Construction Management Breadth Study

There is a substantial difference between the construction sequence and management of a steel structure and concrete structure. Such differences include cost, scheduling, sequencing, and site conditions. Site conditions will be evaluated based on existing conditions and altercations that may be necessary in order to accommodate the construction of a steel and precast plank frame. Scheduling and cost of the proposed steel and precast plank redesign will be evaluated based on information obtained from various interviews conducted with construction management professionals and data obtained from construction references, such as R.S. Means 2008. The schedule and cost of the proposed redesign will be directly compared to the actual schedule and estimate to the concrete frame. Constructability issues will be compared between both systems and conclusions will be made.

Site Conditions

Existing Site Conditions

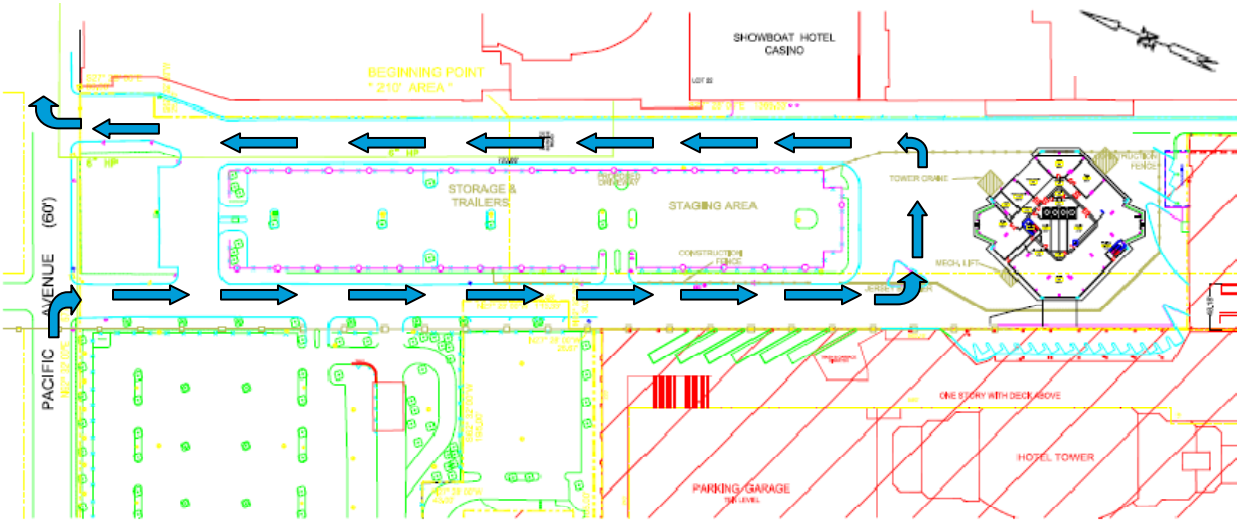

Figure 55: Existing Site Conditions and Delivery Flow

The site of the new Trump Taj Mahal Hotel is located on the 1000 block of the boardwalk Atlantic City, New Jersey, in between the existing Trump Taj Mahal Hotel and Casino and the Harrah's Showboat Hotel and Casino. The site was used as a parking lot prior to construction of the new Trump Taj Mahal Hotel.

The site is relatively unconfined, with ample space for storage and staging of construction materials. The site is easily accessible from Pacific Avenue, as delivery trucks can easily cycle through the site. One

tower crane is located on the north side of the tower, as this is the closest side to the staging area. The longest lifting radius for the project is 180 feet; the swinging radius is impaired by the Showboat Hotel and Casino to the north. The tower crane must be tied to the building frame to erect the upper levels of the tower, as its maximum height will be greater than 250 feet. A mechanical lift is located on the west side of the tower and is utilized for material delivery and as temporary vertical transportation until the elevators are operational.

Proposed Site Conditions

Although a steel structural system often requires much more staging and storage space compared to a concrete system, the 25,000 square foot staging area should provide ample storage space to accommodate the steel frame erection. The delivery route will not need to be addressed, as the same storage area will be utilized. However, the tower crane needs to be investigated because heavy steel built-up column sections and pre-cast concrete planks will need to be erected.

Up to this point, column splicing was to occur at every 4 levels. However, an investigation of the tower crane's lifting capacity limits the column splicing of all built-up sections of the braced frame core to 2 levels, or a maximum member length of 24'-0", 30'-0", and 35'-0" for built-up section 3, 2, and 1 respectively. It is important to note that the lifting radius for these members is taken as 120' (36.6meters). As a result of these findings, built-up sections 3 and 2 will be spliced every 2 levels and built-up section 1 will be spliced every 3 levels. Tower crane specifications for Terex Comedil CTL 630 can be found in Appendix H.

