed for future re-use.

The 150 ton AmQuip mobile crane utilized on the project will work around the building as required. The crane after placement of all floors/ceilings will then continue to be of service when the metal roof trusses are installed. With road access to all sides of the building structure there is no great danger of conflicts when the concrete trucks and cranes are working simultaneously.

A.3.3.3 Mechanical Systems

There are no mechanical rooms to the condominiums but many mechanical closets. On the garage level there are two mechanical closets centrally located in the garage. The other mechanical closets are located in each condo and supply air for that particular condo. The system is an all air and distributes the air through insulated metal ductworks.

In a little more detail, the garage HVAC systems primary concern is air flow with car pollutants. Proper ventilation is critical when the comfort and safety of homeowners is on the line. The designers from Liberty Engineering have specified that 2 main intake lovers 162 X 30 NCA Model XAD – 6 –GL with motor operated control be installed on the north and south side of the garage. On the east face of the building 6 9300 CFM Jenco fans model FSWE – 302A remove the containments that are entered into the building. Two mechanical closets centrally located in the garage each holding a Renzor CAUA indoor gas fired heating units. The heating units are then connected to 18” diameter fabric ductwork that can supply 2200 CFM. This ductwork is attached to the slab above and run the lengthways of the structure. Two gas meters on the building's south east side supplies natural gas to the heating units and other parts of the building where needed.

Other rooms worth mentioning of systems involved are the electric/telephone/cable room, sprinkler room, and elevator rooms. Each room has a 24 X 8 transfer duct that sends in 500 CFM of air directly from the space. The electric/telecommunications/cable and sprinkler rooms have a Q Mark electric unit heater. This unit heater would take the intake air and mix to the temperature required for that space. A 500 CFM Jenko Fan model FDWE – 123A on opposite sides of the room exhaust return air back into the space. The two centrally located elevator rooms also contain a 24 X 8 transfer duct that brings in air from the garage space. These rooms contain a Carrier packaged terminal air conditioning unit which has a capacity of 350 CFM. No electric unit heaters are located in these rooms but they do contain a 500 CFM Jenko Fan model FDWE – 123A to exhaust the return air back into the garage space. Four carbon monoxide detectors are spread across the entire footprint of the garage to detect any large levels of carbon monoxide present from the fumes of cars.

The stairways only contain a Q Mark electric wall heater model AHW - 44083 on the garage floor level. No other return air or supply air acts in the stairways. All refuse rooms from the garage floor up to the penthouse are connected by a main vertical ductwork for return air. This return air is then sent to a 900 CFM Jenko Fan model LPX 120A that is located on the roof. The typical air distribution for the main hallways are two 630 CFM Trane split – system heat pump units with a Metalaire V400 mixing chamber. The fresh air supplied to this system come directly from the roof's Metalaire 5000 air inlet and Trane Condensing Units. This air inlet is fed through a vertical shaft closet to each floor level. No return air distribution system is installed in the main hallways and corridors. It is assumed that the return air is lost through opening of doors, stairs, and elevator shaft. Also a buildup of high pressure is recommended during a fire. Most likely area for a fire is in the condos and if high pressure is built up in the hallway the less likely smoke will occur in the hallway.

The condominiums HVAC systems begin in their own separate mechanical rooms. Each mechanical room is connected to its own Trane condensing unit located on the roof and contains a Trane cooling coil and gas fired furnace. This is then connected into the mixing chamber and then supplied by air ducts off to each room in the condo. There is only one return air duct that is centrally installed into the condos for reuse of air in the mixing chamber. Ductworks from bathroom exhaust air outlets connect back at the mechanical room and are supplied up to the roof to a Jenco Fan. Also typical on the condos façade is a dryer and range hood vent and a gas and fireplace flue. On the roof there is also roof and elevator relief vents for to balance the buildings inner environment conditions.

A.3.3.4 Fire Protection

The life safety operations of the building are all hardwired to the emergency control panel of the building. The sprinkler piping main line comes into the north side of the building and connects to the sprinkler system in the sprinkler room. The sprinkler pipes are then distributed to each floor level where the main piping is branched off into smaller circuits for diffusion. The sprinkler heads used for fire protection are dry type sprinkler heads. This system is also powered and controlled by the fire alarm panel.

A.3.3.5 Electrical

The incoming primary electrical duct bank runs along the west side of the building and into two step down transformers. The primary duct bank has six 4" schedule 40 PVC conduits which 2 will be used for service. The incoming cable duct bank has four 4" schedule 40 PVC conduits which all four will be used. From the transformers the primary duct bank goes into a secondary duct bank and into the building's electrical/telecommunications/cable room main distribution switch board (MDSB). The secondary duct bank encases eight 4" schedule 40 PVC conduits which 5 are used. The main service feed for the MDSB is 1600 ampere, 3 phase, 120/208 V, 38 KAIC rated. The physical size of the MDSB is estimated to be 90"H X 102"W X 28" D. The MDSB feeds into Meter Bank's A, B, C, and D, and the House Distribution Panel (HDP). The four meter bank serves all functions that the condos require in the building. Two meter banks share each feeder run up to their proper level. From there each condo gets fed a service of 125 ampere, single phase, 3 wire, and 120/208 V into their own panel board. The HDP services the elevator motor #1 and #2, HVAC, lighting and receptacles for all floors (other than the condos). The fire alarm panel is fed separately and controls the main sprinkler, elevator control panel, remote enunciator, and all life safety functions of the building. Overall the electrical engineers have designed this system to allow for some redundancy by having the primary duct bank only utilizing two out of the six 4" schedule 40 PVC conduits, the secondary duct bank only utilizing five out of eight 4" schedule 40 PVC conduits, and extra space and spares left on the circuit boards of emergency panels and condos. It is very important to do this because of the ever increasing growth of technology. If a building is able to expand and grow with technology the better able the building is to adapting to an ever constantly changing world.

A.3.3.6 Masonry

To achieve such high standards, the architects and planners first decided on what exterior material to use that was equally appealing and durable at the same time. After much contemplation, the architects and planners determined that the Wellington Condominium's building façade was to consist of predominately a stylish brick and elegant cast stone exterior veneer**.** The transitions of façade materials are central to creating a pleasing environment with future homeowners. The cast stone veneer is primarily situated on the first floor building façade, is utilized around windows and doors as pre cast headers, and serves as a pre cast band and trim linking the transitions of façade materials. From the first floor to the upper floors the elegantly placed cast stone veneer serenely evolves into a modish and colorful brick. The brick façade continues up to the roof line where it is met by a 1 x 12 Azek Trim Board with Fypon BKT8X8x4 décor. Also scattered across the building façade is pre cast medallions and ornamentation to give the condominiums a refined and polished look.

