

**Documentation Requirements for
Contractor Pursuit of Delay Claims**

by

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Submitted to the Department of
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ABSTRACT

Delay claims are very common on construction projects. Yet, contractors usually lack an understanding of how to pursue their claims and the documentation needed to prove their damages. This thesis provides an overview of construction delay claims including the variety of definitions, causes, and classifications commonly used within the construction industry. The often controversial issue of concurrency as it pertains to pursuit of delay claims is discussed as well. Also covered is the subject of contract interpretation as it affects notice of delay, analysis of delay, and finally, recovery of damages occasioned by delay.

This thesis demonstrates two methodologies that can be effectively utilized to prove responsibility of delay in an unbiased and fair manner: 1) the on-the-fly analysis, and 2) the after-the-fact analysis. It then outlines the information and documentation that is required for contractor pursuit of construction delay claims. It stresses that a consistent discipline of collecting and maintaining quality documentation throughout the life of a project is necessary in order to pursue delay claims and amicably resolve each issue.

The information provided throughout this thesis has one main goal: to aid contractors in the pursuit of delay claims either on-the-fly or after-the-fact by identifying the documentation required to effectively perform these methods of analyses. Additionally, the information resulting from this work can be used by owners and owners' representatives to assist with the evaluation of delay claims and more specifically the documentation that owners should expect contractors to produce when pursuing delay claims.

Thesis Supervisor: Robert D. Logcher
Title: Professor of Civil and Environmental Engineering

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Most importantly, I dedicate this thesis to the memories of both my mother, **Kitty Ann Long**, and my grandfather, **Melvin Bryant Garner**, who were the driving forces that kept my spirits high.

BIOGRAPHICAL NOTE

Prior to attending MIT in September of 1993, the author, Darren Long, worked in the field of construction both in the U.S. and abroad for more than twelve years.

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1.0

INTRODUCTION

1.1 General

The construction industry as a whole probably affects the lives of more individuals than any other industry in the world. A construction project can be as simple as a sidewalk in front of one's home or as complex as a high-tech space station on the moon. Regardless of the complexity or nature of the project, it is inevitable that multiple parties will be involved in the construction process. In fact, a large project could require hundreds or even thousands of participants.

The parties involved in a construction project generally vary according to project location, size, type, complexity, duration, etc. Sizable projects often involve a variety of individuals and groups such as architects, engineers, consultants, schedulers, laborers, craftsmen, supervisors, construction managers, prime contractors (contractors), subcontractors, financial institutions, governmental agencies, inspection and testing agencies, material and equipment suppliers and vendors, trucking and shipping companies, and most importantly, owners and end users of the product being constructed.

Regardless of the project or the level of interaction among the parties involved on the project, each participant has separate and distinct interests. The owner(s) may be either a public or a private entity.^{1 2} Publicly funded projects (public projects), including work for

¹ "The owner, public or private, is the instigating party for whose purposes the construction project is designed and built" (Clough and Sears 1994, 3).

² "The prime contractor, also known as the general contractor, is the business firm that is in contract with the owner for construction of the project, either in its entirety or for some specialized portion thereof" (Clough and Sears 1994, 4).

the Federal Government, may include schools, universities, roads, bridges, prisons, courthouses, military bases, post offices, parks and recreation facilities. Privately funded projects (private projects) may include homes, apartment buildings, office buildings, chemical plants, oil refineries, or shopping malls.

Under the auspices of privatization, many projects that at one time would have been public endeavors are now private undertakings. These projects are generally financed and constructed as Build-Own-Operate (BOO) or Build-Own-Transfer (BOT) projects. For example, many toll roads and prisons are now privately owned.

1.2 Consequences of Delay

If a project fails to progress smoothly and without delay, all parties involved stand to lose a great deal. Reputations can be tarnished, future business opportunities can be jeopardized, significant losses of money can be incurred, or the business entity or endeavor itself may collapse. Delays in general are very costly.

In recent years, the costs associated with construction have drastically increased, while in many instances, owners' budgets and contractors' profits have plummeted. In response to tightened budgets, more owners increasingly insist upon competitively bid, lump-sum contracts in lieu of negotiated or cost-reimbursable agreements. This is often done without regard to the inherent risks of delay.

In an effort to survive in an increasingly competitive global market, contractors are often forced to submit lower bids, which usually include smaller profit margins, regardless of any new risks that may have been shifted from the owner. With owners having smaller budgets and contractors making less profits, the consequences of delay are amplified even more. The old and overused adage "time is money" has never been more true than in the construction industry today.

Delays can represent significant losses in revenue. To an owner, these losses may result from delayed production of oil, paper, automobiles, medicine, etc., occasioned by delayed construction of the necessary production facilities. Delay can prevent a company from being the first to enter into a niche market, thus substantially reducing its potential market share. Owners may also suffer loss of rental income, as was the case with delay in the completion of the John Hancock Tower in Boston, Massachusetts from 1973 until 1976. It was estimated that the owner of the tower would suffer more than \$43 million dollars in lost rentals and usage income (O'Brien 1976, 349-356). Since this particular case was resolved out of court, the final damages are not public knowledge, but they are believed to have been extensive.

Similarly and of equal importance, contractors also stand to lose a great deal of money, and in some cases, suffer bankruptcy as a result of delayed construction projects. Potentially profitable new work may have to be postponed or foregone as a result of having resources tied up on a delayed project. Bonding capacity may have reached its limit, and as a result, until costs incurred due to delays are recovered, it may be impossible for the contractor to obtain the necessary bonding for new projects.

Additional and more expensive resources may be required to circumvent and overcome the effects of delay. Equipment and manpower may have to be shifted from one project to another. Overtime or additional shifts not originally scheduled may become necessary, thus causing significant variances between the budgeted and the actual amount of labor dollars. Certain activities may have to be rescheduled or resequenced. As a result of delay, contractors may be forced to share work areas with other contractors or subcontractors. This may cause overcrowding and have a negative effect on productivity.

Job site as well as home office overhead costs, field office and equipment rental costs, salaries, wages, insurance fees, and other burdens may continue to mount. These costs will likely result in large variances between budgeted and actual amounts paid. Delays may

extend a project into a period of differing weather conditions which may reduce productivity, and in some cases, require the contractor to cool or heat the facility under construction.

Delay can also add to the cost of financing a project, which historically only affected owners. Today, however, with many projects being constructed as BOO and BOT projects, contractors may now suffer from increased financing costs as well. These increased costs generally involve one or more of the following:

[a] added interest costs (including expenditures on borrowed funds and interest revenues lost on invested funds) during the construction period--sometimes called 'extended financing costs';

[b] added interest costs during the construction period attributable to higher interest rates during the extended term--sometimes called 'incremental construction interest costs';

[c] added interest costs for the permanent loan attributable to higher interest rates--sometimes call[ed] 'incremental permanent interest costs' (Faison and Barber 1981, 868).

Regardless of who or what causes delay, the fact remains that real costs are incurred by nearly all parties involved. Delays can have significant effects on and impact a project in a variety of ways. Even the smallest of delays can greatly increase the overall time and money required to complete a project. "The duration of an excusable delay may be substantially longer than the duration of the event that caused the excusable delay because of the impact

or ripple effect in disrupting the progress and momentum of the job" (Stokes 1990 ed., 205).

The illustration in Figure 1.1, Consequences of Delay can be summarized as "explosive," similar to a blast of dynamite. Nearly all delays are a source of fuel to ignite subsequent problems, and in most cases, no party is immune to the effects.

1.3 An Overview of Delays, Claims, and Delay Claims

Because "delay claims" are such common occurrences, a clear and distinct definition should exist in the industry; however, this is not the case. Therefore, the terms are defined below as they are often referred to in the construction industry, and more specifically, as they are used in this thesis.

1.3.1 What Is a "Delay?"

In the construction industry, "delay" is a relative term whose definition often varies. For example, delay can be defined as "... the time overrun either beyond the contract date or beyond the date that the parties agreed upon for delivery of the project" (O'Brien 1976, 3).

The first edition of one widely used publication defines delay more specifically as "...the time during which some part of the project has been extended or not performed due to an unanticipated circumstance" (emphasis added) (Bramble and Callahan 1987 ed., 1). On the other hand, the second edition states that delay can be two things, "[1]... the time during which some part of the construction project has been extended beyond what was originally planned due to an unanticipated circumstance" and "[2]...the incident that affects the performance of a particular activity, without affecting project completion" (emphasis added) (Bramble and Callahan 1992 ed., 1).

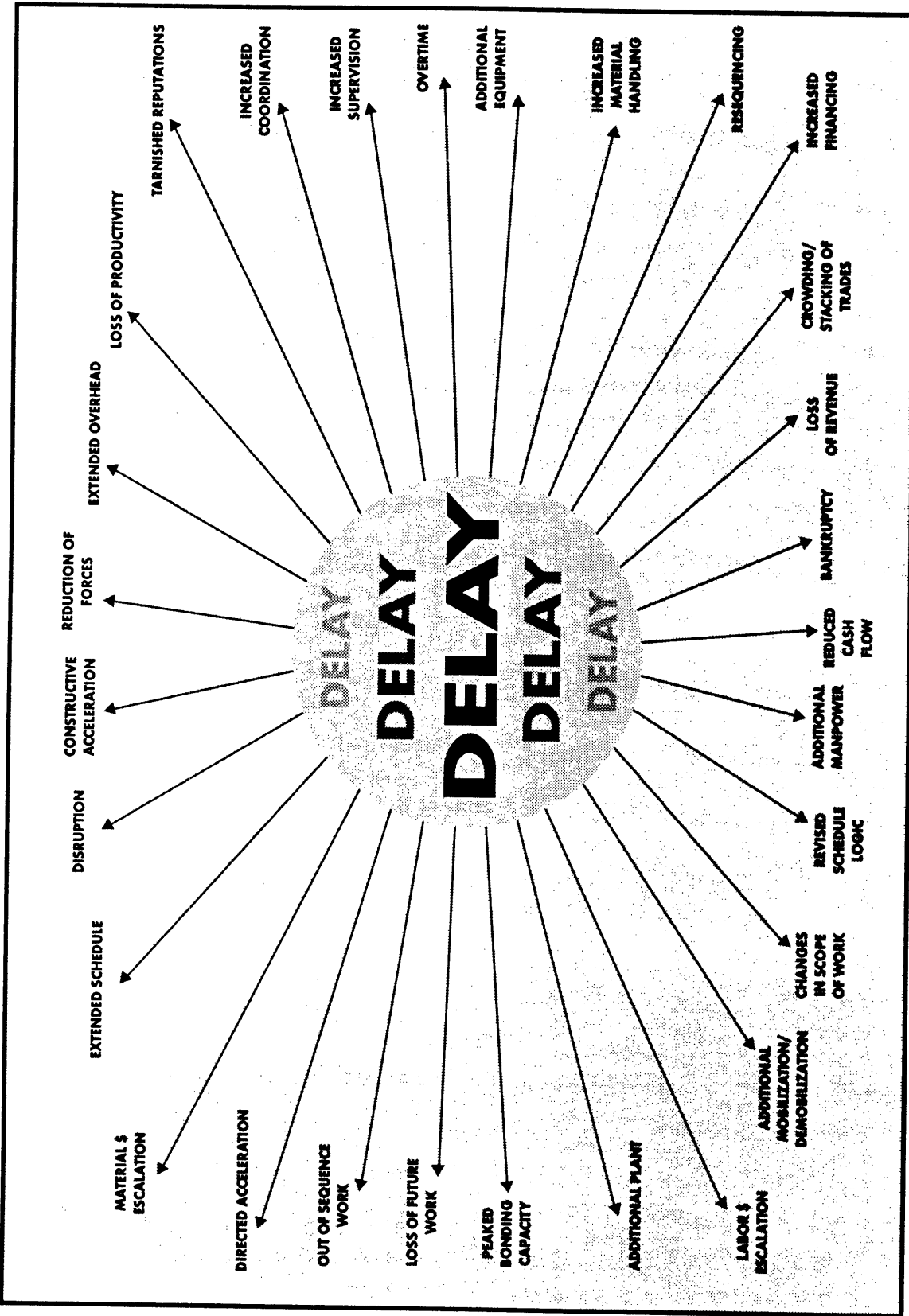


Figure 1.1: Consequences of Delay

In yet another publication, the author posits that "[a] 'delay' per se does not occur absent an overrun of actual contract completion time for the contractor's time entitlement" (Bartholomew 1987, 333).

Others believe that "[d]elays should not be confused with the concepts of suspension or disruption of the work" (Ahuja et al. 1994, 406). There are situations in which it is indeed preferable to distinguish between delays and suspensions or disruptions of work. However, in most cases suspensions or disruptions of work lead to delays. Provisions pertaining to suspensions or disruptions of work are often a contractor's only option to recover damages suffered as a result of delay. The decision to seek recovery of additional costs under the concepts of delay, suspension of work, or disruption of work, etc., should be made on a case by case basis.

In this thesis "delay" shall have the following meaning:

[t]o retard; obstruct; put off; postpone; defer; procrastinate; prolong the time of or before; hinder; [or] interpose obstacles.... The term does not necessarily, though it may, imply dishonesty or involve moral wrong (emphasis added) (Black's Law Dictionary 1993, 293).

1.3.2 What Is a "Claim?"

The term "claim" also has several meanings. One definition is "...a request for payment for costs incurred in completing a contract, where the basis for payment is not precisely defined within the terms of the contract" (emphasis added) (Stallworthy and Kharbanda n.d., 229).

Another author defines claim in the following manner:

Essentially a 'claim' is a request or demand made by one party of a contract on the other party to do or forego doing some act that the claimant asserts is owed as a matter of right. In the construction process there are a variety of actions and types of representations that are said to be claims.

Others offer the following comments regarding the interpretations of the term claim:

...a claim is said to be made whenever the contracting agency's attention is in fact called to a condition or occurrence that has contractual or legal consequences. When a contractor calls attention to an unanticipated water condition or occurrence on the work site or a work delay caused by bad weather, the contractor may later assert that payment should be made for more work or more time should be allowed than was provided for by the terms of the contract. In a[nother] variation of this usage, some recognize a claim only when there is a formal notification of the claimant's demand, its nature, and its basis (Netherton 1983, 3).

In many instances, the costs associated with the actual research and preparation necessary to pursue a claim (e.g., attorney fees, consultant fees, schedule analysis

fees, professional witness fees, etc.) are not recoverable as part of the total dollar amount being sought. For this reason, some contractors refrain from using the word "claim" to request additional compensation. Thus, in some cases they are technically not viewed as pursuing a claim.

For example, some contractors refer to the initial request for additional compensation as "a cost proposal" or "a request for price adjustment." Another reason often noted by some contractors for taking this approach is to maintain a positive working relationship with the owner. Occasionally, creative wording allows contractors to recover otherwise sunk preparation costs. This strategy is most commonly used when government contracts are involved since claims against the government typically preclude recovery of claim preparation costs.

1.3.3 What Is a "Delay Claim?"

As demonstrated above, the terms "delay" and "claim" have various meanings when used separately. Subsequently, the expression "delay claim" is also subject to a multitude of interpretations.

In this thesis, "delay claim" shall mean a request or demand in writing by a contractor to an owner for **a)** additional time pertaining to excusable delays, and **b)** both time and money when the delays are compensable as well as excusable. Hereinafter, when reference is made to a "claim" it shall mean a "delay claim," unless noted otherwise.

Delay claims are among the most difficult of all claims to prove, analyze, and evaluate. Unfortunately, they are also the most common, the most costly, and the causes are infinite.

1.4 Causes of Delay

Though the causes of delays are endless, most delays associated with construction projects are due to the fault of, due to the negligence of, or caused by the following:

1.4.1 The Owner or the Owner's Representative(s)

Typical causes: suspension of work, interference, differing site conditions, design problems, a major change or a lot of minor changes, failure to provide access, poor coordination of the parties under the owner's control, untimely inspection or submittal review, late delivery of owner-furnished equipment, etc.

1.4.2 Other Than the Owner or the Contractor

Typical causes: acts of God (e.g., earthquakes, floods, etc.), war or public enemy, acts of another contractor, fires, epidemics, strikes or labor disputes, freight embargoes, unusually severe weather, delay of subcontractors for similar reasons, etc.

1.4.3 The Contractor or the Contractor's Subcontractor(s)

Typical causes: failure to promptly submit premobilization/mobilization information (e.g., insurance certificates or bonds), slowness in mobilization, inability to sufficiently staff or equip the project, poor or inadequate management practices, inefficiency, inexperience, poor coordination among the parties under the contractor's control, etc.

1.5 Classifications of Delay

Not everyone agrees on the precise terminology used to identify the various "types" of delays. For example, one view is that the types are classic, concurrent, and serial (O'Brien 1976, 5). Others suggest that the types are excusable, nonexcusable, and compensable (McDonald and Baldwin 1989, 83). Depending on the exact situation and the context in which the terms are being used, both views may be appropriate.

However, regardless of the semantics, all delays must be "classified" according to excusability, compensability, criticality, and concurrency as illustrated in Figure 1.2. Some practitioners refer to these classifications as "...[t]he elements of delay analysis" (Bramble and Callahan 1992 ed., 14).

1)	Excusable	or	Nonexcusable
2)	Compensable	or	Noncompensable
3)	Critical	or	Noncritical
4)	Concurrent	or	Nonconcurrent

There are basically five steps that must be initially taken to properly classify delays. Figure 1.3 illustrates these five steps. It is imperative that each step be thoroughly assessed and answered with accuracy and confidence since the final outcome is a direct result of combining the answers to each of the first four steps.

Figure 1.3
Five Steps to Classifying Delay

- Step 1)** Determine if the delay(s) is(are) excusable or nonexcusable;
- Step 2)** Determine if the delay(s) is(are) compensable or noncompensable;
- Step 3)** Determine if the delay(s) is(are) critical or noncritical;
- Step 4)** Determine if the delay(s) is(are) concurrent or nonconcurrent;
- Step 5)** Link the results of steps 1-4 and analyze based on the outcome of each step. The effects of each step have significant impacts on each other. Any error or oversight can completely change the analysis of delays.

1.5.1 Excusable v. Nonexcusable

Most contracts being used in the construction industry today provide examples of delays that will be considered excusable. In nearly all cases, excusability is determined by the provisions of the particular contract. Excusability entitles the contractor to additional time for contract completion.³ Excusable delays are chiefly those beyond the control of, not caused by, or not due to the fault or negligence of the contractor.

The United States Supreme Court has expressed that "the 'foreseeability' of possible events affecting construction is a key point in evaluating excusable delays" (Richter and Mitchell 1982, 168).⁴ For example, as demonstrated in *John F. Miller, Inc., v. George Fichera Const. Corp.*, 7 Mass. Apt., Ct. 494, 388 N.

³
In many instances even though the contractor is entitled to an extension of time, the owner fails or chooses not to grant an extension to the contract time. In these situations, "directed" or "constructive" acceleration typically becomes an issue. However, this is a topic beyond the scope of this document.

⁴
See *U.S. v. Brooks-Callory Co.*, 318 U.S. 120 (1943).

E.2d 1201 (1979); (cited in Bramble and Callahan 1987 ed., 4) a delay may be specified in the contract as excusable, however, the circumstances may dictate otherwise. In this specific case, the court found that late delivery of material due to a labor strike was nonexcusable, even though the contract explicitly stated otherwise. This outcome was due to the fact that the strike was clearly foreseeable when the contract was executed and the contractor should have planned accordingly.

