Resequencing to Make Up Lost Time During the COVID-19 Pandemic: Case Study

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Construction schedules are typically built by organizing activities according to trades as a whole. The entire foundation is poured, then the entire superstructure is erected, followed by interior framing, etc. However, for projects with an unchangeable finish date such as a school, other scheduling methods must be considered when the project is faced with uncontrollable, force majeure events which threaten to delay the project deadline. In order to examine the efficacy of alternative scheduling techniques, analysis of a $50 million school project will provide insight into how tasks can be safely overlapped to gain lost time in a schedule. This research combined with the methodology of interviewing project team members illustrated that activities which usually cannot occur simultaneously, can actually share time on the schedule without increasing risks related to safety, quality or increased cost. The results of the project analysis demonstrated the feasibility of erecting structural steel in sections before the underlying slab is fully poured. Beginning steel erection before the slab is poured allows for acceleration of the critical path by opening up the site for work that would otherwise have to wait for 100% completion of the slab.

Key Words: Schedule, Sequence, Force majeure, Segments, Simultaneous

Introduction

The COVID-19 pandemic provided an unprecedented challenge to a number of industries, and construction has been no different. OSHA enforced COVID check-ins prior to entering the site slowed down work in the mornings, especially on larger sites, and smaller sites were forced to limit crew sizes. Many companies hired new employees just to oversee COVID safety. New safety protocols had to be implemented, and management personnel could no longer have the same on-site presence. Construction projects around the world were delayed well beyond their planned finish dates, which had a significant ripple effect on other industries that needed buildings delivered by a certain time. In addition, vendors and suppliers who were contracted to provide materials for the construction industry were no longer able to fulfill their obligations. CDC guidelines restricted the number of workers allowed in factories and warehouses, which pushed back delivery dates indefinitely, resulting in one of the largest and most impactful force majeure events to ever hit the industry. Day-to-day operations on-site were frequently disrupted by workers unexpectedly calling in with symptoms, and anybody who was in contact with said person had to be sent home, further disrupting work. Another cause of delays was the inability for members of the design team to visit the site and see issues firsthand, making it harder to answer RFI’s in a timely manner. Before diving into the specifics of the case study,
it is important to examine the legal impact of the pandemic on the construction industry, and how other projects made up lost time.

Literature Review

COVID-19 As a Force Majeure Event

There is hardly any legal precedent for a force majeure event of such magnitude causing significant cost increases across the entire industry. Especially considering the small profit margins of most construction contracts, these added costs due to an unexpected, uncontrollable external event like COVID-19 have forced many contractors to suffer losses on their contracts. On top of the unavoidable nature of these costs, unless a contract included a “catch-all” type of force majeure clause which contains language like “anything outside of either party’s control”, then further litigation will most likely be required in order for a contractor to be entitled to any time extensions or liquidated damages. (Hansen, 2020)

One of the most widely used sets of industry construction documents is the AIA (American Institute of Architects) contract forms. The current AIA contract language concerning delay is found in the A201-2017 General Conditions which states:

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by . . . unusual delay in deliveries, unavoidable casualties . . . or other causes beyond the Contractor’s control . . . or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended. (Moran Rodgers-Waire & Stover, 2020)

This language is certainly vague enough for a contractor to qualify for recovery of delay costs. Another document outlining a contractor’s rights in a force majeure situation is ConsensusDocs 200. Under section 6.3.1 of these documents there is a list of excusable delays which includes epidemics as a reason for “equitable adjustment in the contract price”. (O’Brien, 2020)

Since the subject of this case study is a school project with a hard deadline, Overaa has not and will not be pursuing a time extension on the contract. Instead, the project team has been tracking all costs incurred due to COVID, and issuing change orders to increase the contract price to a number that will cover the losses due to the pandemic. The impossibility of a time extension is what forced the project team to resequence the job, and the guarantee of increased contract payment ensures that the accelerated schedule is feasible. (Kog, 1999)

Recovering From COVID Across the Industry

Even before COVID, 53% of typical construction projects finished behind schedule. So the added challenges of conducting problem solving virtually with team members split up between offsite and onsite locations lead to even more communication and knowledge gaps than what is already standard
for a construction project. In order to regain lost time in their schedules, many contractors turned to outside consultants for help during the pandemic. Nick Masci, an engineering consultant for Haley Aldrich, was brought onto two projects whose schedules were negatively affected by the pandemic. One project is a 214,000 square foot courthouse that is being remodeled into 114 residential units. The other project is a 211,000 square foot, 5-level residential building with two levels below grade and 118 units. Although these projects differ in scope from the Piedmont High School project in this case study, the methods for recovering the schedule were both similar and universally effective enough to be used industry-wide. (Epstein, 2020)

Nick Masci discusses 3 solutions to address the unique scheduling challenges COVID has introduced. First, his team applied a “5S philosophy” to improve workplace organization. Secondly, they promoted efficiency through “visual management”. Last, the consulting team introduced a couple technological innovations to fast track communication and collaboration in a virtual environment.

