4. Construction Analysis – Façade Sequencing

Problem Statement

As a developer catering to Class-A tenants, the owners of Two Liberty Center are placing a strong emphasis on the occupancy schedule for the office spaces. The interior work that must be completed prior to the turnover of each office floor is an immediate predecessor of the building enclosure. Therefore, the building enclosure section of the construction schedule has the most potential to benefit the occupancy schedule. The variety of alternative sequences available for façade construction also amplifies the potential impact of these activities on occupancy scheduling. This opportunity was identified through inspection of the project schedule, analysis of the needs of the owner, and conversations with management from the Two Liberty Center contractor.

Analysis Goal

This analysis will develop and compare multiple alternatives for the construction processes and sequences for the building façade of Two Liberty Center. The proposed methods and sequences should provide opportunities for schedule and cost savings on this project, with an emphasis placed on acceleration of the building occupancy schedule.

Building Façade System

Two Liberty Center is enclosed using an architectural pre-cast concrete panel system with a storefront window system at ground level and punch windows on each level above. The southwest corner of the building features an architectural glass tower extending from ground level to above the roof level and is clad with a glass curtain-wall system similar to the system used around the ground level of the building.

Existing Method and Sequencing

Sequencing Description

(See Appendix 3.1 for Existing Detailed Façade Schedule)

The existing construction schedule for Two Liberty Center utilizes a face-by-face façade construction sequence. Staring with the South face of the building, the concrete panels are erected from ground to roof using a mobile crane. Upon completion of each entire face of the building, the crane mobilizes clockwise to the next face and begins erection in the same ground to roof sequence. Window installation begins towards the end of erection of the final face of pre-panels. Windows are installed by floor, beginning at the ground level and continuing upwards as each floor is completed. With moisture as a constant concern on construction projects, interior finish work is not started until the exterior of the building is enclosed. As a tenant fit-out project, interior finish work is concentrated in the core of the building. With the limited interior finishes for this building, and the emphasis placed on occupancy, finish work begins as each floor is enclosed instead of waiting for total building enclosure.

Turnover to Owner

The owner of Two Liberty Center is accepting turnover of the building on a per floor basis. Punchlist and cleaning activities are performed on each floor as the finish work for that floor is completed. This type of building turnover allows the tenants for each floor to begin fit-out work sooner and the owner to arrange earlier starts for their leases. When building for a developer, the earlier that leasing can begin for a building, the earlier that the developer can begin payback on their investment. With priority placed on the building owner and their needs, the Two Liberty Center project demonstrates a very effective method of optimizing an occupancy schedule for a developer.

Turnover Schedule

(See Appendix 3.1 for Existing Detailed Façade Schedule)

The following chart outlines dates for turnover of each floor as indicated by the original construction schedule for Two Liberty Center:

Floor	Activity	Date
1st	Owner Acceptance	9 August 2007
2nd	Owner Acceptance	24 July 2007
3rd	Owner Acceptance	27 July 2007
4th	Owner Acceptance	1 August 2007
5th	Owner Acceptance	14 August 2007
6th	Owner Acceptance	17 August 2007
7th	Owner Acceptance	15 August 2007
8th	Owner Acceptance	30 August 2007
9th	Owner Acceptance	8 September 2007

Alternative 1 – Method and Sequencing

Sequencing Description

(See Appendix 3.2 for Alternative 1 – Detailed Façade Schedule)

For this first alternative façade construction sequence, the existing equipment and methods of construction are being utilized with changes made to the order in which pre-cast concrete panels are erected. Making use of the same mobile crane, pre-cast concrete panels will be erected starting at the south face at ground level and erecting up to and including the fifth floor of panels. After the fifth floor of each face is erected, the crane will mobilize clockwise and repeat that process on the next face of the building. Upon

completion of the first 5 floors of pre-cast panels, the crane will continue around the building erecting the sixth floor and above on each face.

Window installation for this sequencing plan can begin during the erection of the lower level panels on the east face of the building. Starting at the ground floor and working upwards per floor, windows can be installed continuously with the upper levels of pre-cast panels reaching completion before the beginning of window installation on the sixth floor.