Nonexcusable delays are those for which the contractor will not be excused and typically will not be granted additional time for completion of the work. These delays are usually within the control of, caused by, and due to the fault or negligence of the contractor or the contractor's subcontractor(s). Further, those delays for which the contractor assumes the risks would also be nonexcusable. Most contracts clearly state that a contractor will be responsible for overcoming nonexcusable delays, regardless of how it is accomplished. Usually the means and methods of getting back on schedule are at the discretion of the contractor. The main concern at this point is that the project is indeed put back on schedule.

1.5.2 Compensable v. Noncompensable

The issue of whether or not a delay is compensable is extremely important since delay damages can soar to thousands, hundreds of thousands, or even millions of dollars. Customarily, contracts identify compensable delays, meaning that the contractor is entitled to recover additional costs incurred as a result of delay. Compensable delays are primarily those that are caused by **a)** the owner or the owner's representative(s), or **b)** other than the owner or the contractor. Occasionally, the contractor's or the owner's surety may relieve the appropriate party of any financial obligation. An example of this is a delay to a project due to an act of God (e.g., an earthquake). In most cases, one of the parties' insurers would assume the responsibility for the added costs.

1.5.3 Critical v. Noncritical

The issue of whether or not a delay is critical is paramount since it is generally recognized that only critical delays warrant time extensions regardless of excusability, compensability, or concurrency. Critical delays delay "interim milestones⁵" or "overall project completion." In theory, these delays occur to activities that are on a project's critical path(s).⁶ It can sometimes be argued that delay to a near critical path can delay interim milestones or overall project completion and thus be viewed as critical. It is conceivable that a project have more than one schedule. As a result, opposing schedules may have different critical paths, all of which may be equally correct depending on the contractor's plan of execution. Noncritical delays, on the other hand, do not delay interim milestones or overall project completion and usually do not entitle contractors to time extensions.

As an activity diminishes its available float⁷ it becomes critical, and in turn may cause other activities to become critical. This is a topic of much debate since with today's scheduling tools, it is possible to manipulate scheduling of certain activities until the activity becomes critical. This also becomes an issue of who owns float?⁸ Many would argue that absent a clause stating otherwise, a contractor owns float as a resource to be used as needed. Others believe that the ownership of float is determined by who uses it first. A third philosophy is that the project's owner owns all available float.

⁵

See Appendix A.

⁶

See Edward M. Willis, Scheduling Construction Projects (New York: Wiley, 1986).

⁷

See Appendix A.

⁸

See Jerry L. Householder, "Who Owns Float?" Journal of Construction Engineering and Management Vol. 116 No. 1 (1990): 130-133.

Another area of recent concern is the fact that once a project has extended beyond its scheduled completion date, technically it no longer has any available float and every activity is critical. The question often posed is, "How should delays be handled after contract completion?"^{9 10}

1.5.4 Concurrent v. Nonconcurrent

It is difficult enough to prove, analyze, and evaluate the impact of delay after only one delay has occurred on a project. Therefore, when one must prove, analyze, and evaluate concurrent delays, which is often the case, this already difficult task becomes even more complicated. Hence, concurrent delays are the most difficult and controversial classification of delay.¹¹ Concurrency can be used as a sword or shield. The definitions vary and opposing parties rarely agree. However, the most widely recognized definition is "... when there are two or more independent delays during the same time period. The 'same' time period from which concurrency is measured, however, is not always literally within an exact matching period of time [but, the delays must occur to activities on parallel critical paths]" (Bramble and Callahan 1992 ed., 8).

The most common example of concurrency is an owner-caused delay and a contractor-caused delay, putting both the owner and contractor at fault since both parties contributed to the delay, as illustrated in Figure 1.4.

9
See Gui Ponce de Leon, "Float Ownership: Specification Treatment," Cost Engineering Vol. 28 No. 10 (1986): 12-15.

10
See Gary Jentzen, Philip Spittler, and Gui Ponce de Leon, "Responsibility For Delays After the Expiration of the Contract Time." diss.. N.p. [c.1995].

11
See James P. Wiesel. "Refining the Concept of Concurrent Delay," Public Contract Law Journal Vol. 21 No.2 (1992): 161-176.

Figure 1.4
Concurrent Delays -- Example 1

- 1) The owner was five days late reviewing and approving shop drawings (due to an unexcusable reason) which were critical activities.
- 2) The contractor was five days late mobilizing to the job site (due to an unexcusable reason) which was a critical activity.
- 3) Result: Five days of "concurrency."
- 4) ***Probable outcome:*** Five day time extension, but no additional compensation.

In most cases, the issue of time extensions pertaining to concurrent delays only relates to critical delays. In other words, an interim milestone or overall project completion would be delayed if either one of the delays were to occur by itself. However, in some cases contractors can recover damages incurred as a result of excusable delays that are not critical. An example of this is if the owner or the owner's representative delayed a noncritical activity such that additional costs were incurred by the contractor. A second example of concurrency is a contractor-caused delay and an other-than contractor-caused delay, as illustrated in Figure 1.5.

In the past, it was not uncommon for concurrent-critical delays to simply offset each other as the courts usually refused to unravel these often intertwined delays. One of the reasons for this action was that when opposing parties contributed to delays, usually the overall completion of the project would still have been delayed if either delay had occurred by itself. The theory is also based on the premise that the owner forgoes recovery of liquidated damages and the contractor forgoes recovery of additional costs resulting in a "wash."

Figure 1.5
Concurrent Delays -- Example 2

- 1) Due to the contractor's failure to furnish the owner with pre-mobilization documentation (e.g., proof of insurance), the contractor was five days late mobilizing to the job site which was a critical activity.
- 2) Due to an earthquake, the contractor was five days late mobilizing to the job site which was a critical activity.
- 3) Result: Five days of "concurrent" delays.
- 4) **Probable outcome:** Five day time extension, but no additional compensation.

However, with today's technology more thorough analyses are possible making it is easier for courts to unravel concurrent delays in order to assign specific responsibilities and apportion the resulting damages with some degree of accuracy.

Delays are sometimes referred to as concurrent when they are consecutive or simultaneous. Consecutive-concurrent delays are defined as "... those that occur chronologically rather than simultaneously." While "[s]imultaneous-concurrent delays are those that occur at or near the same point in time" (Bramble and Callahan 1992 ed., 336).

One case that is cited in several publications as an example of this type of quasi-concurrent delay is *Raymond Constructors of Africa, Ltd. v. United States* 411 F.2d 1227 (Ct. Cl. 1969). In short, the U.S. Government, the owner in this case, delayed the overall project completion as a result of late delivery of some Government-furnished equipment, and the subcontractor delayed the overall project completion as a result of "inexperience, inefficiency, and failure to use available equipment to maximum advantage" (*Raymond Const. v. US*).

The relevant case history does not clearly indicate whether or not the delays were truly concurrent, consecutive, or simultaneous. However, it is clear that both the owner and the contractor contributed to the overall delay of the project. Since the delays were so intertwined that precise apportionment was not possible, the damages were assigned between the opposing parties on a percentage basis using the "Jury Verdict Method," a method not discussed in this thesis.

1.6 Summary

In spite of innovative contracting strategies, partnering, alternate methods of dispute resolution, dispute review boards, arbitration, issue resolution sessions, advanced technology, etc., the occurrence of delays on most construction projects is axiomatic.

Hopefully, as a result of continued efforts between academia and industry, better management practices, continued innovations in all aspects of technology, and in particular, information technology, the occurrence, the magnitude, and the impacts of delays will be reduced considerably.

As mentioned throughout this document, claims dealing with delays on construction projects are the most difficult of all construction related claims to prove, analyze, and evaluate. Unfortunately, they are also the most common and the most costly. The information required to resolve issues surrounding delays is extremely difficult to identify and even more incommensurable to apply in an effective manner once it has been obtained. In nearly all cases the precise information varies according to the specific situation, the contract documents, the location, the owner, the contractor, etc. These issues are complicated further by the fact that much of the critical information needed to prove actual occurrence of delay is not readily available under many contractors' current practices.

This thesis represents an analysis in the area of construction delay claims, more specifically, contractor pursuit of delay claims. It identifies the documentation required to pursue construction delay claims either **a)** as they occur "on-the-fly," or **b)** "after-the-fact." Research involved review and analysis of technical, nontechnical, and legal information in such areas as construction management, contract management, critical path methods of scheduling, cost engineering, construction law and case histories, construction litigation, and methods of proving responsibility of delay.

Chapter 2, entitled Overview of Contracts, represents an overview of the way in which construction contracts are usually interpreted. Some of the more commonly used contract provisions that address delays are also discussed.

Chapter 3, entitled Contract Clauses Addressing Delay, outlines the most frequently used clauses that address the occurrence and handling of construction delays. Clauses commonly used in the United States as well as abroad are discussed. However, most of these clauses are only portions of a particular contract or clause, and in most cases all clauses are subject to revisions that pertain to specific projects.

Chapter 4, entitled Methods of Proving Responsibility of Delay, outlines two unbiased and effective methods with which to assign responsibility of delay. The first method presented analyzes the impact(s) of delay(s) on-the-fly. The second method outlines the steps required to effectively pursue construction delay claims after-the-fact.

Chapter 5, entitled Information Needs and Documentation Requirements, discusses the fact that both methodologies require information which, in turn, results in the necessity for documentation. This chapter not only identifies the information and documentation needs, but also identifies where and how the required information is produced.

Chapter 6, entitled Conclusions, recaps the results of this research and provides recommendations for generating, maintaining, and collecting the required documentation for contractor pursuit of delay claims either on-the-fly or after-the-fact.

Appendix "A," entitled Additional Definitions and Explanations, defines terms used in this thesis as well as additional terms that should be useful in understanding and applying the methodologies of delay analysis presented in this thesis document.

It is a well-known fact that there are two sides to every story and two sides to every page of a law book. Therefore, this thesis does not attempt to plot a flawless legal or technical path for pursuit of delay claims. The information contained herein is provided to help contractors improve their effectiveness in pursuing delay claims. Additionally, it is useful to owners charged with the responsibility of evaluating delay claims.

2.0

OVERVIEW OF CONTRACTS

2.1 General¹²

A contract is a legally enforceable promise made between opposing parties. When referred to in this thesis, a contract is the written agreement executed between an owner and a contractor setting forth the obligations of the parties thereunder, including, but not limited to, the performance of the work, the furnishing of labor and materials, and the basis of payment. Many of the rights and obligations are established by law while others are negotiated on an individual basis.

For example, when performing work for the U.S. Government, the Federal Acquisition Regulations (FAR) usually govern. Most public work is subject to the laws of the particular state, and more specifically, the relevant local municipalities and governing bodies. The terms and conditions pertaining to most private projects are usually more flexible and are often negotiable.

Several professional organizations and associations within the construction, architectural, and engineering industries publish model contract documents for use on construction projects, both in the U.S. and abroad. Examples of these organizations and associations are the American Institute of Architects (A.I.A.), the Associated General Contractors of America (AGC), the Engineers and Joint Contract Document Committee (EJCDC), and the National Association of Attorneys General (N.A.A.G.). Most of these standardized documents have stood the test of time and have been revised over the years as necessary to

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Where various contract clauses are quoted in this thesis, some words or phrases originally capitalized may have been modified herein for clarity and consistency (e.g., was ENGINEER/now Engineer).

meet the changing demands of the construction industry as well as the multiplicity of administrative and judicial agencies involved.

In most European, Asian, and South American countries laws are based on the respective statutory system, usually referred to as civil law. In the United States, however (except Louisiana), laws are based on the common law system. The common law system encompasses a long history of early English court decisions, as well as decisions of the various judicial bodies within the United States. As a result, courts typically follow the decisions made by other courts in similar situations in an effort to maintain continuity and to provide some degree of predictability.

Relying on the rulings of previous court cases is not as easy or as reliable as it appears because every case is unique and the specific decisions frequently vary among states. Rulings are often revised at the different levels within the judicial system. Furthermore, not only do the decisions vary, but also the laws in general often differ from state to state. Additionally, some dealing with "alternate dispute resolution" fail to recognize case history when attempting to resolve disputes. In most instances, opposing parties only reveal the relevant portion of the case history that will support their side of a particular situation. It is usually possible to identify cases that will support either party's position.

2.2 Four Elements of a Contract

For a contract to be legally enforceable, there are four basic elements that must always exist. These elements are widely known and apply to all contracts. They are as follows:

- 1) ***Competent Parties:*** All parties to a contract must be qualified, fit, capable, etc., and have the ability and authority to carry out the requirements set forth in the contract.

- 2) ***Proper and Legal Subject Matter:*** A contract must pertain to legal subject matter and have a legal purpose.
- 3) ***Agreement Between Parties:*** There must be mutual consent to the terms of the agreement (i.e., "offer and acceptance"). The acceptance can in no way modify the offer, otherwise the offer becomes a counter-offer. If a fundamental misunderstanding exists between the parties, there is no manifestation of mutual intent and the contract will usually be treated as void. Simply put, there must be a "meeting of the minds."
- 4) ***Consideration:***The contract must contain an expression of something of value received by or given at the request of the promisor in reliance upon and in exchange for the promise by the other party.

2.3 Principles of Contract Interpretation

Many general rules and standard practices have been established over the years pertaining to the interpretation of contracts. Some of the more important and applicable aspects which can be useful in resolving delay claims are as follows:

- a) ***Read as a Whole:*** A contract must be read and interpreted as if it were one complete document from the first page to the last page, including any items that are incorporated by reference. This is often referred to as looking at the "four corners" of the contract.
- b) ***Reasonably Intelligent Person:*** The interpretation must be as it would be by a reasonably intelligent person knowledgeable in the particular field.

- c) ***Principal and Apparent Purpose of the Contract:*** Simply put, the purpose of the contract must be apparent and any effort to illogically interpret the requirements will usually be disregarded.
- d) ***Ordinary Meaning of Language:*** Typically the interpretation will be as it ordinarily applies to the particular field.
- e) ***Custom and Trade Usage:*** The interpretation that would be customarily applied in a given trade is used **1)** if without interpretation the obligations of one or both of the parties would be unclear, or **2)** where custom and usage are needed to clarify an ambiguous provision.
- f) ***Knowledge of the Other Party's Interpretation:*** This rule applies to ethics as well as law. In general, this suggests that neither party unreasonably interpret a provision so as to take unfair advantage of another.
- g) ***Concurrent Interpretation:*** This principle generally applies in cases where it is necessary to consider **1)** how other bidders prior to contract award interpreted a given provision, **2)** how the parties to a contract performed prior to encountering the specific problem, or **3)** how the contractor's subcontractors interpreted the provision prior to encountering the problem.
- h) ***Construed Against the Drafter:*** In the event that any of the words are still ambiguous after applying the above rules, the contract is interpreted against the "drafter." This is particularly true for public contracts in which the contractor has no say whatsoever regarding the provisions of a contract.

- i) ***Obvious Ambiguity:*** In the event of an obvious or patent ambiguity, any party noticing the situation has an obligation to seek clarification.

- j) ***Course of Conduct:*** The party's routine course of conduct, prior to encountering a problem, generally establishes its understanding of a particular provision.

- k) ***Order of Precedence:*** Many contracts indicate the order of precedence of various contract documents which would apply in the event of conflict, however, if no procedures are set forth, normally the specific takes precedence over the general. Specifications usually prevail over drawings, and hand written provisions typically take precedence over typed or printed provisions.

Contracts are often ambiguous and difficult to interpret. In addition, they often include subjective, catch-all phrases such as "including but not limited to," "unforeseen," "unanticipated," "as determined by the architect," "beyond the control of," or "without fault or negligence." For example, a contract may excuse delays caused by "inclement" or "unusually severe" weather, leaving the definition open for debate.

3.0

CONTRACT CLAUSES ADDRESSING DELAYS

3.1 General

Most contracts used in the construction industry today include provisions or clauses that pertain to delays in some way or another. Except for "No Damages for Delay," or "No Damages for Acceleration" clauses, these provisions protect contractors, to a degree, from default or breach of contract as a result of excusable delays. With the occurrence of delays being so common, many contracts identify potential delays and define the rights and responsibilities of the various parties in the event that a delay occurs. For example, most U.S. Government contracts generally include, "1) the elements of which must be proven in order for the contractor to establish a delay, 2) the applicable notice requirements with which a contractor must comply, and 3) the effects of concluding that a delay is excusable...." (Barba and Lifschitz 1990, 2 [of] 2).

The most common clause regarding delays is usually referred to as the "Delays and Extensions of Time" clause. However, there are several other clauses that relate to delays either directly or indirectly. As noted in one widely recognized publication, "[d]epending on the apparent cause of any specific delay, it may be necessary to examine the changes clause, the suspension of work clause, the liquidated damages clauseand 'the time is of the essence' provision, if any" (Cushman and Carpenter 1990, 102).

3.2 Clauses Addressing "Occurrence of Delay"

Some contracts address the occurrence of delay fairly and comprehensively, while others are weak or fail to address the issue at all. Some of the commonly used provisions are mentioned below. However, these are only partial examples and in spite of often being referred to as "standardized" or "proforma" documents, contracts are constantly being modified by owners and contractors alike.

The 1976 version of the American Institute of Architects' (A.I.A.) Document A201, General Conditions of Contract, addresses delays in the following manner:

If the contractor is delayed at any time in the progress of the Work by any act or neglect of the owner or the Architect, or by any employee of either, or by any separate contractor employed by the owner, or by changes ordered in the Work, or by labor disputes, fire, unusual delay in transportation, adverse weather conditions not reasonably anticipatable, unavoidable casualties, or any causes beyond the contractor's control, or by delay authorized by the owner pending arbitration, or by any other cause which the Architect determines may justify the delay, then the contract time shall be extended by Change Order for such reasonable time as the Architect may determine

The U.S. Government's Federal Acquisition Regulations (FAR), Section 52, formerly known as Form 23A, addresses the occurrence of delays as follows:

The contractor's right to proceed shall not be terminated nor the contractor charged with damages under this clause if (1) The delay in completing the work arises from unforeseeable causes

beyond the control and without the fault or negligence of the [c]ontractor. Examples of such [causes] include (i) acts of God or of the public enemy, (ii) acts of the Government in either its sovereign or contractual capacity, (iii) acts of another [c]ontractor in the performance of a contract with the Government, (iv) fires, (v) floods, (vi) epidemics, (vii) quarantine restrictions, (viii) strikes, (ix) freight embargoes, (x) unusually severe weather, or (xi) delays of subcontractors or suppliers at any tier arising from unforeseeable causes beyond the control and without the fault or negligence of both the [c]ontractor and the subcontractors or suppliers (cited in Rubin et al. 1992, 53).

The above cited authors also point out that the Engineers and Joint Contract Document Committee's (EJCDC) 1990 version of the Standard Form EJCDC No. 1911-8 addresses delays in the following manner:

Where [the] contractor is prevented from completing any part of the Work within the contract times (or milestones) due to delay beyond the control of [the] contractor, the contract times (or milestones) will be extended in an amount equal to the time lost due to such delay if a claim is made therefore as provided in Paragraph 12.1. Delays beyond the control of [the] contractor shall include, but not be limited to, acts or neglect by owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions or acts of God. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of contractor (cited in Rubin et al. 1992, 53).

3.3 Clauses Addressing "Notice of Delay"

By notifying the owner that a delay has occurred or is inevitably going to occur, the owner has an opportunity to initiate alternative actions, and make changes or adjustments to aide in mitigating impacts. Accordingly, most contracts stipulate that the contractor must furnish the owner with a written notification outlining the delay as soon as realized or within a specified period of time. Usually, this type of notice must be followed by detailed cost data and an analysis of potential impacts to the schedule. Failure to provide proper notice may forfeit a contractor's right to recovery of damages suffered as a result of delay.

