CB&I Office Building and Parking Garage Narrative

The CB&I Office Building and Parking Garage project was an exercise in efficiency. A partial list of the job constraints included:

- Aggressive schedule
- Stringent safety requirements
- No parking onsite for the workers
- No lay down area for materials near the work areas
- Limited delivery times and areas
- Noise restrictions due to the proximity of residential properties
- Minimize interruptions to the adjacent occupied facilities and CB&I employees
- Road closures and traffic control
- Very intense coordination between trades and the owner
- Large scope additions without schedule extensions
- Significant changes in location of the emergency power generator
- Minimal outage to the existing working data center
- Phasing of work
- Periods of trade stacking
- Changes in the utility standards for electrical service
- Sequencing of activities to fast-track the schedule and maintain critical path flow.

Expediting the schedule required multiple tools, techniques, and strategies. One strategy which kept Trio moving in the right direction was quality management. Using phase completions to avoid over run was also a component to help avoid the “final” polishing and error correction that sometimes derails schedules. Delivering finished components in phases allows for the quality problems or issues that exist to be identified early on and rectified before impacting the schedule. The proper use of critical path scheduling and the execution of critical path items were also keys to the success of this project.

One of the key goals outlined in the construction documents for Chicago Bridge and Iron was delivering a high quality product. Balfour Beatty and Trio set a quality control plan (“QCP”) in motion at the outset of the project by implementing inspections, tracking, checklists, and correction reporting. Trio took initiative to correct deficiencies in response to internal inspections by project management and field supervision teams before these became global project issues. Designated Trio representatives who had authority to identify QC problems and provide corrective solutions were responsible for the QCP success. Through teamwork, planning, communication, cooperation, and commitment; Trio completed a quality, safe project.

Software was one of the ways quality was managed. BIM 360 was used to monitor, report, follow up, and maintain records of the QC issues on the job.

Chicago Bridge and Iron Office & Garage — **Issue List** — Balfour Beatty Construction

Trio Electric, LTD (10 issues)

Office Building (1 issues)

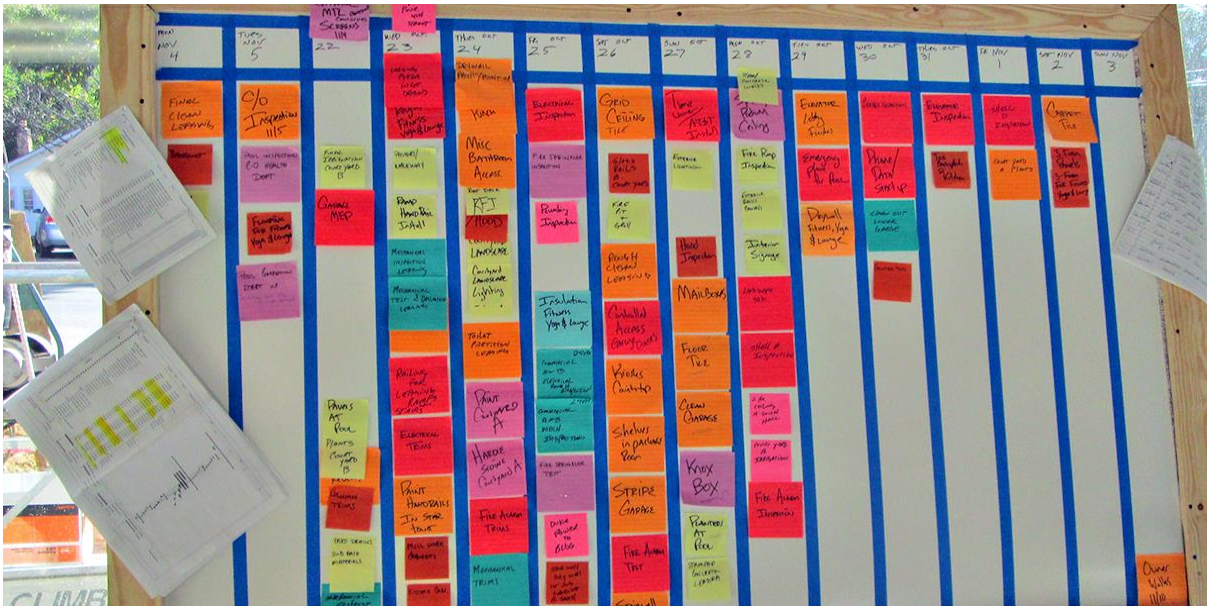
Issue ID	Description	Location Detail	Status	Type	Date Created	Due Date
VB-00005	J-box access blocked by cable tray	2nd Floor south of elevator lobby	Open	Issue	06 May 2014	13 May 2014

Office Building>Level 2>Data Center 22030 (1 issues)

TK-00057	Finish fire caulk penetrations.		Open	Issue	20 Jul 2014	22 Jul 2014

BIM was also used in the beginning of the project to coordinate work and eliminate QC and RFI issues. When closing out the project care was taken to test, inspect, and train and document all the above in a digital format including pdf and video records. Our team used BIM to complete baseline coordination, underground coordination, overhead coordination, and electrical specific shop drawings used for installation. To streamline the exchange of information between team members, Trio offered multi-option solutions for garage lighting, feeder routing, feeder materials, utility coordination, load analysis and field surveys.

