Liquidated Damages in Multi-Contract Construction Projects

by

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Submitted to the Department of Civil and Environmental Engineering
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ABSTRACT

Liquidated damages provisions are the most common mechanism used in construction contracts to enforce the contractor to meet the contract's milestones and to compensate the Owner for losses in case of the contractor's late performance. This mechanism is traditionally used in public projects and is generally effective when applied to projects with a well-defined scope of work that is less likely to be changed (by the Owner, the designer, differing site conditions, or by a third party) during construction.

A multi-contract project, such as the Central Artery/Tunnel (CA/T) Project in Boston is often more complex, schedule-sensitive, with a dynamic, ever changing scope of work, and is more vulnerable to changes and to influences by many stakeholders. Liquidated damages provisions in multi-contract projects are ineffective, and Owners of those projects need to look for alternatives to these provisions. To be beneficial to the Owner of a multi-contract project, any alternative provision should take into account the dynamic nature of the project and the high possibility of delays to occur.

Alternative provisions that have been successfully used in construction contracts in the United States and in other countries, including: incentive/disincentive clauses, biding on time and cost, and tying periodic payments to the contractor's schedule performance of certain contract milestone(s), are studied and their applicability to multi-contract projects is analyzed. Incentive/disincentive provisions are found not to achieve its purpose and perhaps to cause more claims if applied to a multi-contract project. Bidding on time and cost was also found to be hard to implement. Several approaches to tie payment to performance of milestone(s) are presented as valid mechanisms that can be successfully implemented on multi-contract projects such as the CA/T Project.

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To

the memory of my mother

and to

my father

for believing in me

and to

Mary Ellen and Brendan Khaled

for their love and encouragement

Acknowledgement

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Table of Contents

I. Introduction

A. Background and Objective

Many construction projects finish behind schedule, and as a result, Owners often suffer financial loss. Because of inherent additional complexity, a multi-contract project is usually more vulnerable to schedule overruns.

Liquidated damages provisions are the most common mechanism used to compensate the Owner for losses caused by the contractor's failure to complete the project on time. The Owner has to estimate actual damages and include the estimated per diem amount in the contract documents.
By establishing a predefined amount beforehand and therefore eliminating the uncertainty of actual damages, liquidated damages provisions also help the contractor. The contractor can account for liquidated damages based on its own analysis of the risk of overrunning the schedule.

Despite their benefits to the contractor and the Owner, liquidated damages provisions have major disadvantages. They are difficult to estimate, hard to administer, expensive to enforce if challenged in court, and can create a hostile environment between the Owner and the contractor.

Alternative mechanisms to liquidated damages are often used to overcome liquidated damages limitations and disadvantages. Several forms of incentive provisions had been used to replace/supplement liquidated damages provisions. The major advantage of incentive provisions is to encourage and award the contractor performance.

The purpose of this paper is to study the use of, as well as alternatives to liquidated damages in construction contracts. The Central Artery /Tunnel (CA/T) Project is used for illustration throughout this work. Liquidated damages estimating and documenting procedures will be discussed using the model implemented on the CA/T Project. Several court cases will be introduced to illustrate the legal principles of liquidated damages provisions. Disadvantages and limitations of liquidated damages, especially in multi-contract projects, with emphasis on the CA/T Project will be discussed. Finally alternatives to liquidated damages provisions that had been successfully used in construction contracts will be introduced along with several initiatives which have been studied to be used on the CA/T Project.

B. The Central Artery/Tunnel (CA/T) Project

The Central Artery/Third Harbor Tunnel (CA/T) Project in Boston is the largest highway construction job ever undertaken in the United States. The project's original plan proposed in 1968 was to construct a third harbor tunnel crossing from Boston to Logan Airport to supplement the 1934 Sumner Tunnel, and the 1961 Callahan Tunnel. It has grown to a mega-project linking a third harbor tunnel with a depressed central artery through Boston with connections to interstate I-90, I-93, and I-95.

Debates over the need for the third tunnel, the location of the tunnel, and the number of lanes it would provide delayed the approval of the plan. In 1972, the state proposed depressing the elevated central artery. In 1977, the state proposed one combined project to depress the artery and construct a third harbor tunnel. In 1985, the Federal Highway Administration (FHWA) approved the environmental impact study for the combined artery/tunnel project and listed 14 unresolved issues to be addressed in a supplemental environmental impact study. In the same year, the state awarded overall management services of the project to the joint venture's firm of Bechtel Civil Inc. and Parsons, Brinckerhoff, Quade and Douglas (B/PB).

The CA/T Project will replace the six-lane, elevated road through downtown Boston known as the "Central Artery", with an eight to ten lane underground highway, provide a four lane third tunnel joining Logan Airport to the Massachusetts Turnpike I-90, and construct a cable bridge crossing Charles River to the north to establish a new connection to I-93 and I-95. The third harbor tunnel was finished in December 1995.

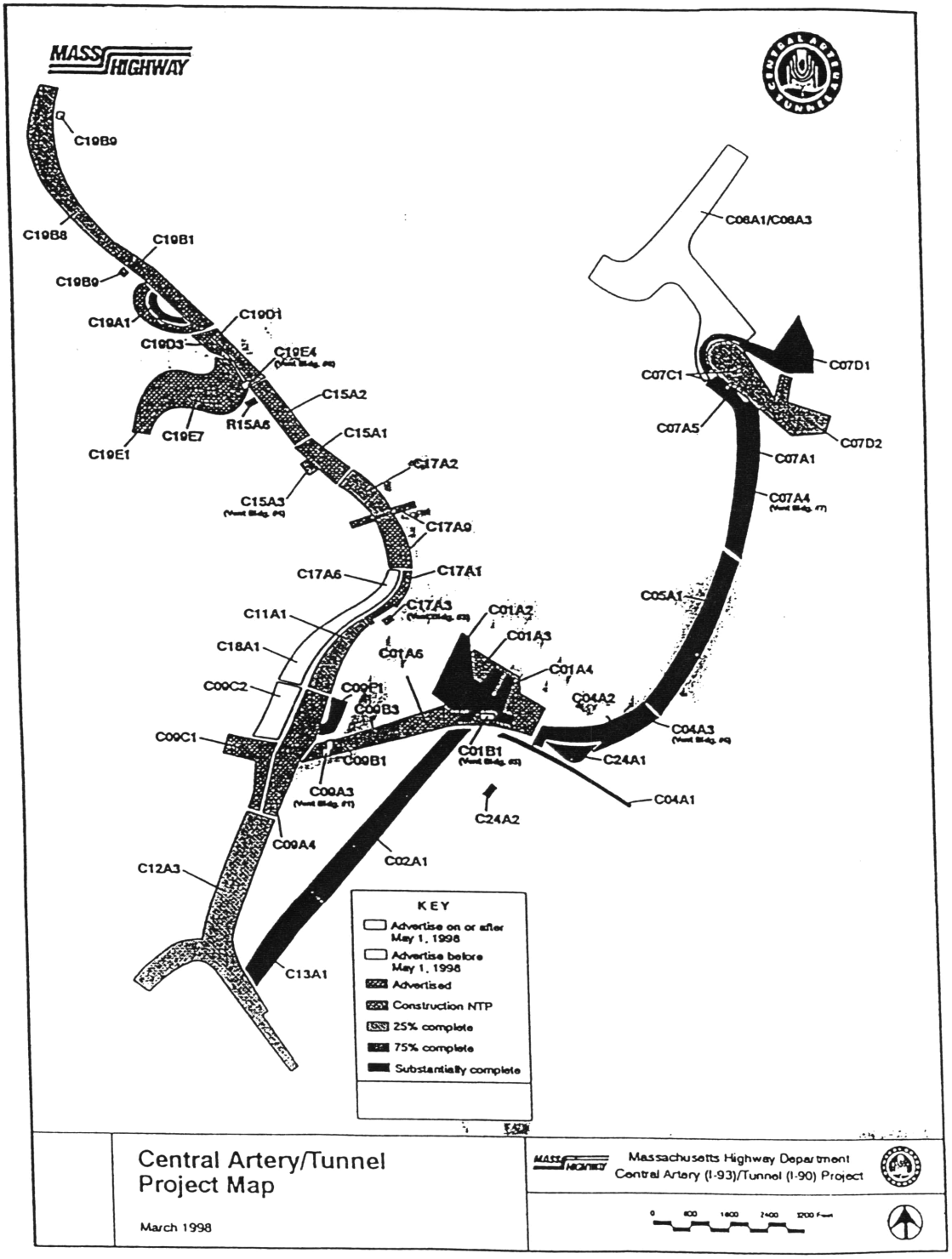
The existing artery was constructed between 1954 and 1959, as part of a transportation program for the Boston region which was generated early in the post-World War II period. It was built as a "collector - distributor" roadway whose design reflected the requirements of locally oriented service, with many closely spaced on and off ramps. It was designed to handle projected traffic volumes that are obviously far less than the current level. The need for the CA/T Project stemmed from the inability of the existing central artery and Sumner and Callahan tunnels to accommodate both current and future traffic demands.

The entire project is scheduled to be completed in 2004 with at an estimated cost of $10.4 billion. Design started in 1985, and construction commenced in 1992. The project is estimated to employ 5,000 workers. The CA/T Project has hundreds of contractors working under a joint venture of Bechtel/Parsons Brinckerhoff (B/PB). B/PB is the Construction Management consultant which is managing the CA/T Project for the Massachusetts Highway Department (MHD), the project's Owner.

1. Interfaces Between Contracts on the CA/T Project

The CA/T Project is being delivered through hundreds of contracts, which establish interface among hundreds of design and construction tasks – figure (I-1) depicts the CA/T Project's general layout map which demonstrates the Project's major contracts and their physical boundary interfaces.

Figure (I – 1)


MASS HIGHWAY
C19B9
C19B8
C19B1
C19B9
C19A1
C19D1
C19D3
C19E4
C15A2
R15A6
C19E7
C19E1
C15A1
C15A3
C17A2
C17A9
C17A6
C17A1
C17A3
C11A1
C18A1
C09C2
C09C1
C09B3
C09B1
C09A3
C09A4
C12A3
C13A1
C01A2
C01A3
C01A6
C01A4
C01B1
C24A2
C02A1
C24A1
C04A1
C04A2
C04A3
C05A1
C08A1/C08A3
C07C1
C07D1
C07A5
C07D2
C07A1
C07A4
KEY
Advertise on or after May 1, 1998
Advertise before May 1, 1998
Advertised
Construction NTP
25% complete
75% complete
Substantially complete
Central Artery/Tunnel Project Map
March 1998
Massachusetts Highway Department
Central Artery (I-93)/Tunnel (I-90) Project

The following examples of interfaces on the CA/T Project contracts illustrate that on the CA/T Project as well as on multi-contract projects time is of the essence. Delays and lack of performance by any party could have substantial cost damages to the Project.