Nearly all contracts require the contractor to provide the owner with either written or oral notification of a particular delay. For example, the notice may be required "upon commencement of the delay," "as soon as the delay is recognized," "as soon as practical," or "within 'x' days after any of the aforementioned times." It is not uncommon for contractors to submit cleverly worded notices that comply with the terms of the contract, yet reserve the opportunity to recover any delay damages realized at a later date.

The American Institute of Architects' 1976 version of the Document A201, General Conditions of Contract, addresses notice of delay as follows:

Any claim for extension of time shall be made in writing to the Architect not more than twenty days after the commencement of the delay; otherwise it shall be waived. In the case of a continuing delay only one claim is necessary. The contractor shall provide an estimate of the probable effect of such delay on the progress of the work (emphasis added).

Most U.S. Government fixed-price contracts subject to the Federal Acquisition Regulations (FAR) mandate the following actions:

The contractor, within 10 days from the beginning of any delay (unless extended by the contracting officer), notifies the contracting officer of the causes of delay. The contracting officer shall ascertain the facts and the extent of delay. If, in the judgement of the contracting officer, the findings of fact warrant such action, the time for completing the work shall be extended (cited in Barba and Lifschitz 1990, 2-26).

In contrast to the above mentioned type of contract, most cost-reimbursable contracts used by the U.S. Government fail to specify a precise time limit and only request the following:

Upon request of the contractor, the contracting officer shall ascertain the facts and extent of the failure. If the contracting officer determines that any failure to perform results from one or more of the causes above [i.e., results from an excusable delay], the completion time shall be revised....(cited in Barba and Lifschitz 1990,2 [of] 26).

The Engineers and Joint Contract Document Committee's 1990 version of the Standard Form EJCDC No. 1911-8 stipulates that requests for time extensions must be provided in the following manner:

The contract times (or milestones) may only be changed by a Change Order or Written Amendment. Any claim for adjustment of the contract times (or milestones) shall be based on written notice delivered by the party making the claim to the other party and to the engineer promptly (but in no event later

than thirty days) after occurrence of the event giving rise to the claim and stating the general nature of the claim (emphasis added).

....[n]otice of extent of the claim with supporting data shall be delivered within sixty days after such occurrence....(emphasis added).

In the United Kingdom, one of the most prevalent conditions of contract used in connection with civil engineering type work addresses delays as follows:

....the contractor shall within 28 days after the cause has arisen or as soon thereafter as is reasonable in all circumstances deliver the full and detailed particulars of any claim to extension of time....(emphasis added).

The ICE Conditions of Contract, 6th Edition, published by the Institution of Civil Engineers, the Association of Consulting Engineers, and the Federation of Civil Engineers in the United Kingdom, incorporates the following clause:

(b) If the contractor intends to claim any additional payment pursuant to any [c]lause of these Conditions other than sub-clauses (1) and (2) of this clause or Clause 56(2) he shall give notice in writing of intention to the engineer as soon as may be reasonable and in any event within 28 days after the happening of the events giving rise to the claim. Upon the happening of such events the contractor shall keep such contemporary records as may be necessary to support any claim he may subsequently wish to make (emphasis added).

The 1990 version of Federal Publication's course manual, *Construction Delay and Disruption*, cites the following with respect to notices:

Courts and boards have tended not to strictly construe the notice requirements for an excusable delay. Thus, a contractor's claim that a delay is excusable will not fail because of noncompliance with the notice provision if the Government is on notice of the causes of the delay, (e.g., due to observations made by the contracting officer or oral notification given by the contractor), and is not prejudiced by the lack of technically proper notification. This result follows because the purposes of the notice requirement are upheld. See *Insurance Co. of the West, ASBCA No. 35253, 88-3 BCA ¶ 21,056 (1989)* (citing *Contract Cleaning Maintenance Inc., 811 F.2d 586 (Fed. Cir. 1987)*) (notice pending is sufficient); *Phillips Construction Co., IBCA No. 1295-8-79, 81-2 BCA ¶ 15, 256 (1981)* (contracting officer had actual knowledge of a fuel shortage-based excusable delay; therefore, time extension should have been granted and default termination was improper).

The above situation rarely occurs, and in most instances, failure to submit the notice of a delay in accordance with the contract waives any right to the recovery of damages occasioned by delay.

3.4 Clauses Addressing "No Damages For Delay"

Occasionally owners incorporate exculpatory language into contracts shifting the risks of all delays or specific delays to the contractor, thus usually placing new liabilities and responsibilities upon the contractor. These clauses attempt to preclude future claims against

the owner for additional time or money.¹³ Examples of some of the verbiage often used is as follows (Richter and Mitchell 1982, 179-180):

- a) No payment or compensation of any kind shall be made to the contractor for damages because of hindrance or delay from any cause in the progress of the work, whether such delays be avoidable or unavoidable.

- b) Apart from extension of time, no payment or claim for damages shall be made to the contractor as compensation for damages for any delays or hindrances from any cause whatsoever in the progress of the work notwithstanding, whether such delays be avoidable or unavoidable.

- c) The contractor will receive no compensation for delays or hindrances to the work, except when direct and unavoidable extra cost...is caused by the failure of the owner to provide information or material, if any, which is to be furnished by the owner.

The National Association of Attorneys General published "Model Design and Construction Documents" for use by public owners. The publication incorporates the following clause in an effort to prevent contractors from recovering monetary damages resulting from delay, regardless of the cause or subsequent impacts:

Except as otherwise provided, extensions of time shall be the contractor's sole remedy for any and all delays. No payment or

¹³ See John B. Miller, "No-Fault' Forfeitures: The Ultimate in Risk Shifting," diss., Gadsby & Hannah Law Firm, Boston: 1990.

compensation of any kind shall be made to the contractor for damages because of hindrance in the orderly progress of the Work or delay from any cause in the progress of the Work, whether such hindrances or delays be avoidable or unavoidable. Contractor expressly agrees not to make, and hereby waives, any claim for damages on account of any delay, obstruction, or hindrance for any cause whatsoever, including but not limited to the aforesaid causes and agrees that the contractor's sole right and remedy in the case of any delay shall be an extension of the time fixed for completion of the contract (emphasis added) (cited in Miller 1990, 15).

Generally speaking, these attempts to limit an owner's exposure to damages resulting from delay are upheld and legally enforceable. However, there are instances in which dispute review boards, administrative review bodies, and courts, for example, have ignored "No Damages for Delay" clauses. In most cases, for an exculpatory clause such as this to be ignored and therefore not enforceable, the delay must have "1) [been]...of a kind not contemplated by the parties, 2) amounted to abandonment of the contract, 3) [been]...caused by bad faith, or 4) [been]...caused by active interference [by the owner or the owner's representative]" (Richter and Mitchell 1992, 180).

3.5 Summary

Delays usually develop over the course of a project and are rarely the result of a single catastrophic event. As a result, minor delays are often overlooked until such time that their cumulative damages create a sizable burden for the parties involved.

As illustrated above, there are a variety of contract provisions that address both the subject of construction delays and the resulting delay claims. Some contracts incorporate language

to preclude the owner from incurring monetary or time-related impacts, thus precluding the contractor from recovering damages resulting from time-related impacts. Other clauses may contain wording that gives the contractor full right to recovery of any and all damages as a result of delay.

Simply put, prior to execution contractors should thoroughly review each and every contract for all clauses that address time and money, regardless of whether or not the form of contract appears to be familiar. Needless to say, knowledge of contract law is very beneficial to contractors when pursuing delay claims.

4.0

METHODS OF PROVING RESPONSIBILITY OF DELAY

4.1 General

Contractors bear the burden of proving responsibility of delay when requesting a time extension or attempting to recover damages caused as a result of a delayed construction project. After a delay has been recognized and proper notice has been given, a contractor must prove not only the extent of delay and the amount of damages suffered, but also and more importantly, that the delay for which a time extension or recovery of damages is being sought was not due to the contractor's own fault or negligence. Even though there may be specific laws and/or contract language entitling a contractor to recover damages occasioned by an excusable delay, recovery is not automatic. Proof of responsibility goes beyond merely proving that an excusable delay occurred.

Most of the standard contracts being used within the construction industry today clearly assign the responsibility of proving delay to contractors. However, the majority fail to specify how to prove responsibility, or what methodology must be followed. Some contracts assign the responsibility to the contractor, but base any extension of time on what is usually a subjective determination by the owner or the owner's representative and not necessarily on the results of a detailed schedule analysis.

For example, the 1976 version of the American Institute of Architects' (A.I.A.) Document A201, General Conditions of Contract, incorporates a clause that states "the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine" (emphasis added). There is no mention of how the time for extension is to be established other than "as the Architect may determine."

General conditions commonly used by the Massachusetts Highway Department (MHD) on many of its projects often includes the following clause:

The Contractor must demonstrate through an analysis of the current Progress Schedule, to the Engineer's satisfaction, that due to some cause beyond the control and without the fault or negligence of the Contractor, that the Work or some part thereof, will be extended beyond the Contract Time(s) or Contract Milestone(s), prior to the Department authorizing any extension in the Contract Time(s) or Contract Milestone(s) (emphasis added).

While the above clause does not directly identify a particular method of analysis, it does put the onus on the contractor and also infers that the analysis must be "on-the-fly" since it must be based on the "current Progress Schedule." Even in the event that an after-the-fact analysis becomes necessary, if the clauses were enforced and adhered to, an As-Built schedule should already exist as a result of the following clause that is also frequently found in many of MHD's contracts:

The Contractor shall status the current Progress Schedule for each activity, utilizing actual start dates, remaining duration, and actual finish dates as measures of progress, to account for the actual physical progress of Work, to portray how completed as-built Work was performed in relationship to the current Progress Schedule and to forecast the work remaining...(emphasis added).

It is generally recognized that a contractor will not be relieved of delay damages incurred simply because an excusable delay was experienced. In addition to proving that an excusable delay occurred, a contractor must also prove that the project would not have been delayed in the absence of the excusable delay for which a time extension or recovery of damages are being sought. Simply put, a contractor must prove that "but-for" the delays for which the owner is responsible, the completion of the project would not have been prolonged, unless as in most cases, the project also experienced nonexcusable and/or concurrent delays.

In *Patham Construction Co. v. Hi-Way Electric Co.* 65 Ill. App. 3d 480, 382 N.E. 2d 453 (1978), the court gave the following summary with regard to the burden of proof:

[T]he issue of apportionment of damages in cases of mutual delay is a question of fact. [citation omitted] The burden of proof is on the party claiming such damages to prove the damages were caused by default of the party to be charged, separate from any damages that may have resulted from the acts of the claimant. The amount of delay attributable to each party is a question that must be resolved by the trier of fact (emphasis added).

Where there is sufficient evidence to allow the court to make a reasonably certain division of responsibility for delay, the assessment of damages may be allocated among several parties. Although the task is particularly difficult when, as here, the performance of the work is sequential and the delay the result of multiple causes, it is not impossible. We note that technological advances and the use of computers to devise work schedules and chart the progress on a particular project have facilitated the court's ability to allocate damages [citation omitted].... (emphasis added) (cited in Cushman and Carpenter 1990, 108).

An often cited case which also stresses that the contractor bears the burden of proof is *Arntz Contracting Co., EBCA No. 187-12-81, 84-3 B.C.A. (CCH) ¶ 17,604*. This particular case also notes the previously mentioned issue of "but-for." The Board of Contract Appeals offered the following comments:

[E]ven assuming a Government caused delay, in order for Appellant to prevail on this issue, it must demonstrate that any such Government caused delays were not concurrent or intertwined with other delays, for which the Government was not responsible. Thus a contractor asserting a delay claim against the Government must prove not only that it incurred additional costs making up its claim, but also that such costs would not have been incurred "but[-]for" some Government action (emphasis added) (cited in Cushman and Carpenter 1990, 109).

Another notable case that is frequently cited is *Fishbach & Moore Corp., ASBCA No. 18146, 77-1 B.C.A. (CCH) ¶ 12,300 (1977)*. In this case the board concluded the following:

It is [the contractor's] burden to show that...any of the delays caused by Government action were not concurrent or intertwined with delays caused by [the contractor's] own actions. We find that [the contractor's] efforts to carry this burden are not persuasive. Accordingly, [the contractor's] claim stands denied.

A contractor's success at amicably resolving delay claims is directly related to his ability to prove responsibility. Proof of responsibility depends on proper application of a sound methodology of schedule delay analysis that is supported by sufficient documentation.

4.2 Measuring a Period of Delay

In general, there must be some form of time standard or requirement established by law or defined within a contract from which to begin measuring a period of delay. As stated in one publication, "[m]easurement of schedule delay requires a yardstick or baseline against which to compare the actual schedule so as to determine the amount of delay" (Barba and Lifschitz 1990, 7-3). If time requirements or standards are not clearly addressed within a contract, the generally accepted rule is that a project must be completed "within a reasonable period of time." This often becomes a major source of contention since the interpretation of what is "reasonable" can vary.

Most contracts state a specific date or time for work on a project to proceed as well as a specific date or amount of time in which substantial or overall project completion must be achieved. Some contracts are extremely detailed and outline interim completion dates, turnover dates, partial completion dates, substantial completion dates, beneficial occupancy and/or use dates, etc. Time requirements are usually stated within a contract as a fixed number of "work days" or "calendar days" with most contracts stating specific dates.

The Massachusetts Highway Department typically incorporates the following clause in most of its contracts:

No extension in the Contract Time(s) or Contract Milestone(s), and no claims by the Contractor for adjustment in the Contract Price on account of any delay in the Work or any delay or suspension of any portion thereof, shall be granted unless the Contractor adequately demonstrates to the satisfaction of the Engineer through an analysis of current Progress Schedule that the Work or any part thereof will be delayed or extended beyond the Contract Time(s) and/or Contract Milestone(s) specified in the Contract Documents...or as adjusted by Change Orders due to unforeseeable events beyond the control and without fault or negligence of the Contractor, or any of its Subcontractors or suppliers at any tier, and despite the Contractor's reasonable and diligent efforts (emphasis added).

4.3 Using Schedules to Analyze Delays and Prove Responsibility

With the development in the late 1950s of critical path methods of scheduling (CPM) and the later development of precedence diagramming methods (PDM), both of which rely on network diagramming of activities, the ease and ability to identify a project's critical activities and thus its critical path(s) has been greatly improved. Additionally, any impacts to these critical activities as a result of delay can be identified and analyzed much easier and far more effectively based on the concepts of CPM.¹⁴

When using CPM schedules, not only can the critical activities be examined, but also near critical and noncritical activities can be isolated and evaluated. CPM schedules allow constraints and interrelationships among the various phases and parties involved in a project to be segregated and properly analyzed. Courts, dispute review boards, boards of appeal, etc., charged with the responsibility of evaluating delays and determining entitlement to time extensions and recovery of delay damages typically rely on some form of CPM schedule.

In *Dobson v. Rutgers*, 384 A.2d 1121 (N.J. Super. 1978) the following summary was given with respect to the application of CPM scheduling when proving responsibility of delay:

The Critical Path Method is a new and powerful tool for planning and management of all types of projects. Essentially, it is the representation of a project plan by a schematic diagram or network that depicts the sequence and interrelation of all of the component parts of the project, and the logical analysis and manipulation of this network in

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Unless noted otherwise, when referred to in this thesis, CPM scheduling refers to the fundamentals based on network diagramming and not any specific application.

determining the best overall program of operation. It is a method admirably suited to the construction industry, and it provides a far more useful and precise approach than the conventional bar graphs and progress charts that previously formed the basis of construction planning and control (emphasis added).

Furthermore, it permits evaluation and comparison of alternative work programs, construction methods, and types of equipment. When the best plan has been prepared in this way, the critical path diagram clearly indicates the site operations that control the smooth execution of the work. Finally, as construction proceeds, the diagram provides the project manager with precise information on the effects of each variation or delay in the adopted plan, thus enabling him to identify the operations that require remedial action (emphasis added).

As noted in the Ninth Annual Construction Conference, Session 1012, Approaches to Schedule Delay Analysis course manual:

In order to successfully deal with a construction delay, disruption or acceleration claim you must determine causation -- the link between liability asserted and damages claimed. One of the primary ways to accomplish this is through the performance of a schedule delay analysis which utilizes the critical path method of scheduling as a tool to evaluate cause and effect (emphasis added).

In spite of the advantages of using CPM network diagrams, many contractors continue to use bar charts. While on some projects this may be acceptable or even preferred, in most instances this continued use of bar charts is due to the simplicity and ease of preparation. However, bar charts typically show only the beginning and ending of activities without regard to the constraints and interrelationships among the various phases and parties involved in the project. Therefore, the bar chart is not well suited for analyzing and proving responsibility of delays.

There is a considerable number of court cases on record in which bar charts were allowed, but failed to successfully prove the responsibility of delay. In many of these cases the contractor's recovery of damages was substantially reduced, if not totally foregone. For example, on appeal of *Minmar Builders, Inc.*, 72-2 B.C.A. (CCH) ¶ 9599 (1972), the General Services Board of Contract Appeals refused to rely on the bar charts which were offered to prove the effects of the delay. The board noted the following:

Since no interrelationship was shown between the tasks, the charts cannot show what project activities were dependent on the prior performance of the plaster and ceiling work, much less whether overall project completion was thereby affected. In short, the schedules were not prepared by the critical path method (CPM) and hence are not probative as to whether any particular activity or group of activities was on the critical path or constituted the pacing element of the project (cited in Bramble, D'Onofrio, and Stetson 1990, 106).

In many instances a bar chart may have been used during construction. However, contractors are often forced to resort to more detailed scheduling methods such as CPM schedules in the form of network diagrams when faced with the burden of proving responsibility of delay.

4.4 "On-the-Fly" v. "After-the-Fact" Analyses of Delay

Whether a contractor is pursuing a claim related to an excusable-compensable delay or an excusable-noncompensable delay, the best time to begin pursuit is usually the instant that the delay occurs, or as soon as it is recognized. This is commonly referred to as "on-the-fly." When pursuit of a delay claim begins after a project has been completed or long after a delay has occurred, it is referred to as "after-the-fact."

In order to force contractors to perform on-the-fly analyses, the Massachusetts Highway Department, like many other owners, frequently uses a form of contract that includes the following clause:

...unless the Contractor adequately demonstrates to the satisfaction of the Engineer through an analysis of "current" Progress Schedule that the Work or any part thereof, will be delayed or extended beyond the Contract Time(s) and/or Contract Milestone(s) specified in the Contract Documents....(emphasis added).

Another example of a similar, but somewhat less stringent clause is one that has been used in the past by the Washington State Department of Transportation. The clause reads in part as follows:

When Change Orders or delays are experienced, the Contractor shall submit to the State a written time impact analysis illustrating the influence of each change or delay on the contract completion time.

Each time impact analysis shall include a fragment smaller, more detailed section of the network demonstrating how the Contractor proposes to incorporate the change order or delay into the logic diagram. The time impact analysis shall be based on the date the change is given to the Contractor and the status of construction at that point in time. The impact to the scheduled dates of all affected activities shall be shown. Upon approval by the State, the time impact analysis shall be incorporated in a supplemental progress schedule to be submitted with the next monthly progress report (emphasis added) (cited in Rubin, et al. 1992, 66-67).

If complete and accurate documentation is maintained on a contemporaneous basis from the inception of a project through its completion, pursuit of any delay claim will be greatly facilitated. Subsequently, proving the responsibility of delay to an owner, dispute review board, or judge and jury, if it becomes necessary, will be much easier and the facts will also be more convincing. If pursuit of a delay claim is on-the-fly, the facts should be easier to recollect since they are not based on historical documents, questionable memories, re-created schedules, As-Built schedules prepared after-the-fact, etc. However, this is not always the case and as a result, pursuit of delay claims often takes place months or even years after a project has been completed.

