

Implementing an On-Site Concrete Batch Plant on a Large Construction Project in the Bay Area

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The demand for ready mix concrete in the San Francisco Bay Area continues to grow with the booming development and construction industry. Concrete is a very common construction material with a wide range of use on projects ranging from parking garages all the way to high-rise buildings. The typical method of ready mix concrete delivery is to order concrete from a ready mix supplier who trucks the concrete to the project from a nearby batch plant. Concrete is a perishable commodity that demands timely batching and delivery to meet customer requested specifications. The small number of batch plants and congested delivery routes in the Bay Area often results in slow delivery service that negatively affects contractor budget and schedule. This paper will explore how Pacific Structures utilized an on-site concrete batch plant for a large Bay Area project that demands around the clock concrete to meet the owner's schedule requirements. The study will touch on the current delivery capabilities of off-site batch plants and focus on why the decision to utilize an on-site batch plant was made. The purpose of the study is to discover the ways in which the on-site plant affected project coordination, deliveries, site-logistics, cost, and risk.

Keywords: Ready Mix Concrete, On-Site Batch Plant, Site Logistics, Productivity, Pacific Structures

Background

Concrete's versatility, durability, and economy have made it the world's most used construction material. The United States Uses about 340 million cubic yards of ready mixed concrete each year. It is used in highways, streets, parking lots, parking garages, bridges, high-rise buildings, dams, homes, floors, sidewalks, driveways, and numerous other applications (Kosmatka & Kerkhoff & Panarese, 2002, p. ix). This high demand in the ready mix concrete industry is supplied by an estimated 15,000 total batch plants in the United States (Collard-Wexler, 2013). This project will focus on the concrete demand and ready mix supply in the San Francisco Bay Area and how it affects construction in the area.

Pacific Structures is one of the leading concrete contractors in the Bay Area. They self-perform concrete work for high-rise/mid-rise buildings, podium decks, parking garages, and building retrofits. This study will focus on the largest concrete job that Pacific Structures has worked on since the company was formed in 2008. The project name and general contractor will not be mentioned in this report due to a non-disclosure agreement in effect with the owner.

The project, located in the Bay Area, includes four individual buildings. The scope of Pacific Structures' work is to construct a two-story podium deck for each individual building utilizing cast-in-place concrete methods. With all the buildings combined the company is looking at 1,000,000 square feet of concrete with a budget of 100 million dollars.

With a concrete scope of this size, there are a few key factors taken into consideration when it comes to how quickly Pacific Structures can finish the work: management team size, field crew size, and ready mix concrete delivery. Pacific Structures can provide enough management and field employees to perform this work at any given pace. The only factor slowing down the construction of a project this size is ready mix concrete delivery.

The production system for concrete is governed by the plant operator's equipment, the contractor's placement method, and of course, their individual schedules as well as the coordination of those schedules between them (Tommelein & Li, 1999, p. 5). With the booming construction and development in the Bay Area, contractors compete head-to-head everyday with scheduling concrete pours due to the limited number of batch plants that service the area. Even on smaller mid-rise jobs, contractors find themselves off schedule and over budget when slow concrete service often extends pours into off-hours. This problem stems from fully booked batch plants and is only made worse as their trucks sit in grid-lock bay area traffic on their way to and from the batch plant.

This issue was discussed between all contractors and the owner of the project who came up with just one feasible solution – implementing an on-site batch plant. This case study will focus on why the decision to implement an on-site batch plant was made and in what ways it accelerated and alleviated construction processes. It will also go into depth on some of the hiccups and improvements that could be made for the next contractor who chooses this method of concrete delivery.

Ready Mix Concrete Delivery in the Bay Area

Due to restricted lay down area on most jobsites in the Bay Area there is usually no room for an on-site batch plant, even for a large high rise pouring concrete every day. Therefore, contractors hire ready mix concrete subcontractors who deliver concrete which is then placed via pump. Contractors typically require a constant inflow of concrete to efficiently build their structures. Therefore, all single deliveries should take place just in time. As soon as one truck has finished its unloading operation, preferably the next truck should already be available and ready to start its unloading operation. Gaps between consecutive unloading operations constitute a trouble for the contractor, therefore they should be avoided to the best extent possible (Schmid & Doerner & Hartl, 2010, p. 6).