1.1 Example 1

A demolition contract was awarded to demolish the existing Minot Steam Plant, beside the Registry of Motor Vehicles building on Nashua Street. This work clears the site for a follow on contractor to construct a boat section, and two transition structures in this area. Failure of the first contractor to finish the demolition on time will deny the follow on contractor access to start work in this area, which is on its critical path.

1.2 Example 2

A utilities contract was awarded to relocate utility lines and abandon existing lines in surface roads to allow various follow on main line tunnel contractors to demolish the abandoned lines during pre-trenching and guide wall construction for slurry wall excavation. A delay by the utility contractor will impact the most critical main line contracts to follow, and could delay overall project milestones.

1.3 Example 3

A common interface issue, which requires a great deal of coordination on the CA/T Project Project, is planning interface between laydown areas. Due to the location of its work in the downtown of one of the major cities in the country, the CA/T Project struggles to make available enough laydown areas for its contractors. Contract documents usually specify the duration the contractor can occupy certain work and laydown areas within the vicinity of its work. After that period the contractor will have to turn over the area(s) to the follow on contractor. If the first contractor fails to vacate the required areas on time, the follow-on contractor can suffer significant delays and additional costs, as a result of materials double handling, delivery delays and additional off site storage.

1.4 Example 4

The CA/T Project contracts require a significant effort in traffic management. Some contracts have dates certain in order to make traffic relocations possible. If the planned traffic shift is delayed by one of the contractors involved in the implementation, all other contractors, which are otherwise mobilized and crewed to shift traffic, will be impacted.

1.5 Example 5

A contract includes the construction of a temporary bridge from Leverett Circle to the existing I-93 on-ramp behind the Fleet Center. This temporary bridge will be used by the traffic currently using the existing Leverett Circle on-ramp to I-93. A follow on contractor can then demolish the existing I-93 on-ramp and build a segment of a tunnel on its location. A delay in

constructing and directing traffic to the new temporary bridge will delay the construction of the tunnel segment by the follow on contractor which can suffer potential cost impact.

1.6 Example 6

Many contracts on the CA/T Project include in their scope of work the construction of interim power facilities, which are then used by follow-on contracts to supply power for construction activities as well as lighting and signs for finished structures ready for initial opening to ease traffic before the final completion of the Project in 2004

1.7 Example 7

Most of the viaducts on the project are awarded in pieces to different contracts. Some of the bents on a long viaduct will be shared by spans on either side, which may belong to different contracts. A great deal of coordination and proper planning are mandatory to reduce potential conflicts and consequence delays and claims. The shared bent must be built on schedule to allow the follow on contractor to erect its span. The follow on contractor must provide its bearings details and templates to the preceding contractor to ensure proper installation of the bent for the follow on contractor's bearings and span. In some cases, the follow on contractor will also need to erect its span on schedule to allow the preceding contractor to install the expansion joint. Failure of either contractor to turn over its scope of work on the contractual specified date could result in expensive equipment loss as well as disruption to the erection process. It could also cause delay to the follow-on contract and the whole project milestones.

1.8 Example 8

Some of the scope of work on the CA/T Project is done by force account contractors hired and paid directly by the Department. Examples are certain utility work, which is usually done by the utility company that owns it, certain work in MBTA and AMTRAK stations and railyards, some geotechnical instrumentation installation and readings work, as well as some contaminated soil exploration and analysis. Most of the force account work is preparatory work to allow for the follow-on contractor(s) to start and therefore a delay could mean a late start and potential cost and time overruns.

C. Delays in Multi-contract Construction Projects

The likelihood of a construction project to overrun its planned schedule is high, and many construction projects are not completed on time. Delays can be caused by the Owner, the contractor, and/or a third party.

In the construction industry, more than in any other business, projects are characterized by uncertainty. Each construction project is unique. Even two typical projects will at least vary in location; and different locations would translate to different site conditions, different economical, labor, political and environmental challenges.

For this very reason of uncertainty, it is often impossible, even for construction professionals with extensive expertise, to estimate a project duration with a great degree of confidence. A project schedule is usually established to account for each project unique circumstances and to accommodate the Owner's needs. The schedule then becomes a goal and most of the time meeting this goal requires a great deal of planning and proper resource allocation on the contractor part.

Meeting the contract's schedule becomes even a tougher task on multi-contract projects. Multi-contract projects are usually large projects that are divided into separate contracts for a variety of reasons. Sometimes, a project will be divided into several contracts simply to take advantage of fast tracking. On other projects, such as the CA/T Project, in addition to fast tracking, because of the contract size, it is impossible to package the whole project as one contract. For one reason, it will be difficult to find many contractors with the bonding capacity to undertake such a multi-billion dollars job. This will reduce competition and increase bid prices. Working on a manageable size contracts makes it easier to package, award, and finish contracts early to prepare for follow-on contracts, to make construction progress and gain public and political support, to set the tune with abutters and agencies, and to provide feed back and regarding the assumptions made by the designers to incorporate into the in-progress design for the remainder of the project contracts.

1. Types of Delays

Delays of construction projects are classified into two categories. excusable and inexcusable delays.

Excusable delays are delays to the construction project attributed to causes beyond the control of the contractor, and therefore justify a contractual modification (i.e. time extension).

Excusable delays can be caused by the Owner such as design changes, requirement of changes to contract documents, failure to approve shop drawings within the time stipulated in the contract documents, failure to respond to the contractor's Request For Information (RFI) on a timely manner, failure to turn over the contract site (in whole or in part) on the dates specified by the contract, delays caused by other contracts due to failure of the Owner to coordinate the work properly, failure to obtain adequate financing, the Owner's suspension of work when contractor is at no fault, the Owner's failure to furnish materials and/or equipment promised under the contract, the Owner's failure to complete any force account work specified in the contract documents.

Excusable delays can also be caused by forces beyond the Owner or the contractor, such as acts of God, differing site conditions, a third party's intervention, abnormal weather conditions, war, and labor strikes.

Excusable delays usually entitle the contractor to time extension to its contractual milestone dates and could be compensable or not-compensable. A compensable delay allows the contractor to recover any additional costs it has incurred attributable to such delay.

2. Extra costs to the contractor caused by delays

Compensable (and therefore excusable) delays directly affect the contractor's time-dependent costs. Time dependent costs are defined as the contractor's costs that are based on the passage of time rather than actual construction progress. They include field supervision and staff salary and benefits, job site temporary facilities and utilities, owned and rented equipment, field supervision vehicles and trucks, maintenance of temporary roads, site weather protection (i.e. sanding and snow removal), and any other costs associated with the passage of time.

They can also include under recovered home office overhead, and may indirectly cause claims for escalation in labor rates, materials, and equipment cost.

The contractor may also lose productivity because of disruption. Frequent delays may force the contractor to start and stop and to work out of sequence. The contractor may suffer from productivity loss due to time lost in set ups, clean outs, demobilize and mobilize crews, traveling time, and disrupted normal crew learning curve.

When the Owner directs the contractor to accelerate to recover any excusable delays, other costs may be incurred by the contractor. Disruption, increased crew size, crowding, extended shifts, and/or multiple shifts can lead to productivity loss and extra cost to the contractor.

On the other hand, not-compensable excusable delay does not entitle the contractor to adjustment in the contract price for any additional costs because of the delay, although the contractor will ordinarily be granted a time extension. Not-compensable excusable delays are usually concurrent delays, where delays caused by both the contractor and the Owner occur at the same time.

Inexcusable delays take place as a result of the contractor's negligence, the contractor's improper performance, the contractor's inadequate resource allocation, the contractor's poor management, the contractor's failure to submit shop drawings on time, the contractor's failure to coordinate work among its vendors and subcontractors, the contractor's failure to plan for equipment and/or materials that require long lead time for manufacturing and/or delivery, rejection of deficient work due to failure of the contractor to adhere to the contract provisions.

Inexcusable delays do not entitle the contractor to time extension or cost recovery. On the contrary, in the absence of concurrent excusable delays, inexcusable delays usually entitle the Owner to recover costs resulting from the delay

3. Examples of Owner's losses caused by delays

The Owner usually experiences financial losses because of the consequences of any delay. Certain losses - namely those caused by inexcusable delays - can be recovered by the Owner from the Contractor.

Damages to the Owner could be economic (i.e., loss of revenue the completed project was supposed to generate), strategic (i.e., loss of competitive advantage - the Owner would not be able to tap into new market or product), environmental (i.e., a completed project would have improved traffic and reduced congestion and pollution), and political (i.e., failure to meet certain opening date.), road user benefit and inconvenience to the public (i.e. time lost to the public due to congestion caused by construction, and revenue as well as time lost to businesses and to individuals that otherwise would have been gained if the new road were in use). Many of the damages listed above are difficult or impossible to quantify, and hence can not be recovered, while others can be quantified and recovered.

D. Liquidated Damages

Most contracts include liquidated damage provisions as a mechanism to permit the Owner to recover costs attributable to inexcusable delays. Liquidated damages are a contractually stipulated amount to be paid to the Owner in lieu of actual damages (since they are almost always difficult to determine in advance), if the contractor fails to meet the contract's milestone dates.

To be enforceable, liquidated damages provisions need to pass two tests. First, the liquidated damages estimated amount must represent a reasonable pre-estimate of the actual loss likely to be suffered by the Owner in the event the contractor fails to meet its contractual obligations. Second, the amount must not be so unreasonably high that it bears no relationship to any potential loss. If it is too high courts will construe the clause as a penalty, and not enforce its provisions. The logic behind this result is that the remedy for breach of contract is compensation not punishment.

Liquidated damages provisions stipulate an amount to be paid to the Owner by the contractor, if the latter fails to complete the project on time. Usually Liquidated Damages are tied to the substantial completion date, the date by which Owner is able to use the completed project for its intended purpose. However, some projects tie Liquidated Damages to the final acceptance. The final acceptance is issued after the project is taken by the Owner as substantially complete and a punch list of remaining and defective work is compiled and completed.

On multi-contract projects, including the CA/T Project, because of the interfaces between one contract and other contracts and agencies, and because of the Owner's need of various portions of the project at different times, interim milestones have been established. In these cases, liquidated damages are also assigned to interim milestones. On the CAT, the majority of contracts includes milestones and access restraint dates. Each milestone of a contract is an access restraint in a follow-on contract.

Valid liquidated damages provisions can benefit both the Owner and the contractor by establishing the contractor's liability exposure for late completion. The Liquidated damages clause establishes an agreement between the contractor and the Owner for a definite amount to

compensate the Owner for its anticipated financial loss. Absence of this mechanism will require the Owner, through litigation that can be time consuming and expensive to both parties, to prove its actual damages. The uncertainty of litigation makes it hard for the contractor to account for late completion and incorporate the anticipated risk into its bid price. On the other hand liquidated damages levels the play field for all bidders, while eliminating the uncertainty of the amount and outcome of actual damages.