On-the-fly and after-the-fact pursuits of delay claims require similar schedules. The major difference between the methodologies is the manner in which the schedules are used in performing the actual analysis of delays. In most cases, the following schedules are required to effectively and amicably resolve construction delay claim(s).

<p style="text-align: center;"><u>Schedules Used</u> <u>in an On-the-Fly Analysis</u></p>	<p style="text-align: center;"><u>Schedules Used</u> <u>in an After-the-Fact Analysis</u></p>
<ol style="list-style-type: none"> 1) The As-Planned Schedule 2) The Current-Progress Schedule 3) The As-Adjusted Schedule 	<ol style="list-style-type: none"> 1) The As-Planned Schedule 2) The As-Built Schedule 3) The As-Adjusted Schedule 4) The But-For Schedule

The on-the-fly methodology of analysis is based on the Current-Progress schedule. In this case, current literally means that the schedule reflects progress up to the very moment an excusable delay is recognized. This schedule will be adjusted and used to look forward and forecast new completion dates as a result of the delay(s). If the progress schedule was updated the previous week or even more recently and the contract only requires monthly updates, an update must still be performed the moment a delay occurs to arrive at the Current-Progress schedule. The newly recognized excusable delay(s) can be inserted into the schedule to arrive at the As-Adjusted schedule which will show new estimated durations occasioned by delay. The difference between the durations shown in the As-Adjusted schedule and the durations shown in the Current-Progress schedule indicates when specific deadlines are currently expected to be met as a result of nonconcurrent-excusable delays. This duration also represents the contractor's entitlement to any extension of time.

The after-the-fact methodology of analysis, which is generally much more difficult to perform than the on-the-fly analysis, begins with the development of the As-Built schedule based on actual dates and durations and in the same logic and format as the As-Planned

schedule. The As-Built schedule can be adjusted and manipulated to create the As-Adjusted schedule. The excusable delays can then be backed out of the As-Adjusted schedule to arrive at the But-For schedule which will show when a project would have been completed, but for the excusable delay(s). The difference between the durations shown in the But-For schedule and the durations shown in the As-Adjusted schedule indicates the amount of time owed to the contractor by the owner as a result of nonconcurrent-excusable delays.

4.4.1 The As-Planned Schedule

Regardless of who or what establishes the time within which a project must be completed, or in most cases substantially completed, it is generally recognized that contractors are responsible for planning how the work will be executed to meet the required deadlines. A description of what work is to be performed is typically shown on the drawings and described in the specifications, and the contractor's forecast of how the work is to be performed within the allowable time is shown on the As-Planned/Baseline schedule.

The As-Planned schedule breaks down the construction process into a multiplicity of small, manageable activities. The As-Planned schedule demonstrates not only when the activities are planned to take place, but also the logical sequences, constraints, available float, and necessary interaction and/or coordination with other activities and participants involved in the particular construction project. In most instances, the planned resources such as manpower and equipment will also be represented along with the expected production rates of each. These expected rates along with other factors such as expected durations and quantities to be completed provide a valuable benchmark to evaluate and

compare actual data against. This will allow a contractor to prove, where applicable, that the As-Planned schedule was reasonable and achievable when not delayed.

Once time requirements have been established, agreed to by all parties involved, and incorporated into a contract, a point for measurement of any changes in a project's duration has been established. This point for measurement is usually based on the contractor's As-Planned or Baseline schedule. "Baselines are defined as a point in time when all parties agree that a plan exists to accomplish an activity or activities, and that performance is measured relative to that plan" (Zocher and Thompson 1992, H.3.1).

Most contracts being used within the construction industry today require contractors to submit preliminary schedules soon after the contract has been awarded. In most cases failure to do so carries a stiff penalty. As noted in one of Bechtel Construction Company's publications, entitled Prime Contracts Management, "the schedule is such a critical baseline document that contract terms and conditions frequently include a strong warning such as '[f]ailure to submit and update the contract schedule in accordance with the requirements of the contract may be grounds for denial of any claim for extension of time'" (Vol., 1 No. 2, 1988). The publication further states that most of the time a properly updated contract schedule is the single most effective document for substantiation or repudiation of a claim.

An example of an actual clause that is often used by the Massachusetts Highway Department to request a preliminary schedule detailing how the contractor plans to carry out the work is as follows:

The Preliminary Progress Schedule, shall be submitted within twenty-one (21) Days after the Notice of Award, and shall represent the Contractor's detailed work plan....

The provisions are very clear as to what must be shown on the Preliminary Progress Schedule. The Department's General Conditions of Contract usually include the following provisions regarding Preliminary Progress Schedules:

The Preliminary Progress Schedule and Contract Progress Schedule shall fully detail and delineate all activities of the Contractor and its Subcontractors including but not limited to: mobilization; shop drawings and other submittals; procurement, fabrication and delivery of equipment and materials to the site; construction and installation; testing and commissioning; and demobilization.

All activities of the Engineer or others that affect progress shall be shown, including, but not limited to, the Engineer's review and acceptance of submittals required by the Contract Documents; the issuance of permits and licenses; delivery of equipment and materials to be furnished by the Department in accordance with

the Contract Documents, if any; and site inspection and testing by the Engineer and other responsible parties, as required.

Generally speaking, after an owner, or the Engineer in this case, has reviewed and accepted the preliminary schedule, including any and all necessary revisions, the preliminary schedule becomes known as the As-Planned or Baseline schedule. The above mentioned provisions also usually state:

[t]he Contractor shall not maintain any schedules, and shall not perform any Work operations or activities, which are inconsistent with the Progress Schedule accepted by the Engineer.

Unless stated otherwise in a contract, or by default due to an owner's actions or inactions, it is generally recognized that owners will not interfere with a contractor's plan of how the work will be executed. Generally contractors determine the most effective, efficient, and timely manner to apply in order to get from start to finish of a project within the allowable amount of time.

Most contracts clearly state that the contractor shall be responsible for the means and methods of construction. To inform the owner of the contractor's means and methods, or how the work will be performed, many of the contracts being used in the construction industry today include provisions outlining specific instructions that must be adhered to when preparing the As-Planned schedule for submission and approval by the owner.

The As-Planned schedule also identifies the responsibilities of the owner, the owner's representatives, agents, etc. Many of the contracts being used in the

construction industry today incorporate provisions addressing this issue. Such a requirement is a clause found in many of the Massachusetts Highway Department's construction contracts which requires contractors to include in the As-Planned schedule all interactions and dependencies of the owner and other parties that could possibly have an impact on the schedule. The clause reads in part as follows:

All activities of the Engineer or others that affect progress shall be shown, including, but not limited to, the Engineer's review and acceptance of submittals required by the Contract Documents; the issuance of permits and licenses; delivery of equipment and materials to be furnished by the Department in accordance with the Contract Documents, if any; and site inspection and testing by the Engineer and other responsible parties, as required (emphasis added).

Most experienced contractors usually develop a schedule that is logical and has been well thought out in such a manner as to clearly and distinctly demonstrate to the owner how substantial completion of interim milestones or overall project completion will be satisfactorily achieved within the time allowed. Another comment noted in one of Bechtel's publications states that nothing can replace careful work on the original As-Planned schedule so that it reflects good logic and achievable dates that are consistent with the way the project was actually intended to be executed. The most important aspect regarding the As-Planned

schedule is that it was reasonable and generally achievable, otherwise it will provide no foundation or baseline from which to measure performance and any subsequent delays.

4.4.2 The Current-Progress Schedule

The "Current-Progress" schedule, as the name implies, is based on progress to date and shows the remaining duration of those activities that have not yet been completed, as well as when contract deadlines are currently forecast to be met. The Current-Progress schedule shows the actual start and finish dates, prior changes in the scope of work, changes in logic, updates or revisions to the original As-Planned schedule, etc. The Current-Progress schedule is usually supported by a narrative. An example of a clause often incorporated in many of the Massachusetts Highway Department's construction contracts is as follows:

All Contract Time(s) and Contract Milestones shall be imposed, flagged and separately identified in all Progress Schedule submittals in conformance with the Contract Time(s) and Contract Milestone dates set forth in the Contract Documents. The Contractor shall impose no other dates, events or activities in the Progress Schedule. Contract Milestones incorporated in the Contractor's Progress Schedule shall be assigned a duration of zero (0) Days.

In the absence of an approved Change Order which extends the Contract Time(s) and Contract Milestone(s), no initial or revised version of the Progress Schedule submitted by the Contractor which extends beyond the Contract Time(s) and Contract Milestone dates specified in the Contract Documents shall be accepted by the Engineer. Stated Progress Schedules periodically submitted by the Contractor as required herein shall forecast, accurately portray, and report all activities of Work remaining to be completed, and shall compare such forecast against the current Progress Schedule.

Based on the information provided in the Current-Progress schedule, one should be able to compare planned durations and/or production rates, based on time expended, with actual production rates, based on time remaining, and determine the likelihood of meeting the remaining durations within the forecasted completion times.

4.4.3 The As-Built Schedule

The "As-Built" schedule and the As-Planned schedule should be developed based on the same breakdown of activities to ensure a fair and reasonable analysis. In theory, if a realistic As-Planned schedule is followed in the field and a project

runs smoothly and without delay, then the As-Planned schedule and the As-Built schedule will be identical. However, in the real world this rarely happens.

As a result, the logic of the As-Built schedule will usually vary to some degree. Nevertheless, the As-Planned schedule with its logic is the starting point when developing the As-Built schedule. Once all of the activities shown on the As-Planned schedule are placed or arranged on the As-Built schedule as they actually occurred, it will be possible to identify where the original As-Planned logic was followed, as well as where new logic was introduced, inadvertently or otherwise.

The As-Built schedule will contain logic resulting from delays due to both the owner and the contractor. In some cases, this logic may be different than originally planned in order to reflect changes in the scope of work, value engineering, changes in the contractor's means and methods, etc. This logic must be sufficiently redundant so that if owner-caused changes in the logic are removed, the remaining logic will resemble the As-Planned logic or at least indicate when and where the contractor deviated from the As-Planned logic for its own purpose(s).

Recognition of changes in the logic is very important when pursuing a delay claim, since undesired changes in logic imposed by actions or inactions of the owner, the owner's representatives, or the owner's representatives can certainly lead to delay and thus impact a project's schedule.

4.4.4 The As-Adjusted Schedule

The "As-Adjusted" schedule, as the name implies, is a schedule that has been properly adjusted to reflect all delays that were included within the actual durations shown on the As-Built or when adjusting a Current-Progress schedule, those delays not already accounted for in the Current-Progress schedule. Determining which schedule to adjust depends primarily on the methodology being utilized. In other words, if an on-the-fly analysis is being performed, the Current-Progress schedule will be adjusted and if an after-the-fact analysis is being performed, the As-Built schedule will be adjusted.

Augment the Current-Progress schedule or the As-Built schedule accordingly with specific details to account for all delays. Show details by adding subactivities, additional logic, and possibly constraints reflecting the impacts of delays on specific parts of the schedule or the project as a whole. Once the schedule has been properly adjusted and the completion dates recalculated, it will show where activities were delayed as well as the reason(s), and thus the responsibility of delay. In the after-the-fact analysis, the start and finish dates of each of the activities shown in the As-Adjusted schedule will be identical to the start and finish dates of each of the activities shown in the As-Built schedule.

4.4.5 The But-For Schedule

The "But-For" schedule is developed by backing out or eliminating all of the impacts caused by excusable delays from the As-Adjusted schedule. These delays were added to the As-Adjusted schedule to indicate when the project would have

presumably been completed "but-for" these excusable delays. Constraints, impacted logic, and excusable subactivity duration should also be eliminated from the But-For schedule. The But-For schedule represents how far behind the As-Planned schedule a project was completed due to the contractor's own fault or negligence.

4.5 On-the-Fly Analysis of Delay

Before illustrating the steps necessary to properly carry out an "on-the-fly" analysis, it should first be understood that on-the-fly means that one looks at the state of a project the moment delay is recognized. The on-the-fly analysis starts by adjusting and manipulating the Current-Progress schedule to include all newly recognized excusable delays and new durations.

The on-the-fly methodology is based on a project's Current-Progress schedule. As such it must initially be compared to the As-Planned schedule to identify any differences in duration, production, etc., that exists between the two schedules. Once these schedules have been properly evaluated, all newly recognized excusable delays are inserted in the appropriate place on the Current-Progress schedule to arrive at an As-Adjusted schedule. Further manipulation by elimination of all newly recognized excusable delays will result in a But-For schedule. This schedule is then used to show when interim milestones or overall project completion could have presumably been reached "but-for" the excusable delays.

The individual steps required to perform an on-the-fly analysis of delays are outlined below:

Step 1

Compare the As-Planned Schedule to the Current-Progress Schedule

Compare the As-Planned schedule to the Current-Progress Schedule and identify any differences that exist between planned durations and/or production rates and actual durations and/or production rates. Evaluate any differences and determine the cause(s). The Current-Progress schedule must be current to the time of the first impact caused by any newly recognized excusable delay(s). The Current-Progress schedule should contain and reflect all prior adjustments.

Step 2

Identify All Excusable Delays

Identify all newly recognized excusable delays. It is not necessary to identify the nonexcusable delays since they will be recognized as extended periods not due to excusable delays. (On large projects this list could be very extensive as well as controversial.)

Step 3
Develop the As-Adjusted Schedule

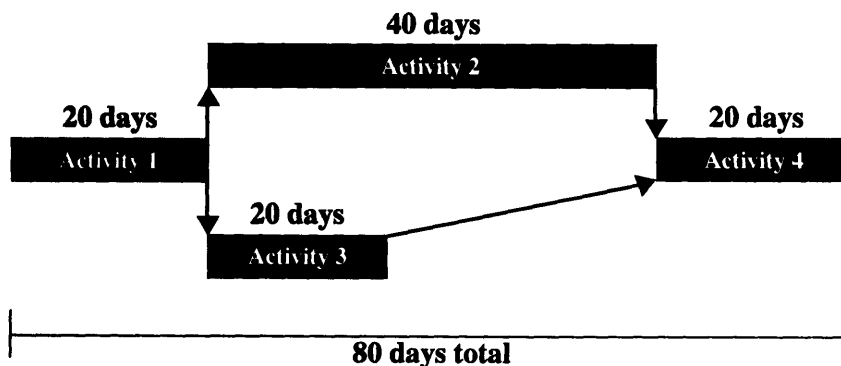
Plot the Current-Progress schedule and insert all impacts as a result of the excusable delays that were identified in Step 2 as separate and distinct activities, or subactivities. Add any additional or new precedences, logic changes, and/or constraints. Delays must be inserted in the appropriate places on the schedule according to actual impact dates and expected durations. Completion dates should then be recalculated.

The difference between the completion dates shown in the As-Adjusted schedule and the completion dates shown in the Current-Progress schedule indicates the amount of time extension owed to the contractor by the owner as a result of excusable delay(s).

Figures 4.2 through 4.7 demonstrate the on-the-fly methodology of analysis that is presented above. All individual figures and steps are based on the As-Planned schedule shown below in Figure 4.1.

ON-THE-FLY ANALYSIS

Figure 4.1: Original As-Planned Schedule



Example 1 (On-the-Fly)

As shown in Figure 4.1, the Original As-Planned schedule requires project completion within 80 days with the critical path passing through Activities 1, 2, and 4. In this example, there are no owner imposed deadlines other than an overall duration of 80 days.

Figure 4.2 represents the Current-Progress schedule which has been updated to reflect the current status of the project as of the specific day that the newly recognized delay initially impacted the project as represented by the data date. This updated schedule illustrates that Activity 1 started 10 days late or possibly took 10 days longer to complete than the contractor had originally planned. In this example, the 10-day overrun is assumed to be due to the fault or negligence of the contractor, a nonexcusable delay.

The As-Adjusted schedule in Figure 4.3 reflects only one new excusable delay of 10 days (D-1) that directly impacts Activity 2 as of day 40 shown as the data date. For simplicity, the cause of the delay is not specified in this example. However, in reality it could be any delay categorized as excusable (refer to Chapter 2 for examples). Since D-1 impacts Activity 2 which is critical, recalculation of the overall project completion date is extended by 10 days and is now forecasted to be 100 days. Nevertheless, as mentioned above, the contractor is responsible for 10 days of the extended duration as a result of the nonexcusable delay to Activity 1.

The difference between the overall duration shown in the As-Adjusted schedule of 100 days (less the nonexcusable delay of 10 days in Activity 1) and the overall duration shown in the As-Planned schedule of 80 days represents the amount of time owed to the contractor by the owner as a result of the impact caused by the excusable delay. In this example, the contractor is entitled to a time extension of 10 days. As a result, the Original As-Planned schedule (Figure 4.1) had to be revised to account for the owner's responsibility for the excusable delay. The project must now be completed within 90 days with the critical path still passing through Activities 1, 2, and 4 as shown on the Revised As-Planned schedule (Figure 4.1-R1).

ON-THE-FLY ANALYSIS

Figure 4.2: Current-Progress Schedule

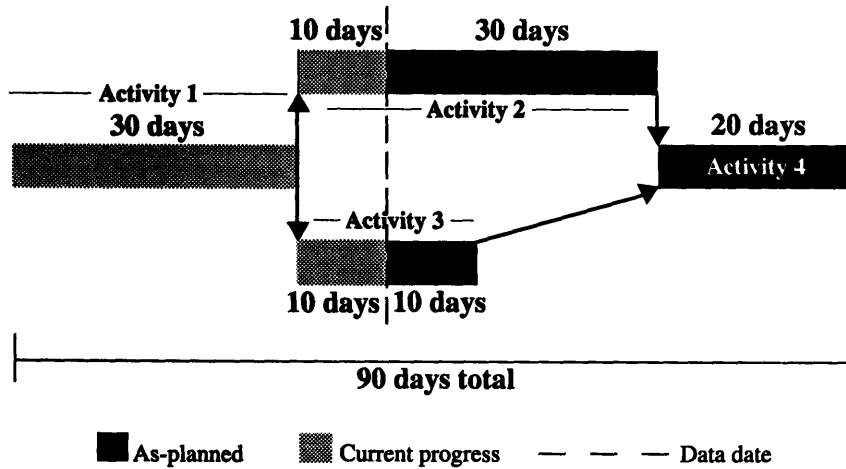


Figure 4.1: Original As-Planned Schedule

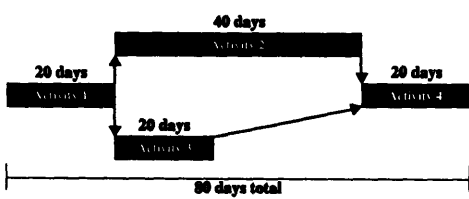


Figure 4.1-R1: Revised As-Planned Schedule

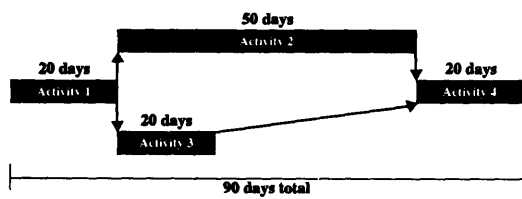
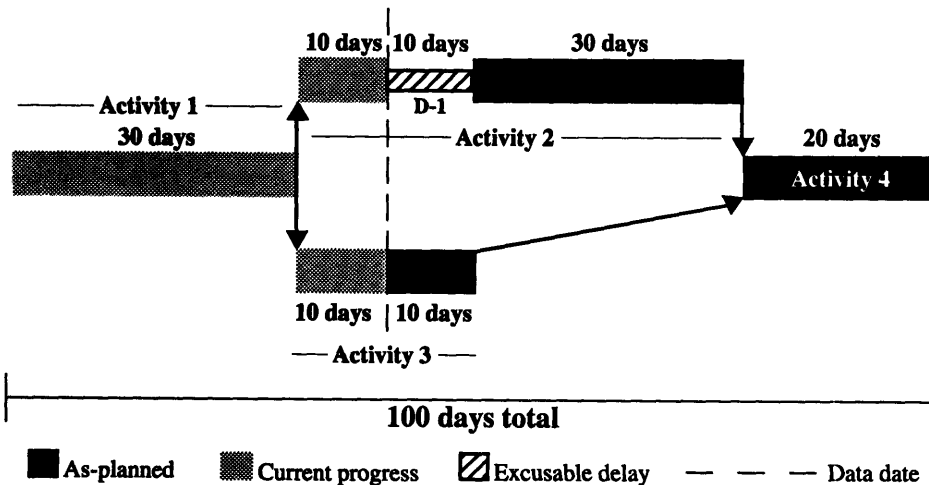


Figure 4.3: As-Adjusted Schedule



Example 2 (On-the-Fly)

Figure 4.4 represents the Current-Progress schedule as of the data date (day 50), at which time another delay impacted the project. The previous delay (D-1) is shown in this update as PD-1, but it has already been accounted for as mentioned above and is reflected as a 10 day extension to Activity 2 which extends the overall project duration by 10 days as shown in the revised As-Planned schedule (Figure 4.1-R1). This update to the Current-Progress schedule also illustrates that Activity 3 experienced a nonexcusable delay from day 40 to 50, an actual duration of 10 days. It can be assumed that the delay was not recognized at the time of impact, otherwise it would have been reflected in the previous update to the Current-Progress schedule similar to the way the delay to Activity 1 was depicted in the previous update. This illustration of the nonexcusable delay which occurred on Activity 3 demonstrates two things: **1)** that the delay is incorporated into the schedule as soon as it is recognized in the appropriate point in the schedule, and **2)** that since the delay is noncritical the overall project duration is not affected. In general, it is not necessary to single out nonexcusable delays in such a detailed manner.

