



## Construction Schedules: Back to Basics

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*In the author's experience, there are four main pillars for the development and use of effective construction schedules. These are: (i) adequate industry experience of the scheduler and clear communication of the schedule; (ii) consideration of external factors in the broader project environment (such as stakeholder input, supply chain issues, statutory regulations, unusual weather or access issues); (iii) adequate incorporation of the design process, when necessary (proper recognition of critical design inputs, the need for design freeze, and the challenges of incorporating the iterative nature of design); and (iv) active use of the schedule as a predictor of project outcome and forecasting tool through consistent schedule updating, tracking of costs and productivity data, and performing schedule risk analyses. This article discusses the first of these main pillars.*



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### Introduction

Construction projects are becoming increasingly large and complex. To deal with this complexity, we break projects down into individual work packages so that the activities to be performed can be clearly defined, communicated and understood. This is achieved through the use of construction schedules.

Construction schedules range in sophistication from simple one-page Gantt charts (or a list of milestones), as seen in Figure 1, to those with many thousands of activities, developed using scheduling software such as Microsoft Project or Primavera ("P6").

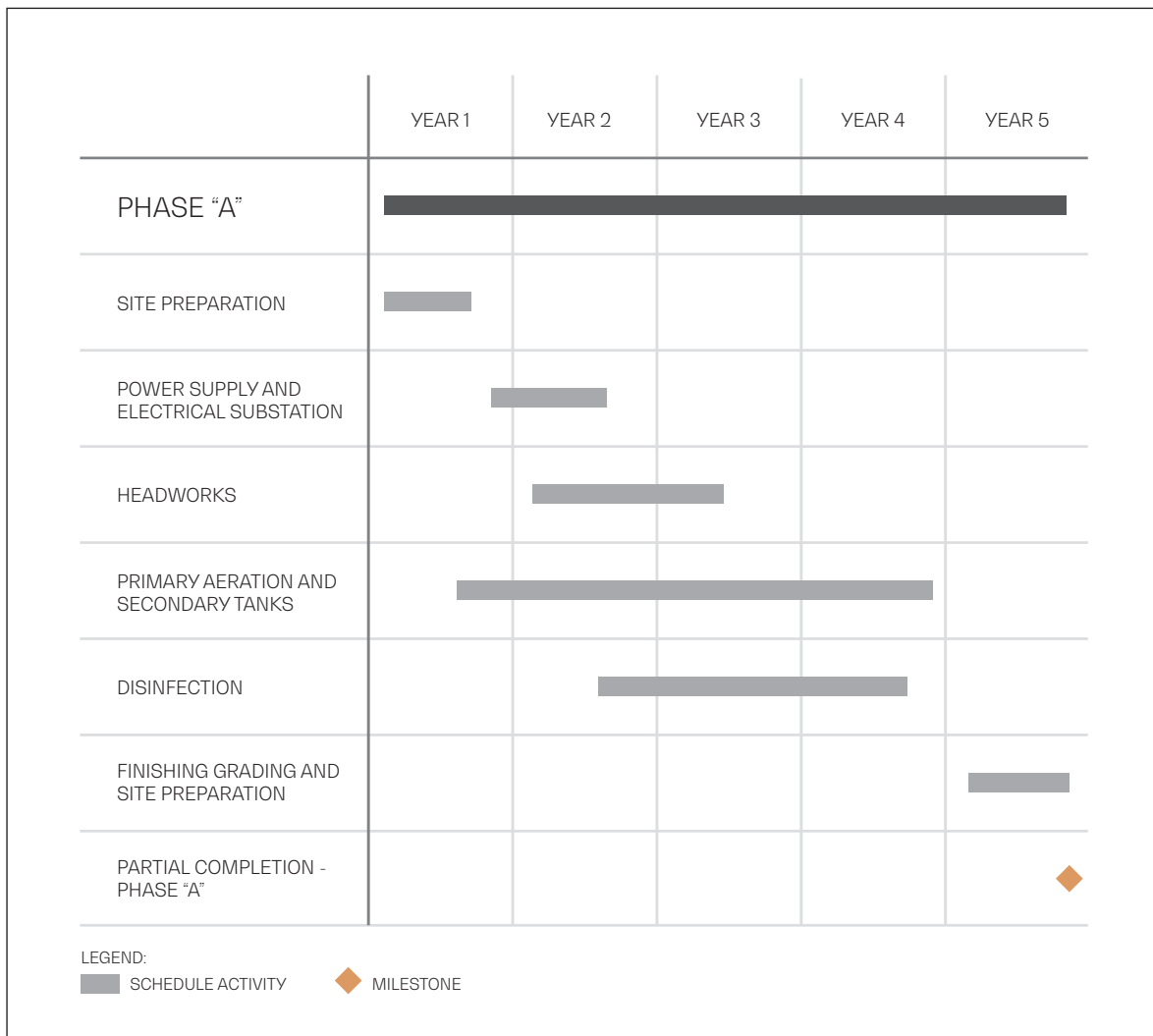
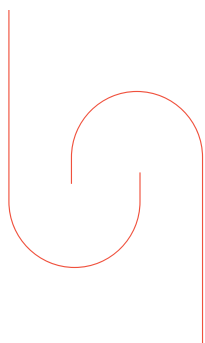