There are a few models to estimate liquidated damages. Estimating liquidated damages becomes a hard task when actual Owner's damages are intangible, and not easy to quantify. The assessment of liquidated damages becomes especially difficult in multi-contract projects, where delays affect the subject contractor as well as the follow-on contractors.

Incentive/disincentive provisions can be used as alternative to liquidated damages. The most common situation for using these provisions is when the Owner does not only lose if the project delays, but also gains if the project finishes earlier.

II. Elements of Liquidated Damages

A. Introduction

As defined earlier, the liquidated damages clause establishes a remedy to the Owner for late completion of the contract (or any of its milestones) due to inexcusable delay by the contractor.

The legal rules regarding application and enforceability of the liquidated damages clause are well established and evidenced by past court decisions. However, most of the disputes regarding liquidated damages revolve around two questions: first, when does the liquidated damages amount cease to be assessed, and second, when is it unenforceable.

This chapter will try to answer these two questions, and to present several court rulings, which further explain the legal aspects of liquidated damages. Finally, examples of the liquidated damages clause from the CA/T project as well as different domestic and international projects will be presented.

B. Legal Aspects of Liquidated Damages

1. Background

To be enforceable, the liquidated damages amount needs to pass two tests: first, the Owner must be able to prove that the liquidated damages amount is a reasonable pre-estimate made at the time of contract formation to forecast the actual damages the Owner might incur as a result of the contractor's late completion of the project, and second, the amount should not be unreasonably too high when compared to potential damages. As several court decisions will explain later, failure of the Owner to prove that the liquidated damages amount is a genuine estimate of the anticipated actual damages will deem such amount to be a penalty to punish the contractor for the delay and therefore not enforceable in the court of law.

2. Examples of court interpretations of unenforceable liquidated damages clauses

2.1 Unreasonable Estimate

The following cases establish the first legal aspect of liquidated damages. That is that the liquidated damages clause is unenforceable, if its amount was not based on a genuine estimate of the anticipated actual damages to be suffered by the Owner in case of a delay.

2.1.1 Case one

Milton Construction Co., Inc. v State of Alabama Highway Department
568 So.2d 784 (Ala. 1990)

The State of Alabama Highway Department awarded an interstate highway improvement contract to Milton Construction Co., Inc. The contract called for liquidated damages of $600 per day for late completion. The contract also called for a "disincentive/incentive clause". If the contractor falls behind schedule, for each day of overrun, up to 60 calendar days, the contract price would be reduced by $5,000 in addition to any liquidated damages assessment. The same clause also established incentive payments for early completion. Milton completed the project behind schedule and was assessed both liquidated damages and disincentive payment. Milton challenged the enforceability of the disincentive clause.

The Alabama Supreme Court ruled that the disincentive provision was designed as a penalty and therefore was unenforceable. The Court said that to be enforceable, a disincentive clause has to meet the same standards required of liquidated damages provision. The stipulated amount ($5,000 per day in this case) has to represent a reasonable attempt, at the time of contract formation, to estimate the actual damages the Owner might incur as a result of contractor breach. The Court ruled that this disincentive clause could not pass the test, and that the large daily rate was intended to encourage timely completion by penalizing the contractor for slow performance.

The Highway Department acknowledged that the disincentive rate had been established arbitrarily. This, combined with the fact that the disincentive payment and liquidated damages assessment were cumulative, established conclusively that this was an unenforceable penalty.

The Court rejected the Highway Department's argument that Milton had waived the right to challenge the disincentive provision by accepting incentive payments on other contracts.

The Highway Department then sued Milton for actual damages claiming "road user costs" caused by the contractor's late completion. The Department cited cases allowing project Owners to recover actual damages after a liquidated damages clause had been ruled unenforceable.

The Court ruled against the Department, indicating that in cases where Owners were allowed to recover actual damages, they had not been able to assess liquidated damages. In this case, the Department had been allowed to assess liquidated damages, fully compensating it for late completion of the project.

2.1.2 Case two

Rohlin Construction Co., Inc. v. City of Hilton
476 N.W.2d 78 (Iowa 1991)

The City of Hinton and County of Plymouth, Iowa, awarded three separate highway resurfacing contracts, ranged from $37,957 to $251,696, to Rohlin Construction Co., Inc. Each of the three contracts had construction duration of 40 days, and each called for liquidated damages of $400 per day for late completion.

Rohlin completed two of the contracts behind schedule and was assessed a total of $32,400 in liquidated damages. Rohlin challenged the enforceability of the liquidated damages clauses arguing that they constituted unenforceable penalties.

The Owner defended its practice stating that the $400 per day rate was determined after consultation with the State Department of Transportation. The Department construction manual called for a sliding daily rate based on the total contract value, however, the three contracts, which vary widely in total value, had a flat rate of $400 per day for liquidated damages. The contractor used that discrepancy to argue that the by misapplying the standard formula in the state manual, the project Owner failed to prove that the liquidated damages amount represents a reasonable estimate of the anticipated actual damages.

To make matters worse, one of the County's engineers defended the $400 per day rate by testifying that "we wanted the liquidated damage amount to be sufficient to make the contractor aware that we need the project completed." This added to the impression that the liquidated damages provisions were intended to serve as penalties and therefore unenforceable.

The Iowa Supreme Court concluded that liquidated damages clauses in the three contracts were unenforceable penalties citing that "no witness was called to justify the suggested liquidated damage amounts contained in the DOT manual schedule. The county Engineer did not conduct studies or present any other data suggesting that defendants anticipated that the Government entities and the public could sustain damages equivalent to $400 per day liquidated damages amount contained in each of the three contract. Therefore, we conclude that the $400 per day liquidated damages clause is an unreasonable amount and therefore a penalty that should not be enforced."

2.1.3 Case three

Appeal of Fred A. Arnold
ASBCA No. 26867 (January 10, 1986)

Fred A. Arnold was awarded a contract by the Navy to construct a bachelor enlisted quarters building. Arnold completed the building behind schedule. As a result, the Navy assessed liquidated damages based on the contract clause, which called for $1,728 per day. This amount was calculated according to a Navy guideline specifying six dollars per day for each man to be housed in the facility.

The court ruled that this amount bore no relationship to the foreseeable actual damages and that at the time of contract formation, the Navy made no effort to measure the actual damages, and therefore the liquidated damages clause was unenforceable. The Court stated that "the only witness who could testify on such matters had no idea, at the time of contract formation, what the Government expected regarding off-base living expenses in the event of untimely completion. We can only conclude that the losses reflected by the $1,728 per day bore no relationship to the actual damages experienced and reasonably anticipated. The liquidated damages are accordingly unenforceable."

2.1.4 Case four

Appeal of Great Western Utility Corp.
ENG BCA No. 4934 (April 5, 1985)

Great Western Utility Corp. was awarded a contract by the Government for the construction of rest area facilities. The $29,189 contract called for liquidated damages of $143 per day The Government assessed $18,447 liquidated damages against the contractor for his late completion of the facilities. The Corps of Engineers Board of Contract Appeals ruled against the Government defense that the daily rate represented the estimated cost of extended supervision and inspection. The Board concluded that the liquidated damages provision in this contract was not based on any reasonable forecast of probable damages that might follow a breach, and therefore that the liquidated damages provision will not be enforced.

2.1.5 Case five

Appeal of Dave's Excavation
ASBCA No. 36161 (June 8, 1988)

The Armed Services Board of Contract Appeals refused to enforce a liquidated damages clause based on the Government improper use of its own guidelines when estimating the daily rate. The contract was to build a computer room and called for liquidated damages of $125 per

day for late completion.

The contractor finished the project 169 days behind schedule and was assessed liquidated damages. The contractor challenged the enforceability of the liquidated damages provisions, pointing out that the government guidelines called for liquidated damages rate of only $50 per day for a contract of that amount.

The Board said that it had no objection to the government's use of standard tables for estimating liquidated damages, as long as the rates reflect an attempt to predict the actual damages which would be incurred due to a delay. Once those tables are established, they must be followed unless there are extenuating circumstances. In this case, the government exceeded its own standard table rate without any explanation, and therefore the liquidated damages provision was ruled as unenforceable penalty.

2.1.6 Case six

Appeal of weddle Plumbing & Heating Co.
VABCA No. 2209 (September 27, 1985)

In a similar decision to that of case five, the Veterans Administration Board of Contract Appeals ruled that liquidated damages clause was unenforceable, saying that the government improperly misapplied a "Liquidated damages Schedule" found in the VA Procurement Regulations.

The contract was to install a boiler and called for liquidated damages of $100 per day for late completion. The VA engineer estimated that the government would lose savings of $45 per day if the boiler was not operating. To cover other miscellaneous losses, the engineer added $55 per day, which was the Schedule's recommended amount for contracts of that amount.

The board said that this was an improper use of the government own schedule and ruled the provision unenforceable citing that "to add the recommended amount from the schedule to the estimated actual damages is to double the estimated loss and can not be permitted."

2.2 Concurrent and Excusable Delays

As the following cases indicate, the liquidated damages clause is unenforceable if the Owner and the contractor each contributed to the late completion, and the contract could have been completed on time if it were not for the Owner's delay, or it is not possible to apportion the contribution between the parties.

This ruling was established by the Supreme Court decision in Robinson v. United States 261 U.S. 486 (1923). The rule is that liquidated damages may be apportioned according to degree of contribution unless the contract would have been completed on time but for the delay caused by the Owner.

Needless to add to this, liquidated damages will not be allowed if the delay caused by the contractor is found to be excusable.

2.2.1 Case one

Appeal of C.D. Murray Co., Inc.
ENG BCA No. 5018 (October 31, 1988)

The government awarded a contract to the C.D. Murray Co., Inc. for dredging of a channel. A delay was caused by the government's failure to promptly establish the ranges and gages for performing dredging. A concurrent delay was caused by the contractor's inefficient performance of the work because of a variety of managerial and equipment deficiencies. As a result, the project was completed behind schedule and the government assessed liquidated damages amount according to the contract documents.

The Corps of engineers Board of Contract Appeals ruled that liquidated damages may not be assessed because the contractor and the government both contributed to the delay, and it is impossible to apportion responsibility.

2.2.2 Case two

Appeal of C. G. Norton Co., Inc.
ENG BCA No. 5182 (January 19, 1988)

The government awarded a contract to C.G. Norton Co., Inc. for repair of a fish weir. A delay was caused by the government's failure to promptly make a decision regarding the proper design of concrete form bags used to pour columns under water. Additionally, a concurrent delay was caused by the contractor due to problems from its subcontractor, which is fabricating the bags. This delayed progress of the work. The government assessed liquidated damages; meanwhile the contractor challenged the government, seeking it responsible for the delay.