The As-Adjusted schedule in Figure 4.5 reflects two newly recognized excusable delays (D-2 and D-3) each having an estimated duration of 10 days. D-2 directly impacts Activity 2 beginning on day 50, however, D-3 is noncritical and does not impact the overall project duration. Again, the causes of the delays are not specified in this example. Since D-2 is a critical delay, recalculation of the overall project duration results in another extension of 10 days. The new forecasted overall project duration is now 110 days which includes the extended duration as a result of the nonexcusable delay to Activity 1.

The difference between the overall duration shown in the As-Adjusted schedule of 110 days (less the nonexcusable delay of 10 days in Activity 1) and the overall duration shown in the Revised As-Planned schedule (Figure 4.1-R1) of 90 days represents the amount of time owed to the contractor by the owner as a result of the impact caused by D-2. In this example, the contractor is entitled to an additional time extension of 10 days. As a result, the Revised As-Planned schedule (Figure 4.1-R1) had to be revised a second time to account for the owner's responsibility for the excusable delay. The project must now be completed within 100 days with the critical path still passing through Activities 1, 2, and 4 as shown on the second revision to the As-Planned schedule (Figure 4.1-R2).

ON-THE-FLY ANALYSIS

Figure 4.4: Current-Progress Schedule

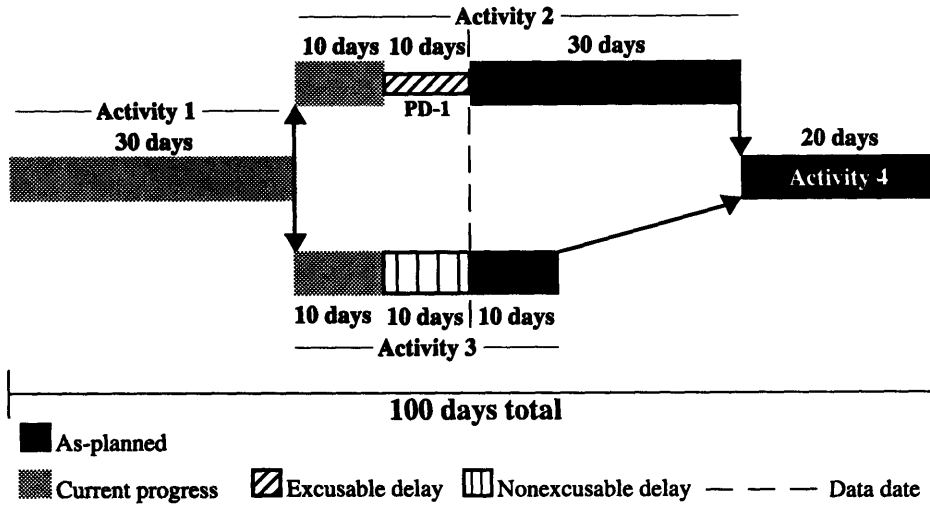


Figure 4.1-R1: Revised As-Planned Schedule

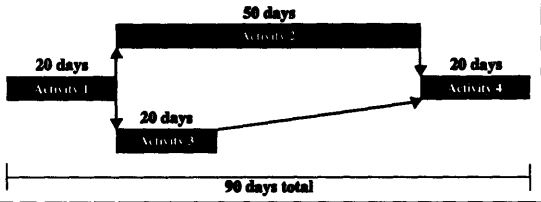


Figure 4.1-R2: Revised As-Planned Schedule

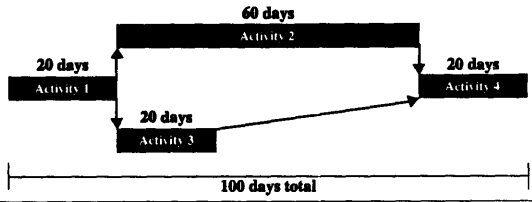
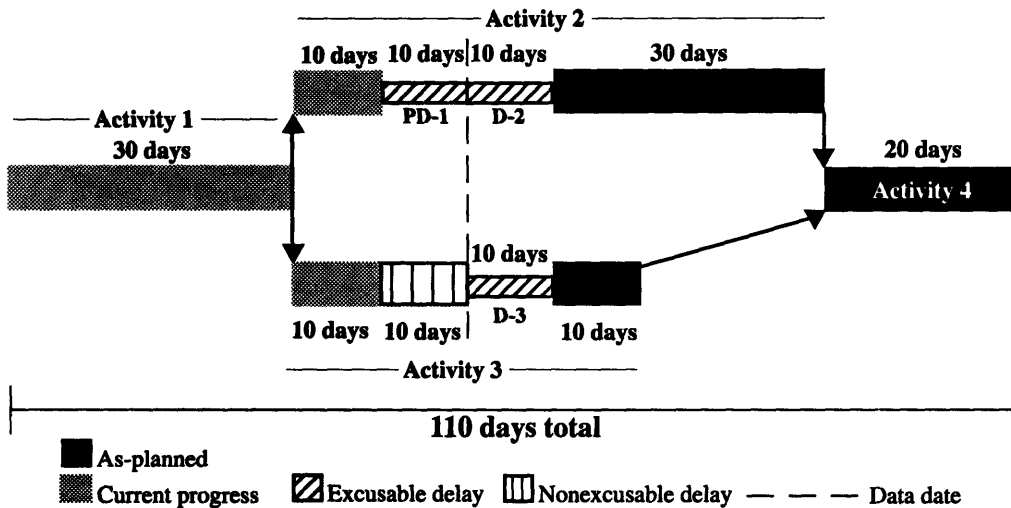


Figure 4.5: As-Adjusted Schedule



4.6 After-the-Fact Analysis of Delay

If a contractor has failed to maintain sufficient documentation to support an on-the-fly analysis of delay or in the event that the delay(s) was(were) not realized until after project completion, then typically an "after-the-fact" delay analysis should be performed. In some cases, after-the-fact may literally mean months or even years after a project has been completed. In general, after a project has been completed or long after a delay has occurred, the ability to recover any damages suffered as a result of delay have most likely been reduced, but not necessarily foregone. In most cases, if a contractor has enough historical documentation to accurately create an As-Built schedule, then an after-the-fact analysis can be performed to prove responsibility of delay.

To maintain harmony and progress, it is preferable to understand the extent of the damages caused by delays as they occur, not months or years after a project has been completed, or possibly not completed because of the damages suffered as a result of delay.

The individual steps to perform an after-the-fact analysis of delays are outlined below:

<p style="text-align: center;">Step 1 Develop the As-Built Schedule</p> <p>Develop a schedule <u>based on actual dates and overall durations</u> that reflects the same activities as the As-Planned schedule.</p>
--

Step 2

Incorporate the As-Planned Logic into the As-Built Schedule

Add the As-Planned logic to the As-Built schedule. If the project was built as planned, there will be no difference in logic between the two schedules. If there were any changes in the logic, it should be recognized at this point and the reason(s) for any change(s) in logic should be determined and documented. For example, the project may have experienced changes in scope, material and equipment shortages, strikes, resequencing of work, poor productivity, or severe weather to mention a few possible causes. Logic changes resulting from any excusable delay(s) should not be included at this point, however, the logic shown on the As-Built schedule must be complete.

Step 3

Identify All Excusable Delays

Identify all excusable delays. It is not necessary to identify the nonexcusable delays since they will be reflected in the extended durations in the As-Built schedule. (On large or complex projects this list may be very extensive as well as extremely controversial.)

Step 4

Develop the As-Adjusted Schedule

Plot the As-Built schedule and insert all of the excusable delays into the schedule as separate and distinct activities, subactivities, and/or constraints in their appropriate places according to actual date(s) of impact. Identify any necessary changes in logic as a result of the excusable delays. Recalculate completion dates to show that the As-Adjusted schedule results in the same activity dates as the As-Built schedule. Any steps to overcome these delays should be taken into account at this point also.

Step 5

Develop the But-For Schedule

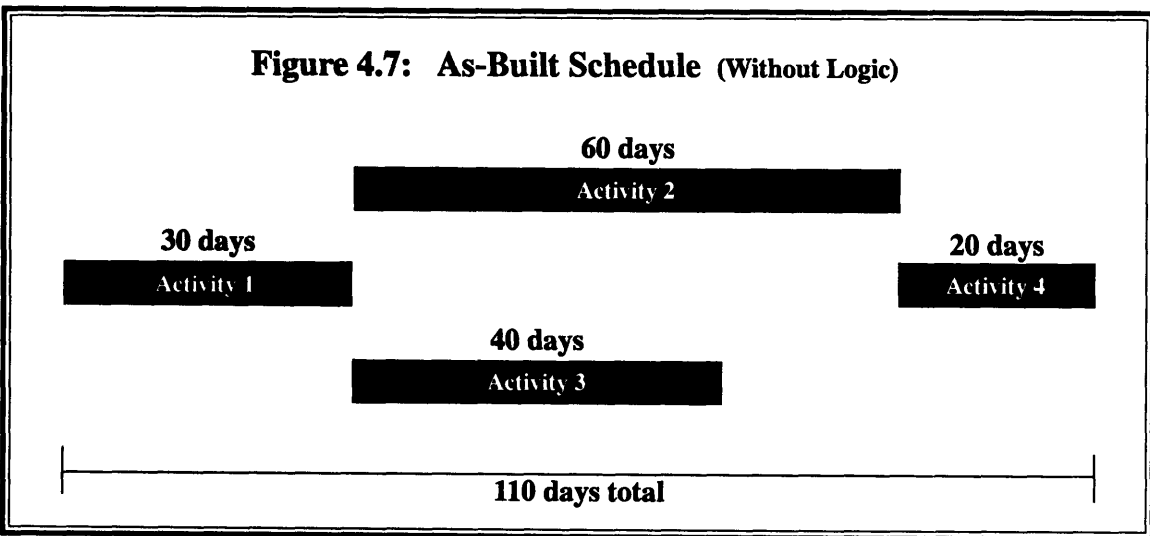
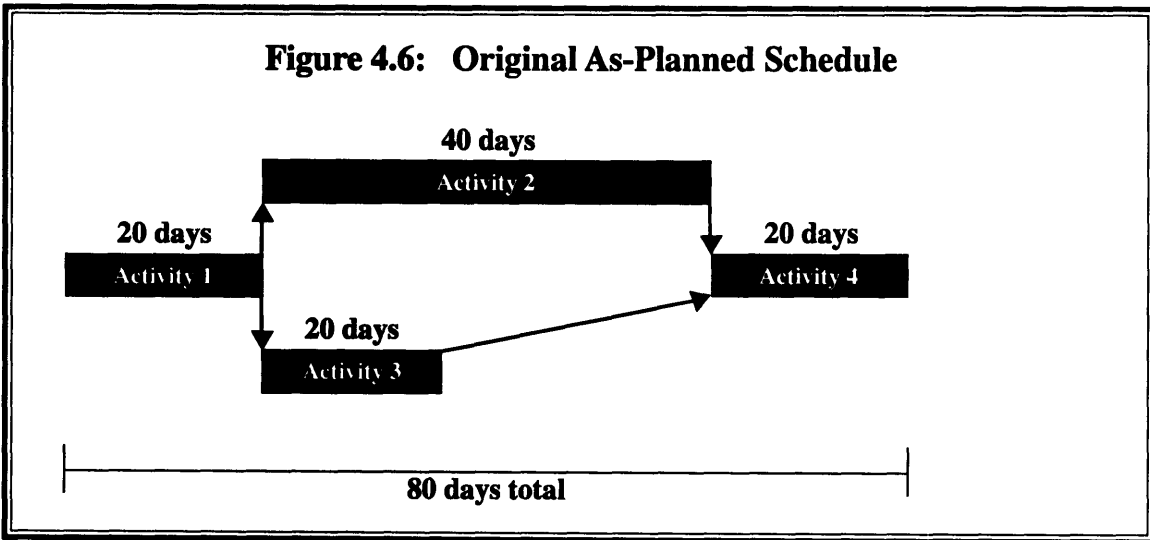
Backout all excusable delays from the As-Adjusted schedule (or set their duration to zero) to arrive at the But-For schedule. The difference between the duration(s) shown after completing Step 4 and the duration(s) resulting from this step represents the total amount of excusable delay which is also equal to the additional time that the contractor is owed by the owner as a result of the excusable delays.

Figures 4.6 through 4.10 demonstrate the after-the-fact methodology of analyzing delays. The relevant figures shown below are based on the project shown in the As-Planned schedule above in Figure 4.1.

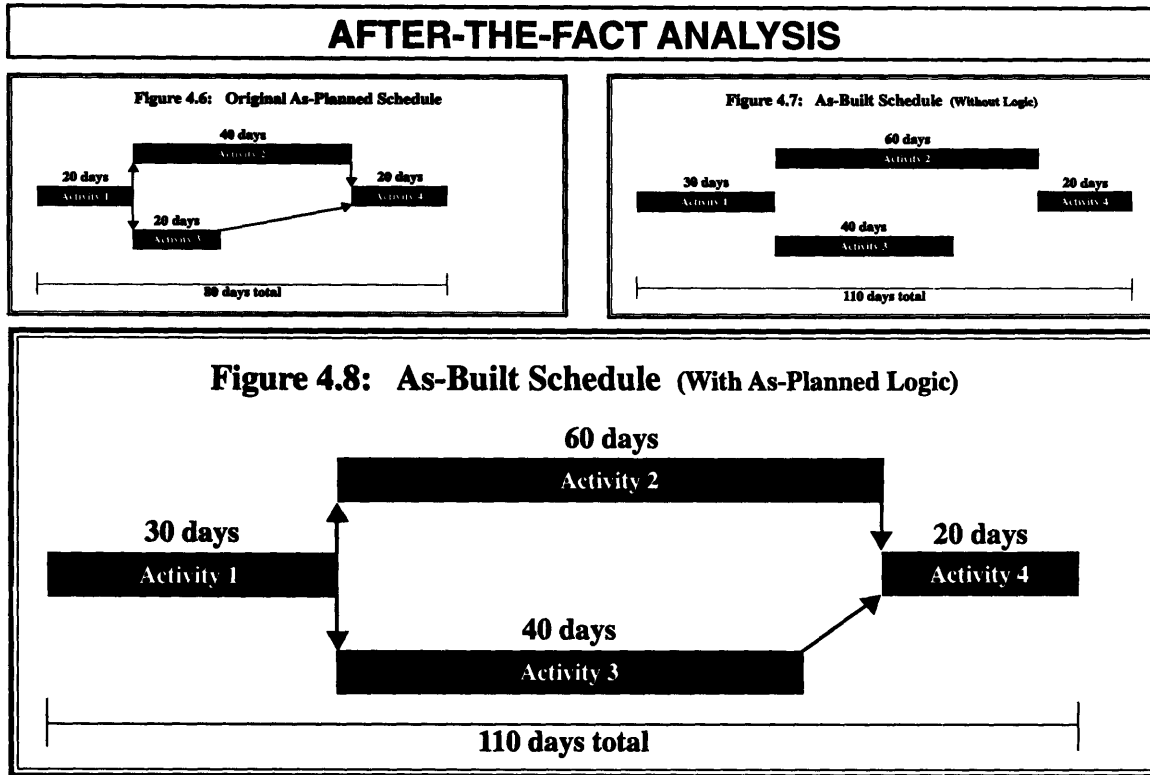
Example 1 (After-the-Fact)

Figure 4.6 represents the Original As-Planned schedule including the original logic. Figure 4.7 illustrates the overall duration of each activity based on actual start and finish dates, but without logic. As shown in Figure 4.7, Activities 1, 2, and 3 all took longer to complete than originally planned. As a result, the project was completed 30 days later than originally scheduled.