Figure 1 - Example of a Gantt Chart Schedule

Additional tools, such as linear schedules (or time chainage schedules)<sup>1</sup> are often used on large linear infrastructure projects, for example, highways, bridges, pipelines, tunnels and railways, as shown in Figure 2.



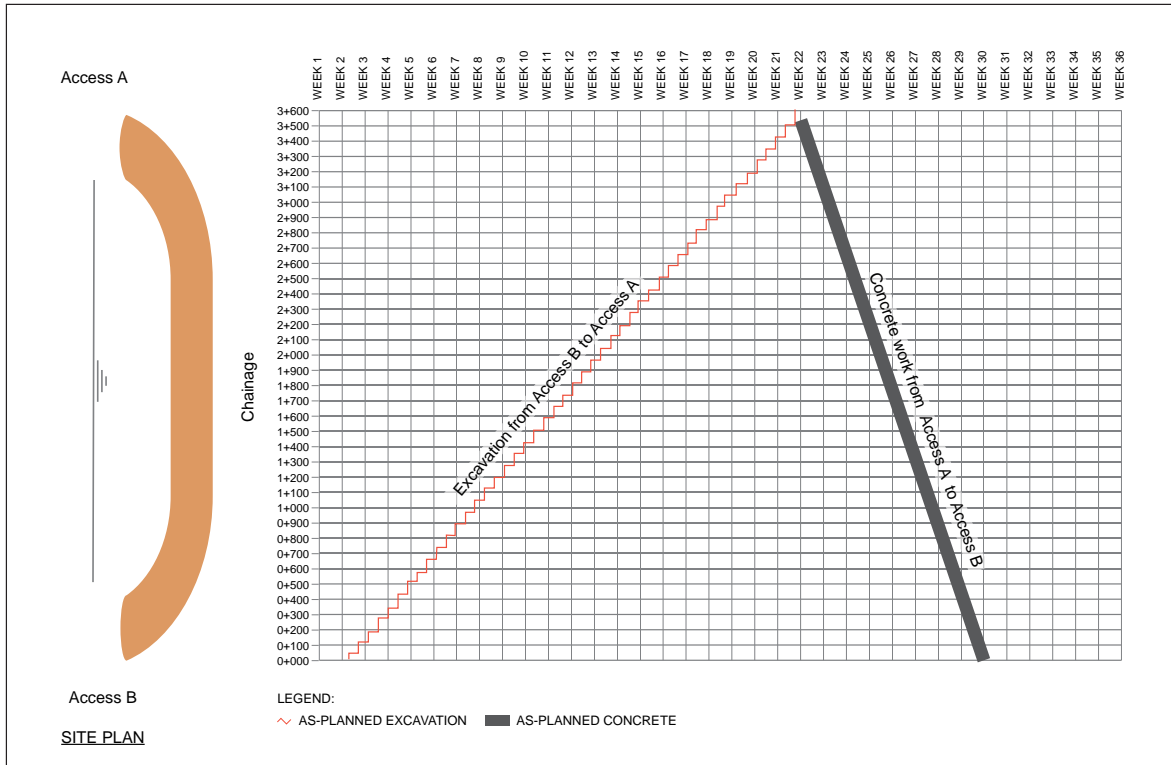


Figure 2 - Example of a Linear (or Time Chainage) Schedule

Regardless of the choice of software or complexity of the schedule, it remains that forward-looking construction schedules all share a common characteristic — they are imperfect. They are limited to being a vision of what we want reality to be, and we strive to make this vision as realistic and reliable as possible. Reliable schedules are important for contractors because they are almost always commercially exposed if they do not achieve contractual milestone dates. For their part, owners also rely on schedules for planning, financing, and managing their project portfolios.

In order to prepare reliable, quality construction schedules which can be easily understood by different project stakeholders, a certain level of experience and effort is required. This article focuses on this particular issue.

## Difference between Planning and Scheduling

While the terms planning and scheduling are interrelated and are often used interchangeably, they are fundamentally different.

The planning process “involves the choice of technology, the definition of activities, the estimation of the required resources and durations for individual activities, and the identification of any interactions among the different activities. A good construction plan is the basis for developing the budget and the schedule for work.”<sup>2</sup>

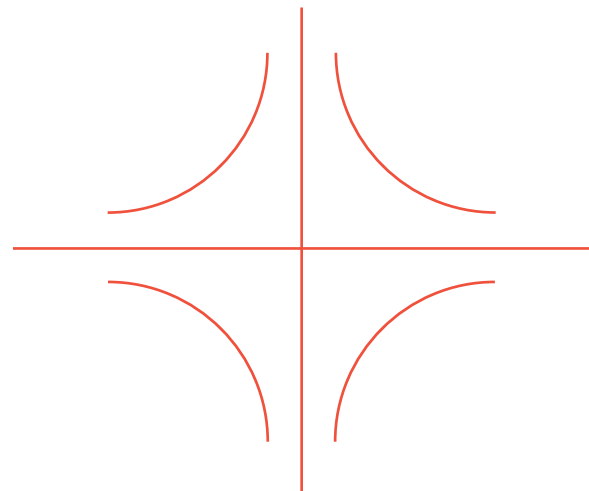