The Corps of Engineers Board of Contract Appeals said that both parties contributed to the delay, the government by its design indecision and the contractor through problems with its subcontractor. The Board ruled that the government may not assess liquidated damages for that delay and the contractor may not recover delay damages from the government, citing that "when a delay is caused concurrently by both parties to the contract, the Board will not attempt to allocate blame. Neither party may hold the other accountable for the period of concurrent delay."

2.2.3 Case Three

Appeal of J. B. C. Construction Co., Inc.
VABCA No. 1799 (November 7, 1985)

J.B.L. Construction Co., Inc. was awarded a contract to install fire doors and a smoke detection system in a VA hospital. The specifications were not clear regarding the required materials and hardware. As a result, it took five months for all shop drawings submittals and hardware schedule to be approved. The contractor brought a claim for delay damage.

The Veterans Administration Board of Contract Appeals found that the government was unreasonably slow in responding to submittals. The Board also found that the contractor had not submitted shop drawings according to the contract schedule and many submittals had been vague or incomplete. Accordingly, the Board ruled that neither party could hold the other responsible for the delay citing that "when delays result from a combination of causes, and both parties are at fault to such extent that it is not possible to determine the degree of guilt of each, the government loses its right to assess liquidated damages and the contractor loses the right to collect delay costs."

2.2.4 Case four

Appeal of Sauter Construction Co.
ASBCA No. 27050 (March 30, 1984)

The Armed Services Board of Contract Appeals refused to allow the government to assess liquidated damages for a period of time when the government personnel were unavailable to perform final inspection of the work.

Sauter Construction Co. was assessed liquidated damages for completing construction of a maintenance shop 43 days after the contractually stipulated date. The contractor argued the delay was excusable.

The Board found most of the delay to be not excusable. For 14 days, however, no inspector was available to conduct final inspection; therefore, the liquidated damages were disallowed for that period.

3. Termination of Liquidated Damages Assessment

As stated before, liquidated damages assessment usually ceases when the scope of work of the corresponding milestone reaches substantial completion. At this stage, the Owner can have beneficial use of the project (or the subject portion of the project) for the intended purpose. However, in some cases, liquidated damages are tied to Final Acceptance. The following cases will present examples of the Court rulings regarding this issue.

3.1 Case one

Ledbetter Brothers, Inc. v. North Carolina Department of Transportation
314 S.E.2d 761 (N.C. App. 1984)

The North Carolina Department of Transportation awarded a contract to Ledbetter Brothers, Inc. for highway renovation. The contract called for $300 liquidated damages, which would be assessed for every day of delay until "completion date" of the work.

The work included reflectorized signs. After the highway was substantially complete and open for traffic, the Department inspected and rejected the reflectorized signs. The Department withheld liquidated damages until the signs were replaced and accepted. The contractor challenged the action arguing that liquidated damages should not have been assessed once the highway was operational and open to the public.

The North Carolina Court of appeals interpreted the contract to allow liquidated damages to run until final inspection, not just substantial completion, and therefore ruled in favor of the Department.

3.2 Case two

U.S. for the Use and Benefit of Control Systems, Inc. v. The Arundel Corp.
814 F.2d 193 (5th Cir. 1987)

The Army Corps of Engineers awarded a contract to a joint venture headed by the Arundel Corp. to construct a lock in a canal. The electrical portion of the work included the installation of a computerized control system of sensors and cameras. The contract required the project to be "functionally operational" by January 18, 1982, and provided for liquidated damages of $520 per day for late completion.

The installation of the control system ran behind schedule and the project was not accepted until June 3, 1982. As a result, the Corps assessed liquidated damages of $70,720. Arundel in return assessed the same amount against its electrical subcontractor.

The U.S. Court of Appeals, Fifth Circuit, ruled that the electrical subcontractor could not be responsible for the late completion because the control system was not required in order for the lock to be "functionally operational." It could be controlled with an additional operator. Therefore, the completion of the control system had no relevance to the assessment of liquidated damages against the prime contractor.

3.3 Case three

Appeal of Rivera Construction Co., Inc.
ASBCA No. 30207 (April 12, 1988)

The government awarded a contract to Rivera Construction Co., Inc. for office space alteration. The contract called for liquidated damages amount of $85 per day for late completion. The contractor completed the project late and was assessed liquidated damages. A dispute ensued as to whether the liquidated damages ceased when the government took occupancy of the office space or when the contractor completed the punch list items.

The Armed Services Board of Contract Appeals said that liquidated damages compensate an Owner for loss of use of a project. Therefore, they must cease when the project is substantially complete, and the Owner takes beneficial occupancy of the project, not when the contractor completes the punch list work.

The Board ruled in favor of the contractor citing that "beneficial occupancy usually occurs when the government occupies or uses a facility before its final acceptance for the purpose for which it was intended, provided it was satisfactorily completed to that extent. The space was essentially complete and ready for its intended use on 3 February, even if the incomplete status of some features may have caused some inconvenience in its use."

3.4 Case four

Appeal of Mitchell Engineering & Construction Co., Inc.
ENG BCA No. 3785 (April 4, 1989)

The Corps of Engineers Board of Contract Appeals ruled that although a contractor may be defaulted for failure to complete punch list work, liquidated damages pertain only to loss of use of the facility, and therefore must cease when the project is available for its intended purpose.

The government awarded a contract to Mitchell Engineering and Construction Co., Inc. to build an oil and paint storage facility. The contract called for liquidated damages of $85 per day for late completion.

The contractor performed work behind schedule, and by August 29 work was substantially complete and the government prepared a punch list of the remaining work. The list included a leak in the roof and a heater to be installed.

The roof was repaired on September 9 and the heater was installed on October 3. The government accepted the project on November 11. A dispute ensued as to until which date the liquidated damages should be assessed.

The Board concluded that the building was not available before September 9, as the roof

leak prevented storage of materials. The heater was not necessary for the use of the building, however, as the heating season had not arrived. Liquidated damages therefore could not be assessed after roof repair of September 9.

3.5 Case five

Stone Heavy Equipment Company v. City of Arcola
536 N.E.2d 1329 (Ill. App. 1989)

The City of Arcola, Illinois, awarded a contract to Stone Heavy Equipment Company to construct a sewer facility. The contract allowed 365 calendar days to complete the work and called for liquidated damages of $200 per day for late construction.

The contractor finished work behind schedule. By October 10, 1983, the contract work was substantially complete and the plant was operational. However, the City assessed liquidated damages until the following spring when the facility was accepted.

A dispute ensued as to whether the liquidated damages ceased when the government took occupancy of the office space or when the contractor completed the punch list.
The contractor then challenged both the enforceability of the liquidated damages provision and the period of time for which it was assessed.

The City estimated the $200 per day rate based on the anticipated extended service of the resident engineer. At the time of the contract formation, the City estimated such cost to be higher, but tried to keep liquidated damages amount low to encourage more competitive bids.

The Appellate Court of Illinois found the City practice in estimating liquidated damages amount reasonable, and therefore the provision enforceable. However, the Court ruling, regarding the period of time liquidated damages could be assessed, was that the City had to stop assessing liquidated damages once the contractor achieved substantial completion of the project. The Court cited that "the trial court found substantial completion on October 10, 1983. Since the project was sufficiently complete at that time to be used for the purpose for which it was intended, then it would seem appropriate to construe the liquidated damages provision to close at the time of substantial completion, even though there may be minor repairs, adjustment, or finishing work remaining."

3.6 Case six

J. M. Beeson Company v. Sartori
553 So.2d 180 (Fla. App. 1989)

Ernesto Sartori awarded a contract to J.M. Beeson Company to construct a shopping center. The contract called for liquidated damages of $1,000 per day if the contractor failed to substantially complete the work within 300 days from Notice to Proceed. The contract also called for a bonus of $1,000 per day if the project was completed ahead of schedule.

With about $69,000 worth of work remaining, a dispute developed regarding substantial completion date and liquidated damages. In the resulting litigation, the District Court of Appeal of Florida ruled that the project is substantially complete, when the Owner is able to use the facility for its intended purpose. The cost of the remaining work is irrelevant to this determination.

The court stated that the shopping center project was substantially complete when the space became available for occupancy and fixturing by tenants. And, liquidated damages shall cease to run at this point.

4. Other Court Decisions

The following examples provide other legal decisions and precedence regarding liquidated damages.

4.1 Case one

Liquidated Damages assessment does not cease with contractor abandonment

City of Boston v. New England Sales & Manufacturing Corp.
438 N.E.2d 68 (Mass. 1982)

New England Sales and Manufacturing Corporation was awarded a contract for the removal and replacement of traffic controls cables. The contract called for liquidated damages of $40 per day for late completion. The contractor performed behind schedule and eventually abandoned the incomplete site, twenty-six days after the contractual completion date.

Five months after the abandonment, the Owner awarded the contract to a second contractor to finish it. The primary issue in the resulting litigation was the correct computation of liquidated damages. The Owner argued that liquidated damages should be assessed until the second contractor actually finished the project. The contractor argued, and a trial court agreed, that liquidated damages apply only to delay, not abandoned performance, so the damages are not payable after the date of abandonment.

The Owner appealed to the Supreme Judicial Court of Massachusetts, which ruled that liquidated damages might be recovered beyond the date of the contractor abandonment and until the date a substitute contractor could reasonably complete the project. The court stated that "the appropriate rule is to allow recovery of reasonable liquidated damages beyond the date the defaulting party abandons the work. A contrary rule would permit a party to limit its liability for liquidated damages by abandoning the work and would deny the injured party those damages which were agreed to."

The Court also noted that "the period of delay for which liquidated damages may be recovered must be limited to the period of reasonable delay. The injured party must act with reasonable promptness to complete the work. Unreasonable delays by any successor contractor

should not be charged against the party who abandoned the work."

4.2 Case two

Unilateral changes to Liquidated damages amount deems makes the clause unenforceable

Appeal of Jacqueline Howell, Ltd.
ASBCA No. 27026 (September 30, 1982)

The liquidated damages clause was omitted from the contract. After the contract award, the government amended it to add a liquidated damages clause for an amount of $23 per day. The Armed Services Board of Contract appeals ruled that although many procurement regulations have the effect of law, even when not included in the contract, the government may not unilaterally impose a liquidated damages provision which was inadvertently omitted from the contract documents.

The Board concluded that even if the Defense Acquisition Regulations, which contains liquidated damages provision, could be read into the contract, there was no prior agreement as to the amount of liquidated damages. Therefore, the unilateral imposition of liquidated damages is unenforceable.

4.3 Case three

Appeal of Coliseum Construction, Inc.
ASBCA No. 36642 (December 6, 1988)

In a similar decision to that in case 4.2, liquidated damages provision was ruled unenforceable as its amount was unilaterally changed in the contract documents by the Owner.

The government awarded a contract to Coliseum Construction, Inc. to build the foundations for a radar tower. The contract called for a liquidated damages amount of $1,820 per day for late completion. However, the Owner's contracting officer reduced the liquidated damages to $220 per day after realizing that the initial rate was too high.