The issue here is that there are far more contractors compared to ready mix batch plants, forcing contractors to compete for delivery service. This combined with congested highway delivery routes in the Bay Area results in frequent delayed deliveries. Contractors face serious budget and quality control issues when concrete shows up late: the concrete mix approaches its 90-minute expiration while sitting in traffic, a placing crew is being paid to wait for concrete, and the concrete already placed begins to cure which can lead to potential cold joints.

The three major companies who deliver ready mix concrete to commercial projects in the Bay Area are Central Concrete Supply, GraniteRock, and Cemex. At the beginning of a concrete job, contractors choose one of these suppliers to supply them with concrete throughout the entirety of a job. The contractor's decision on which supplier to hire is based on which company has the nearest batch plant to their project. Contractor project managers and engineers then proceed to work closely with the concrete supply engineers to discuss mix designs as well as concrete pour schedule and strategy.

Central, Graniterock, and Cemex supply have contracts with hundreds of contractors in the bay area who are all building around each other. Each project needs concrete delivered just as fast and as frequent as the one next door. The issue here is that each company only has a handful of batch plants, mapped out in figure 1 below.



Figure 1 – Map of Bay Area Ready-Mix Concrete Batch Plants

When looking to accelerate the construction of a large-scale concrete project, contractors and owners often find that slow concrete delivery is their only obstacle.

Methodology

The objectives of this case study are as follows:

- To report on the decision to utilize an on-site batch plant versus delivery
- To analyze how the batch plant alleviates coordination, deliveries, site-logistics, and risk.
- To highlight aspects of the on-site batch plant that could be improved for future projects

The methodology used for this project was a case study, relying on qualitative info gathered from review of the project development documents, interviews from Project Managers and Engineers from both Pacific Structures and Central Concrete Supply, and lastly, published journal entries and case studies on the issues surrounding ready mix concrete delivery. Additional information was gathered first-hand from personally working on the project during the testing stages of batch plant operation. The research collected focused primarily on why the on-site batch plant route was chosen, the pros and cons of operation, and how it could be improved for the next time a contractor builds one.

Case Study

During the developmental stages of the project, Pacific Structures approached the project's owner and general contractor with certainty that none of the ready mix concrete delivery services in the Bay Area would be able to deliver concrete as quickly and as frequently as the schedule requires. As a company, Pacific Structures had never implemented an on-site batch plant on a project, yet they were confident it was the best way to complete their work. The three parties worked closely to examine the obstacles that both forms of concrete supply presented, their deliberation is outlined below.

Project Specifics

- Cost of Concrete Work: 100 million dollars (exact figures not disclosed)
- Concrete Work Timeline: January 2016 – December 2018
- Concrete Subcontractor: Pacific Structures Inc.
- Proposed Batch Plant Supplier: Central Concrete Supply
- Concrete Place and Finish Subcontractor: Dolan Concrete
- Project Limits: Undisclosed site in the Bay Area
- Concrete Square Footage: 1.1 million sq ft

Problem Statement

Determine whether an on-site concrete batch plant should be utilized for concrete work from piles through level 2 slabs. Furthermore, determine if an on-site bath plant alleviates coordination, delivery, site logistics, cost, and potential risk issues presented with typical concrete delivery from off-site batch plants. In addition, the on-site batch plant must meet the following criteria:

- Meet project site logistic requirements
- Meet mix design requirements
- Provide concrete at a rate to keep up with project schedule
- Abide by SWPPP and other Owner site requirements
- Meet project QC requirements including documentation
- Meet SSSP plan including LOTO plan, fall protection plan, etc.
- Reduce potential project emissions
- Meet permitting requirements with applicable agencies

Alternate #1 – On-Site Batch Plant

The batch plant requires 1.5 acres of space to be set aside on the project site. This area will include staging room for four 10-14 cubic yard concrete trucks to move concrete from plant for placing. The area also includes room for raw concrete material storage (sand, rock, cement) as well as the operation of a front-loading tractor to load raw material from stockpile into plant. Raw concrete material will be delivered 24 hours before the scheduled pour through a dedicated access point – their deliveries will not impact other site deliveries.