Construction scheduling is, among other things, the “[p]rocess of converting a general or outline plan for a project into a time-based schedule based on available resources and time constraints.”<sup>3</sup> In other words, construction scheduling takes the activities, resources and logic defined during the planning phase and places these onto a timescale. The construction schedule can then be used as a tool for visualizing the flow of work on a project, monitoring progress during construction and forecasting the impact of changes and disruption events, which is usually done using one or more scheduling software tools.

In order to develop reliable and realistic construction schedules, the planning and the scheduling processes should be closely aligned, and the schedules should reflect the assumptions that have gone into the planning process.

## Schedule Quality

There is no universally accepted definition of what constitutes a good quality construction schedule. However, various industry organizations publish their own guidelines recommending what they consider to be the essential requirements for such a schedule.<sup>4</sup> These guidelines generally indicate that construction schedules should be logically laid out; contain robust logic links between activities; use realistic durations; and minimize the use of artificial constraints, as these can prevent the accurate calculation of a project’s critical path.<sup>5</sup>

Some scheduling software providers offer tools that allegedly measure the quality of a schedule. That said, these tools should be used with caution as the results seldom address the four main pillars for the development and use of effective schedules highlighted by the author in the introduction of this article.



### Importance of the Scheduler's Experience in Developing Reliable Schedules

Common sense dictates that the value that can be derived from a construction schedule is directly proportional to the level of effort and quality of the information that are put into it.

While construction schedules can be developed with a basic technical knowledge of scheduling software, it takes experience in the execution of construction and/or design activities, including their relationships and constraints or limitations, to develop a reliable plan.