The type of connection for the masonry is typical among the construction industry. The system that holds the façade and interior walls together is 22 gauge galvanized metal ties. The specifications call for the following list of items to be completed for the correct installation of anchoring masonry veneers:

1) Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
2) Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.
3) Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4) Space anchors by no more than 16" o.c. vertically and 24" o.c. horizontally with not less than 1 anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12" of openings and at intervals, not exceeding 36", around perimeter.

With all the early delays on the project it has pushed construction of the building façade to the winter months of 2006. This creates logistical issues on how to construct the building façade and keep on schedule. Sometimes the winter months can be harsh in Pennsylvania therefore proper weather days accounted for cannot be overlooked. With that in mind, the scaffolding at this current time is through the use of a typical metal modular frame scaffolding system. This system is very easy to assemble and light to handle. This system if done in the winter would have to be protected from the winter elements and provide a proper work place for all construction workers. Decreased productivity will result if the scaffolding operation is not properly planned for in the winter months.

A.3.3.7 Curtain Wall

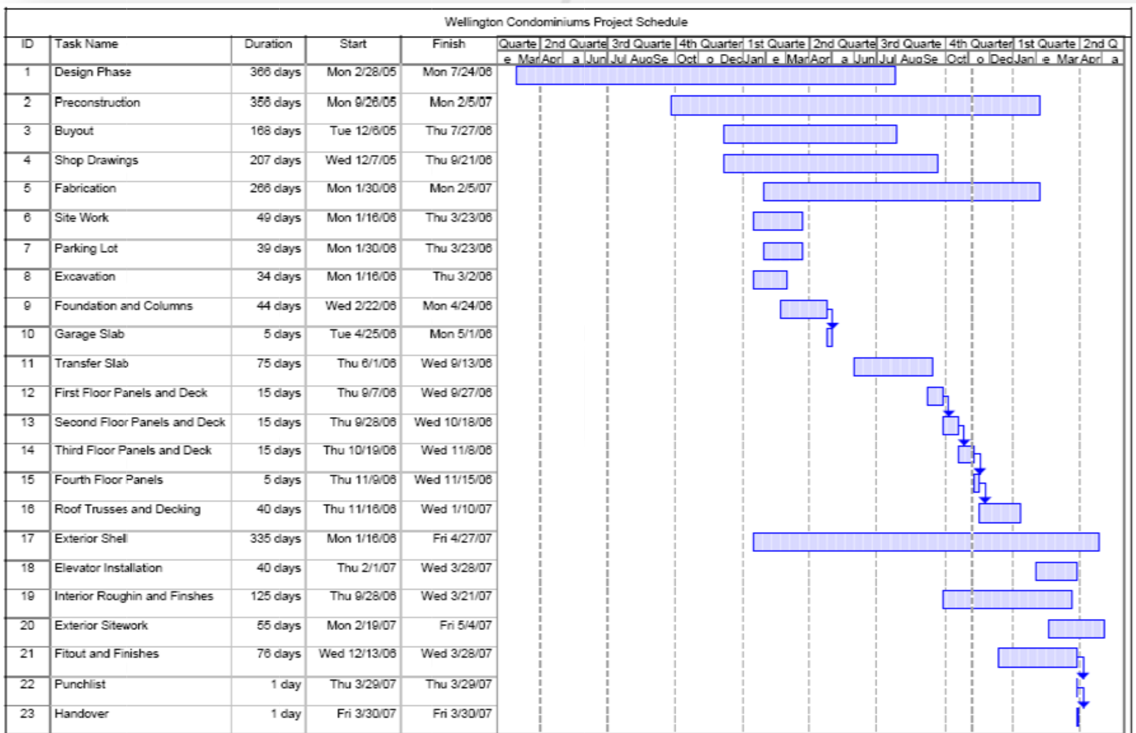
The composition of the 1 hour fire rated exterior wall section of the first through the fourth floor starting from the exterior to the interior are as follows: brick/stone veneer, metal ties, 1 ½" minimum air space, 15" building felt, 5/8" dens glass gold sheathing, 6" metal studs, R-19 batt insulation, vapor barrier, and 5/8" type 'X' G.W.B. The foundation wall which encloses the parking garage has architecturally exposed concrete and is composed of with the following: a fluid applied waterproofing membrane extended to cover footing, a bituthene liquid member joint sealant, and a 12" concrete foundation wall.

The construction methods in producing a sustainable curtain wall starts with having a solid foundation. Once the foundation is constructed the shell of the building structure can be built. For the Wellington Condominiums the base utilizes a concrete floor and walls while the upper levels consist of composite decking with metal stud wall framing. Once the main framing of the exterior is complete the curtain wall can then begin construction. Starting from the base and working your way up with scaffolding placing stone and brick veneer at the locations the drawing documents require. The construction of the building curtain wall will take a little more time due to the fact that is being constructed in the winter but the schedule has taken into the account of possible weather day occurrences. The design responsibility falls directly on the structural engineer in specifying the ties and loads present. The contractor is responsible for the correct placement of the curtain wall elements and is to make sure construction is up to code requirements. For example the contractor is responsible that all concrete masonry units be ASTM C90 grade N and have a minimum compressive strength of 1900 PSI, provide temporary bracing for masonry walls during entire erection of walls until adequate strength is developed (usually 7 days or longer), all 8" masonry walls be reinforced with #5 @ 32" vertical minimum, and fill masonry wall cores containing reinforcing with coarse grout.

A.3.4 Project Schedule

The following sections will give an overview and detailed breakdown of the Wellington Condominiums Project Schedule. With the owner as a developer and early delays on the project, time is a major factor for the project team and is outlined as followed:

A.3.4.1 Project Schedule Overview



Wellington Condominiums Project Schedule

ID	Task Name	Duration	Start	Finish
1	Design Phase	366 days	Mon 2/28/05	Mon 7/24/06
2	Preconstruction	356 days	Mon 9/26/05	Mon 2/5/07
3	Buyout	168 days	Tue 12/6/05	Thu 7/27/06
4	Shop Drawings	207 days	Wed 12/7/05	Thu 9/21/06
5	Fabrication	266 days	Mon 1/30/06	Mon 2/5/07
6	Site Work	49 days	Mon 1/16/06	Thu 3/23/06
7	Parking Lot	39 days	Mon 1/30/06	Thu 3/23/06
8	Excavation	34 days	Mon 1/16/06	Thu 3/2/06
9	Foundation and Columns	44 days	Wed 2/22/06	Mon 4/24/06
10	Garage Slab	5 days	Tue 4/25/06	Mon 5/1/06
11	Transfer Slab	75 days	Thu 6/1/06	Wed 9/13/06
12	First Floor Panels and Deck	15 days	Thu 9/7/06	Wed 9/27/06
13	Second Floor Panels and Deck	15 days	Thu 9/28/06	Wed 10/18/06
14	Third Floor Panels and Deck	15 days	Thu 10/19/06	Wed 11/8/06
15	Fourth Floor Panels	5 days	Thu 11/9/06	Wed 11/15/06
16	Roof Trusses and Decking	40 days	Thu 11/16/06	Wed 1/10/07
17	Exterior Shell	335 days	Mon 1/16/06	Fri 4/27/07
18	Elevator Installation	40 days	Thu 2/1/07	Wed 3/28/07
19	Interior Roughin and Finshes	125 days	Thu 9/28/06	Wed 3/21/07
20	Exterior Sitework	55 days	Mon 2/19/07	Fri 5/4/07
21	Fitout and Finishes	76 days	Wed 12/13/06	Wed 3/28/07
22	Punchlist	1 day	Thu 3/29/07	Thu 3/29/07
23	Handover	1 day	Fri 3/30/07	Fri 3/30/07

