

## **7. Project Logistics**

### 7.1 Project Schedule Summary

When the plans for 1881 North Nash Street were purchased by Turnberry Limited and Facchina Development in 2005, the process for developing a project schedule for the newly named Turnberry Tower Arlington began immediately. On September 26<sup>th</sup>, 2006, demolition on the existing building began. The schedule has a substantial completion date set for July 7<sup>th</sup>, 2009 and the owner expects to move in on September 4, 2009. The schedule that is attached in Appendix A breaks down the major activities into different phases including procurement, temporary construction, new construction, and project commissioning and testing.

#### *Foundation*

From the soil boring reports prepared by the geotechnical engineer, it was discovered that this site would have a significant amount of rock that would need to be removed. When the site was brought down to approximately elevation 70', dynamite was needed to bring the site down to approximately elevation 50'. Some over excavation was needed for the continuous footings that were poured for under the perimeter wall. After the extra rock was removed, 2500 PSI lean concrete was needed to be poured and this was used for leveling the excavated hole to place the perimeter walls. This has a major impact on the schedule because of the amount of rock that needed to be removed (approximately 4200 BCY) as well as the limitations on how much could be blasted each day. On blast days all roads around the site would have to be closed for a period of time which caused traffic on major highways and roads. On site, it would put a stop to excavation because of the placement of live explosives.

### *Structure*

The structure of this building is designed in two different ways; one in the parking levels and one in the tower levels. In the parking levels, two tower cranes with two separate crews were used to erect the concrete structure. This footprint of the parking level has a large enough area that allowed two crews to work independently of one another and still be fully efficient. They worked in a clockwise matter going from one zone to another until the parking level was complete.

The tower level of the building was done utilizing only one of those crews from the parking level erection and the use of one tower crane. The slabs were split into three zones and each would be poured on a separate day. The columns would be poured on a fourth day. At the rate the project was going and with the available man power, the project was averaging about a floor a week.

### *Finishing Sequences*

This job uses the Short Interval Production Schedule or SIPS method to complete the interior of the building. Refer to Appendix A for the SIPS schedule for Turnberry Tower Arlington. Some of the finish activities include:

- Install curtain wall and window wall
- HVAC / Plumbing rough-in
- Electrical rough-in
- Drywall
- Install plumbing fixtures
- Install lighting fixtures
- Install doors, hardware, and toilet accessories
- Testing and balancing

These activities were all done in a sequence agreed upon by all the subcontractors involved before the start of construction and was created to maximize productivity. Although tweaking was needed during the first few floors of construction, this schedule is helping to keep everyone on track and responsible for their own work. The subcontractors can schedule crews at their discretion because they know how much work they will need to complete during the week.

## 7.2 Detailed Project Schedule

The schedule that has been created is based on the two phases of construction for Turnberry Tower Arlington. The first phase includes the erection of the 6 story underground parking garage and the second phase includes the erection of the 26 story residential tower. The detailed scheduled can be found in Appendix A. Below in *Table 7.1* you can find the abridged version of the detailed schedule which includes only the summary activities.