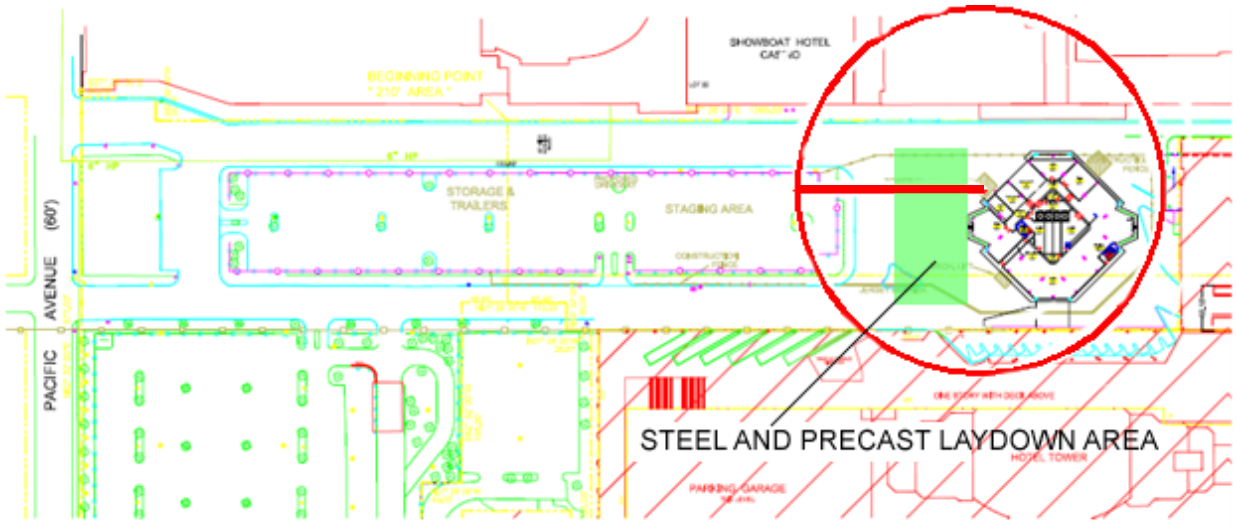

Figure 56: Steel and Precast Plank Lay Down Area with Tower Crane Radius

Schedule Analysis

Existing Schedule

According to the schedule provided by Bovis Lend Lease, the erection of the superstructure started in October of 2006 and was completed in January 2008. This equates to a total erection time of 64 weeks and an 8 day cycle per typical floor. Design and detailing of the concrete (foundation and superstructure) and excavation with on-site deep utilities started in April 2006. The lead time required for the structural concrete was 3 months, or 13 weeks. Foundations started in July of 2006 with completion in October 2006. A summary of the schedule is shown below in Figure 57.

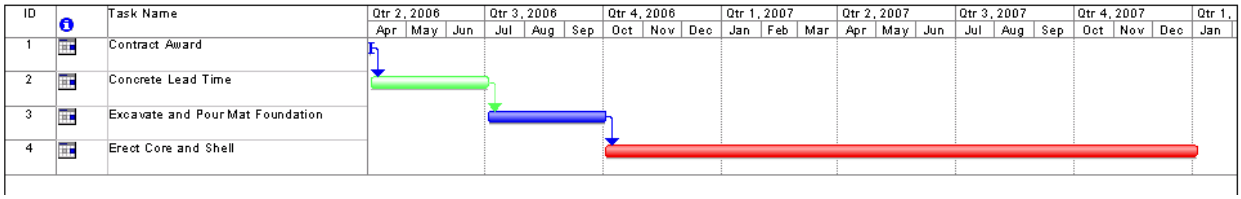

Figure 57: Summary of Concrete Shear Wall and Filigree Floor System Schedule

Proposed Schedule

The scope of this project merited interviews of various construction professionals in order to obtain viable data to estimate the schedule of the redesigned steel structural system. The following data was used to determine the schedule of the steel structural system:

Structural Steel and Precast Plank Lead Time……8 months
Steel Erection……40 Pieces per day
Precast Concrete Planks……3600 SF per day
Tower Crane Jumps……3 Add'l weeks
Plumbing and Bolting of Steel……3 Add'l weeks

The structural steel requires much more lead time (8 months) compared to that of concrete (3 months). The lead time pushes the start of the mat foundation to September 2006 and the completion to December 2006. This means that the steel erection will not commence until December 2006.

The erection of the steel will start in December 2006 and complete in December 2007. This equates to a total erection time of 52 weeks and a 6 ½ day cycle time per typical floor. A summary of the structural steel schedule can be seen below in Figure 58.