The contractor finished work 98 days behind schedule and was assessed liquidated damages which he challenged its enforceability.

The Armed Services Board of Contract Appeals ruled that by reducing the daily rate, the Owner acknowledged that the original amount was unreasonably high and did not reflect a good faith effort by the government to predict the actual damages. Therefore, the Board concluded that, the Government lost the right to assess any liquidated damages against the contractor.

4.4 Case four

Liquidated damages enforceable regardless of the absence of actual damages

Appeal of Preston – Brady Co., Inc.
VABCA No. 1892 (March 3, 1987)

The government awarded a contract for a hospital renovation. The contract had duration of 270 days, and called for liquidated damages of $260 per day.

The contractor finished behind schedule and was assessed liquidated damages for 22 days of delay. The contractor challenged the liquidated damages enforceability, noting that the government did not even occupy the hospital until five months after final acceptance. The contractor used that as evidence that the government did not suffer any actual damages from the delay, and that the liquidated damages clause was used as a penalty

The Veterans Administration Board of Contract Appeals ruled that if the liquidated damages amount is a reasonable estimate of the actual damages at the time of the contract formation, it is enforceable whether or not the government suffers actual damages

4.5 Case five

Evidence that time was not of the essence to the Owner deemed liquidated damages unenforceable

Appeal of Sunflower Landscaping & Garden Center
AGBCA No. 87-342-1 (July 16, 1991)

The Soil Conservation Service awarded a contract to Sunflower Landscaping & Garden Center for a drainage system improvement project, which was to be substantially complete in 264 days. The contract provided for liquidated damages of $148 per day for late completion.

The contractor performed behind schedule and eventually was terminated for default, with 130 days remaining in the contract. The contractor was assessed liquidated damages as well as reprocurement costs. The contractor challenged the enforceability of the liquidated damages provision.

The substitute contractor completed the remaining work in 14 days. The Department of Agriculture Board of Contract Appeals used that as evidence that the Owner was not really concerned about the time (and consequently about late completion) when it provided for 264 days for completion of work that evidently required much less time. Therefore, liquidated damages amount was inserted as a penalty not as a reasonable forecast of anticipated actual damages. The Board ruled that the liquidated damages provision was not enforceable.

4.6 Case six

Liquidated damages should be limited to delay caused by the contractor

Mattingly Bridge Co., Inc. v. Holloway & Son Construction Co.
694 S.W.2d 702 (Ky. 1985)

If more than one party is responsible for the delay, liquidated damages should be assessed only to the delay caused by the contractor, provided that the delay could be assigned to each party.

The government awarded a contract to Holloway and Son Construction Co. as a prime contractor to build a state highway. The Contractor then hired Mattiney Bridge Co., Inc. as its subcontractor for the concrete structures.

The subcontract called for liquidated damages of $750 per day, which was the same amount, contained in the prime contract. The subcontract allowed for a completion date 15 days before the prime contract completion date.

The contractor completed the project seven months behind schedule for a variety of reasons, including delay by the subcontractor. The prime contractor assessed liquidated damages against its subcontractor for 193 days.

The Supreme Court of Kentucky ruled that the subcontractor is liable only for the number of days of delay it actually caused to the prime contractor. The Court found that to be 32 days, and therefore the subcontractor can be held liable only for 32 days of liquidated damages.

4.7 Case seven

Release of retainage and final payment does not waive Owner's right to liquidated damages

Illinois State Toll Highway Authority v. Gust K. Newberg, Inc.
531 N.E.2d 982 (Ill. App. 1988)

The Illinois State Toll Highway Authority awarded a contract to the joint venture of Newberg-Kurg-Brighton to construct a highway. The contract stipulated liquidated damages for late completion. The contractor finished work behind schedule. The Owner released retainage and final payment and later filed a claim for liquidated damages.

The contractor challenged the claim arguing that the Owner waived its right to assess liquidated damages by making final payment.

The Appellate Court of Illinois stated that nothing contained in the contract limited the Owner's right to recover delay damages and ruled in favor of the Owner.

C. Examples

1. Clauses from the CA/T project

1.1 A construction contract

The following is a liquidated damages clause for a construction contract on the CA/T project. Each liquidated damages amount is estimated independently and then assigned to each corresponding contract milestone. Final Acceptance is usually assigned a liquidated damages amount of zero, since the contract is considered functionally operational at substantial completion.

> "The contractor shall complete the work within the contract time, and to achieve the contract milestone(s) specified in the contract division I Special Provision, and both parties recognize that these contract times and contract milestones are of the essence to this contract.
>
> If the contractor fails to complete the work required to achieve a contract milestone or complete the work within the contract time, as specified in the contract documents, or as adjusted by change order(s), the contractor shall pay to the Department, not as a penalty, but as liquidated damages, the amounts set forth for each calendar day of delay stated in the contract Division I Special Provision for this Subsection.
>
> Liquidated Damages
>
> | | |
> |---|---|
> | Milestone #1 (Final Acceptance) | $0 per Calendar Day |
> | Milestone #2 (Substantial Completion) | $13,200 per Calendar Day |
> | Milestone #3 | $4,500 per Calendar Day |
> | Milestone #4 | $15,200 per Calendar Day |
> | Milestone #5 | $12,500 per Calendar Day |
>
> The assessments against the contractor for liquidated damages may be cumulative and additive to each other.
>
> In the event that the work has been physically completed, but there remains to be submitted to the Department by the contractor any reports or other documents in accordance with the requirements of the contract documents, the work shall not be considered satisfactory completed within the meaning of MGL Chapter 30, Section 39G, until the receipt of such reports or documents by the Engineer.
>
> Whatever sum of money may become due and payable to the Department by the contractor under this subsection may be retained out of payments yet to be made to the contractor by the department. The requirements of this subsection

shall not be construed or treated by the parties to the contract as imposing a penalty upon the contractor for failing to complete the work within the contract time(s) or contract milestones(s), but as liquidated damages to compensate the Department for additional costs incurred by the Department because of the failure of the contractor fully to complete the work within the contract time(s) and contract milestone(s).

If the Department permits the contractor to continue and finish the work or any part thereof, after the date fixed for the completion of the work, it shall not operate as a waiver by the Department of any of its rights."

1.2 A design contract

The following is a clause from a design contract on the CA/T. There is no liquidated damages clause, and therefore in case of a delay, the Department needs to prove consequential actual damages.

"The Consultant shall commence its services upon receipt of the Department's written Notice to Proceed, prosecute said services diligently, and complete the services to meet the contract milestones set forth in Attachment C to this contract. Failure by Consultant to meet these schedule requirements that is not excusable under Section A-8, Subsection 2.0 "Excusable Delays" of this contract, could result in withholding of payments or termination of this contract pursuant to Attachment A-4, "Termination."

2. Clauses from other projects

2.1 Project one

The following clause is from a multiple prime contract project to build a 3,400 square foot addition to a student center for a college. The project involves separate contracts for General Construction, Electric, HVAC, Structural Steel, and Plumbing. However, only one liquidated damages clause was used for the five contracts. Also, as the following clause indicates, the Owner stated that liquidated damages are in addition to consequential actual damages.

"In the event of the failure of the Contractor to complete the said work within the time stated in his proposal, the contractor shall be liable to the College in the sum of one thousand ($1,000) dollars per day, or the sum equal to 1/20th of one percent of the total consideration provided for under his contract per day, or that sum mentioned in the contract, whichever is greater, for each and every day that said work shall be and remain uncompleted. This sum shall be treated as liquidated damages and not a penalty, for the loss to the College of use of premises in a completed state of construction, alteration or repair, as the case may be, and for added administrative and inspection costs to the

College on account of the delay; provided, however, that the liquidated damages provided for herein shall be in addition to other consequential losses or damages that the College may incur by reason of such delay, such as, but not limited to added costs of the project and the cost of furnishing temporary services, if any. Any such items for which the Contractor is liable may be deducted by the College from any monies due or to become due to the Contractor.

It is hereby understood and mutually agreed by and between the Contractor and the College that the date of the beginning the dates of required intermediate milestones, and the time for completion, as specified in the contract of the work to be done hereunder are essential conditions of this contract.

The Contractor agrees that said work shall be prosecuted regularly, diligently, and uninterruptedly at such rate of progress as will insure full completion thereof within the time specified. It is expressly understood and agreed, by and between the Contractor and the College that the time for the completion the work herein is a reasonable time for the completion of the same, taking into consideration the average climatic range and usual industrial conditions prevailing in this locality."

2.2 Project two

In this project the Owner used a unit rate-based liquidated damages, instead of per diem rate. The scope of work is to upgrade a wastewater treatment plant. The Owner specified liquidated damages amount to be an amount per day for each million gallons that the Owner had to bypass the facility under construction and treat the diverted wastewater at other plants. The actual provision states:

"The contractor further agrees to allow the Owner to deduct from progress payments and retention (or securities in lieu of retention) and to pay to the Owner as liquidated damages, and not as a penalty, the amount of: (a) Ten Thousand Dollars and No/Cents ($10,000) for each day that expires after the contract time specified in this attachment for the completion of the designated parts of the work, until that part is complete, and (b) Two Hundred and sixty-three Dollars and No/Cents ($263) per day for each MGD that the Owner must bypass the 23rd Avenue Wastewater Treatment Plant and treat at other plants."

2.3 Project three

This project is a turnkey project in the Middle East. The scope of work includes design, engineering, procurement, construction, and initial operation of LNG upstream facilities.

As presented throughout this project's liquidated damages provision, the Owner explicitly used the word penalty to describe the liquidated damages amount.

*"**Milestone completion and payment:***

The Owner shall pay contractor for completion of the work of each milestone. Each milestone represents a fixed percentage of the total price for project management, engineering, construction, commissioning, and initial operation. The percentage allocated to each milestone shall be in accordance to contract documents. Upon successful completion of a milestone, the contractor shall submit all required information and documents for issuance of completion certificate.

Penalty milestones shall be applicable as defined in table (II – 1). The penalties defined in table (II – 1) shall become due if the associated milestone has not been completed by the respective schedule completion date as defined in the contract documents. The daily penalties, as a percentage of the total contract price, shall be due for each calendar day following the scheduled completion date until either, the associated milestone has been completed, or the maximum percentage has been reached. Such penalty shall be deducted from the next payment requisition submitted by the contractor."

Table (II – 1)

Penalty Milestone Number	Associated Milestone	Description	Penalty per Calendar Day (% of Contract Price)	Max. Value of Penalty (% of Contract Price)
1	3	Completion of Mobilization and Commencement of construction.	0.1	2
2	4	Procurement and on site delivery of wellhead power and communication cables.	0.1	2
3	5	Preparation of site to allow construction start by pipelines and flow lines contractor.	0.1	2
4	13	Substantial Completion	0.15	10

It is worth noting that the Owner of this project used the payment mechanism to motivate the contractor to meet the contract's milestones. Each milestone is assigned a percentage of the contract total price. In this case the contractor is implicitly rewarded for performance – the faster the contractor complete a milestone, the faster it gets paid. The contractor is also punished for lack of performance - if the contractor fails to achieve a milestone on this contract, in addition to withholding liquidated damages amount, the Owner also disapproves payment requisitions until the milestone tied to these payment requisitions is completed.