AFTER-THE-FACT ANALYSIS



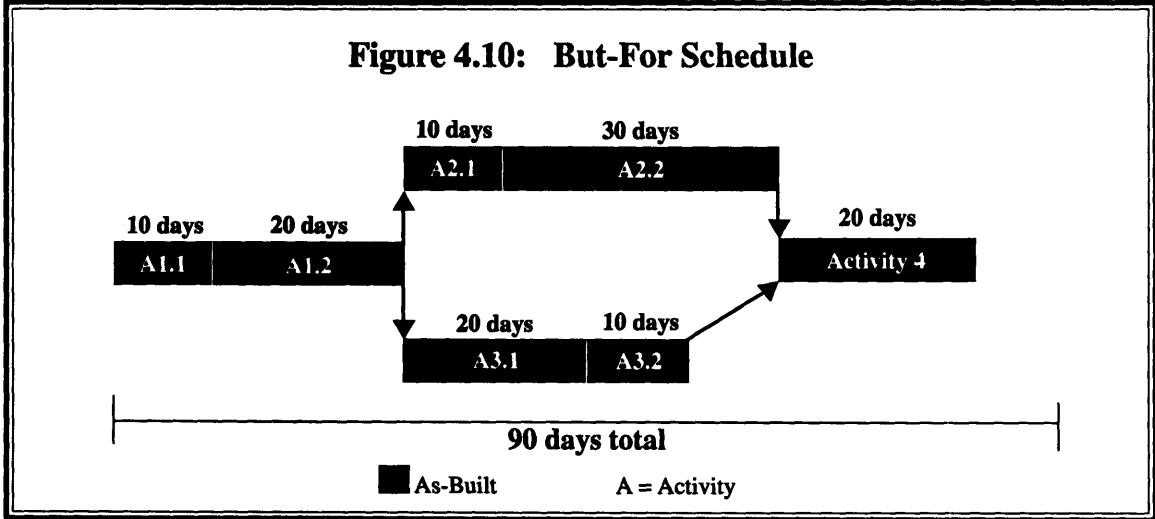
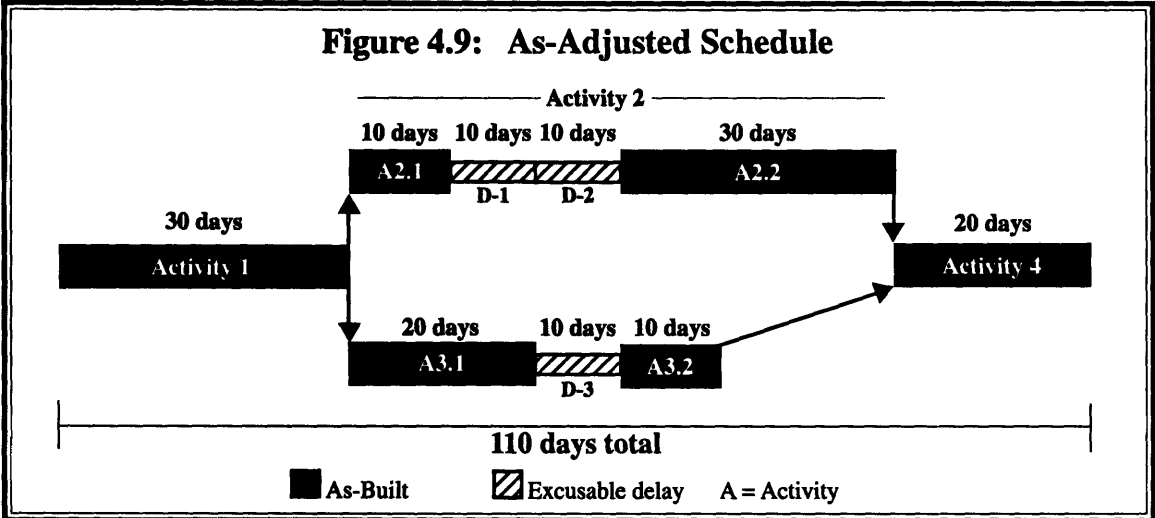
As shown in Figure 4.8, the As-Planned logic must be added to the As-Built schedule and evaluated for any changes that may have occurred as a result of excusable delays. In this case even though the project duration was extended by excusable delays, there was no change in the planned logic.



As illustrated in Figure 4.9, there were three excusable delays recognized and inserted into the As-Built schedule to arrive at the As-Adjusted schedule. Activity 1 experienced a nonexcusable delay that was critical and resulted in a 10 day delay to the project. Activity 2 experienced two excusable delays: D-1 began on day 40 and ended on day 50, and D-2 began on day 50 and ended on day 60. Activity 3 also experienced an excusable (D-3) and a nonexcusable delay (A3.2), but both delays were noncritical and therefore did not affect the project's overall duration.

The But-For schedule shown in Figure 4.10 was arrived at by backing out all of the excusable delays that were recognized above. The only delays that had any impact on the overall project duration were D-1 and D-2 since they were critical. D-3 simply used available float and therefore did not delay project completion. After subtracting the total duration in the But-For schedule (90 days) from the total duration in the As-Adjusted schedule (110 days) the difference is 20 days. Therefore, but-for the excusable delays, the contractor could have presumably completed the project 20 days sooner than actually happened. The difference between the total duration in the But-For schedule and the total duration in the As-Planned schedule represents the amount of delay for which the contractor is ultimately responsible as a result of nonexcusable delays, which in this case is 10 days.

AFTER-THE-FACT ANALYSIS



4.7 Summary

The task of proving responsibility of delay is a necessary burden that contractors must face if a delay claim is to be pursued and won. This burden exists whether a contractor is attempting to receive an extension of time associated with an excusable delay and/or additional time and money for any excusable-compensable delay(s) that were occasioned as a result of a delayed construction project. The two methods of delay analysis discussed in this thesis represent effective and unbiased methodologies that, if properly used, can clearly prove responsibility of delay.

However, as pointed out above, under most circumstances the best time to pursue a delay claim is the instant that it is recognized. Contractors should be prepared to update the Current-Progress schedule at any point in time. This is not to suggest that contractors should practice "claimsmanship"; nevertheless, it does suggest that contractors should aggressively address the issue of construction delay claims. As such, adequate records should be maintained on all construction projects in such a manner that will allow the proper documentation to be generated in the event it becomes necessary to pursue a delay claim.

Regardless of the methodology a contractor uses, without sufficient documentation it is highly unlikely that an equitable and favorable settlement will be received by a contractor in pursuit of a delay claim. The following chapter identifies the documentation that should be generated and maintained on virtually all construction projects if pursuit of a construction delay claim is even remotely possible.

5.0

DOCUMENTATION REQUIREMENTS

5.1 General

This chapter focuses on the documentation that contractors should collect and maintain on a construction project from start to finish in case excusable delays are experienced. Also outlined is the additional and more specific documentation that should be collected from the moment an event occurs that may give rise to an excusable delay or from the moment delay is recognized. The documentation required to prove the continued validity of the As-Planned schedule is also discussed. Emphasis is placed on the documentation required to support the two methodologies of delay analysis presented in Chapter 4.0.

5.2 Documentation Required to Perform an On-the-Fly Analysis of Delay

In general, compilation of the necessary documentation to perform an on-the-fly analysis of delay should begin long before a delay is experienced, and in most cases, long before a project begins. However, as soon as a delay is recognized additional information that is more specific and detailed must be produced.

One of the major reasons for performing an on-the-fly analysis is to resolve the issue of delay in an expeditious manner and hopefully preclude further delay to the project. Another important reason is to ascertain the impacts expected on the remainder of the project. As previously stated, on-the-fly literally means looking at the state of a project at the moment of impact caused by delay(s). In general, an on-the-fly analysis of delay is easier to complete

if an event-oriented approach is taken. By tracking and monitoring events that may give rise to a delay, it is more likely that comprehensive, contemporaneous documentation will be available if the event does result in a delay.

When performing an on-the-fly analysis of delay(s) contractors must be prepared to follow, support, and defend each of the three steps required to carry out this type of analysis. The three steps that were discussed in Chapter 4.0 are summarized as follows:

Step 1	Compare the As-Planned Schedule to the Current-Progress Schedule
Step 2	Identify All Excusable Delays
Step 3	Develop the As-Adjusted Schedule

Effective on-the-fly analysis of delay(s) depends first and foremost on the contractor's ability to prove that **1)** the As-Planned schedule is reasonable; **2) (a)** the As-Planned schedule is being attained and the durations and/or production rates indicated in the schedule were being met until the time of impact caused by the excusable delay(s), or **(b)** if forecasts indicated in the As-Planned schedule were not being met prior to the excusable delay(s), the reason(s) for failing to perform as planned will not impact future activities and there is little likelihood of future concurrent-nonexcusable delays; if not, then changes must be reflected in the Current-Progress schedule, and **3)** the Current-Progress schedule does reflect the current state of the project at the moment the excusable delay(s) impacted the project such that when the excusable delay(s) is backed out, the result is the As-Adjusted schedule.

5.2.1 As-Planned Schedule Must Be Reasonable

In many ways, the As-Planned schedule is the most important project schedule prepared by a contractor since it typically forms the starting point for measuring all delays experienced on a construction project. Traditionally, the first schedule

that a contractor submits to an owner becomes known as the As-Planned schedule. Some commentators suggest that it is the most financially significant document submitted to an owner. Any value in a contractor's proposal to perform work that is a function of time is ultimately derived from the As-Planned schedule. The As-Planned schedule is usually based on the prebid schedule that was developed when the work was originally estimated. In some cases, it is the schedule that was submitted with the bid. The bid amount is based on the lowest possible cost of labor, equipment, and materials needed by the contractor to complete the project.

The detailed individual steps required to initially develop the As-Planned schedule are beyond the scope of this document; however, since the As-Planned schedule is such an important element in the analysis process, its development is briefly discussed herein to facilitate the identification of the necessary documentation to pursue delay claims. The As-Planned schedule is most often developed from an endless list of documents, but is ultimately based on the Request for Proposal (RFP); addenda; questions and answers; associated or referenced drawings, specifications, codes, and regulations; photographs; meeting minutes/notes taken during prebid meetings; site visits; bid estimate; construction process plans; vendor quotes; general conditions terms, etc. These documents are usually generated by the owner but they can be extremely valuable to the contractor when pursuing a delay claim.

It is assumed in this thesis that the As-Planned schedule is comprehensive and is based on sound scheduling practices that are commonly used and accepted within the construction industry. Further, it is assumed that the scheduler is familiar with standard construction operations. In general, all activities should be defined so that the schedule will result in a logical and systematic completion of structural elements such as foundations, slabs, columns, roofs, walls, electrical, and

mechanical systems. The As-Planned schedule must initially include those activities associated with pre-construction, procurement, mobilization, shop drawings, site surveys and layout, permitting, bonding, close-out, demobilization, etc. However, when the As-Planned schedule is being used in an analysis, it may sometimes be necessary to eliminate some of the immaterial activities from the schedule without affecting the integrity of the schedule. For example, in some cases it may simplify the analysis process by eliminating certain procurement activities, shop drawings, etc.

Regardless of whether or not the action to be carried out is procurement, mobilization, or actual construction, the clock has usually started ticking once the owner has given the contractor the Notice to Proceed (NTP). As such, each and every activity that comprises the project as a whole has a deadline that must be met--even if not stated as such in the contract--in order to comply with contractually stipulated interim milestones and overall completion dates. With this in mind, the contractor's first action must be to implement an accurate and reliable means and method of both measuring and reporting the productivity and efficiency related to the various activities that must be carried out to successfully achieve substantial completion.

As mentioned in Chapter 4.0, the As-Planned schedule establishes a starting point from which delay can be measured. Therefore, it follows that the As-Planned schedule also forms a basis from which performance can be measured. As a result, it is critical for contractors to generate and maintain detailed records regarding expected production rates, durations, staffing needs, etc. When attempting to prove that the As-Planned schedule is reasonable, this information is necessary.

To facilitate this, contractors should collect and maintain detailed estimate work sheets that are complete in every respect and self-explanatory. These estimate

work sheets should clearly indicate how and why activity durations and/or production rates were established and this information should subsequently be reflected on the As-Planned schedule. In most cases, the majority of the durations are owner driven, meaning that they were contractually imposed based on owner needs and requirements. As such, work sheets should reflect all owner-imposed constraints, responsibilities, coordination requirements, etc. The estimate work sheets should also indicate any expected need for winter protection, hurricane protection, etc.

5.2.1.1 Equipment

In addition to the general estimating work sheets that should be prepared for each individual project, contractors should generate and maintain more specific estimate work sheets pertaining to major pieces of equipment required to complete a project as planned. These work sheets should be based on and keyed to the individual activities that make up the project as a whole and should indicate whether the equipment is to be rented, leased, purchased, etc., as well as under what terms and conditions.

By breaking down the equipment needs and expected production rates for each piece of equipment by activity, it will be much easier to determine if the estimated durations and/or production rates are being met and if they can continue to be met as the project progresses. Additionally, it will be much easier to associate extended durations and/or variations in production rates with specific delays. Detailed estimate work sheets such as the following example are very advantageous when attempting to accurately forecast new completion dates. Further, detailed

estimates will assist the contractor with informing the owner of the reason(s) specific rates and/or durations were not met as planned.

If the activity to be performed is "Excavate Footings for Electrical Substation," then the equipment estimate work sheet should provide detail similar to that which is shown in the example below. This example of an equipment estimate work sheet represents just one type of production forecast that may have to be reviewed and analyzed in the event of delay. This is not to suggest that this is the best format, but it does provide an example of the level of detail required. Depending on the circumstances surrounding the specific project, far greater detail than shown in this example may be necessary.

5.2.1.2 Personnel/Manpower

The same type of detailed information that is necessary regarding equipment is also required with respect to the personnel who work on a project. Contractors should break down each activity by the number of manual and nonmanual workers that will be directly and indirectly required to carry out a project from start to finish, as well as the length of time that each individual will be utilized on the project. In addition to the required number and mix of manual and nonmanual employees, contractors must further delineate specific details such as the number of supervisors, managers, salaried versus hourly-paid employees, etc.

Example:
Equipment Estimate Work Sheet
Excavation of Footings for Electrical Substation

Earth Excavation: 36,000 CY loose granular material.
 Haul one-way 2.5 miles.
 Use 2.5 CY endloader and 10 CY dump trucks.

Endloader capacity 100 CY hours.

$36,000/100 = 360$ hours or 45 eight hour days.

$100/10 = 10$ trucks loaded per hour.

Average hauling speed estimated at 15 MPH. $2 \times 2.5 = 5$ miles round trip.

$5/15 \times 60 = 20$ minutes hauling time. $60/10 = 6$ minutes loading time.

Estimated 4 minutes dumping time. 30 minutes total time per truck load.

$60/30 = 2$ loads per hour per truck.

$10/2 = 5$ trucks required to keep endloader working at capacity.

$100 \times 8 = 800$ CY hauled per 8 hour day.

Need one bulldozer (can spread 1400 CY daily).

Need one grader to keep haul road in shape.

1 bulldozer (can spread 1400 CY daily).

1 tractor & tandem sheepsfoot roller (can compact 1200 CY daily).

1 water truck with sprinkler for moisture control.

1 rubber-tired wobbly wheel roller on standby for compaction and sealing fill when rain is expected. (Can be towed by above bulldozer or tractor.)

5.2.2 Summary of Proving the As-Planned Schedule is Reasonable

To facilitate proving that the As-Planned schedule is reasonable, contractors should collect and maintain the following documentation as a minimum:

- **Original Bid Documents:** (varies by project)
 - Invitation to Bid
 - Instructions to Bidders
 - Information to Bidders
 - Specimen Agreement
 - General Conditions or Provisions
 - Special Conditions or Provisions
 - Supplementary Conditions or Provisions
 - Technical Specifications
 - Drawings
 - Vendor Data Sheets/Drawings/Sketches
 - Addenda
 - Proposal
 - Prebid Meeting Minutes/Notes
 - Test Reports/Data
 - Special Requirements such as laws requiring filed subbids
 - Estimate Work Sheets
 - Preliminary Schedules indicating durations, production rates, resources, etc.
 - Notice of Award/Notice to Proceed

- **Conformed Contract Documents:** (varies by project)
 - Agreement
 - General Conditions or Provisions
 - Special Conditions or Provisions
 - Supplementary Conditions or Provisions
 - Technical Specifications
 - Drawings
 - Vendor Data Sheets/Drawings/Sketches
 - Amendments
 - Notice to Proceed
 - Supplemental Agreement(s)
 - Schedule(s), Staffing Plans, Equipment Plans, etc.

If contractors sufficiently document how and why its resources were quantified and how and why the expected production rates and/or durations of each were established, then the task of proving that the As-Planned schedule is reasonable will be considerably easier.

5.2.3 As-Planned Schedule Is Being Attained

When analyzing delay on-the-fly, contractors must be able to show that the dates and/or production rates depicted on the As-Planned schedule were being met prior to impact caused by the excusable delay(s) and shown in the Current-Progress schedule accordingly. If the contractor was not successfully meeting the forecasted dates on the As-Planned schedule, then the contractor must be able to substantiate any deviation and ultimately prove to the owner that failure to meet progress as planned did not and will not affect the durations of future activities.

As such, contractors must maintain enough data to accurately determine if the progress is being attained as planned. Contractors should track and monitor activities and record progress on a daily basis. This data must be available for review and analysis as soon as a delay is recognized so that the analysis can take place on-the-fly. The rates of progress of those under the control and/or responsibility of the contractor must also be collected and maintained, i.e., subcontractors, vendors, etc. In addition, the contractor should maintain records indicating how those parties not under its control, but likely to affect its schedule, are performing. For example, even though the owner is not under the contractor's control, it is imperative that the contractor document all actions or inactions of the owner that affect the timing of the project. More importantly, the timeliness of the various actions should be adequately documented.

5.2.3.1 Executing the Work

The task of proving that the As-Planned schedule is reasonable must also address the fact that the schedule is being met on a daily basis. In order to be in a position to prove that the As-Planned schedule is being followed with reasonable accuracy, contractors must consistently maintain comprehensive and detailed job site records as a normal course of business. In most instances, this is best accomplished by collecting and maintaining the following documentation as a minimum:

- **Daily Field Reports/Diaries.** The contractor should maintain daily field reports pertaining to its own work force identifying such things as: project name/subname, customer(s), customer representative(s), contract number, applicable activities/cost codes/references, subcontractor(s) on site, visitor(s) on site, shift(s) (including any part thereof), manpower (manual, nonmanual, number of workers on site by trade, craft,

discipline, etc.), list of major equipment utilized, list of major equipment idle (and reason for idleness), description of work (by specific activity) planned for the day of report, description of work performed the day of report, weather (at various times, e.g., 8:00 a.m. and 1:00 p.m.), problems encountered, unusual events, (e.g., hurricane, unusually heavy traffic that stops or disrupts progress), accidents (including who, what, when, where, and actions taken), conversations with the owner, the owner's agent or representative, subcontractors, visitors (particular those visitors that affect the project such as an OSHA representative), etc.

Most importantly, the daily field report should expand upon any circumstances or events that result in delay or may result in delay. Depending on the size of the project, some contractors use the daily field report to record daily progress, material deliveries received, etc. On other projects there may be several versions of this report to accommodate certain portions of the project.

- **Field Engineering Reports.** All field engineering problems and solutions should be described and documented in this report. Depending on the particular problem, distribution should be made to any or all of the following: construction, construction engineering, mechanical engineering, electrical engineering, civil engineering, engineering files, owner, subcontractors, vendors, etc. In some cases, receipt of this information by other parties must be documented.

- **Production Rates (Forecasted and Actual).** Contractors should monitor and evaluate the production rates for all phases of the project and record with reference to specific activities. Refer to the equipment estimating worksheet on page 85 for an example of estimated production rates.

- **Progress/Coordination Meeting Minutes.** Contractors should maintain records of all progress reviews and/or coordination meetings, whether formal or informal. These records must indicate the parties in attendance, the issues discussed, the actions assigned (or unassigned), the solutions agreed upon, and finally the decisions made.

- **Material and Equipment Delivery Tickets/Slips.** Contractors should maintain adequate documentation to ensure and prove that contractor supplied material(s) is being fabricated and delivered as scheduled. In addition, material(s) delivered to the job site such as concrete, pipe, backfill material, insulation, equipment, or supplies should be adequately documented to verify such things as type, quantity, delivery times, exact location of delivery, associated activity, security provisions, problems encountered in delivery (including transporting and off loading).

- **Submittal Logs.** Contractors should maintain detailed records concerning all submittals, material or otherwise. These logs should provide a complete and concise description of the item(s) being submitted, the reason (i.e., approval, information), the time allowed for review, the elapsed time from submittal to return of the submittal, etc.

- **Shop Drawing Logs.** Contractors should maintain detailed logs indicating when specific drawings were submitted for review and/or approval as well as when they were returned by the owner. In addition, the method of delivery should also be noted, i.e., formal transmittal, fax, verbal, etc.