Figure 3: Project Schedule Overview

As the project schedule shows, the preparation for the construction site took a lot of time before the foundation system could be installed. Being that the project was fast tracked; the team had to communicate effectively on the issues of poor quality subsurface conditions. This took a lot of time and reorganization of how the structure would be built but once the permanent dewatering system and soil compaction was completed the actual construction of the foundation footers, walls, columns, and slab could begin. The most critical part of the schedule came when the 12" transfer slab was being constructed. This took by itself 75 days to complete and was very critical to the project being completed on time. Once the transfer slab was completed, the rest of the structure was erected with the

innovative composite deck system. Some of the disadvantages to the schedule are installing the final decking and roof trusses in the middle of winter. For that reason shingles cannot be installed until the following spring when the temperature reaches at least 40 degree Fahrenheit.

Another point worth mentioning is that the building envelope is continually being worked on from the start for installing waterproofing, membranes, etc. and trying to enclose the building as soon as possible. Brickwork is not scheduled to start until January 8, 2007. This creates a longer duration of 80 workdays to lay the brickwork due to the fact of weather days and decreased productivity. The rough in and finish sequences follow very closely to the structural sequence since the project utilizes a new composite deck system. This is where the schedule saves time and allows for the finish trades to get started earlier than usual. To the developers and owners on the project any way the project team can save time but not necessarily money is of great value. The sooner the project can reach the handover date the sooner the revenue can come in.

A.3.4.2 Detailed Project Schedule

A detailed project schedule was developed for Wellington Condominiums to provide a breakdown of the construction phasing and sequencing. The project schedule begins with preconstruction on September 26, 2005 and ends on May 4, 2007 with exterior landscaping. A highlight breakdown of the project schedule is as followed:

- **Preconstruction:** *355 Days Scheduled From Sept. 26,2005 thru Feb. 5, 2007*
  - Project Management
  - Buyout
  - Shop Drawings
  - Fabrication

- **Construction:** *340 Days Scheduled From Jan. 16,2006 thru May 4, 2007*
  - Exterior
    - Site Work
    - Parking Lot
  - Substructure
    - Foundations & Columns
    - Garage Slab
    - Transfer Slab
  - Superstructure
    - Wall Panels & Hambros Composite Deck System
    - Roof Trusses and Decking

- ♦ Arriscraft & Brickwork
- Interior Shell
  - ♦ Non-load Bearing Partitions
  - ♦ MEP Rough-in and Distribution
  - ♦ Drywall & Finishes
- Fit out
  - ♦ Phase 1
  - ♦ Phase 2

~See the Attached Appendix for the Detailed Project Schedule~

A.3.4.2.A Brief Analysis

A.3.4.2.A.a Critical Point in Schedule

The detailed project schedule breaks down how the project will flow throughout construction. The transfer slab is a key transition point to the flow and sequence of the project. It takes the project team 65 days to complete the 12” thick 6,000 PSI strength concrete pour versus only spending 60 days to complete the entire foundation systems. If a schedule reduction or acceleration is needed on this project the transfer slab would be the first sequence that should be looked at. After the completion of the foundation and transfer slab sequence, the 4 story superstructure takes 172 days to complete.

A.3.4.2.A.b Phase 1 and 2

Near the end of completion before handover, a phase 1 and phase 2 are established on the project schedule. Phase 1 and 2 include final framing, rough-in, finishes, and punch list. After the main load bearing walls and MEP rough-in and distributions are installed these phases are then utilized. As seen in the diagram below, the structure is cut into two work zones named phase 1 and phase 2. Phase 1 begins trades on the first floor and then moves floor to floor completing condominiums only in the area highlighted. Phase 2 is scheduled to start and finish 28 days after phase 1. The project team decided to do this to speed up the time for handover and make one of the condominiums a show room for potential home owners. Caution must be taken when trying to accelerate the schedule and setting up phases like this. Home owners will be moving and living in phase 1 potentially while construction is in the process of phase 2. How a worker enters the space and how is each room and floor sequenced are questions that the project team must pay attention to when constructing.

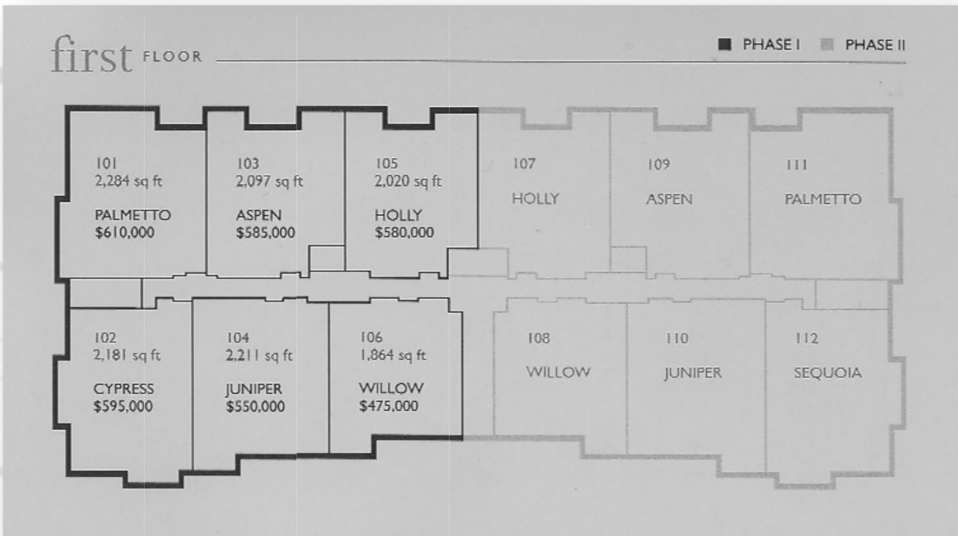


Figure 4: First Floor Phase 1 and 2 – Wellington Commercial Construction

A.3.4.2.A.c Project Delays

The project schedule attached is an updated best case scenario for the project to be completed. The project team has faced many challenges and has delayed the schedule numerous times. Some of the reasons why the schedule has been delayed are as followed:

- Poor Subsurface Conditions
- Architect and Local Township Approvals
- Change Orders by Owner
- Learning curve to installing new Hambros Joist Composite Deck System

A.3.5 Project Cost Evaluation

The Wellington Condominiums Project Cost Evaluation has been broken down to compare with industry standards utilizing D4 Cost Estimate and RS Means. An assemblies and detailed estimate have been compiled in the following sections of the building envelope and structural system respectively. Also a General Conditions for the Wellington Condominiums Project have been attached for project estimating reference.