2.4 Project four

The following is the liquidated damages clause included in the European Community General Conditions (FIDIC). The liquidated damages amount is stated in the Appendix to Tender of the contract in question. Such amount is usually presented as a percentage of the total contract price.

The following is the liquidated damages for delay clause:

> *"If the Contractor fails to comply with the time for completion in accordance with contract documents for the whole of the works or, if applicable, any section within the relevant time prescribed by the contract documents, then the Contractor shall pay to the Employer the relevant sum stated in the Appendix to Tender as liquidated damages for such default and not as a penalty (which sum shall be the only monies due from the Contractor for such default) for every day or part of a day which shall elapse between the relevant time of completion and the date stated in a taking-over certificate of the whole of the work or the relevant section, subject to the applicable limit stated in the Appendix to Tender. The Employer may, without prejudice to any other method of recovery, deduct the amount of such damages from any monies due or to become due to the contractor. The payment or deduction of such damages shall not relieve the Contractor from his obligation to complete the works, or from any other of his obligations and liabilities under the contract.*
>
> *If, before the time for completion of the whole works or, if applicable, any section, a taking-over certificate has been issued for any part of the works or of a section, the liquidated damages for delay in completion of the remainder of the works or of that section shall, for any period of delay after the date stated in such taking-over certificate, and in the absence of alternative provisions in the contract, be reduced in the proportion which the value of this part so certified bears to the value of the whole of the works or section, as applicable. The provisions of this clause shall only apply to the rate of liquidated damages and shall not affect the limit thereof."*

2.5 Project five

This is a clause from a Build Operate and Transfer (B.O.T.) project in Europe. The scope of work includes the design, construction, and provision of financing services for two Motorway sections to a major city in Eastern Europe. The clause is from a draft proposal, which indicates that the final liquidated damages amount is to be negotiated before signing the contract.

"The Contractor agrees to ensure completion of each section of the work by the respective date indicated below:

Section I to be agreed
Section II to be agreed

Liquidated damages shall be payable by the contractor in the following amounts for late completion of the work

Section I: $(to be negotiated) for each day of completion to a maximum of 2.5% of the portion of the contract price applicable to this section.

Section II: $(to be negotiated) for each day of completion to a maximum of 2.5% of the portion of the contract price applicable to this section.

The above liquidated damages for late completion shall be exclusive remedies to Employer for delay in completion."

2.6 Project six

This is an example of a B.O.O.T concession project in North Africa. The scope of this Concession is to design, finance, develop and operate a new port and as an option to finance, develop and operate a free zone.

The total duration of the Concession is fifty years.

The design and construction of the Port shall be completed in three years and six months from the date of signing the Concession.

The following is the liquidated damages clause from the bidding documents of the Concession.

"Detailed Design and Construction Phases:

In the following cases, the Concessionaire shall incur the following penalties, without prejudice to the provisions of clause 28 – Termination of the Concession.

In case the prescribed duration of the detailed design phase is exceeded, the

concessionaire shall pay a penalty of DH 50,000 per calendar day of delay.

In case the prescribed duration of the construction phase is exceeded, the concessionaire shall pay a penalty of DH 100,000 per calendar day of delay.

The Operation Phase:

If, within the prescribed period, the Concessionaire does not send the Conceding Authority the documents required by the Concession, and if a formal request has remained unanswered for a period of thirty days, the Concessionaire shall pay the Conceding Authority a penalty of DH 50,000 per document it has not sent.

If the guarantees for the number of containers handled at the Port are not achieved, the Concessionaire shall pay DH 45 per container of the shortfall as a penalty.

The penalties incurred under this clause are capped at 5% of the global cost (excluding taxes) of the design and construction as set out in the financial plan

Penalties become payable without a prior formal request.

The Conceding Authority may suspend the penalties provided in this clause while waiting for start up operation. If such start up operation occurs on the contractual date, the Conceding Authority shall notify the Concessionaire whether it decides to waive such penalties."

III. Estimating Liquidated Damages on the CA/T

A. Introduction

The CA/T Management Consultant established procedures as well as a model for estimating liquidated damages. The procedures are adhered to for all construction contracts that are to be bid on the CA/T. This chapter describes the procedures followed for the estimation and documentation of liquidated damage amounts for construction contracts on the Central Artery/Tunnel Project. The estimating model for calculating liquidated damage amounts will also be illustrated and a case study will be presented to explain the model application on one of the CA/T contracts.

B. The CA/T project procedures to calculate and document liquidated damages

1. Purpose

The purpose of the procedure is to outline the process and to establish instructions and guidelines to assure that liquidated damage amounts do not represent (and can not be construed as) a penalty, but rather a genuine estimate of the damages which MHD may incur as a result of failure of the contractor to complete contract milestone(s) on time.

2. Definitions

Subject contract:

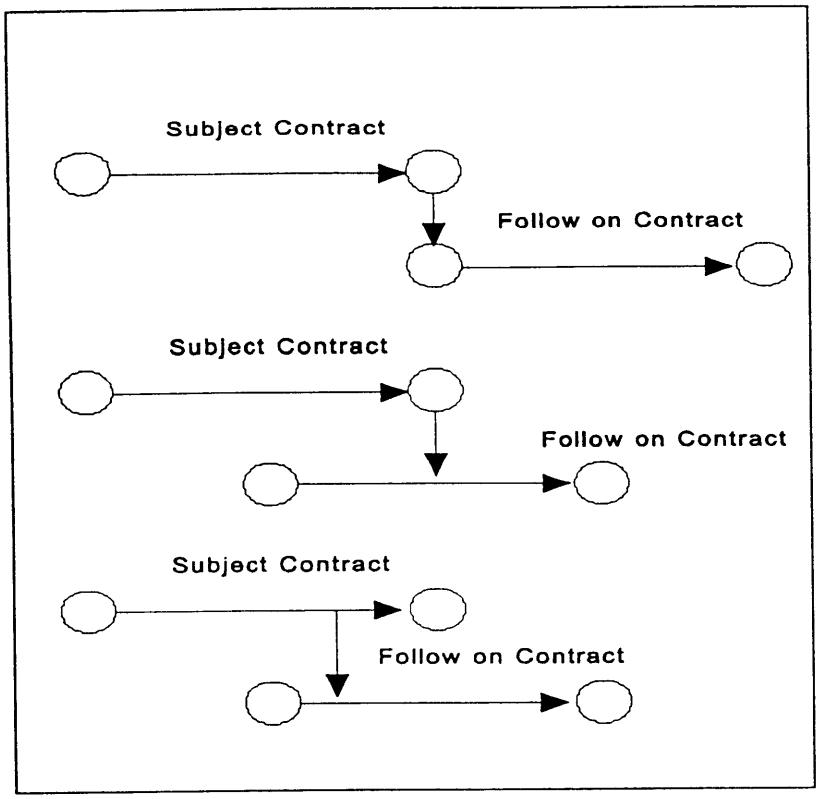
The contract for which liquidated damages are to be calculated and included in its bid documents.

Follow on Contract:

The contract, which partially or totally depends on the subject contract and subsequently, can be adversely impacted if the interfering portion of the subject contract extends beyond its contractual dates.

Figure (III- 1) shows three cases of interfaces between a subject contract and a follow on contract. In the first chart, the whole impacted contract can not start until the subject contract is fully complete - the two contracts are done sequentially. In the second chart, the whole impacted contract is dependent only on the completion of a portion of the subject contract. In the third chart, while the two contracts are done concurrently, a portion of the impacted contract can not start until a preceding portion of the subject contract is complete.

Figure (III –1)



Milestone:

A contractual date in the subject contract bid documents stipulating when the subject contract completes certain construction activities before a follow-on access restraint can start.

Access restraint:

A contractual date in the impacted contract bid documents stipulating when the subject contractor completes a milestone activity and turns over an area or a completed segment to the follow-on contractor.

Work papers:

The documentation of basis of all calculations, assumptions, and reference documents used to estimate liquidated damages.

Liquidated damages estimate package:

Includes work papers, summary sheet of subject contract milestone(s) with recommended liquidated damage amounts, and cover sheet for signature approval.

3. Examples of Milestone clauses from CA/T contracts

A typical milestone clause in a CA/T project will specify completion of certain construction activities in number of days after Notice to Proceed as in the following clause: "The contractor shall complete all structural work for the Central Artery tunnel box including SPTC walls, cast in place concrete walls, roof structure and base slab for turnover to follow on mechanical, electrical, IPCS, and tunnel finishes contract no later than one thousand eight hundred twenty one (1,281) calendar days after Notice to Proceed.

In some cases, milestones also specify work hours instead of calendar days as indicated in the following clause:

> "The contractor shall complete all underpinning load transfer work and remove all traffic diversion equipment from the Elevated Artery by 9:00 A.M. Sunday morning of the weekend on which night time lane restrictions take place.

4. Access Restraint clause examples from CA/T contracts

A typical access restraint clause will restrict certain work to start until a number of calendar days from Notice to Proceed elapses as in the following clause:

> "The contractor shall not begin work in construction phase 2A1 as defined by activity descriptions for each work zone in the Traffic Management Plans until one hundred sixty seven (167) calendar days after Notice to Proceed.

An access restraint could also restricts work in certain hours as was the case with Milestones:

> "The contractor shall not begin installing traffic management diversion equipment on the Elevated Artery, as required to initiate underpinning load transfer work, until 10:00 P.M. Saturday evening of the weekend on which night time lane restrictions take place."

Access restraints can also identify logic within the same contract as states the following clause:
"The contractor shall not begin tunnel excavation on either the north or east sides of the State Street block building until the facade of that building has been tied back in accordance with the contract documents."

5. Calculation procedures

As mentioned earlier, the procedures are adhered to for all CA/T construction contracts, and as figure (III - 2) depicts, the process is initiated by the procurement specialist request to the project controls manager for liquidated damage amounts to be included in the subject contract bid documents before advertisement for bids. The project controls manager forwards the request to the estimating department manager who assigns a cost estimator to the subject contract. The cost estimator gathers all pertinent information for the subject contract as well as the impacted contract(s). Such information includes milestones dates, staffing requirement, cost estimates, and construction duration. Contract milestone dates and duration are provided by the area cost/schedule engineer who also provides schedule analysis for the interface(s) between the subject contract and the impacted contract(s), identifying the portions of the impacted contracts which can be delayed should the subject contract fail to meet the required date of the milestone interfering with the impacted contract. Using all gathered information, the cost estimator studies all interfaces, and the impact of the subject contract milestones delay on the follow-on contract(s). He/she then applies the gathered data to the project model to estimate liquidated damages amount for each milestone of the subject contract. The cost estimator assembles the liquidated damages estimate package and forward it to the estimating supervisor for approval process.