This method of sequencing the façade construction of Two Liberty Center allows for an acceleration of the turnover schedule by an average of 40 working days. Schedule savings of this magnitude could translate into an additional month of rent collected by the owner.

Turnover Schedule

(See Appendix 3.2 for Alternative 1 – Detailed Façade Schedule)

The following chart outlines dates for turnover of each floor as indicated by the proposed schedule for Alternative 1:

Floor	Activity	Date
1st	Owner Acceptance	13 June 2007
2nd	Owner Acceptance	28 May 2007
3rd	Owner Acceptance	4 June 2007
4th	Owner Acceptance	11 June 2007
5th	Owner Acceptance	18 June 2007
6th	Owner Acceptance	25 June 2007
7th	Owner Acceptance	2 July 2007
8th	Owner Acceptance	9 July 2007
9th	Owner Acceptance	16 July 2007

Alternative 2 – Method and Sequencing

Sequencing Description

(See Appendix 3.3 for Alternative 2 – Detailed Façade Schedule)

This proposed alternative for the façade construction of Two Liberty Center explores the utilization of the tower crane already on-site that would otherwise not be used for the erection of the building façade. Use of a tower crane for façade panel erection allows a much more flexible sequencing of the process due to the full rotational range of a tower crane compared to the limited range of a mobile crane. Although mobile cranes do have the ability to relocate to different points around a building, it is inefficient to relocate a mobile crane multiple times due to the time needed to break down, mobilize, and re-set the crane in the new location.

With the full use of the on-site tower crane, the pre-cast concrete façade panels will be erected in the same per-floor sequence as the window installation. Panels will be placed starting with the ground level at the south face of the building and erecting each panel of a floor in succession before continuing upward to the next level. Each floor of façade panels can begin after the completion of the concrete work on the floor above, but to keep a continuous work flow for the façade construction the ground level should begin during the 6th floor concrete work. Window installation can start for each floor following the completion of the panel erection for that floor and continue upwards with the flow of the panel placement.

To successfully implement this proposed sequencing of the façade construction for Two Liberty Center, the tower crane would need to be fully utilized for a full shift on every working day. This full utilization of the tower crane would require the use of a second shift operation for façade construction. This second shift could provide an opportunity for significant acceleration to the schedule, either to expedite the completion of the building or to make up for time lost to possible delays. Second shift work would

add some additional cost to the project, but these costs could be countered by the potential early occupancy by the tenants.

This proposed alternative for the sequencing of the façade construction for Two Liberty Center would allow for an average schedule savings of 72 working days from the original construction schedule. Schedule reductions of this magnitude could translate into two additional months of collected rent for the owner of Two Liberty Center.

Turnover Schedule

(See Appendix 3.3 for Alternative 2 – Detailed Façade Schedule)

The following chart outlines dates for turnover of each floor as indicated by the proposed schedule for Alternative 2:

Floor	Activity	Date
1st	Owner Acceptance	30 April 2007
2nd	Owner Acceptance	11 April 2007
3rd	Owner Acceptance	18 April 2007
4th	Owner Acceptance	25 April 2007
5th	Owner Acceptance	2 May 2007
6th	Owner Acceptance	9 May 2007
7th	Owner Acceptance	16 May 2007
8th	Owner Acceptance	23 May 2007
9th	Owner Acceptance	30 May 2007

Conclusions

With some additional planning, there is some potential within the existing schedule for an acceleration of the occupancy of the building. Alternative 2, while it may provide 72 day acceleration of the occupancy schedule, would require significant changes to the construction planning to allow for the full use of the tower crane for the façade panel placement. Adjustments made to accommodate Alternative 2 could also carry

additional costs and resources. The most realistic option for acceleration of the occupancy of Two Liberty Center would be the implementation of the proposed Alternative 1. This alternative schedule offers substantial time savings while maintaining the same required resources and costs as the existing sequencing plan for façade construction. The sequencing proposed in Alternative 1 should be considered as a means to either catch up from a schedule deficit or to achieve an early completion and occupancy.