A.3.5.1 Actual Building Cost

Actual Building Cost:

- $17,818,947
- At 147, 069 SF – $121.16/SF

Total Project Cost:

- $18,105,952
- At 147,069 SF - $123.11/SF

Building System Costs:

- Mechanical: $1,137,000 - $7.73/SF
- Electrical: $1,541,212 – $10.48/SF
- Structural: $3,257,291 - $22.15/SF
- Site work: $776,348 – $5.28/SF
- Plumbing: $890,000 - $6.05/SF
- Fire Protection: $270,000 - $1.84/SF

A.3.5.2 D4 Cost Estimate

~See the Attached Appendix for the D4 Cost Estimate~

A.3.5.3 R.S. Means Building Cost

2006 RS Means Square Foot Costs			
UsedSection M.020 Apartment, 4-7 Story, 100,000 SF			
General Estimate	**Quantity**	**Unit Price**	**Amount**
Face Brick w/ Concrete Frame	116349 SF	$130.70/SF	$15,206,814.30
Added Revisions			
Garage	30,720	$27.30/SF	$838,656.00
Elevators	2	$127,300/Unit	$254,600
Emergency Lighting	50	$259/Unit	$12,950
Smoke Detectors	250	$164/Unit	$41,000
Ovens	48	$1000/Unit	$48,000
Trash Compactors	1	$600/Unit	$600
Garbage Disposal	48	$200/Unit	$9,600
Hood Vents	48	$500/Unit	$24,000
Assumptions:		**Total:**	$16,436,220.30
Based Calcultions on RS Means Max Data of 100,000 SF (Wellington Condominiums 116,349 SF)			x 1.02 location factor (Allentown, PA)
Used mid to high unit prices for added revisions			**$16,764,944.71**
Assumed Brick and concrete frame structure			

Figure 5: R.S. Means Estimates

A.3.5.4 Discussion

Actual Building Cost:
- **$17,818,947**

D4 Estimate Building Cost:
- **$17,460,844**

R.S. Means Building Cost:
- **$16,764,944.71**

From the information provided the estimates and actual building costs are very good. The methods performed for the two estimates were done in very dissimilar manners therefore differences are to be expected. The RS Means data goes by the average project cost in the United States today. The Wellington Condominiums Project is not an average apartment complex but has a higher level of quality demanded. Also Wellington Condominiums project is a little higher square footage then the 100,000 square foot industry project

average. Therefore being that RS Means bases its calculations off an industry average and lower square footage estimate the estimate should be a little low as shown.

The D4 estimate made use of two closely related residential projects of similar characteristics to the Wellington Condominiums. One project called Eola South Residential Condominium is a four story complex of the same structure system but has a smaller cost and square footage footprint. The Convent and High School project was very similar in size and cost but has some different structural systems to the project. Therefore to gain a better cost estimate of the project the two projects were averaged to get the results shown. The D4 Estimate Program recommends that if one project is to be manipulated then the analysis should stay within 20%. The Eola South Residential Condominium as mentioned had a sizeable difference in square footage and therefore the averaging system was utilized for the best results possible. The D4 estimate was very accurate for what is to be expected for a project of this size and style. One of the major reasons for the difference in the D4 estimate and actual building cost data is that the actual building costs includes change orders. Most of the change orders are from bad soil conditions that were encountered on the project and added just by itself over $160,000. There were other change orders that added to this amount and made the actual building cost higher than the estimates. Also the Wellington Condominiums are utilizing very expensive materials like granite countertops and add additional costs to the project.

A.3.5.5 Assemblies Estimate

An assembly’s estimate was created for the building envelope system. The estimate includes the concrete foundation, brick/cast stone façade, doors and windows, and roof skin composition. The estimate was broken down with reference to 2006 RS Means Assemblies Estimating Guide. A location factor was applied to the estimate for Allentown, PA for each category as listed in the attached assemblies estimate.

~See the Attached Appendix for the Assemblies Estimate~

A.3.5.5.A Brief Analysis

A.3.5.5.A.a Assumptions

A list of the following assumptions has been made for the attached assemblies estimate and is as followed:

- Doors and Windows are similar in size and composition
- The building is rectangular in form with no other façade protrusions
- All material and equipment needed for installation are included
- Concrete walls are 12’ and not 8’ in height

- Metal stud walls are 22 gage not 20 gage in composition
- Copper Gutters are 6” half round not 5” half round

A.3.5.5.A.b Comparison of Assemblies Estimate v. Actual Project Estimate

The total amount for the assemblies and actual estimates are listed as followed:

- Assemblies Estimate: $1,966,198.55 = $13.37 / SF
- Actual Project Estimate: $1,958,226.00 = $13.32 / SF
- Estimate Difference: $7,972.55 = 0.41%

A.3.5.6 Detailed Structural Systems Estimate

An estimate for the cost of the entire superstructure was analyzed for the structural systems. To calculate more accurately the amount of formwork, rebar, and concrete utilized on the substructure a program called RAM Concept was utilized. A 3D model of the structural system was developed to calculate more accurately the system. Below are figures of the RAM Concept program utilized for the detailed structural systems estimate. The superstructure of the building was calculated manually with the guide of 2005 Cost Works software.