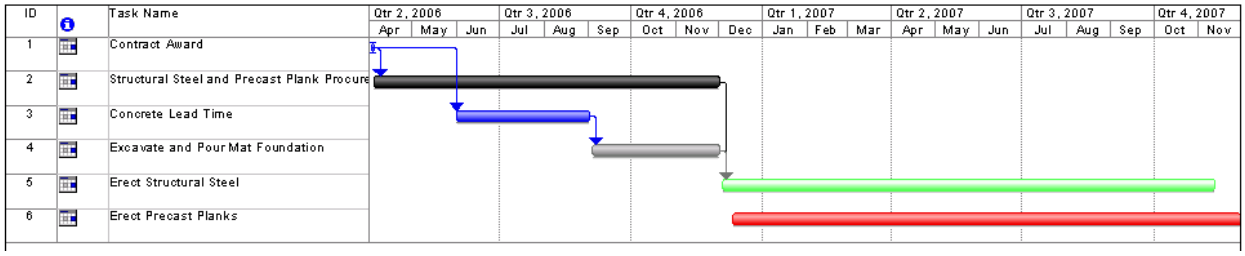

Figure 58: Summary of Steel Shear Wall Core and Precast Plank Floor System Schedule

Cost Analysis

Concrete and Filigree Structural System Cost

The structural cost breakdown, as obtained from Bovis Lend Lease, of the concrete and filigree structural system is as follows:

Foundations Cost	$3.3 mil
Superstructure Cost	$41.5 mil
Misc. Structural Steel	$3.5 mil
Metal Stairs	$1.4 mil
TOTAL	**$49.7mil**

Steel Structural System Cost with Additional Cost

By interviewing various construction professionals and also utilizing R.S. Means 2008, the following data was compiled for use in determining the cost estimate of the steel structural system (15% overhead and profit is included):

Structural Steel……$3,800.00/ton

Beam Connection Allowance	7.00%
Column Splice Allowance	10.00%
Brace Connection Allowance	20.00%

10” Precast Concrete Planks	$15.00/SF
3000 psi 2 inch Topping Slab	$3.75/SF
Shear Studs	$5.75/EA

A 10% premium was added to the cost of built-up column sections and atypical precast concrete planks.

By speaking with the lead estimator on the Trump Taj Mahal Hotel project, John Adams of Bovis Lend Lease, the following data was compiled for use in determining the additional cost of the structural steel system (15% overhead and profit is included):

Sotawall Hybrid Curtain Wall……..……..$85.00/SF
Otis Elevator……...$260,000.00
Mechanical Piping……..$500,000.00
Sanitary System……..$250,000.00
Domestic Water……..$250,000.00
Bathroom Exhaust……..$250,000.00
Busduct……..…$50,000.00

Additional costs of beam and column soffits, fireproofing, and fire-rated partitions reflect those costs recorded in Table 7 of the architectural breadth studies. Again, these costs were obtained using R.S. Means 2008.

A summary of the costs of the steel and precast plank structural system is as follows:

Foundations Cost……...$3.3 mil
Superstructure Cost……..…..$34.1 mil
Additional Cost……..$5.9 mil
Misc. Structural Steel……... $3.5 mil
Metal Stairs……$1.4 mil

TOTAL……...…….$**48.2mil**

All detailed cost calculations including takeoff can be found in Appendix H.

Construction Management Studies Conclusions

The following table compares both the cost (including additional costs) and schedule of the steel and concrete structural systems:

	Steel and Precast Plank System	Concrete/Filigree System
Total Structural Schedule (Weeks)	**88**	**92**
Superstructure Schedule (Weeks)	52	65
Cycle Time per Typical Floor	6 ½ days	8 days
Cost of Construction (Total)	**$48.2million**	**$49.7million**
Cost of Construction/SF	$65.50/SF	$67.50/SF

Table 8: Cost and Schedule Comparison

As it can be seen by Table 8, the cost and schedule of both systems is very similar. The steel structural system is $1.5 million lower than the concrete/filigree system. The steel structural system will also top out 4 weeks earlier than the concrete/filigree system; requiring approximately 13 less weeks for superstructure erection (cost savings are also reflected by this). However, this does not include any additional cost and schedule time reflected by the requirement of a tuned mass damper. The impact of such additional items was also not taken into consideration in the total schedule. This will be discussed further in the final conclusions and recommendations part of this report.

Structural steel and precast concrete systems require much more area for staging and storage, however the 25,000 square feet of provided space on-site should suffice. A tower crane will able to lift the large built-up steel column sections without the use of a supplemental mobile crane. Steel columns of precast plank systems are fabricated in larger lengths (more than 40 feet lengths) and are erected prior to the planks. This means that the tower crane operator will have to be careful to avoid hitting an erected steel column with a precast concrete plank. A tower crane with a luffing boom will help alleviate this issue.

On-site quality control of a cast-in-place concrete system is always a concern of the structural engineer of record and the construction manager. For this particular project, The Harman Group has provided an on-site field inspector. As precast planks are fabricated in a controlled environment, a higher quality product is obtained. This may eliminate the need for the on-site presence of a field inspector.