6. The approval process

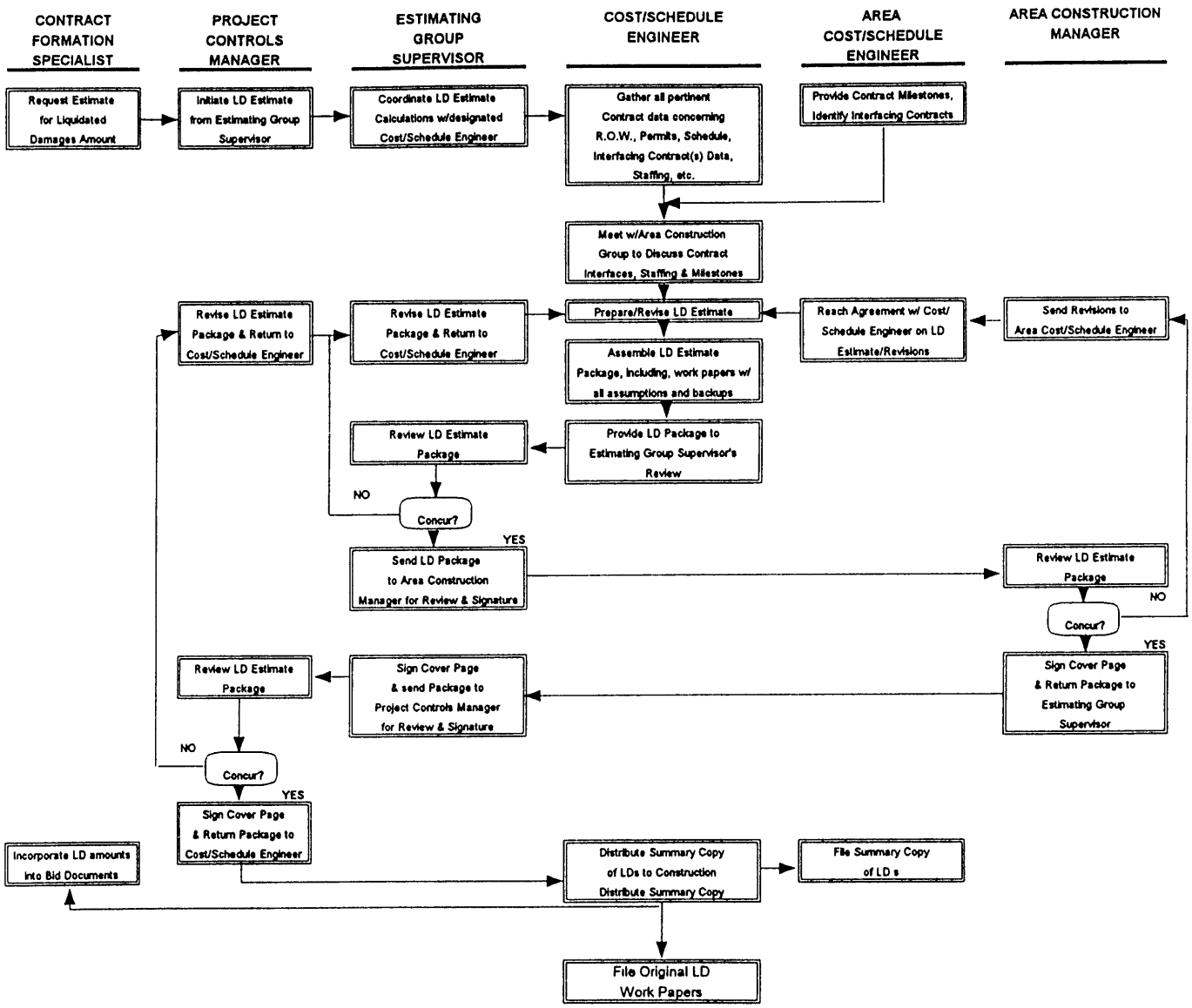
After the estimating supervisor reviews the liquidated damages estimate package, and if he/she concurs, he/she sends it to the Area Construction Manager for review and approval. If revisions are required, the cost estimator incorporates them and the package is reviewed again by the estimating supervisor, before it is sent to the Area Construction Manager.

After the Area Construction Manager reviews the package, and if in concurrence, he returns the approved package to estimating supervisor. If revisions are required, the package is sent to the Area Cost/Schedule Engineer, who work through the revisions with the Cost estimator, before returning the modified package to the Area Construction Manager for approval.

The approved package is then sent back to the estimating supervisor, who forwards it to the Project Controls Manager. If in concurrence, the Project Controls Manager approves and returns the package to the Cost Estimator for distribution. Otherwise, he returns it to the Cost Estimator to modify before approving it.

The approved package is then sent to the procurement specialist to incorporate in the contract documents. A copy is filed in estimating files, a copy in procurement, and a copy is sent to Area Construction Manager for filing.

Figure (III - 2), Flow Chart for Calculation, Documentation and Approval of Liquidated Damages for Construction Contracts



C. The Calculation Model

1. Introduction

If the contractor of the subject contract fails to achieve a milestone, there is usually an impact to the follow-on contract. The impact is generally a delay to all or part of the follow-on. As a result, the follow-on may be extended and incur the additional costs associated with time extension, or if the follow-on is on the project critical path and time extension is not allowed, the contractor will be forced to add more resources and/or to work overtime and extra shifts to recover the lost time and subsequently will incur additional costs. In some cases, achieving the milestone in question is on the critical path for a project wide milestone, and as such the milestone is not allowed to be delayed. The only option then is to recover the expected delay in the subject contract by adding more resources and by working extended hours. This is defined as self-acceleration. In any event, there will be additional costs, which can be passed on to MHD if there is no mechanism in place to recover these additional costs. Liquidated Damages clauses ensure that MHD will recover these costs.

The purpose of the CA/T model is to calculate the additional costs for all cases, then an amount, which is appropriate to the situation in hand, will be incorporated into the liquidated damages clause. The CA/T model consists of three separate models, delay, disruption, and acceleration. It is important to note that the project, for simplicity, treats these three cases as if they are mutually exclusive.

2. The Disruption Model

Disruption as defined in the CA/T model occurs when a delay forces the contractor to accomplish the same amount of work in a shorter time frame, and usually with higher costs than estimated in the contractor's bid price for same work.

The disruption model estimates the additional costs the contractor may suffer above the bid price of the impacted work. The disruption model assumes that the contractor will recover the time of delay by adding more resources and by doing work in an out-of-sequence manner. It also assumes that the contractor bid estimate is based on an optimal allocation of resources as well as optimum crew sizes for each construction activity, given its nature, quantity, site condition, market conditions, space, contract milestone and access restraint dates, etc.

An optimum crew size is the minimum number of workers required to perform a construction activity within the scheduled duration to meet contractual milestones. Optimum crew size shall have an acceptable production rate to support schedule and to achieve milestones while maintaining the lowest possible labor costs that are incorporated in the bid amount. Any decrease to crew size shall jeopardize schedule, and any increase to the crew size above the optimum level can result in a higher production rate, but at a higher unit cost, since each new worker will increase crew productivity as well as labor unit cost.

The model calculates disruption damages according to the following equation:

Disruption damage = disruption inefficiency factor x value of impacted work

The inefficiency factor used in the CA/T disruption model is adapted from a model developed by the U.S. Army Corps of Engineers Modification Impact Evaluation Guide. However, the Corps definition of this model is acceleration by increasing crew size.

Table (III-1) shows the loss in production (the inefficiency factor) as a function of percent increase in resources (crew size) above its optimum level. This table is derived from the Composite Effect of Crew Overloading chart included in the "Modification Impact Evaluation Guide EP 415-1-3", which is published by The Department of the Army, Office of the Chief Engineers, July 1979.

Table (III -1)

Percent of Additional Resources	**Percent of Inefficiency**
0.1	0.1
2.5	0.5
5.0	1.0
7.5	1.5
10	2.0
12.5	2.5
15.0	3.0
17.5	3.5
20.0	4.0
22.5	4.5
25.0	5.0
27.5	5.5
30.0	6.0
32.5	6.4
35.0	6.9
37.5	7.4
40.0	7.8
42.5	8.3
45.0	8.9
47.5	9.5
50.0	10.0
52.5	10.6
55.0	11.2

57.5	11.8
60.0	12.5
62.5	13.0
65.0	13.5
67.5	14.0
70.0	14.5
72.5	15.0
75.0	15.5
77.5	16.0
80.0	16.5
82.5	17.0
85.0	17.5
87.5	18.0
90.0	18.5
92.5	19.2
95.0	20.0
97.5	20.5
100.0	21.0

Equation (III-1) calculates the percent increase in crew size as a function of the required reduction in the construction duration and the original duration of the impacted work.

Equation (III - 1)

Percent increase in resources = Delay in Construction Duration / (Original Duration - Delay)

The above equation is derived mathematically by assuming a uniform distribution of resources over the activity duration, therefore that the crew day for the activity before and after the delay remains constant.

Table (III-1) and equation (III- 1) streamline the process of calculating the disruption inefficiency factor, as the case study will show later in this chapter.

3. Overrun Probability

Both inefficiency factor, in the disruption model, as well as the cost factor, in the acceleration model, discussed later in this chapter, vary depending on the overrun amount as a percentage of the time planned to construct the impacted work. The amount of overrun can not be estimated before hand, and for the purpose of estimating the liquidated amount, an overrun probability table has been driven. Three probability distribution curves have been studied in developing this

table. Initial distribution, normal distribution, and beta distribution were analyzed The classic normal distribution used a standard deviation of 10% - 95% of all projects will complete within 80% of the estimated duration. The initial distribution used an in-house assumption that 80% of all contract overruns will be less than 10% of the forecasted duration. The beta distribution was based on statistical analysis of in-house historical data. The probability curve used in the calculation model is created by averaging the probabilities of the initial and normal distributions. The final overrun probability values are presented in table (III - 2).