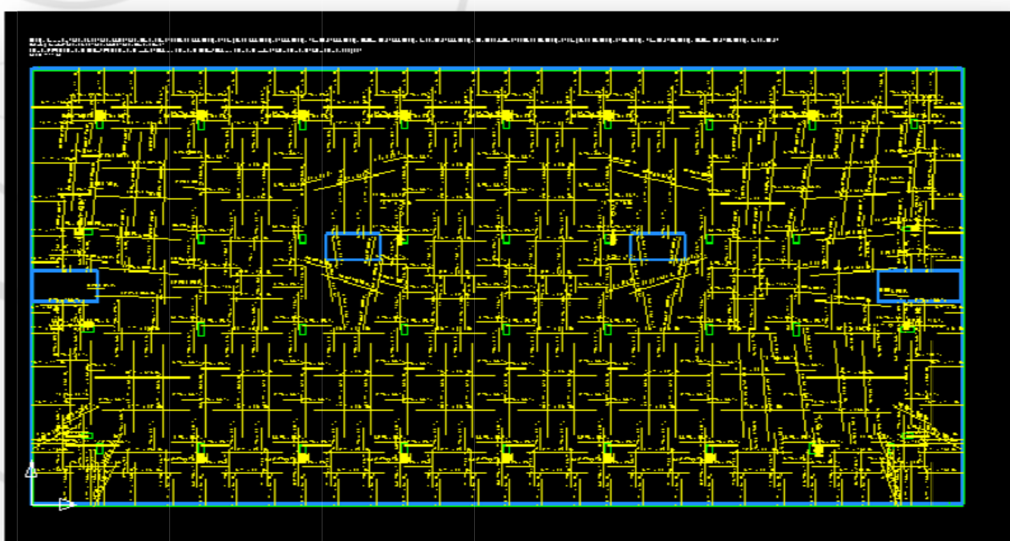


Figure 6: Transfer Slab Rebar Placement – RAM

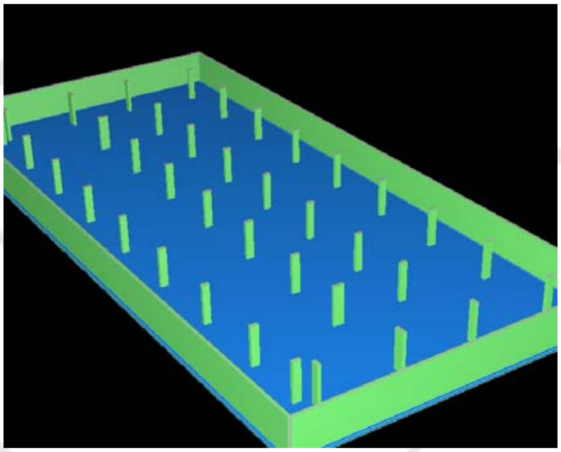


Figure 7: Foundation – RAM

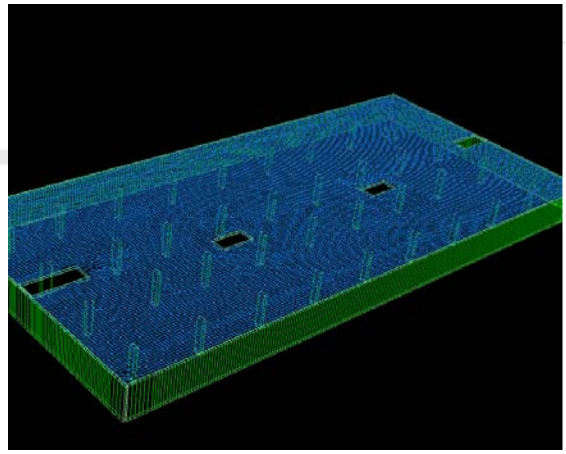


Figure 8: Transfer Slab – RAM

~See the Attached Appendix for the Detailed Structural Systems Estimate~

A.3.5.6.A Brief Analysis

A.3.5.6.A.a Assumptions

A list of the following assumptions has been made for the attached structural estimate and is as followed:

- Concrete is 6000 PSI strength not 5000 PSI strength
- No vapor barriers/insulation/waterproofing/non load bearing walls
- No stairways or elevators
- Foundation wall forms include temporary shoring
- No expansion joints, inserts, sleeves, chases, splicing
- No metal roof framing – design and built by specialty company
- Accessories/tools found in general conditions
- No Waste was included in calculations
- Balcony reinforcing similar to other parts of composite deck
- Not including steel W members assume part of metal stud framing
- The second, third, and forth floor the same
- No detail connections required for joist members
- Footings on the same grade and reinforcing

A.3.5.6.A.b Comparison of Detailed Estimate v. Actual Project Estimate

The total amount for the detailed and actual estimates are listed as followed:

- Detailed Estimate: $1,966,198.55 = $13.37 / SF
- Actual Project Estimate: $2,530,307.00 = $17.20 / SF
- Estimate Difference: $564,108.45 = 3.12%

The results are different due to the fact the detailed estimate performed did not take into consideration waste or the need of such things like detailed connections or splices. The detailed estimate is a near perfect representation of everything performing up to expectations without delays or problems. Just the structural miscellaneous metals on the project were alone budgeted for $200,000.00. To compare more accurately the estimates, if add a factor of 20% for waste, detailed connections, and miscellaneous metals the totals are as followed:

- Detailed Estimate: $2,359,438.26 = $16.04 / SF
- Actual Project Estimate: $2,530,307.00 = $17.20 / SF
- Estimate Difference: $170,868.74 = 0.94%

A.3.5.7 General Conditions Estimate

An estimate for the general conditions was assembled for the Wellington Condominiums Project. Part of the estimate includes the following costs: management team, inspections, permits, temporary signs, temporary utilities, construction trailers, tools, and punch list. What are not included in the general conditions are consultants and geotechnical services. These costs are paid for by the owner of the project and not on the general conditions.

~See the Attached Appendix for the General Conditions Estimate~

A.3.5.7.A Brief Analysis

A.3.5.7.A.a Comparison of General Conditions Estimate v. Industry Standards

The total general condition cost for the Wellington Condominium project is $692,725.00. The percentage of the total construction dedicated to the general conditions is 3.83%. The 3.83% of total construction cost that the general conditions accumulate are low in today's construction industry.

A.3.6 Site Plan of Existing Conditions

Two Site Plans have been assembled for the Wellington Condominiums Project. A General Site Plan of the Utilities and a Superstructure Phased Site Plan are outlined in the following sections:

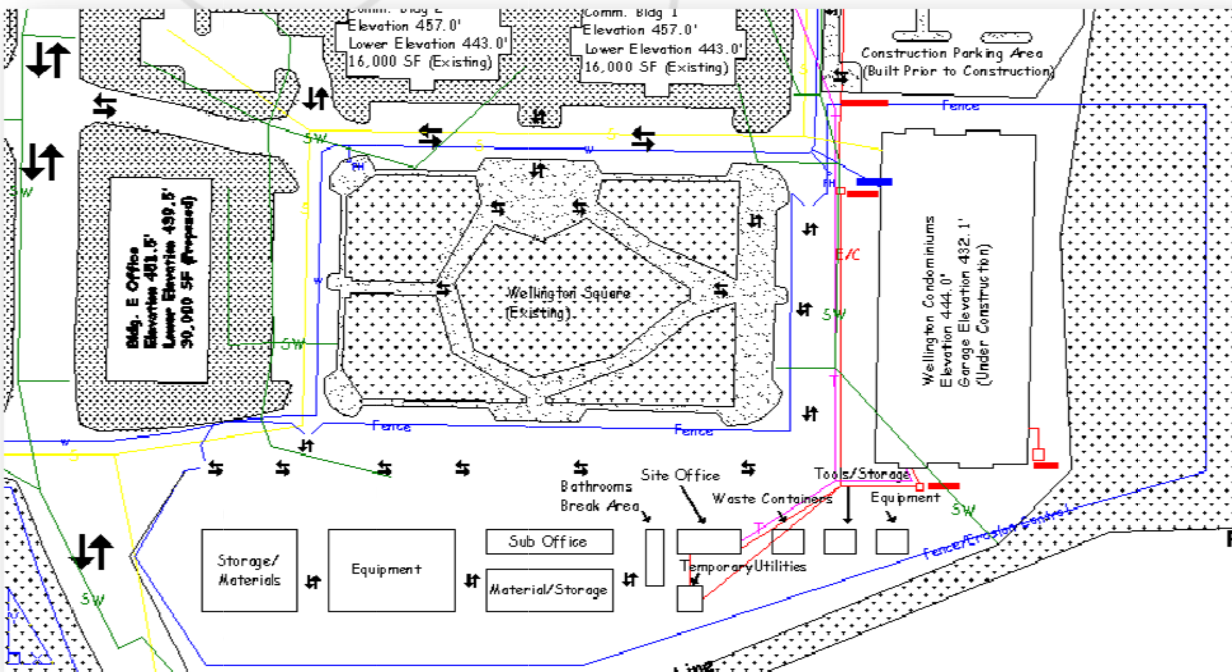


Figure 9: Wellington Condominium Site Plan

~See the Attached Appendix for the Enlarged Site Plan~

A.3.6.1 Superstructure Phased Site Plan

A more in depth study of the superstructure phase was utilized through the use of a site plan. The critical phase of the Wellington Condominium project is the construction of the first floor transfer slab and installation of a repeated load bearing stud walls and Hambros joist composite deck system. Sixty five days is spent constructing the transfer slab and the project has before been delayed numerous times. At that current time it was imperative for the project team to be efficient and accelerate the schedule to get back on track. A good way of proper site planning and organization is to sequence the work through the use of a site plan.

~See the Attached Appendix for the Superstructure Phased Site Plan~

A.3.6.1.A Brief Analysis

A.3.6.1.A.a Key Site Project Zones

The superstructure phased site plan has three main zones named: the unloading and traffic vehicle zone, the storage/equipment/office zone, and the construction zone. These zones offer different functions to the job site for safety and organization. The proper layout of material/equipment/vehicle pathways and sequencing of work is critical to the success of accelerating productivity on the project site. Needed equipment, tools, and material are placed in each zone by the management team to ensure that crews do not have to travel from one side of the site to the other. All other materials that are not needed are secured in designated storage areas.

A.3.6.1.A.b Superstructure Sequence

The superstructure phase can be broken down to three main stages of construction. The first stage is doing the floor pour. A concrete pump is used around the entire structure pouring the 4 bays. The concrete pours work in a counterclockwise fashion from the north east corner of the construction zone. The concrete pump and trucks work around the site as noted in the site layout plan until all pours have been completed. Once the concrete pour is completed a 120 ton crane is then positioned on the north side of the building structure to place load bearing metal stud walls. The walls are sequenced and placed so that the crane can easily pick them up and bolted/welded into place without wasting time. The flow of work in placing the metal studs and future construction work will go from the north to the south side of the structure. After the metal studs are in place the Hambros joist composite deck system can be installed as detailed in the site layout plan. This work flow sequence of concrete pours, stud wall placement, and composite deck system will continue right through to the fourth floor. Initially a learning curve for the crew is to be expected with the new composite deck system and work sequence. As construction continues the project team expects productivity to increase and schedule time savings.

A.3.6.1.A.c Critique of Contractor Layout

The site layout utilized by the contractor at this current stage has worked fairly well. When at the project site the delivery truck drivers and construction workers felt that the site layout did the job. Delivery Trucks come from the north end entrance and get unloaded at the construction zone or the designated unloading and vehicle traffic zone. Once the truck is unloaded they proceed to exit out the west side of the site without having to turn around. Construction workers did not have a problem when it came to parking. Ample parking spaces surround the construction site allowing the flexibility of

workers to park wherever they see fit. The project management team reorganized the schedule to build the parking lot before construction started. By many construction workers this had made work on the construction site much more productive.

Some of the areas that I can see improvements in are accessibility to floor work zones and waste removal. As noted in the attached site layout plan, there are only two ladder access points for workers to reach above grade levels. Both ladders being on the south east side of the structure. There should be more ways of easily moving up and down floors while construction is underway. Workers trying to hall equipment back and forth everyday can create issues and lost productivity time. By placing material hoists or more ladders around the structure will create more productivity and worker morale. Another issue is waste removal on the project site. The waste containers are located on the south side of the project site. This means that any waste must be hauled to this location for removal. If these waste containers are put on either end of the job site less hauling would have to be required by equipment.

A.3.7 Local Conditions

The Wellington Condominiums Project is located in Exton, Pennsylvania, where to the project team's knowledge the area does not any preferences to what method of construction have is presented to them. The most important thing to the project team is not whether or not it is a steel or concrete building rather what is the fastest and best way to constructing the building. The condominiums project features a new composite deck system which saves time and money for the developer. It makes use of steel and concrete and at first takes longer to install then scheduled due to the learning curve involved in constructing the composite decks. But once an established repetition is put into motion the faster the crews get as they go up floor by floor. Also the Chester County Local District doesn't establish rules or regulations on whether union or non union labor forces are required for this area. This gives the project team some flexibility in picking who they would want on the job and take out the factor if or if not they is union laborers.

The project also features the construction of a new parking area for the Wellington Condominiums before the building footprint ever takes rise. In the original design the parking lot was supposed to be the stockpile of excavated material that would be used at a later time. The project team decided that a parking lot would be preferred due to the lack of space during construction. During the site work phase of the schedule, the material was shipped elsewhere so that the parking area could be built at the time of excavation. This proved to be a great decision in that it gave extra parking for not only the people on the construction site but other local business as well. This was one way to give some positive reception to the community's patience for when trucks and huge equipment were digging,

creating noise and dust, and creating what might look like a sizeable hole in the ground to local residences.

The project makes use of recycling and proper disposal of waste at the south side of the construction site. This project is not going for a LEED rating but the developers and owners of the project have experience in LEED rated buildings. The fee for disposing of waste will run you $500 per dumpster in Chester County. It is expected on the construction site to go through about 60 dumpsters totaling $30,000 in getting rid of waste for the project duration. Also simple things like reusing plywood for forms are a big thing on the Wellington Condominiums Project. With the use of the new composite deck system, plywood forms can be used many times without having to throw them away. This is just one of the many ways that the project team has thought of for recycling and disposing of materials.