At one end of the spectrum, construction schedules may be developed by schedulers who can “drive the software” but who are relatively inexperienced with the execution of construction and/or design activities. Such schedules are vulnerable to challenge when used as the basis for demonstrating delay and disruption and the impact of changes, and should therefore be avoided, if possible.

At the other end of the spectrum, construction schedules may be developed by staff well experienced with not only the scheduling software, but also the execution of construction and/or design activities. Such schedules are more likely to be defensible when used as the basis for demonstrating delay and disruption and the impact of changes. Wherever possible, a contractor should try to develop schedules that fall at this end of the scheduler resource spectrum.

In the middle of the spectrum, construction schedules are developed with some amount of experience or knowledge in scheduling software and in the execution of construction and/or design activities. While often reasonably

reliable, these schedules may be susceptible to some degree of technical challenge. Most construction schedules in Canada fall into this “middle-of-the-road” category, in the experience of the author.

Based on the above, in cases where contractors do not have dedicated full-time professional scheduling resources, acquiring independent expertise to strengthen their scheduling competency for critical bids, as well as for monitoring and updating schedules during project execution, is almost always a good investment.

### Importance of Alignment between the Plan and the Schedule

Proper planning is an essential part of estimating. The collective experience of a contractor's team, including that of its subcontractors (and designers for design-build or P3 projects), forms an integral part of how a project can be economically and efficiently built. In order for a construction plan, an estimate, and ultimately, a construction schedule to be reliable, the contractor's staff must take into consideration the performance limitations of labour, materials, equipment and other resources (for example, designers).

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The contractor's plan developed at the estimating stage and the construction schedule should, in general, be closely aligned, as ultimately, they should reflect common project information, assumptions and targets. However, at times this is not the case. This lack of alignment may result from different groups of individuals being involved during the estimating stage versus the development of the construction schedule during contract negotiations (or shortly after contract award).

It is important that the construction schedule be developed using the contractor's plan developed at the estimating stage as a reference point. In other words, the construction schedule should clearly not be developed in isolation. Furthermore, when developing the construction schedule after contract award, it is always beneficial to include, or at least consult with, individuals who were involved in planning at the estimating stage of the project.

### Why Is a Reliable Schedule Important in the Case of a Claim?

An owner's acceptance of a contractor's construction schedule is not the same as an owner's agreement to all of the contractor's construction logic, constraints and activity durations. As such, it is important that the construction schedule be as reliable and realistic as possible.

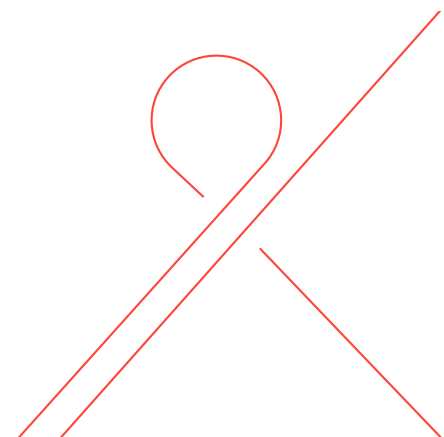
While schedules developed in the early stages of the project (for example, a bid schedule submitted with the contractor's bid or a baseline schedule submitted shortly after contract award) can be, and usually are, expanded with many more activities as construction progresses, it remains that these

schedules (which typically incorporate contractual milestones) are generally used as the basis for assessing delays to the project, should they occur.<sup>6</sup> Accordingly, the contractor should develop such schedules with a high level of rigour. Otherwise, fundamental mistakes and omissions, or lack of alignment with the construction plan developed at the estimating stage, may come back to haunt the contractor.

In the event of a claim or dispute, a lack of alignment between the construction plan developed at the estimating stage and the construction schedule may impact the contractor's ability to clearly demonstrate its bid intent when attempting to receive compensation for additional time and/or money.