5S Philosophy

The first problem Masci tackled on his impacted projects was poor site organization. One site in particular was so cluttered it was completely unclear which teams were responsible for the mess. One day, a team spent 30 minutes looking for one piece of equipment, and on average workers were wasting 22% of their day searching for materials or tools. Not only was the clutter slowing down work, it was also making physical distancing much more difficult. (Masci, 2020)

In order to remedy the disorganized site, Masci and his consulting team implemented 5S which stands for sort, set in order, shine, standardize, and sustain. One example of sorting was collecting all the sheet metal tabs and connectors and organizing them into crates, labeling them, and placing all the crates onto a cart with the right amount of material for one week worth of work, then moving the cart to the area of the project where it will be used. (Masci, 2020)

Employing 5S on the jobsite improved safety by removing clutter, allowing for proper socially-distanced pathways throughout the building, as well as reducing trip hazards and making materials easier to access. In addition, a neater workspace meant subs could turnover work areas faster. It became much easier to perform work and clean up to assure the next trades could begin work with minimal waiting and set up time. (Pink, 2020)

Visual Management

The second tool Masci and his team helped improve on their consulting jobs was a physical poster board of tasks which needed to be completed. The contractor previously had the board hanging in the trailer, until the consultants enlarged it and moved it to the actual space where the work was occurring. The new, more accessible location allowed foremen to see and update the board as work was happening, which helped teams stay on top of what task came next and why work was not moving forward. The consultants also changed the board from black and white to color, which made it quick
and easy to see where work was incomplete or stalled. In addition, through the use of colored stickers, workers could more easily update their progress. (Masci, 2020)

Figure 1. Visual Management Task Board (Masci, 2020)

**Technological Innovations**

Finally, Masci and his consulting team introduced a couple technological innovations which were highly impactful in recovering the project schedules. The first piece of technology that was used to accelerate the schedule was sending architects video requests for information. With the pandemic making site visits difficult, sharing site conditions through video helped resolve RFIs 50% faster than traditional methods. (Masci, 2020)

The second technological tool that was used to help COVID-impacted projects was a software called MURAL. This program enabled project teams to work using virtual “sticky notes” to share, understand, and collaborate on problems in a shared, online workspace. Everything was completely transparent and accessible as if the entire team was physically working together on a whiteboard.
MURAL greatly helped project teams overcome the challenges of physical distancing by allowing for real-time, multi-user input and for team members to contribute asynchronously. (Masci, 2020)

Methodology

This case study uses qualitative research gathered from several primary sources including the American Bar Association, reports from scheduling consultants, engineering journals, and personal interviews. Secondary news sources were also used for general background information about how COVID impacted the industry at large. In addition, there was quantitative research performed in terms of how much time and money companies are legally entitled to under force majeure clauses, as well as how much time was lost, on average, on construction schedules.

After the preliminary research stage, project team members from both the field and the office were interviewed using the twelve structured questions below. Interviews were conducted on site in the job trailer, with all participants wearing masks. The superintendent’s interview was focused mainly on the challenges the team faced in terms of site organization and subcontractor coordination. The superintendent shed light on how the project was able to maintain sufficient crew sizing to complete work as fast as possible while also practicing social distancing. The foreman provided insight into the benefits of fully virtual RFIs, and why the pandemic has changed his view on how he will manage crews on future projects. The project manager was the biggest innovator in terms of resequencing, and his interview goes into detail about which specific tasks had to be resequenced and why it was effective.

Interview Questions

1. How did you balance proper crew size with physical distancing restrictions?
2. How were material lead times affected by COVID?
3. What specific tasks had to be resequenced to gain time on the schedule?
4. Which task saved the most time?
5. Will you continue to schedule work this way in the future?
6. How did you overcome the challenge of working with the project team virtually?
7. What compromises did you have to make with the owner to keep the schedule from being delayed even further?
8. How did you ensure subcontractors met deadlines while complying with new safety precautions?
9. How did you prevent the RFI/submittal process from being slowed down in a fully virtual setting?
10. How has COVID impacted the way you will run jobs in the future?
11. How did you manage to only have the site shut down for 2 working days?
12. How did you perform pull planning without being able to physically gather tradespeople in the trailer?
Results