The subsoil conditions on the construction site as specified in the geotechnical report from Earth Engineering was not very good and that a good portion of the sub grade soils would have to be removed and replaced with structural fill. This material as specified by the specifications and recommendations of the geotechnical engineers was that if the structural fill was placed and properly rolled or vibrated that the subsoil would be able to properly distribute the loads from the building's foundation. Another cause for alert to the project team in the geotechnical report was that the foundation floor grade was under the groundwater level. If the design was to stay as planned the whole bottom third of the foundation would be underwater. The geotechnical engineers offered two solutions to the problem in both raising the foundation up to where the Uwchlan Township zoning would specify or permanent dewatering systems and waterproofing would have to be instituted to the design. The architects and designers felt that it was best to proceed with installing permanent dewatering systems with waterproofing.

Another problem with continuing the original design is substantial excavations below the existing grade would have to be done to achieve the proper amount of required structural fill. This would result in having to rock excavate and use equipment like hydraulic hammering, splitting, or other rock removal techniques. Blasting was not recommended therefore a rock crusher and other equipment would have to be brought on to do the job. All these added expenses can be seen in the estimate to how much it costs the developer and owner. The total expenses just for poor subsurface conditions not including the dewatering and waterproofing systems was well over $160,000. This also delayed the construction and handover date for the project. Other means and methods would be achieved to try to accelerate the schedule as best as possible and try to make up for lost time from having to deal with poor subsurface conditions.

A.3.8 Client Information

The owner of the project is the Hankin Group and is a development company that owns a large portion of the land in the area. Hankin Group has its roots in being a family owned company that has been developing real estate and communities for a long period of time. Hankin group is recognized as a leader in developing high quality homes and communities in the construction industry. In the recent years the company has developed commercial and industrial parks that well suit the residential areas. The company takes great pride and devotion to how the communities are organized and how to develop the land for future use. The company is very sound in commitment to the communities that they developed and have very strong company values and ethics in doing good business with and for others.

One of the main reasons that Hankin Group went forth with the Wellington Condominiums was that the building would offer home owners a luxury style home right at the center of the local community town square. The ease and convenience of walking out your door and being walking distance to shops and offices was something of great demand. Also with the boom of the residential market in that area for the past few years the opportunity presented itself and Hankin Group then gave the project the green light to start construction. The expectation's from the owner's perspective is only the very best in quality. Top of the line materials and construction are utilized in order to attract the higher cliental. Granite countertops, wooden floors, walk in closets, large bay windows, private balconies, etc. are some of the things that Hankin group has pushed for in the design of the condominiums. Safety is something else that the developers take seriously and is their number one issue when it came time to constructing the project. The project team enforces to all subcontractors of the proper ways of construction so that it is safe to not only to them but future home owners as well. The schedule is another important issue to Hankin Group. The faster the project is constructed, the faster people will want to move in. Future buyers even with the nicest of renders do not want to buy something of great value without ever seeing a building. Once the building takes form, future home owners can see progress made and make the decision to buy a condo. It is up to the project team's best interest to construct the most efficient way possible and still keep the quality of the project at high standards. The cost even though it is not the largest concern is still something that they pay very close attention to. Hankin Group is a business and in order to stay in business it has to make money. If the costs are in check and the quality and schedule is up to par then the Hankin Group is very content with how the project performs.

The main sequencing issues that are of interest to the owner are when it is time for people to move into the condos. The sooner the future home owners can move in, the faster the owner can get their money. During construction the owner is most concerned with getting out of the ground and seeing a structure being developed. The transfer slab is the big stepping point for the project and once that is complete the rest of the structure will go up very quickly. Once the building starts taking form the building can start being enclosed and initiate the selling of condos.

Some of the keys to completing the project to the owner's satisfaction are to produce a high quality project on time and if possible stay as close to the budget. The owner wants to use the very best in materials and results in the budget continuing to rise. It is the project team's goal and responsibility to keep the owner involved and voices an opinion on decisions. Some things like granite countertops or the fancier brick façade is what the owner expects and wants to see. Most of the time if present the information correctly to the owner of what the situation is, the owner is satisfied with having to pay a little more for what they really want. But in the end to construct a successful project the communication line between the project team and owner is critical when doing a project of this size and magnitude.

A.3.9 Project Delivery System

The project delivery method that was used on the Wellington Condominiums project was a fast-tracked CM @ Risk. The owner and developer Hankin Group wanted to be very flexible in the design and coordination of the project but not take on the bulk of contractual risk. Time is essential on the project and a systematic approach design-bid-build delivery method would not be very effective. Hankin Group's major goal is to deliver the highest quality building at the fastest time possible.

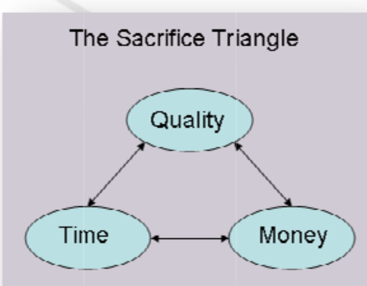


Figure 4: The Sacrifice Triangle
- Reference: Fundamentals of Construction Management

To help explain this concept of the sacrifices an owner has to make is by looking at the sacrifice triangle. For example the Hankin Group on this project wanted high quality as fast as possible. This leaves the owner to make the sacrifice of money. More money would have to be done to fulfill the owner's needs and requirements. This chart also works with any other two systems of sacrifice. For example if an owner wants the lowest cost and highest quality then the owner must accept that the project will take longer to be built. If the owner wants the lowest cost and shortest time to complete a project then quality should not be the main issue for the owner. These things must be understood and analyzed by the owner in order for the project to be successful. Feasibility studies and analysis on the Wellington Condominiums was conducted by Hankin Group and was found that the sooner the condominium would be built the greater the potential profits would be. With this in mind Hankin group then proceeded to go with a fast-tracked CM @ Risk rather than a traditional project delivery system.

The contractual relationships for the Wellington Condominiums are very straight forward in that the owner Hankin Group has contracts with the GC/CM, Architect, land surveyor, and geotechnical engineer. The surveyor and geotechnical engineer have a lump sum contractual arrangement, the GC/CM on the project has a GMP, and architect utilizes a cost plus fee arrangement.

Another interesting point is that "Wellington Commercial Construction" is really part of the developers firm. For protection reasons the developer creates a company for that particular project and acts like its own separate entity from the firm. Even though the project manager has an office at Hankin Group under a GMP contract, legally he works for Wellington Commercial Construction. The architect's job by contract is to manage the design team on the project while the GC/CM is fully responsible for the management of contractors and construction of the project. The architect and GC/CM work very closely together on the project in any changes that are requested from the owner. Every other day a call from the owner is issued to the project team and this request from the owner is put on the project team's table. The team then gets together and meets with consultants on the conditions of the order and sees if it is possible to do within reason. The architects are then in charge of the consultants to change the design and GC/CM is in charge of the contractors to see that those changes are constructed. All the consultants and contractors contracts go by a lump sum to each party on the project.