The batch plant can output 200 cubic yards/hour whenever needed which will satisfy project requirement of 1500-2000 cubic yards per day. The batch plant will only provide concrete for said project – concrete goes directly from plant to pour location requested. Concrete trucks will have specific delivery routes from batch plant to working areas which will be determined by Pacific Structures' site-logistics plan.

Central is capable of any number or combinations of mix designs, however, increased number of mix designs will increase space required for batch plant. Minimizing the number of mix designs will increase overall efficiency of batch plant.

Batch plant provider, Central Concrete Supply, maintains plant-specific SWPPP plan and must adhere to project specific SWPPP. Truck wash required on access route for all raw material delivery trucks leaving site. On-site trucks will wash out in batch plant area with designated wash out basins – tire wash not required as trucks will not leave site.

The batch plant must receive industry certification which states that the plant is calibrated to create ASCI approved concrete. Furthermore, Pacific Structures must perform on-site verification of quality control by its project team and inspectors. Any discrepancies found against ASCI standards can be easily fixed with due to direct access to batch plant. The short distances from plant to placing area present little to no risk of 90-minute expiration of concrete and make it easy to maintain optimal water-cement ratios.

Central Concrete Supply plant operators and laborers will require a dedicated SSSP and must abide by the General Contractors' SSSP requirements.

The plant will require temporary site utilities during all hours of operation. Overall, the plant has potential to reduce overall emissions with less concrete truck travel. The trucks will also be loaded past California highway requirements which will increase the number of cubic yards per trucks.

Permits required from Owner as well as BAAQMD (Bay Area Air Quality Management Department).

Alternate #2 – Typical Concrete Delivery from Off-Site Batch Plant

Large amounts of staging space will be required for 20-25 trucks with a nine-cubic yard load as they prepare for their turn to pour at given location. Staging space will also be required for truck wash out and tire wash post-pouring. Trucks will be intermingled with other site deliveries and traffic which may require additional space for laydown or parking.

Any number or combination of mix design available upon request.

Concrete deliveries could come from multiple local plants at an estimated rate of 150 cubic yards/hour for daytime pours depending on traffic and plant wait times. Concrete must be delivered at time of pour and delivery speed is dependent on plant schedule and other customer demand. To meet the volume demand that the schedule requires, Pacific Structures must schedule pours at off-hours which has a serious cost impact for overtime labor. Unforeseen traffic delays can create down-time or idle-time on-site which again impacts cost and schedule.

Concrete delivery trucks must abide by SWPPP as they enter and leave site.

Concrete expiration risk dependent on traffic which can require extra water or completely expired loads being sent back to plant.

Concrete truck drivers must abide by SSSP.

High potential to get deliveries from smaller booster trucks instead of larger slider trucks

No additional permitting required.

Advantage Analysis

Before coming to an ultimate recommendation, the project teams came together to break down the advantages that both alternates presented.

Implementing the on-site plant will reduce incoming traffic to site because concrete trucks will not leave the site and raw material will be delivered on a dedicated access route during off hours. On the other hand, without the on-site plant, the 1.5 acres it would take up would allow for more on-site space for laydown, parking, etc.

Mix-design capabilities were deemed to be an irrelevant factor as both proved to be more than capable of meeting project needs.

The high concrete output of the on-site plant alone is enough to out-weigh traditionally delivery methods – once you add in bay area traffic and the busy schedules of off-site plants, the advantage exponentially increases. On-site production will also allow for schedule acceleration by increasing flexibility of pour times.

As far as the SWPPP goes, both options have minimal impact. On-site plant keeps trucks onsite, while off-site requires a tire wash out – a quick and easy procedure.

Quality control is another area where the on-site plant proves to be a better option. Especially during hot summer months, loads that sit in traffic face serious deviations from the mix design once they are finally on-site and ready to pour. This results in added water and time when trying to fix how to mix changed on the highway. With a batch plant located right next to the pour locations, it is easy for Pacific Structures' project engineers and inspectors to radio the plant and verify the accuracy of mixtures.

Safety is a major area where off-site production takes liability from the general contractor. The on-site batch plant is a major piece of machinery that brings on safety risks that are traditionally never monitored by SSSP.