Superintendent: The superintendent on the job said that early on when COVID restrictions were first implemented, they could only schedule a skeleton crew to maintain proper physical distancing. Later on, the project team coordinated a rotating schedule throughout the building. Since each classroom basically had all the same components, the superintendent worked with the subcontractors to establish a “round robin” type of work schedule, with one trade at a time working in each classroom. For example, one day the painters would all be working in the second floor east classrooms, and the electricians would work in the second floor west, and then they would switch. This prevented intermingling of different crews within the same workspace. The superintendent also said that having a night crew was essential to avoid overcrowding the site. In regards to performing virtual pull planning, the superintendent and the rest of the project team struggled early on in the pandemic with getting subcontractors to understand their place on the critical path, and how their tasks related to the other trades before and after them, all while meeting on zoom. In order to solve this problem, the project team got a large whiteboard on wheels and had outdoor meetings with all the subcontractor foremen and project managers, allowing for safe and comprehensive pull planning.

Foreman: The foreman said his biggest challenge throughout COVID has been employee turnover due to workers having to leave the site for a few days at a time because of exposures. The foreman thought the “round robin” style of having tradespeople rotate throughout the classrooms to avoid exposure between crews would be an effective method for scheduling work on similar projects, regardless of COVID. He said on future classroom buildings or jobs where there are several identical rooms he will strongly consider organizing subcontractors in a similar fashion. In regards to the fully virtual RFI process, the foreman also said that one thing he thought should become standardized is video RFIs. He thought it was much easier to illustrate a problem on the site through a video rather than the typical RFI format, and he felt that the architect and other consultants were able to provide better answers to RFIs when they were sent a video, and there was less of a need for back and forth phone calls trying to further explain the questions.

Project Manager: The project manager made it clear that changes in material lead times due to COVID were the biggest delaying factor in the schedule. In addition to the steel fabricators being temporarily shut down, YKK the fastener suppliers had a factory burn down, and the epoxy countertop suppliers were understaffed and desperately trying to make predetermined deadlines, which led to another warehouse fire and the project management team had to scramble to find another casework shop that could fabricate what was already in the completed drawings. Furthermore, the Suez Canal incident delayed the delivery of interior metal studs by 3 weeks because the raw steel got stuck on a boat halfway across the world. In order to make up for these detrimental hits to the schedule, the project manager spent days figuring out how to resequence the entire job so that students could still come back to class on the scheduled date. The solution he came up with is partially represented in figure 2 below, and shows how changing the slab pour from monolithic to a segmented pour created the time and space needed to keep the critical path on track. The project manager said that as long as the budget and the physical size of the jobsite allowed for it, he would always prefer to schedule work this way in the future. For example, changing the task “MEP 1st Floor” to “MEP 1st
Floor South” made it much easier for him to manage the smaller task, and when the foremen had smaller work packages they could focus on one problem at a time, rather than trying to juggle the scope for an entire floor which ends up creating RFI's that are not actually critical path and end up slowing the job down. When asked which specific resequenced task saved the most time, the project manager identified pouring the slab after initial steel columns were set as the biggest help. In the original schedule, the slab was going to be poured first with blockouts in the forms for steel columns. Bringing in the steel subcontractor immediately after footings were poured allowed for successive tasks on the critical path to begin sooner. As seen in figure 2, work on the second floor and roof were already well underway before the slab had even been completed, and in the original schedule, steel would not have even begun erection until the slab was fully poured.

![Figure 2. Final slab section being reinforced well after upper level work had begun](image)

Through comparative analysis of the schedule changes, along with interviewing the project team members, the elements which contributed to an accelerated schedule have become clear. Below, in figure 3, a sample schedule can be seen which displays the efficacy of breaking tasks down beyond trades, and sequencing work according to independent sections or quadrants of a building.
Per the interview with the project manager, the most crucial step in condensing the schedule was not pouring the slab monolithically, which allowed subsequent tasks to be completed faster as they did not have to complete the scope for the entire building. In the original schedule, erecting structural steel for the whole project after the slab is poured would have taken weeks, whereas beginning the steel scope before the slab was poured enabled decking and framing for the second floor to begin much sooner. This had a cascading effect on the critical path, and down the line rough MEP could start before the entire superstructure was complete. Obviously when sequencing a job like this, crew sizing becomes a major concern, especially considering COVID restrictions at the time. Luckily, due to the size of the site the superintendent was able to facilitate spacing crews out vertically to avoid having to physically share workspaces.

**Conclusion**

COVID-19 has caused drastic changes to how jobs are run in the construction industry. Although a majority of these changes will disappear along with the rise in vaccination numbers, this pandemic has certainly provided a newfound perspective for many people in the industry. Changes to safety, jobsite organization, scheduling, and virtual communication will remain long after masks are no longer required. Understanding why some of these changes will be considered innovations and why some will be gladly forgotten may provide some deeper insight into how the industry can learn and grow from the pandemic.
References and Appendix