Scheduling the critical path items and starting them as early as possible was a technique used at CB&I to ensure the schedule would be met. An early item in the critical path was completing the emergency power duct bank at the beginning of the project to enable the use the spare conduits in the bank for temporary power to the site. There is a balancing act between starting trade contractors too early and risking redesign versus starting too late and missing schedule milestones. Thus, utilization of the CPM played an important role in the success of the project. Some of the tools utilized to keep the project on schedule, effectuate communication between trades and achieve “buy in” for schedule dates and durations were: a six week look ahead based on the original fully man loaded schedule, weekly field updates from construction meetings, and a pull schedule. Our look-ahead schedule allowed us to be nimble and to grade ourselves on whether or not we were hitting the dates and durations. The pull planning addressed the schedule with the milestones in mind and worked backward to a work flow plan. See example illustration below. Subcontractors broke down their activities and durations on post-it(s) on the whiteboard grid and plotted their own look-ahead to achieve the desired milestones. This helped to visualize the needs and held the team accountable.



One not so friendly “sounding” technique, schedule compression, was also used with success. As the team got better at defining duration, we challenged each other to beat that duration as we progressed through the schedule. Crashing was used in a very limited fashion, when it had to be done the extra resource cost was balanced by the time savings of adding resources (manpower). Fast tracking was used often and basically allowed more parallel work activities that would normally be sequential. Prior to fast tracking we minimized risk by identifying any misses or changes that could potentially impact the schedule.

One other technique Trio used to stay on schedule and as efficient as possible was to encapsulate key parts of the project to be supervised separately. Dividing the work responsibilities this way and having the additional supervision allowed for more responsive teams that could move with an ever changing schedule and keep up with changes in the scope, impacts to the bottom line, and schedule. We established a desired hierarchy chart at the start of the project and tweaked it as the needs of the job changed with time.

Week Starting:
Week Ending:
Prepared By:__J.R.____

6 WEEK LOOK AHEAD

##	Scheduled Activity/Task	Total Hours	JR Need on Site (TRIO)	Estimated Ship Dates (CED)	1-3 PANEL CANS	1-3 floor panel cans	SERVICE GEAR	LOB 1-3 FIXT & LOB GEAR	1-3 Lighting Controls & Lobby, 4-6 Panel cans
		WEEK ENDING 2/23/2014				WEEK ENDING 3/2/2014		WEEK ENDING 3/9/2014		WEEK ENDING
		2/17	2/18	2/19	2/20	2/21	2/22	2/23	2/24	2/25	2/26	2/27	2/28	3/1	3/2	3/3	3/4	3/5	3/6	3/7	3/8	3/9	3/10	3/11	3/12	3/13
		M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T
1	1st floor - wall rough-in	240																					3	3	3	3
2	1st floor - pull branch wire	208							2	2	2	2	3			3	3	3	3	3						
3	1st floor light fixture tails	0																								
4	1st floor - install fixtures	0																								
		0																								
5	Data Center overhead/underfloor work	600																								
6	roof electrical	0																								
7	Entergy yard - set gear/pull feeders	0																								
8	transformers/panels and one line diagram	1280	2	2	2	2	2		2	2	2	2	3			3	4	4	4	4			4	4	4	4
		0																								

Trio brought value engineering (VE) to the table starting on bid day. One of the VE items that survived and was implemented included large aluminum feeders used in lieu of copper. This was not without scrutiny and review and had to meet the spec put forth by the engineer. We adhered to specific feeder types, termination requirements, and preferred sizing for appropriate ampacity. Another item that helped save the owner money was reducing spare feeder conduits; especially in long and large duct banks. Trio identified where and how many conduits could be eliminated and worked with the engineer to remove them from the scope.

As the project took shape, Trio continued to look for opportunities to save the client money. Our team identified substantial savings in meeting the design requirements for the garage lighting. By utilizing new led technology in the new and existing garage; both emergency and lumen requirements were satisfied. This outperformed the original design of metal halide fixtures with arc keepers at less cost and also covered the cost of updating the existing garage. Our team helped the design team navigate the new utility requirements from Entergy by securing a custom power yard design approval. This significantly reduced the cost that would have been required to meet standards versus the original budgeted design. Trio also helped to coordinate the custom utility cabinets and approval from the local utility to use them. Most of this potential added cost came from the requirements necessary to add a 2000A data center midstream in our project. Trio also identified several ways to reroute large feeders to the

emergency power system that proved to be a savings. The emergency power generator and associated yard were moved after the initial location was already complete. Trio worked between the design team and the owner to come up with the most cost effective routing and mounting of the feeders and yard layout.

Continual phasing and re-phasing of work was necessary to maintain original schedule milestones and to achieve the level of quality desired with minimal corrections. Coordination efforts to meet our move in date included:

- Site traffic plans
- Rigid delivery schedule
- Hoisting schedules
- Method of procedures for outages
- Parking requirements
- Specific path to and from the site for the workers
- Staging materials with absence of laydown areas
- Traffic control planning
- Landing materials and getting to work areas with no buck hoists,
- Interiors consolidated framing sequences and completion requirements