We see a major reduce in emissions by not trucking in concrete from off-site plants. A 2,000-yard concrete pour means that around 200 concrete trucks will be commuting to and from the site. By keeping trucks off the road, we keep them out of staging zones where they would be idling waiting to pour. On-site trucks can also be loaded over the maximum highway requirements to keep the number of them to a minimum.

Permitting is a major obstacle when it comes to implementing a major production facility like this. Pacific Structures avoids dealing with owner and BAAQMD by opting for traditional concrete delivery.

Recommendation

The recommendation is to proceed with the on-site concrete batch plant based on readily available concrete for critical path pile/concrete work. The recommendation brings reduced delivery coordination, minimized schedule delays from delayed concrete deliveries, increased labor efficiencies, and reduced emissions associated with the project.

Recommendation Results

The Owner accepted the recommendation to proceed with building a batch plant on-site. Central Concrete Supply agreed to supply the project with a portable batch plant for an 18th month lease per Pacific Structure's request. Plant construction was completed in June of 2016 – plant will stay on the project until December 2018.

Pacific Structures' Verdict

Pacific Structures sees this plant as a breakthrough in concrete delivery and schedule acceleration. Having a batch plant that services just their project means that they have access to around the clock concrete without delays incurred by orders from other contractors. In the eyes of Pacific Structures' project management and engineers, the plant will perform whenever and however they want it to.

Like any other concrete job, mistakes made on the working deck often lead to failed inspections and cancelled concrete pours. Due to the size, complexity, and strict owner inspection of this specific job, Pacific Structures has seen some serious delays due to failed inspections. This is where having a batch plant comes in handy, allowing Pacific Structures to quickly get back on track after mistakes are made in the field. The time and money that the batch plant is saving the company allows room for the back charges from Central due last-minute pours and cancelled pours.

Pacific Structures leased the plant for 18 months – meaning it will have serviced 70% of Pacific Structures' work on the project when it comes time to disassemble. This is the case is because the space it occupies is being built upon, and the plant cannot mix the materials needed for the last 30% of Pacific Structures' work. The last 30% of concrete work calls for a lightweight material mix that the plant was not designed to batch – not a huge issue as the space is

needed regardless. Production will slow for this portion of the work as concrete will be ordered from off-site plants. This is not a huge issue given how much time the on-site batch plant will have saved by the time it is removed.

Central Concrete Supply's Verdict

Central Concrete Supply is a major player in the ready mix concrete delivery service in the Bay Area. Their management and employees work very hard to keep up with the schedule of the on-site batch plant and their four other Bay Area plants. The management team on this project's batch plant agrees that the plant serves its purpose very well, however, they are experiencing little mercy from their customer, Pacific Structures. While not an everyday occurrence, the customer tends to take advantage of the batch plant as if it was their own. Central orders raw material and hires Batchmen per customer schedule, and any deviation leaves Central stuck with either an excess or shortage of raw material and personnel.

There are a few situations where Pacific Structures puts the batch plant in a tough spot: opening the plant for pours less than 100 yards, un-finished pours, last minute pours, and completely cancelled pours. These situations lead to issues because: the plant is not designed to batch less than 100 yards, purchased drivers and raw material go to waste when pours are canceled or un-finished, and lastly, it is difficult to get last minute trucks and raw material to the plant. It is tough for the Central team to keep an eye on Pacific Structures' field work which means they are caught off guard when these situations occur. These complications impact the on-site team along with other, off-site, Central operations as resources must be relocated to or taken from other plants.

Conclusion

As Bay Area development continues to boom and projects become larger and larger, it is essential that concrete contractors and ready mix suppliers work together to further develop the on-site batch plant approach. This case study involving Pacific Structures and Central Concrete Supply highlighted why the decision to implement an on-site batch plant was made, the ways in which it was successful, and the areas where it could be improved. It was discovered that complications with Pacific Structures work seriously impacts Central operation as they are still working out the kinks of balancing the on-site plant operation with the rest of their Bay Area plant operations. Overall, it proved to be a successful operation that is heavily dependent on customer quality assurance and schedule execution. With diligent planning and management from both the customer and supplier, an on-site batch plant is an excellent way around poor concrete service that will drastically accelerate concrete schedule.

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