- **Requests for Information (RFI).** Contractors should maintain detailed records regarding all requests that it makes to the owner for additional information, clarification, etc. A standard preprinted form often tailored to suit individual project needs is usually used to accomplish this task. In most cases, an RFI form has spaces or blanks that should be filled-in with the following information as a minimum: contract name/number; date of initial request; specific need date for owner's response; date(s) of follow-up request(s); specific activity that may be affected; reason(s) for request; field(s) that may be affected, i.e., civil, structural, mechanical, piping, etc.; complete but concise descriptions of information and/or clarification desired; related contract changes; and drawing/specification numbers.

- **Meeting Minutes/Notes**
 - Safety Meetings
 - Job Progress/Schedule Meetings
 - Coordination Meetings
 - Problem Solving Sessions
 - Staff Meetings
 - Negotiations
 - Scope Review Sessions

- **Correspondence.** Contractors should maintain separate and distinct records of all communications with the owner, the owner's representative(s), subcontractors, etc., in the form of letters, facsimiles, transmittals, memos, telephone notes, minutes, Requests for Information (RFI), etc.

5.2.3.2 Changes

When progress reported in the Current-Progress schedule does not match prior plans, the contractor is under more of an obligation to prove that the remainder of the current schedule is still valid except for the excusable delay(s), or make appropriate changes to activity durations and logic as necessary. Contractors must be able to accurately revise and adjust the Current-Progress schedule to reflect newly forecasted durations if and when the scope of work changes.

In the event that the scope of work does change, contractors must have the proper information to support any variances that occur as a result. This type of documentation is crucial when attempting to perform an on-the-fly analysis of delay. In general, the documentation required to record changes is described below:

- **Construction Change Request.** Proposed and accepted construction changes should be documented including the change itself and the effect of the change along with any special terms and conditions that may be applicable.
- **Contract Change Notice.** Any change in a construction contract should be documented, regardless of the magnitude. The project is listed and the change should be described.

- **Contract Change Agreement.** A change in contract should be agreed to by all parties to the contract and documented, including any change in price and/or schedule. The As-Planned schedule should also be revised if necessary.
- **Field Change Notice.** Changes in the field should be described, justified, and properly documented.
- **Authorization for Extra Field Work or Extra Work Order.** A change in the scope of work may result in the need for extra work to be performed by the contractor. This extra work should be documented accordingly and noted on the As-Planned schedule as a revision if applicable.
- **Schedule Change Notice.** When a change requires a revision to the As-Planned schedule, it should be documented along with any necessary owner approvals.
- **As-Planned Schedule.** The contractor should maintain an up-to-date As-Planned schedule at all times that clearly and distinctly identifies every aspect of the project from procurement of materials to completion of the project.
- **Coordination Plan(s).** The contractor should maintain complete and accurate coordination plans that address the needs of all other parties involved in the project that could possibly affect the contractor's plan of execution. This information must be maintained not only as it specifically relates to the contractor, but also as it applies to other parties that may ultimately impair the contractor's ability to perform.

- **List of Subcontractors, Vendors, and Suppliers, etc.** The contractor should maintain an up-to-date list of any and all portions of a project that it plans to subcontract to others including expected durations of the contracted work. In addition, the contractor should document owner approvals and recommendations of the same. Furthermore, contractors should document any stipulations by the owner forcing the use of a particular subcontractor, vendor, or supplier. More importantly, contractors should properly document approvals, objections or concerns that it has regarding owner-imposed participants.

- **Subcontractors' As-Planned Schedules.** The contractor should require and maintain a complete As-Planned schedule from all subcontractors. These schedules should identify every aspect of the project from procurement of materials to completion and closeout of the project.

- **Subcontractor Coordination Plan(s).** The contractor should maintain complete and accurate coordination plans based on the need for coordination and interaction among subcontractors.

- **Subcontractor Staffing Plan(s).** The contractor should maintain an accurate and up-to-date staffing plan from each subcontractor indicating total number of manual and nonmanual employees to be used on the project. This list should be broken down by craft(s) and/or discipline(s). The list should also identify the forecasted durations of each

category including need dates and locations from which the employees will be staffed such as direct hire, job shop, union hall, etc.

- **Subcontractor Production Rates (Forecasted and Actual).** The contractor should maintain sufficient information regarding all of the subcontractors' estimated production rates for all phases of the work to be subcontracted as well as utilize some method of tracking and verifying the subcontractors' actual production rates.

- **Subcontractor Progress/Coordination Meeting Minutes.** The contractor should maintain records of all subcontractor progress reviews and coordination meetings, whether formal or informal.

- **Subcontractor Material and Equipment Delivery Tickets/Slips.** The contractor should maintain adequate documentation to ensure that each subcontractor's supplied material(s) is being fabricated and delivered as scheduled. In addition, material(s), equipment, etc., delivered to the job site such as concrete should be adequately documented indicating time of delivery, type of delivery, exact delivery location, etc.

- **Subcontractor Daily Field Reports.** The contractor should maintain daily field reports similar to its own regarding any subcontractors. The reports should include the following: project name, customer, customer representative(s), contract number, subcontractor name(s), date, shift, manpower

(manual and nonmanual), list of major equipment utilized, list of major equipment idle or being serviced as well as the reason for idleness, description of work planned for the day of report (by activity), description of work performed, weather (at various times), problems encountered, unusual events, etc.

All of the above information must be used to revise the Current-Progress schedule in order to forecast a revised completion date but for newly identified excusable delays. The impacts of any new excusable delay(s) must be reflected in the As-Adjusted schedule such that the amount of time entitlement due the contractor as a result of the excusable delay(s) is the difference in deadline dates between the two schedules.

5.2.4 Accuracy of the As-Adjusted Schedule

The As-Adjusted schedule is basically the end result of an on-the-fly analysis. The As-Adjusted schedule is an extension of the Current-Progress schedule showing the impacts of the new excusable delay on the current plan. By listing all activity and logic changes and then running a computer scheduling program incorporating these changes, the impacts on deadlines will be shown.

The documentation required to determine and support necessary adjustments to the As-Adjusted schedule is generally derived from the previously mentioned documentation. However, some of the more specific documents required to show adjustments in logic, extended durations, additional subactivities, etc., due to excusable delays are as follows:

- **Stop Work Orders.** In some cases, an owner will find it necessary to issue a stop work order to a contractor. Stop work

orders usually affect the schedule. Under most circumstances the extent of a stop work order is not clearly known and contractors should track them carefully because of this. While tracking this type of item every activity effected should be tracked and documented separately in case delays result.

- **Change Orders/Change Order Logs.** Change orders were mentioned earlier, but are stressed again since significant change orders or a sizable number of change orders may warrant adjustments to the schedule.
- **Record of Drawing Changes (including standard contract drawings, show drawings, etc.).** All drawing changes should be adequately documented and tracked for possible impact on the schedule.
- **Record of Specification/Regulation/Code Changes.** Items that fall within this category are very important to track. A minor change in a code, for example, may have a significant effect on the means and method of performing a project. This may in turn cause a change in logic that will ultimately have to be shown on the As-Adjusted schedule.
- **Correspondence/Meeting Minutes/Telephone Notes, etc.** In many cases, owners impose logic changes due to added or deleted constraints which in turn may necessitate adjustments to the schedule. For example, an owner may advise a contractor that utility work must be performed at night, however, the contractor may not have been aware of this, and as a result, adjustments would be necessary.

An individual knowledgeable about the impacts of the delay must prepare documentation of the impacts. This documentation may be in various forms, however, it is usually communicated to those with a need to know by the following documents:

- **Daily Reports.** Depending on the form of report being used some reports specifically have blank lines that must be filled out when delays are encountered to identify what activities will possibly be effected.
- **Field Engineering Reports.** Many field engineering reports provide spaces to discuss activities that may be affected by a delay also.
- **Problem Statements .** Many projects use a specialized forms to communicate the impacts of delays.
- **Meeting Minutes, Notes, etc.** In most cases, the knowledge of what immediate activities will be affected by a delay is in someone close to the project. As a result conversations should follow the recognition of delays. This can also be done in advance. For example, on Boston's Central Artery Tunnel Project every Friday a meeting is held to discuss possible delays and the likely impacts to others. Each individual Resident Engineer (RE) discusses his/her contract and highlights any potential delays that may impact the milestone of Early Opening. As items are tabled, the issues are discussed and the probable outcomes are discussed. The RE is usually

the knowledgeable person who knows what will be impacted as a result of being very familiar with the contract, the schedule, various restraints, and the schedule.

Once a new delay has been recognized, the contractor must determine which if any of its subcontractors or vendors will be effected. After this has been determined, the contractor must get detailed information from its subcontractor giving specific details regarding any impact expected. In many cases, a subcontractors cost proposal will provide details that will assist with determine what activities may be affected.

On many projects, for example, when a delay is caused by an extensive change in design, the contractor must document the change, as well as all of the individual activities that will be affected. If a contractors proposal is detailed enough a considerable amount of this data can be gained from a contractor's detailed proposal. A significant change may result in the contractor needing to change its means and method of carrying out the work.

The list of documents that can be utilized in adjusting the schedule is endless. In addition, one of the areas of documentation that is quite often overlooked is that which supports a contractor's efforts to mitigate excusable delays. The contractor should maintain records which support and verify that it has taken all of the possible steps within reason to mitigate delay, even those that are excusable. If the contractor resequences work, delays portions of the work, etc., it should be appropriately documented in case it becomes an issue when delays are experienced.

5.3 Documentation Required to Perform an After-the-Fact Analysis of Delay

The process of analyzing delay after-the-fact is extremely dependent upon the documentation that was collected and maintained on a project from its inception to completion. To properly perform an after-the-fact analysis of delay, one must depend on existing documentation and basically rebuild the project on paper from start to finish as it was actually built in the field including any delays, changes in logic, etc., that were experienced during the life of the project.

The documentation to be used in an after-the-fact analysis must have been prepared contemporaneously as a routine task during the normal course of business. Documentation prepared after-the-fact will likely be incomplete and biased, or at least viewed as biased by the opposing party, especially if prepared for pursuit of a delay claim. Even if the documentation is not biased, the opposing party will most likely find it less convincing if it was not already in existence prior to performing an after-the-fact analysis of a delay.

The individual steps discussed in the previous chapter that must be taken to properly carry out an after-the-fact analysis of delay are summarized below to facilitate discussions in this chapter.

Step 1	Develop the As-Built Schedule
Step 2	Incorporate the As-Planned Logic Into the As-Built Schedule
Step 3	Identify All Excusable Delays
Step 4	Develop the As-Adjusted Schedule
Step 5	Develop the But-For Schedule

The guidelines and principles set forth previously with regard to the As-Planned schedule should be referred to when performing an after-the-fact analysis of delay. When the analysis is being performed after-the-fact there were probably several revisions to the As-Planned

schedule that must be considered and reflected in the analysis accordingly. It is important to consider the effects of each revision to the As-Planned schedule and utilize the appropriate schedule(s) when evaluating specific delays.

5.3.1 Develop the As-Built Schedule

Development of the As-Built schedule can be easily supported by a variety of documents, assuming the proper documentation is available. In an ideal situation, the contractor will have developed the As-Built schedule as the project progressed, however, this is rarely the case. In most cases, the As-Built schedule must be developed from scratch based on the documentation that was collected and maintained during the course of a project. Many times, the after-the-fact analysis may take place several years after project completion. As stated earlier, creation of an As-Planned schedule is beyond the scope of this document; nevertheless, it should be noted that an after-the-fact creation of the As-Planned schedule is extremely difficult, if not impossible. Therefore, the importance of documenting the As-Planned schedule cannot be over emphasized.

With this in mind, the first document needed to prepare the As-Built schedule, in most cases, is the As-Planned schedule since it forms the foundation upon which to create the As-Built schedule. This is due to the fact that the two schedules must be based on an identical breakdown of activities. In addition, the As-Built schedule must be based on the same logic that was reflected in the As-Planned schedule. If the As-Planned schedule does not exist, the first step is to create one.

By referring to the existing As-Planned schedule or after creating the missing As-Planned schedule, itemize each activity shown on the As-Planned schedule and assign actual start and finish dates as well as overall durations for each activity as well as for the overall project. Durations can be determined from a variety

documents, most of which were discussed in detail in the previous section. Not all of the documents will be repeated in this section, however, some will be reemphasized, but not redefined or explained. One of the first places to find information about actual dates and durations is any progress schedules that were developed, maintained, and properly updated throughout the life of the project.

If a proper progress schedule is sufficiently developed and maintained during the life of a project, most of the information will exist in schedule format. Quite often contractors fail to utilize the Current-Progress schedule as a tool for recording actual as-built conditions to reflect progress. For example, many contractors use the Current-Progress schedule to support progress payments, to satisfy owner requirements, etc, but not to track and record as-built progress on a current basis. Further, in many cases the owner is not involved with the Current-Progress schedule; however, if the owner had been involved it would be much easier to substantiate the resulting information.

In general, the goal is to show actual start and finish dates and thus overall durations. This in turn will reflect the actual logic that was followed when carrying out the project, whether the logic was as-planned or not. As a result, it will demonstrate where the As-Planned logic was violated. At a later point in time, the reason for any violations or deviations in logic must be justified. As a minimum, the following documents should be generated to support establishment of start and finish dates of each activity:

- **Daily Field Reports/Diaries.** See previous section.
- **Material Delivery Tickets, e.g., concrete delivery receipts.** While material delivery tickets may not appear to have many uses on the surface, much information can be obtained from this type

of document. A concrete delivery ticket may provide evidence that a specific concrete foundation was placed on a specific date. At the same time, the delivery ticket may indicate that a concrete placement was not carried out according to schedule.

- **Concrete Placement/Pour Logs.** Depending on the size and type of a project, these can be simple forms indicating that a specific piece of work is ready for concrete. It can also be a detailed form or card which is usually located in the vicinity of the work identifying the following as a minimum: initials of relevant field engineers, i.e., civil, mechanical, electrical, piping, etc.; QA/QC sign-offs; number of yards of concrete estimated and actual; time placement started and finished; any delays, etc. The list can go on forever, but it should at least indicate location, activities affected, placement date(s), and any problems encountered.
- **Inspection Reports/Results.** Inspection reports can provide a wealth of information. Typically, inspection reports provide exact dates on which particular portions of a project were inspected, and in most cases, provide a somewhat accurate detail regarding the status of the specific activity at the time of inspection. For example, an inspection of a pipeline would typically indicate where and when welds and possibly backfill have been completed along the pipeline.
- **Employee Time Records.** Official time records can be extremely beneficial when establishing As-Built dates and times. A variety of information can be gained from this type of record. On many projects, especially those funded by the Federal Government, payroll records must be certified to be accurate and complete.

- **Updated Schedules (Daily, Weekly, Biweekly, etc.).** If schedules are properly updated on a regular basis, the development of the As-Built schedule is considerably easier.
- **Photographic Records.** Project photos documented with the proper information such as date and time of photo, location, point from which photo is taken, as well as photographer's name can greatly facilitate any effort to create an As-Built schedule after-the-fact.

5.3.2 Incorporate the As-Planned Logic

As mentioned in Chapter 4.0, by incorporating the As-Planned logic into the As-Planned schedule one can see where the As-Planned schedule was followed, as well as where new logic was introduced, either inadvertently or otherwise. The most obvious place to look for information about the As-Planned logic is the As-Planned schedule. In most cases, a narrative of the schedule will exist. Therefore, it should be clear that two very important documents that should be generated on every construction project are the As-Planned schedule and a complete narrative explaining the specific details behind the schedule.

In addition to this information, there are many other documents that should be collected and maintained during the life of a project. Some of these documents and how they can be utilized to gain insight after-the-fact about As-Planned logic are as follows:

- **Information to Bidders.** Occasionally owners will incorporate specific requirements that must be met by contractors regarding

how certain activities must be carried out. As a result, this may affect logic to some degree.

- **Notice to Proceed (NTP).** Quite often the NTP will require that specific events be started at specific times, which may or may not be consistent with what was initially planned. As a minimum, the NTP provides a point from which work should start on a project or parts of a project.
- **Notice of Award.** Like the NTP, the Notice of Award can usually offer details regarding the logic ties surrounding the beginning of a project as well as intermediate activities.
- **Letter of Intent.** Though not as common as the Notice of Award, the Letter of Intent is used by some owners. If it is used, it is likely to provide some useful information regarding the logic followed on a project.
- **Conformed Contract Documents.** Refer to the typical list that is provided in the previous section.
- **Correspondence.** All correspondence to and from the owner should be collected and maintained since frequently this is how a contractor officially communicates its intended logic to an owner.
- **Meeting Minutes/Notes.** All notes and minutes should be adequately maintained, especially those that pertain to scheduling, progress, coordination, etc.

The list of documents that can be used to document the As-Planned logic are not as common as some of the other aspects regarding an after-the-fact analysis of delay. As a result, contractors must ensure that the As-Planned schedule as well as a complete and accurate narrative are always produced. Additionally, if the owner requires changes or deviations from the As-Planned logic, it must also be properly documented for later use should it become necessary.

5.3.3 Identify All Excusable Delays

This step of the analysis process greatly depends on the documentation that is available. Under most circumstances, since the burden of proof lies with the contractor, there must be sufficient documentation available to prove the occurrence of delay. The identification process itself can range from relatively simple to extremely difficult, and sometimes impossible. This is true especially after-the-fact and even more so long after-the-fact. The simplest of excusable delays to identify are those clearly initiated by the owner such as changes, suspensions of work, interferences, etc. Those that are not clearly prompted by the owner such as differing site conditions, unusually severe weather, etc., are not as easy to identify, but with the proper documentation it is possible. In many cases, if these delays are not recognized and documented, they may be overlooked in an analysis. Typical documentation that can help identify excusable delays is as follows:

- **Change Orders.** All change orders should be maintained for review of the details leading to the change. Not all changes lead to an excusable delay. However, in many cases changes do result in some type of delay or impact and should be documented accordingly.

- **Change Order Logs.** Depending on how a contractor has its change order log setup, it may be beneficial to refer to the log when attempting to identify excusable delays. The log may also reveal an excessive amount of changes.
- **Request for Information (RFI).** Not all RFIs lead to delay, but many do. Sometimes they may even prevent delay. Regardless of any thought of delay when an RFI is processed, all documents of this nature should be archived for later review in case an after-the-fact analysis of delay occurs.
- **Revised Drawings, Specifications, Codes, etc.** In many cases, revisions to any of these documents will result in an excusable delay. The key is to maintain all documents of this nature from the original version to the final version for future review and comparison if necessary.
- **Revised Schedules.** This includes all schedules whether weekly, monthly, quarterly, or otherwise. Changes or deviations in schedule are very often one of the best places from which to identify delays. After the delay is recognized, a determination can be reached regarding excusability.
- **Test Results.** In many cases the results of a test can be the best indication of an excusable delay, especially when the delay is a differing site conditions.

Logs should be created and properly updated such that delayed owner approvals of shop drawings, submittals, RFIs, etc. Access restraints imposed by the owner should be noted on this log also. Events such as strikes should be monitored and tracked via this log. Owner commitments not maintained should be documented

and logged as well. In other words contractors should maintain an accurate log that reflects all events that impact the schedule.

5.3.4 Document Impacts of Delays

While reviewing and analyzing all of the available documentation, contractors should create a log identifying the impacts caused by delays. This log should identify, as a minimum, the each individual activity affected, when the impact began and ended, nature of change if applicable, constraints, affect on logic, etc. By creating a detailed log such as this, new logic is introduced to the schedule where necessary. These logic changes will be needed to create the As-Adjusted schedule. In addition to owner-induced changes in logic, contractors should collect and maintain the same type of information regarding its own changes in logic.