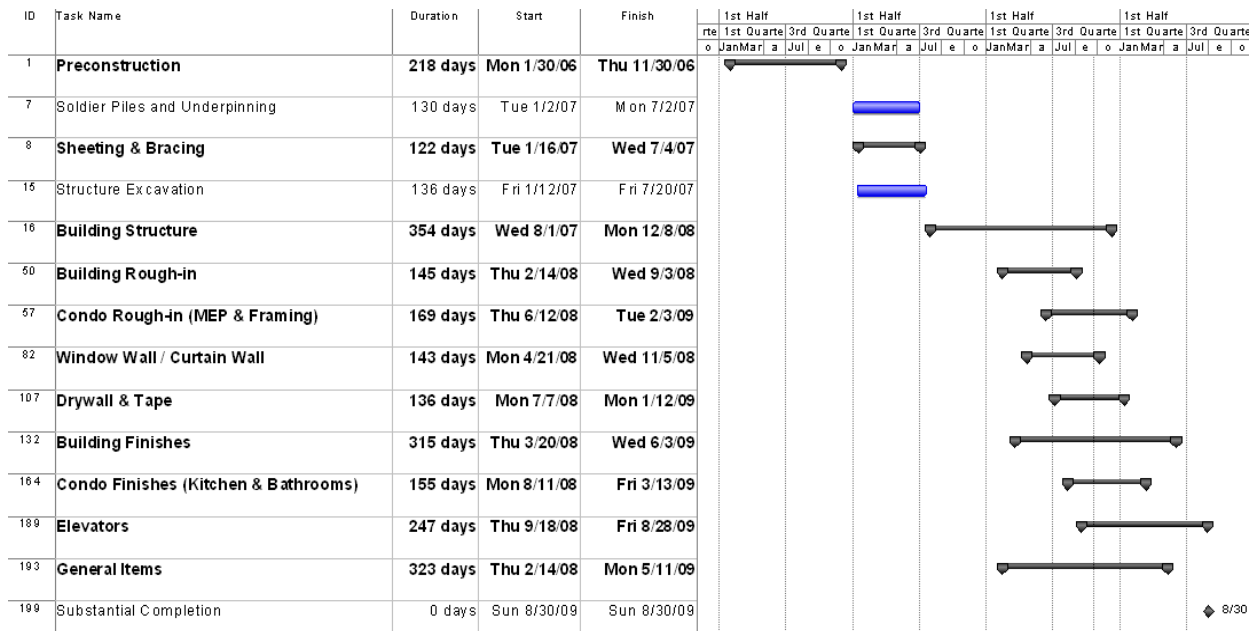


Table 7.1 – Abridged Detailed Schedule

From the above schedule, some of the key completion dates for Turnberry Tower Arlington include:

Structure Excavation	July 2 <sup>nd</sup> , 2007
Building Structure Erection	December 8 <sup>th</sup> , 2008
Condo Rough-in (MEP & Framing)	February 3 <sup>rd</sup> , 2009
Window Wall / Curtain Wall	November 5 <sup>th</sup> , 2008
Building Finishes	June 3 <sup>rd</sup> , 2009
Elevators	August 28 <sup>th</sup> , 2009
Substantial Completion	August 30 <sup>th</sup> , 2009

The schedule that has been created shows the Short Interval Production Schedule (SIPS) that is being used on this project. Building structure erection, rough-in, window wall / curtain wall, drywall, and finishes are broken down according to each level. Both the garage and the tower levels were grouped together where the same type of work would be taking place (concrete placement) and separated where different work would be occurring (different types of finishing). A copy of the SIPS being used on this job that was utilized to create the detailed schedule can be found in Appendix A. Durations and start dates for the activities in the detailed schedule were obtained from the general contractor.

### 7.3 Project Cost Evaluation

Below in *Tables 7.2 to 7.4* are the costs associated with the construction of Turnberry Tower Arlington.

#### Actual Cost

##### Actual Building Construction Cost (CC)

Construction Cost (CC)	\$155,500,000
CC / SF	\$210.14

Table 7.2 – Actual Building Construction Cost

##### Total Project Costs (TC)

Total Project Cost (TC)	\$250,000,000
TC / SF	\$337.84

Table 7.3 – Total Project Cost

##### Major Building Systems Cost (BSC)

Structural	\$28,600,000
MEP	\$33,200,000
Fire Protection	\$2,300,000
Curtain Wall / Window Wall	\$15,200,000
Major Building System Cost (BSC)	\$79,300,000
BSC / SF	\$105.73

Table 7.4 – Major Building Systems Cost

#### R.S. Means Square Foot Estimate

R.S. Means 2008 was used to develop an estimate for both the residential tower of the building as well as the parking deck. Once the square foot estimates were calculated, a total building estimate was created. An 8-24 story apartment building was used at 500,000 SF. Perimeter adjustments were calculated in the estimates. Additions include elevators and fully furnished kitchens. For the parking garage, a perimeter adjustment was needed and the typical height of the parking garage was kept the same. Below in *Table 7.5 and 7.6* are the calculated values and the details for the calculations can be found in Appendix B.