The selection process for the Wellington Project is based on trust and previous relationships with the owner. The architect, civil engineer and land surveyor, geotechnical engineer and owner have in past worked very closely with other projects and therefore got the job. By doing many development projects over the years the owner starts to develop a relationship with someone they can get along with and function well. Again time is money and the less introducing to a new system or format the quicker it is to get a project completed. The GC/CM is in reality part of the owners company but for legality reasons is seen as its own entity. The contractors on the job were either selected due to trust and previous experience or had the most economical and value adding to the project. These decisions were made by the GC/CM and then passed onto the owner for final approval.
With bonding and insurance, the GC/CM holds much of the responsibility and not the owner. Since the owner and GC/CM are of the same company the owner tends to shed most of that responsibility to the GC/CM on the project so that the owner is free from any legal stance. The owner is only going to do what is necessary to protect themselves and let the GC/CM do as they see fit to protect themselves during the project. The contractors on the project are expected to have their own insurance and liabilities when working on the construction site.

The contract types and delivery systems for the project are a good selection for a developer for the very reason time is money. If an owner has to wait for the project to be designed, bid and built in a systematic way the opportunity for larger profitability is over. Therefore flexibility in design and construction, easy paths of communication with many parties, and ways of protection for the owner are the major reasons for why the project was setup this way. Risk is a big factor to play in being a developer and by shedding responsibility to another entity in the company for that project and working with familiar faces is critical to whether or not this project is successful.

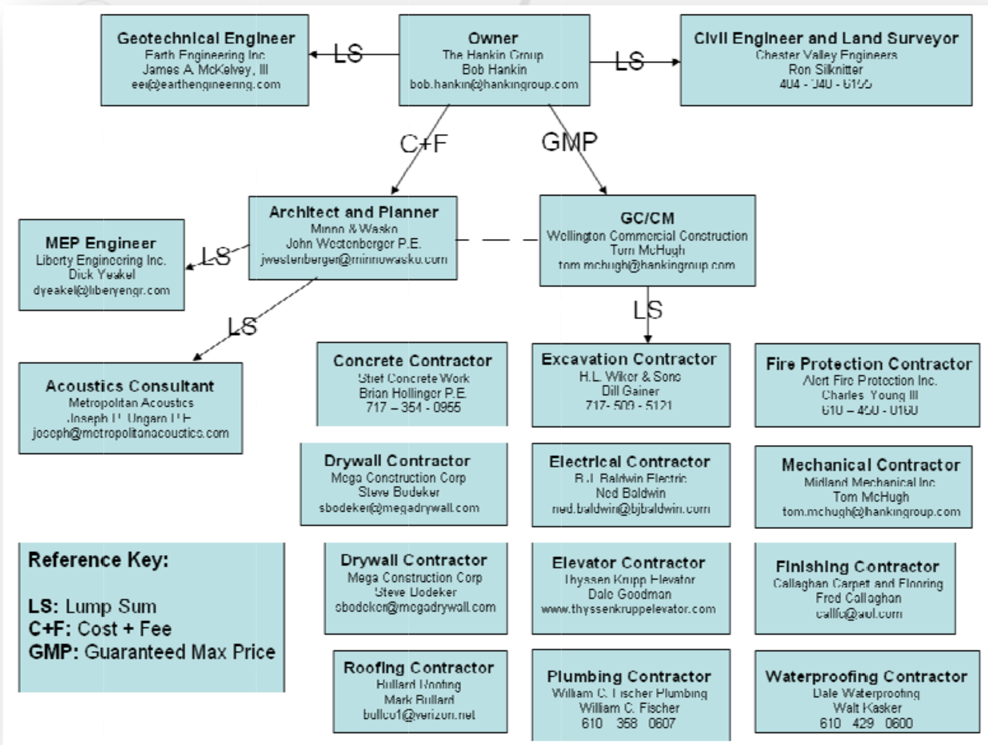


Figure 10: Project Delivery of Wellington Condominiums

A.3.10 Staffing Plan

First and foremost Bob Hankin; president from Hankin Group oversees all projects including Wellington Commercial Construction which is run by Tom McHugh; director of construction. Even though technically by contract Bob Hankin has nothing associated with the company he still has authority and control over what the GC/CM dose on the project. Bob Hankin is primarily concerned over the big picture of the project and leaves the details to Tom McHugh. Tom McHugh's primary responsibility is to manage the everyday issues on this particular project and is the key link between the owner and GC/CM on the project. The senior project manager Ray Winch organizes and manages what happens on the construction site. The rest of the staff answer in the same fashion one way or another to Ray Winch and predominately are on the construction site full time managing the crews and production of the project. The staff from working on many other projects is very close and knows from experience what to expect from each other. Everyone has their role to play and have been very successful up to this date.

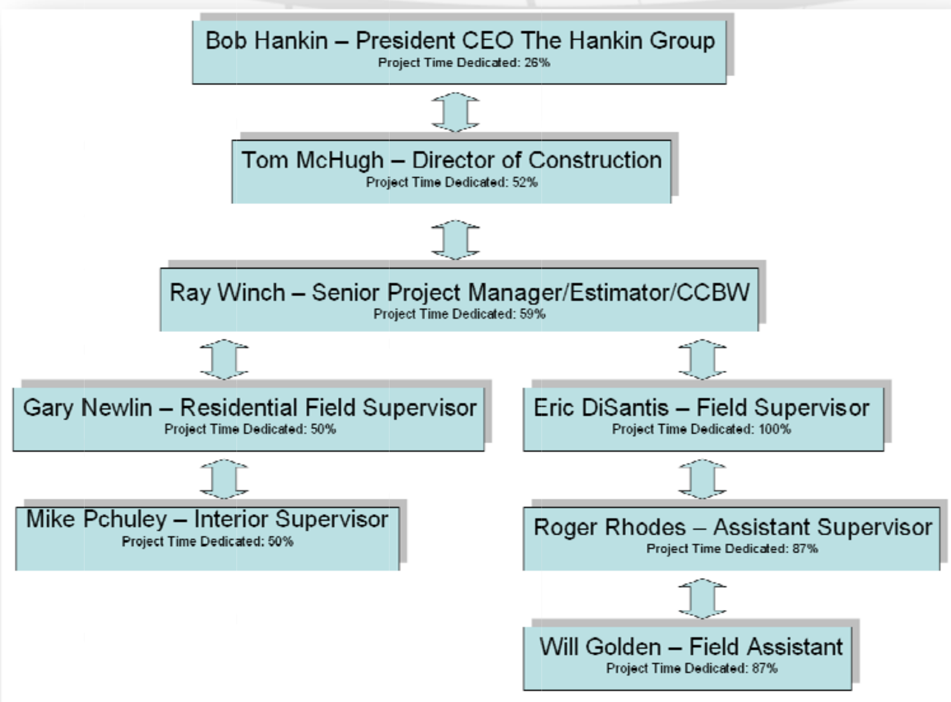


Figure 11: Staffing Chart of Wellington Commercial Construction