5.3.5 Develop the As-Adjusted Schedule

The As-Adjusted schedule is developed from the As-Built schedule by incorporating all of the necessary adjustments that were recognized after reviewing and analyzing the project's documentation. In general, the documents required to develop the As-Adjusted schedule result from carrying out the first three steps in the after-the-fact method of analysis. Once the As-Planned schedule, the As-Built schedule and a complete list of excusable delays have been completed, the process of creating the As-Adjusted schedule simply involves incorporating all of the necessary adjustments. The actual documentation necessary to produce an As-Adjusted schedule is basically as shown in the previous section.

5.3.6 Develop the But-For Schedule

The But-For schedule is basically the end result of an after-the-fact analysis. As a result the But-For schedule simply falls out of the other schedules once the excusable delays are backed out. By listing all activity and logic changes caused by the contractor and rerunning the schedule with these changes incorporated, the various impacts to deadlines will be evident. At this point it will usually be necessary for the contractor to provide evidence showing that it took all of the reasonable steps necessary to mitigate the impacts of all delays.

5.4 Summary

The documentation required to carry out an analysis of delay after-the-fact is very similar to the documentation required to perform an analysis of delay on-the-fly. The primary difference is the precise way in which the information must be used. When carrying out an analysis of delay after-the-fact, each step of the process builds on the documentation that was generated during the life of the project. The results of an after-the-fact analysis are directly dependent on the documentation that is generated from inception to completion of a project. When carrying out an analysis of delay on-the-fly, each step of the process builds on the documentation that was generated from the inception of the project as well as from the moment a delay is recognized.

6.0

CONCLUSION

6.1 General

The list of documents required for contractor pursuit of delay claims is infinite. However, if the proper documentation is adequately collected and maintained on construction projects, pursuit of delay claims will be greatly facilitated. This thesis presents two methodologies of analyzing construction delays: the on-the-fly analysis of delay and the after-the-fact analysis of delay. Under many circumstances, it is most advantageous to perform an analysis on-the-fly. With the costs of delay being such a significant factor in today's construction market, it benefits all parties involved to know the extent of impacts as they occur in real-time. Unfortunately, for various reasons this is not always possible. As a result, in some cases it is necessary to pursue delay claims after-the-fact which under some circumstances is long after a project has been completed. In other cases, the pursuit may begin right away, but it may drag out for a sizable number of years.

As can be gathered from the previous chapters, documentation plays a major role in the area of delays, and more specifically, in the area of delay claims. While the actual use or application of the documentation that must be collected and maintained is important, the most significant step is the actual collection and maintenance of quality documentation. If sufficient documentation has been collected and maintained by the contractor during the life of a project, external sources can be hired if necessary to analyze it. External sources cannot, however, be hired to produce documentation that does not exist. Therefore, if and when construction delay claims occur, contractors are in the best possible position if they have maintained quality documentation from inception to completion of a project. As a minimum the documentation identified in this thesis should always be produced.

APPENDIX "A"

DEFINITIONS AND EXPLANATIONS

A.1 Schedule Related Terms

Source: (Unless Noted Otherwise) Willis, Edward M. Scheduling Construction Projects. New York: Wiley, 1986.

Critical Path: The longest path(s), measured in time, that can be traced through a project's network diagram is termed the critical path(s).

Disruption: An interruption in the [contractor's] planned work sequence or flow of work. (Bramble et al. 1990)

Early Completion: As defined in many of the contracts used by the Massachusetts Highway Department, an "early completion" progress schedule is one which anticipates completion of all or a specified part of the work ahead of the corresponding contract time.

Event: The term event, when used in a scheduling context, means a point in time at which something, or some things, happen. The first event in a project schedule is that the project starts. The last event in a project is that the project ends.

Float: Float is a measure of the difference between a task's early and late start. The value of a task float is a measure of how noncritical. The term "slack" is sometimes used. It has the same meaning as float. There are several ways of measuring float:

Total Float (TF) is the difference between a task's LF time and the sum of its ES time and its duration. It is the amount of time that a task's completion may be delayed without delaying project completion.

Free Float (FF) is the amount of time that a task's completion may be delayed without delaying the start of another task beyond that task's ES time.

Interfering Float (IF) is the difference between a task's total float and its free float. The completion of a task may be delayed by an amount of time equal to that task's IF without delaying project completion; however, such a delay will delay the start of a subsequent noncritical task.

Fragnet/Subnet: A fragment of a network diagram to highlight a group of selected activities which is not meant to replace the complete network.

Logic Diagrams: A logic diagram (sometimes termed a network) is a graphic depiction of a project. The tasks that make up the project and the logical relationship that exists between those tasks are represented by symbols...

Milestone: As defined in many of the contracts used by the Massachusetts Highway Department, a contract milestone is an event specified in the contract documents for final acceptance of the work, or for completion of a separate and distinct portion of the work.

Project: A planned undertaking that involves the performance of work.

Substantial Completion: Contractual fulfillment of the obligation of the contractor to the owner with only the existence of small defects or omissions that will not jeopardize the intended use of the work and/or the work of others.

Task: Part of the Work that makes up a project. The task has been defined, meaning that the work it encompasses has been specified and such attributes as duration have been assigned to it.

Task Duration: Any interval of time (weeks, days, hours, etc.) can be used to specify task duration; however, it is customary to use days in construction scheduling.

Work Days Versus Calendar Days: The duration of a task may be expressed in work days or in calendar days. Although both methods of expressing task duration have advantages and disadvantages, most schedulers will express task duration in work days.

Task Time: A task time is the time when a task may start or end.

Early Start Time (ES) is the earliest time at which a task can be started. The early start time for a task may be specified by a contract provision; it may be dictated by the climate (in arctic regions, until the spring thaw); or it may be based on the estimated time at which some precedent task or tasks will be completed.

Early Finish Time (EF) is the earliest time at which a task can be completed if it is started at its ES time and is completed within its estimated duration.

Late Start Time (LS) is the latest time at which a task can be started if it is to be completed by its LF time and if its actual duration is equal to its estimated duration.

Late Finish Time (LF) is the latest time at which a task can be completed without delaying project completion. For critical tasks, the EF and LF times are identical.

A.2 Construction Organizations

Build-Operate Transfer Team: One business entity that performs the design, construction, long-term financing, and temporary operation of the project. At the end of the operation period, which can be many years, operation of the project is transferred to the owner.

Construction Manager: A single business entity acting as a construction consultant to the owner and project manager, either for a fixed fee or a fee as a percentage of the cost.

Design-Build Team: A single business entity that performs both the design and construction of a project. The team can be one company or a partnership of firms.

General Contractor: A single business entity acting as the contractor in complete and sole charge of the field operations, including the marshalling and allocation of manpower, equipment, and materials (Clough 1981, 4).

Multiple Prime Contractors: More than one contractor holding contracts directly with the owner to perform specific parts of the same project. The contractors can be general contractors overseeing various trades, or subcontractors performing one trade. The owner is responsible for overall project management and coordination, replacing a general contractor or a construction manager.

Turnkey Team: One business entity that performs the design, construction, and construction financing of the project. Payment is made at the completion (when the contractor turns over the "key").

A.3 Contract Types

Source: (Unless Noted Otherwise) Gordon, Christopher M. Compatibility of Construction Contracting Methods With Projects And Owners. Cambridge: MIT, 1991.

Cost-Plus: The contractor is reimbursed the cost of doing the work, including labor, materials, and project overhead, plus a fee, including company overhead and profit. The fee can be a fixed sum, a percentage of the cost, or a formula incorporating both.

Fixed Fee: The contractor is paid a lump sum fee, including company overhead and profit, but reimbursed for labor, materials, and project overhead.

Guaranteed Maximum Price: The contractor is reimbursed the cost of doing the work, including labor, materials, and project overhead, plus a fee, including company overhead and profit, up to a prearranged maximum price. Once that price is reached the contractor must finish the job at no additional cost to the owner. If the job is finished under the maximum price, there is often a sharing of the cost difference between the owner and the contractor as an incentive to the contractor to reduce costs.

Lump Sum: The contractor agrees to perform the stipulated work in exchange for a fixed sum of money (Clough 1981, 127). This lump sum commonly includes all labor, materials, project overhead, company overhead, and profit.

Unit Price: The contractor agrees to be paid a set cost per unit of each item, such as per-cubic-yard of excavation. The actual total amount paid is based on the actual measured units constructed on the project, times the unit price agreed to. The unit-

cost for each item commonly includes all labor, materials, project overhead, company overhead, and profit. Sometimes overhead items are paid separately.

A.4 Award Methods

Cap: A fixed price is set by the owner against which contractors propose a level of quality and options for a project.

Competitive Bid: A contractor is selected by the lowest price proposal, in market competition.

Design and Price Proposal: The contractor is competitively selected based on their proposed design and price. The process is often quantified with a ranking formula.

Negotiation: The price and/or contractor are selected by negotiation between the owner and either several contractors or one contractor.

Qualification and Price Proposal: The contractor is competitively selected based on qualifications and price. The process is often quantified with a ranking formula.

Qualification, Time and Price Proposal: The contractor is competitively selected based on their qualifications, proposed schedule, and price. The process is often quantified with a ranking formula.

Time and Price Proposal: The contractor is competitively selected based on the proposed schedule and price. The process is often quantified with a time-price formula.

A.5 General Explanations

Source: (Unless Noted Otherwise) Clough, Richard H., and Glenn A. Sears. Construction Contracting 6th ed. New York: Wiley, 1994.

Acceleration: Acceleration refers to the owner's directing the prime contractor to accelerate its performance so as to complete the project at an earlier date than the current rate of work advancement will permit.

Addenda: When a project is being competitively bid, it is occasionally necessary during the bidding period to make changes, modifications, corrections, or additions to the bidding documents. Notice of such revisions is made by means of an addendum issued by the owner or architect-engineer and sent to all bidders of record. On public projects, an addendum is sometimes referred to as an amendment.

Bonding Capacity: A useful concept widely used by the construction industry is that of "bonding capacity" or "bonding line." These terms have no precise definition but refer to the maximum value of uncompleted work the surety will allow the contractor to have on hand at any one time. A contractor's bonding capacity is a function of its net worth and cash liquidity and can vary depending on the volume of work on hand, accumulated retainage on current jobs, type of work involved, time durations of outstanding contracts, and other considerations.

Change Order: As defined in many of the contracts used by the Massachusetts Highway Department, a written order signed by the Engineer which amends the Contract Documents to provide for changes in the Work, or changes in Contract Price or Contract Time, or both.

Construction Estimating: Construction estimating is the compilation and analysis of the many items that influence and contribute to the cost of a project. Estimating, which is done before the physical performance of the work, requires detailed study

of the bidding documents. It also involves a careful analysis of the results of the study in order to arrive at the most accurate estimate possible of the probable cost, consistent with the bidding time available and the accuracy and completeness of the information submitted.

Cost-per-Function Estimate: An analysis based on the estimated cost per item of use, such as cost per patient, student, seat, car, space, or unit of production.

Square-foot Cost Estimate: An approximate cost obtained by using an estimated price for each square foot of gross floor area.

Cubic-foot Cost Estimate: An estimate based on an approximated cost for each cubic foot of the total volume enclosed.

Modular Takeoff Estimate: An analysis based on the estimated cost of a representative module, this cost being extrapolated to the entire structure, plus the estimator's assessment of common central systems.

Partial Takeoff Estimate: An analysis using quantities of composite work items that are priced using estimated unit costs. Preliminary costs of projects can be computed on the basis of making estimates of the probable costs of concrete in place, per cubic yard; structural steel erected, per ton; excavation, per bank cubic yard; hot-mix paving in place, per ton; and the like.

Panel Unit Cost Estimate: An analysis based on assumed unit costs per square foot of floors, perimeter walls, partition walls, ceilings, and roof.

Parameter Cost Estimate: An estimate involving unit costs, called parameter costs, for each of several different building components or systems. The costs of site work, foundations, floors, exterior walls, interior walls, structure, roof, doors, glazed openings, plumbing, heating and ventilating, electrical work, and other items are determined separately by the use of estimated parameter costs. These unit costs can be based on dimensions or quantities of the components themselves or on the common measure of building square footage.

The unit prices used in conjunction with the foregoing approximate cost methods can be extremely variable, depending on specific contract requirements, geographical location, weather, labor productivity, season, transportation, site conditions, and other factors. There are many sources of such cost information in books, journals, magazines, and the general trade literature. Unit costs are also available commercially from a variety of proprietary sources as well as from the contractor's own past experience. In addition, there are many forms of national price indexes which are useful in updating cost information of past construction projects. When using such costs or cost indexes, care must be taken that the information is adjusted as accurately as possible to conform to local and current project conditions.

Cost Summary: On completion of the quantity survey, the total amount of each work classification is obtained and listed.

Direct Labor Costs: Direct labor cost is determined from basic wage rates--that is, the hourly rates used for payroll purposes--and does not include indirect labor costs.

Drawings: The drawings, or plans, are instrumental in the communication of the architect-engineer's intentions concerning the structure it has conceived and designed. They portray the physical aspects of the structure, showing the arrangement, dimensions, construction details, materials, and other information necessary for estimating and building the project. Drawings are individually prepared for almost every project. A job covered by drawings that are complete, intelligible, accurate, detailed, and well correlated can be priced much more realistically and be better constructed than one described as sketchy, poorly drawn, ambiguous, and incomplete documents. When well-prepared documents are provided, disputes and claims for extra payment during construction are minimized, and the owner is likely to get a much better finished product at a lesser cost.

Equipment Cost Estimating: Unfortunately, the term "equipment" does not have a consistent meaning in the construction industry. A common usage refers to motor graders, power shovels, pile drivers, and other such items used by contractors to accomplish the work. However, equipment is also sometimes used with reference to various kinds of electrical and mechanical furnishings that become a part of the completed project.

General Overhead: General overhead, or office overhead, includes general business expenses such as office rent, office insurance, heat, electricity, office supplies, furniture, telephone and telegraph, legal expenses, donations, advertising, travel, association dues, and salaries of executives and office employees. The total cost of this overhead expense generally ranges from 3 to 10 percent of a contractor's annual business volume. This percentage represents inescapable costs of doing business, and the contractor must include in the cost estimate of each project an allowance for general overhead expense.

Indirect Labor Costs: Indirect labor costs are those expenses that are additional to the basic hourly rates and that are paid by the employer. Indirect labor expense involves various forms of payroll taxes, insurance, and employee fringe benefits of wide variety. Employer contribution to social security, unemployment insurance, workers' compensation insurance, and contractor's public liability and property damage insurance are all based on payrolls.

Liquidated Damages: Many projects are of such a nature that the owner will incur hardship, expense, or loss of revenue should the contractor fail to complete the work within the time specified by the contract. Where the contract makes time an essential part of the contract, either by the phrase "time is of the essence" or by explicit reference to the stated time requirement, failure to complete the project on time is a breach of contract and can make the contractor liable to the owner for damages.

Markup: On competitively bid projects, the markup or margin is added at the close of the estimating process and is an allowance for profit plus other items such as general overhead and contingency. Markup, which may vary from 5 to more than 20 percent of the job cost, reflects the contracting firm's considered appraisal of a whole series of imponderables that can influence the probability of it being the low bidder and its chances of making a reasonable profit if it is.

Material Costs: For purposes of discussion in this text, the term "materials" is construed to include everything that becomes a part of the finished structure. This includes electrical and mechanical items such as elevators, boilers, escalators, and transformers, as well as the more obvious and traditional items such as lumber, structural steel, concrete, and paint.

Project Overhead: Overhead expenses are costs that do not pertain directly to any given construction work item but are nevertheless necessary for ultimate job

completion. Project overhead, or job overhead, refers to costs of this type that are incurred on the project site. Job overhead costs can be estimated with reasonable accuracy and are compiled on a separate overhead sheet. This overhead is a significant item of expense and will generally contribute from 5 to 15 percent of the total project cost, depending somewhat on where certain project costs are included in the cost estimate.

Project overhead expense should be computed by listing and costing each item of overhead individually rather than by using an arbitrary percentage of project cost. This is true because different projects can and do have widely varying job overhead requirements. The only way to arrive at an accurate estimate of job overhead is to analyze the particular and peculiar needs of each project.

Typical items of job overhead are listed below. This list is not represented as being complete, nor would all the items necessarily be applicable to any one project. The project overhead items listed below disclose that the prime contractor normally provides and pays for temporary job utilities and standard site services for use by the entire construction team.

Job mobilization	Timekeepers
Project manager	Security forces
General superintendent	Engineering services
Nonworking foremen	Job sign
Heat	Temporary lighting
Electricity	Drinking water facilities
Water	Badges
Storage buildings	Equipment move-in and assembly
Sanitary facility	Equipment dismantling and move-out
Field office supplies	Worker transportation

Job telephone	Worker housing
Small tools	Legal expenses
Temporary enclosures	Surveys
Temporary stairs	Field office
Permits and fees	Parking areas
Special insurance	Security clearance
Builder's risk insurance	Load tests
Photographs	Temporary roads
Barricades	Storage area rental
Winter operation	Travel expenses
Concrete and other tests	Protection of adjoining property
Cutting and patching	First aid
Drayage	Storage and protection
Cleanup	Temporary partitions

Proposal: A proposal or bid is a written offer, tendered by the contracting firm to the owner, which stipulates the price for which the contractor agrees to perform the work described by the bidding documents. A proposal is also a promise that, on its acceptance by the owner, the bidder will enter into a contract with the owner for the amount of the proposal. Thus timely acceptance of a proposal by the owner is automatically binding on the bidder.

Quantity Survey: A quantity survey, or takeoff, is the detailed compilation of the quantity of each elementary work item that is called for on the project. The quantity survey is the only accurate and dependable procedure for compiling a detailed estimate.

Specifications: Specifications are written instructions concerning project requirements. The drawings show what is to be built, and the specifications describe

how the project is to be constructed and what results are to be achieved. Historically, the word "specifications" has referred to specific statements concerning technical requirements of the project such as materials, workmanship, and operating characteristics. However, it has become customary to include the bidding and contract documents together with the technical specifications, the entire aggregation being variously referred to as the project manual, project handbook, construction documents book, or most commonly, simply as the specifications or "specs."

Supplementary Conditions: Any standard set of general conditions is intended to apply to a relatively broad range of construction and must be amended and/or supplemented at times to conform to the idiosyncrasies of a given project. This is accomplished by a section of the specifications, called the supplementary conditions, which immediately follows the general conditions. Supplementary conditions are occasionally also referred to as special conditions.

A.6 Administrative Boards, Associations, Organizations, Etc.

AAA: American Arbitration Association

AECBCA: Atomic Energy Commission Board of Contract Appeals

AGBCA: Agriculture Board of Contract Appeals

AGC: Associated General Contractors of America

AIA: American Institute of Architects

ASBCA: Armed Services Board of Contract Appeals

ASCE: American Society of Civil Engineers

BCA: Board of Contract Appeals

CFR: Code of Federal Regulations

DOTBCA: Department of Transportation Board of Contract Appeals

EBCA: Energy Contract Board of Contract Appeals

ENGBCA: Corps of Engineers Board of Contract Appeals

F.A.R.: Federal Acquisition Regulations

FHWA: Federal Highway Administration Department of Transportation

FIDIC: Federation International des Ingenieurs-Conseils

GSBCA: General Services Board of Contract Appeals

IBCA: Department of Interior Board of Contract Appeals

OSHA: Occupational Safety and Health Administration

PODBCA: Post Office Department Board of Contract Appeals

PSBCA: Postal Services Board of Contract Appeals

VABCA: Veterans Board of Contract Appeals

VACAB: Veterans Administration Contract Appeals Board

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