##### R.S. Means SF Total Building Estimate

	Square Feet	Cost / SF	Total Cost
Residential Tower	500,000	\$169.79	\$84,895,000
Parking Garage	240,000	\$77.90	\$18,696,000
			\$103,591,000
R.S. Means Location Factor (Arlington, VA)			1.04
		Total Estimate	\$107,734,640

Table 7.5 – R.S. Means 2008 Estimate

Actual Building Construction Cost (CC) vs. R.S. Means 2008 SF Estimate

Estimate Type	Cost	Cost / SF
Building Construction Cost (CC)	\$155,500,000	\$210.14
R.S. Means Estimate	\$107,734,640	\$145.59
<b>Difference in Estimates</b>	<b>\$47,765,360</b>	<b>\$64.55</b>

Table 7.6 – Actual Building Cost vs. R.S. Means Estimate

To compare the R.S. Means estimate to the actual estimate, the total estimate was divided by the total square footage of the tower and garage. The estimate above shows \$145.59/SF. When this is compared to the building construction cost obtained from the general contractor of \$210.14/SF, this method is off by \$64.55/SF. The reason for the error in calculation can be because of the following reasons:

- The use of post-tension concrete instead of reinforced concrete
- The actual building has varying ceiling heights
- The building has very high end kitchen appliances, tile floors, and bathroom accessories
- No fire suppression or life safety devices is included in the R.S. Means estimate
- Elevators for the additions in R.S. Means do not include the use of 3 hydraulic elevators

#### D4 Cost Analysis

In the database for D4 Cost 2002 there are no buildings that match Turnberry Tower Arlington. To get an approximate cost, 5 buildings that were the same type and above \$15 million were used. Below in *Table 7.7* are the calculated values obtained by D4 Cost compared to the actual building construction cost. The details from the D4 Cost Analysis can be found in Appendix B.

Actual Building Construction Cost (CC) vs. D4 Cost 2002

Estimate Type	Cost	Cost / SF
Building Construction Cost (CC)	\$155,500,000	\$210.14
D4 Cost 2002	\$95,416,943	\$128.94
<b>Difference in Estimates</b>	<b>\$60,083,057</b>	<b>\$81.19</b>

Table 7.7 – Actual Building Cost vs. D4 Cost 2002

The estimate above gives \$128.94/SF from the D4 Cost Analysis. When this is compared to the number obtained from the general contractor for building construction cost of \$210.14/SF, there is a difference of \$81.19/SF. Some of the possible errors in this estimate are:

- Buildings in the database are not close to the complexity or cost of finishes in the actual building
- There is a much more complex conveying system than the compared buildings
- The use of post-tension concrete instead of reinforced concrete
- The building has very high end kitchen appliances, tile floors, and bathroom accessories
- A 6-story underground parking garage

#### 7.4 General Conditions Estimate

A general conditions estimate was created by the general contractor for the Turnberry Tower Arlington project. Because of the complexity of this project and the owner’s expectation to pay close attention to cost, schedule, and quality, the general conditions are very specific. Appendix B has the complete breakdown of the general conditions estimate including the prices, percentages, units, unit costs, and cost per month. Some of the numbers have been slightly modified based on the request of the general contractor. *Table 7.8* below shows the main breakdown of the general conditions for this project.

General Conditions		
Item	Cost	% of GC
Staff	\$5,881,000	43.62%
Site Work	\$1,193,000	8.85%
Temporary Utilities	\$1,300,000	9.64%
Site Office & Job Needs	\$985,500	7.31%
Site Security	\$491,000	3.64%
Contracts	\$77,000	0.57%
Insurance	\$3,555,000	26.37%
<b>TOTAL</b>	<b>\$13,482,500</b>	<b>100%</b>

Table 7.8 – General Conditions Breakdown

The final estimate for the general conditions totals \$13.5 million which is approximately 9% of the \$150 million total project cost. There is a Contractor Controlled Insurance Policy (CCIP) for this job but there is still a need for the umbrella liability, general liability, and workers compensation insurance policies to be added to make the insurance complete. Although the general contractor’s site offices will be housed inside of the future café of the building, a space needed to be rented out until such time that the café area was complete and enclosed by the window walls to make the space watertight. This explains why the cost of the site office is not lower than one would anticipate.

Like most general conditions on any given project, a majority goes towards paying the staff of the general contractor. This project is staffed so most of the people on the project team are on the project for the entire duration.