## Communicating the Schedule

Construction projects are completed by diverse teams. The more effectively the project team can communicate the schedule internally and externally, the more likely the schedule will serve its purpose and the more likely the project will be successful. The construction schedule is the primary communication tool on a project: a good schedule communicates what needs to be done, by who and when.



## Different Project Stakeholder Audiences and Associated Schedule Presentations

Care must be taken to ensure that the project schedule is structured in such a way that it can be communicated to very different audiences. At one extreme, a board of directors may want nothing more than a one-page summary, or dashboard, to understand the constituent parts of a project, when they occur and which of these are on the critical path. At the other extreme, the contractor's and owner's project management teams on site may need all planned start dates to be visible so that individual design and construction activities can be initiated on time. This requires flexibility in the visual presentation and reporting of a schedule, which is commonly achieved through the use of different levels that can be sequentially rolled up.

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As for the day-to-day work on site, the workforce seldom studies the overall project schedule in detail. Hence, the contractor will often use other more appropriate schedule formats, such as daily task sheets and location-specific short-term look-ahead schedules, etc. These types of secondary communications of the project schedule are also critical.

## Schedule Narratives

Contractors should consider producing a narrative, wherever possible, to accompany their construction schedules. Particularly on larger projects, it is not always easy for a third party to understand all of the key assumptions behind a construction schedule (such as the use of different calendars, allowances for bad weather, use of leads and lags, allowances for equipment repair, etc.). Most of these are generally hidden, except to other scheduling professionals who have access to the native files. A well-structured schedule narrative can efficiently convey the contractor's key schedule assumptions to a non-scheduling expert (which, crucially, includes most other members of the contractor's own project team) and can support the contractor's position in any later disputes that might occur. Schedule narratives help bridge the gap between the planning and scheduling processes.

## Conclusion

In conclusion, the construction schedule is a key project management tool on any construction project. As such, it is important that it be reliable and realistic. However, technical competence in scheduling and scheduling software alone is not always sufficient to ensure reliable and realistic construction schedules.

Carrying the planning developed at the estimating stage through to scheduling is crucial to developing a good quality schedule. Regardless of the software used, all construction schedules are prone to “garbage in, garbage out,” so at all times, the most experienced resources available should be deployed to identify activity durations and dependencies.

It is also important that effort is put into making the schedule easily understandable to a wide variety of audiences, by using the appropriate scheduling software correctly and employing different reporting tools and layouts. Schedules and key assumptions should also be supported with a detailed schedule narrative wherever possible.

*Further reports in this Back-to-Basics series will discuss the other three identified main pillars for the development and use of effective construction schedules: (ii) consideration of external factors in the broader project environment; (iii) adequate incorporation of the design process into the schedule; and (iv) active use of the schedule as a predictor of project outcome and forecasting tool.*

- 1 Also referred to as “line of balance schedules”, “time-distance schedules” or “time-location schedules.”
- 2 Chris Hendrickson, *Project Management for Construction: Fundamental Concepts for Owners, Engineers, Architects, and Builders*, version 2.2, prepared Summer 2008 (1<sup>st</sup> edition, Prentice Hall, with co-author Tung Au, 1989; 2<sup>nd</sup> edition prepared for World Wide Web publication, 2000). [https://www.cmu.edu/cee/projects/PMbook/09\\_Construction\\_Planning.html](https://www.cmu.edu/cee/projects/PMbook/09_Construction_Planning.html)
- 3 AACE International, *(Draft) Glossary of Terms for Planning and Scheduling Professional (PSP) Certification*, Morgantown, WV, AACE International, Nov. 2005, quoted in AACE International, *Recommended Practice No. 14R-90 Responsibility and Required Skills for a Project Planning and Scheduling Professional*, Morgantown, WV, AACE International, 2006, p. 2-3.
- 4 Such as the guidelines put forth by the American Association of Cost Engineering International (AACEI), Project Management Institute (PMI), Association of Project Management (APM) and other similar organizations.
- 5 The critical path of a project represents the longest sequence of activities leading to project completion.
- 6 Unless these schedules are revised later to allow for changes, variations, etc.

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