#### 7.5 Detailed Structural System Estimate

Turnberry Tower Arlington’s primary structural system is post-tension concrete for the tower level and cast in place concrete for the parking levels. A structural system estimate was created from takeoff notes for the entire structural system of the building. Below in *Table 7.9 through Table 7.11* are the results from the estimate. All takeoff notes can be found in Appendix B.

Total Material Cost		
Item	Amount	Total Cost
Concrete	37,351 CY	\$4,668,875
Reinforcing Steel	3071 Tons	\$3,071,000
Miscellaneous Items		\$2,481,385
<b>Total</b>		<b>\$10,221,260</b>
<b>Total per CY</b>		<b>\$273.65</b>

Table 7.9 – Total Material Cost

Average Labor and Equipment			
Description	Labor	Equipment	Unit
Footings	\$54.50	\$0.33	CY
Columns	\$435.00	\$42.50	CY
Slab on Grade	\$55.00	\$0.41	CY
Slabs	\$207.00	\$19.60	CY
Beams	\$490.00	\$48.50	CY
Shear Walls	\$430.00	\$42.50	CY
Curbs, Pads, Toppings	\$129.00	\$1.78	CY
<b>Average per CY</b>	<b>\$257.21</b>	<b>\$22.23</b>	<b>CY</b>

Table 7.10 – Average Labor and Equipment Costs

Construction Cost of Concrete System for Turnberry Tower Arlington						
Description	Qty	Unit	Material	Labor	Equipment	Total Cost
Cast In Place Concrete including placing and stripping formwork, placing rebar, placing concrete, and finishing concrete	37351	CY	\$273.65	\$257.21	\$22.23	\$20,658,837
					<b>TOTAL</b>	<b>\$27.55 per SF</b>

Table 7.11 – Construction Cost of Structural System

R.S. Means 2008 Building Construction was used to find the average price of labor and materials that were needed to create this construction estimate. Prices for concrete per cubic yard, rebar per ton, and PT cable cost per pound were obtained directly from the subcontractor. Prices that were given include:

Concrete = \$125 / cubic yard

Rebar = \$1000 / ton

PT Cable = \$1.15 / pound

These numbers were used with the takeoff values to obtain the material cost for the structural system which totaled \$10,221,260. When this number is divided by the number of cubic yards of concrete for this project the total is \$273.65 per cubic yard. This number was added to the average cost of labor

(\$257.21 per cubic yard) and equipment (\$22.23 per cubic yard) and the total cost of \$20,658,837 was obtained for the construction of the concrete structural system. This number, when divided by the projects 750,000 square feet, yields \$27.55 per square foot (as seen in *Table 7.11*).

The price of \$27.55 is a bit high for concrete construction. Normal construction averages \$25 per square foot. Some of the reasons that this estimate may be high include:

1. Rise in prices for steel and rebar
2. Transportation costs to get the material to site
3. Cost of the automatic climbing formwork and flying formwork to gain time on the schedule
4. Post-tension steel cables
5. Much larger waste factor was calculated than was necessary

*Figure 7.1* shows a typical tower level with rebar cages for shear walls and columns, part of a concrete deck poured, and exposed PT cables laid out and ready for a concrete pour. *Figure 7.2* shows the use of the Automatic Climbing System (ACS) for the core of the building.

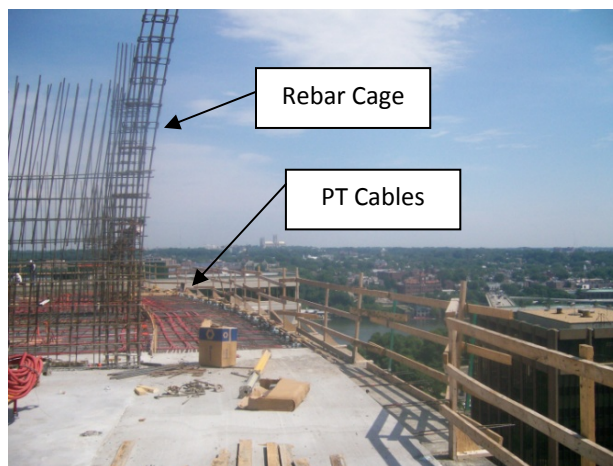


Figure 7.1 - Working Deck



Figure 7.2 – ACS Formwork for Core