Table (III - 2)

Range of Overrun		Probability
0.0%	2.5%	0.12
2.5%	5.0%	0.12
5.0%	7.5%	0.33
7.5%	10.0%	0.17
10 0%	15.0%	0.13
15.0%	20.0%	0.09
20.0%	25.0%	0.03
25.0%	& above	0.01

4. The Acceleration Model

Acceleration as defined in the CA/T model occurs when a delay requires the contractor to increase shift length, increase workdays per week, or work multiple shifts. Acceleration is similar to disruption in its purpose of accomplishing the same amount of work at a shorter period of time. However, acceleration differs from disruption model in assuming that the recovery of delay is achieved by using overtime. The model calculates the expected increase in costs to the contractor associated with crashing the construction schedule of the impacted work. The increase in cost results from the inefficiency from working abnormal hours, and the premium paid to labor for working overtime or different shifts. The normal workweek is 40 hours, eight hours per day, five days (Monday - Friday) per week. Working more hours per week introduces premium pay rates and inefficiency loss. The acceleration model uses the following equation to calculate the acceleration damages:

Acceleration damages = (Inefficiency factor x cost factor - 1) x value of the impacted work

5. Inefficiency factor

Table (III - 3) is used by the CA/T to determine the inefficiency factor for the acceleration damages calculation. The table is driven from interpolating and fitting curve using data from various studies by the Army Corps of Engineers, and papers presented in the ASCE Journal of Construction Engineering and Management.

Normal acceleration is when the number of days to be recovered is less than 25% of the original schedule of the impacted work. Extreme acceleration is when the recovery is more than 25%. The inefficiency factor is a function of the number of days of working overtime and the nature of the acceleration (normal or severe).

Table (III – 3)

Number of days to be recovered	Inefficiency Factor Normal Acceleration	Inefficiency Factor Severe Acceleration
0-1	1	1
1-10	1.05	1.1
11-30	1.1	1.2
31-50	1.2	1.3
51-70	1.3	1.45
71-&above	1.4	1.5

6. Cost Factor

For normal acceleration, up to ten hours of overtime per week, labor is usually paid 1.5 the regular pay rate for the first ten hours of overtime. This is a total of five hours paid as premium, or 10% of the 50 hours actually worked during the week.

For sever acceleration, more than 10 hours per week, say average 20 hours, the first 10 hours are paid five hours premium, and the second 10 hours are paid 10 hours premium. This is a total of 15 hours premium, or 25% of the 60 hours worked in the week. Table (III - 4) summarizes the cost factor calculations.

Table (III – 4)

Acceleration	Cost factor
Normal	1.1
Severe	1.25

7. The Delay Model

The delay model estimates the cost associated with time extension of the follow on contract due to delay by the subject contract. There are four components of the delay model additional costs: time dependent job site overhead costs, home office overhead costs, escalation costs, markups.

8. Job site Overhead Costs

Time dependent job site overheads are defined as the contractor time dependent general conditions which can not be allocated to specific tangible pay item work but rather to the whole field or to a group of items. Examples are field supervision, temporary utilities, temporary facilities, hoisting equipment, pick up trucks, site weekly clean up, and maintenance of temporary roads.

Table (III -5) summarizes the time-dependent job site overhead per diem costs that are used on the CA/T. The table was created after analyzing cost, schedule and contract data of fourteen projects ranging from $1.4 million to $194 million.

Table (III - 5)

Size of Contract	Time Dependent Job site Costs
$1 million to $2 Million	$1,000 per day
$2 million to $5 Million	$1,000 per day plus $500 per day per $1 million over $2 million
$5 million to $10 Million	$800 to $1,200 per day per $5 million
$10 million to $100 Million	$1,200 to $1,800 per day per $10 million
$100 million to $210 Million	$800 to $1,200 per day per $10 million

9. Home Office Overhead Costs

The total home office overhead costs are assumed to be between 2 to 7% of the total contract value for the general contractor; and about 10% for a subcontractor.

10. Escalation

The impacted contractor will also experience an escalation cost for each day of extension above its contractual dates due to delays by the subject contract. The annual escalation rate is an estimate that changes every year, based on projection of the trend of the ENR quarterly construction price index. The model multiplies the escalation yearly rate by the whole contract value and divide by 365 to calculate the daily cost.

11. Mark-ups

The mark-ups cost represents bonds, insurance, and profit and is currently assumed to be 10%. The cost estimator however could use a different percentage as appropriate.

D. The CA/T Estimating Model

1. The Subject contract scope of work

The subject contract scope of work is the construction of the initial Leverett Circle connectors (Ramp S-N connecting Storrow drive east bound to I-93 North bound, and Ramp N-S connecting I-93 south bound traffic to Storrow drive west), from an interface with a bridge adjacent to the Charles River, crossing the North Station Railyard, to an abutment adjacent to Nashua street eastbound; the construction of transition structures south of the Nashua Street abutment; the construction of Temporary Ramp LC-N carrying traffic from Leverett circle into the existing I-93 on-ramp; modifications to existing highway ramps and connections into existing highway ramps; underpinning existing I-93 on ramp foundations, demolition of about 400 feet of the existing I-93 on-ramp, and the construction of surface streets and utilities.

The scope of work also includes the following to be performed in the North Station Railyard: construction of drilled shaft foundations for Ramps S-N and N-S; demolition and reconstruction of platforms and associated utilities to construct foundations; utility and drainage structures; and surface restoration to pre-construction conditions.

The work also includes construction staging and traffic management to ensure the maintenance of vehicular traffic; staging of operations in the North Station Railyard to maintain rail traffic; and mitigation to limit construction impacts to neighboring facilities.

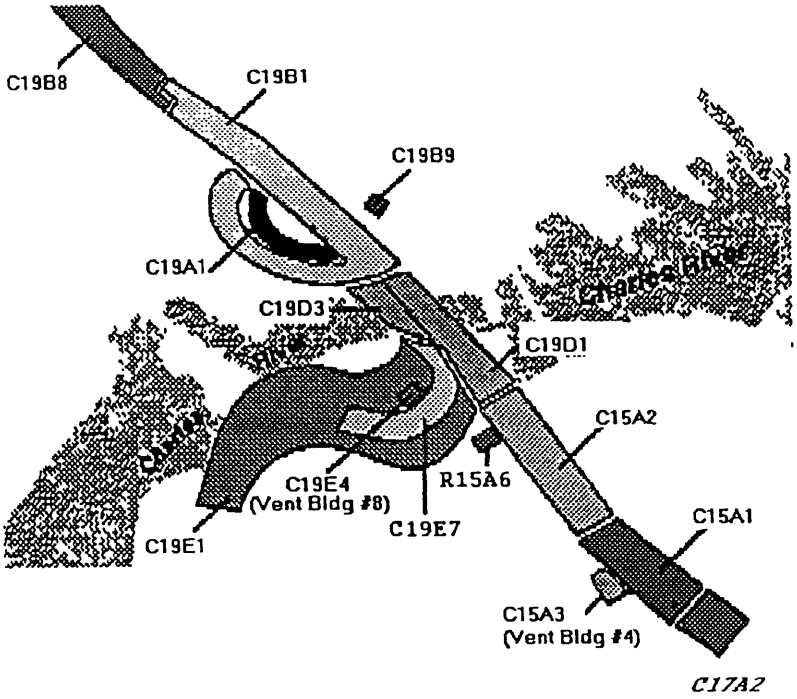
The contractor shall also provide two interim power facilities for highway lighting and construction activities. The two facilities will be also used by another CA/T contract C19D3.

2. The follow-on and interfacing contracts

During the contract time, there is expected to be up to six contractors performing work in the area east of the MBTA rail area and between the Fleet Center, the existing I-93 viaduct, and the Charles River (figure (III - 3)):

C19D3 - Storrow Drive Bridge
C19D1 - Mainline Bridge
C19E1 - Tunnels under North Station tracks
C19E4 - Ventilation Building
C19E5 - Storm Drain Outfall Structure
Just to the south, the mainline contract C15A2.
And west of Nashua Street abutment, and on Ramps N-S and S-N alignment, the demolition of Minot Steam plant, R19E3.

Figure (III – 3)



3. Milestones and access restraints

The contract documents included the milestones and access restraints shown in figure (III - 4)

Milestone #1

The contractor shall complete the entire work for Final Acceptance by the Department, in accordance with contract documents, no later than seven hundred forty (740) days after Notice To Proceed (NTP).

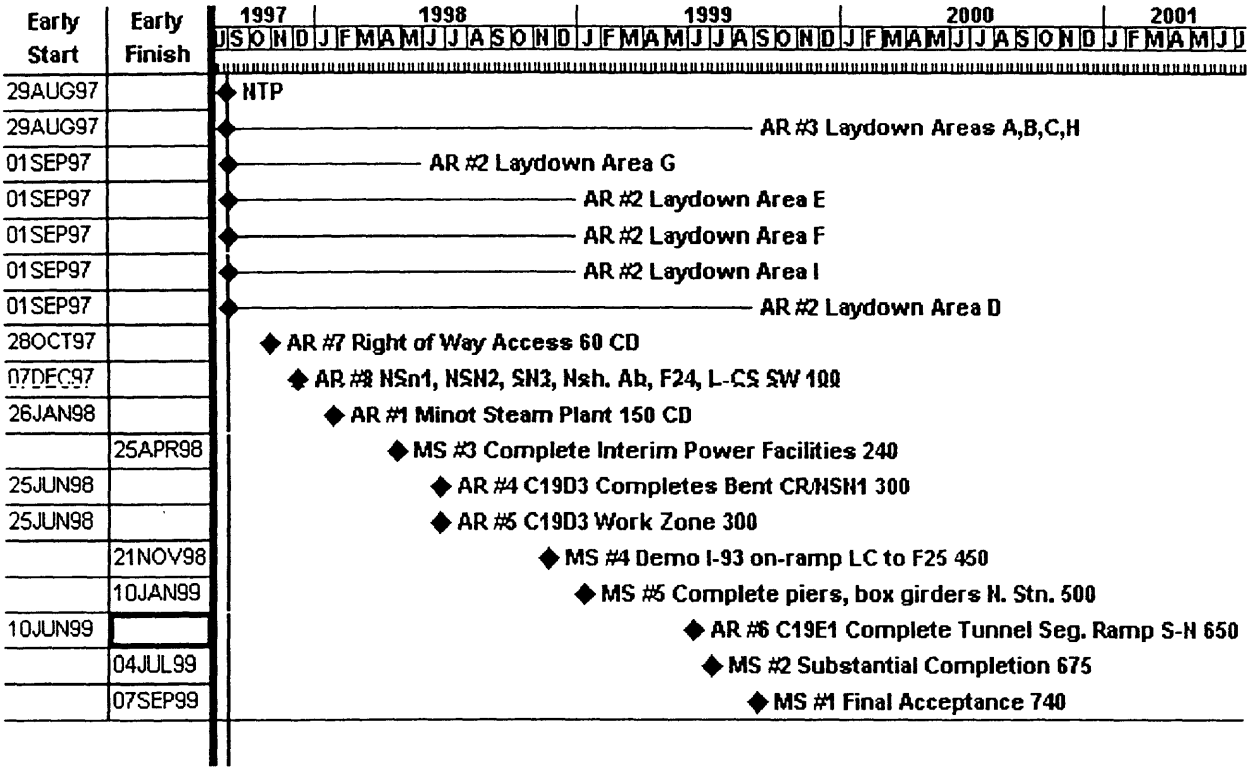
Milestone #2

The contractor shall complete the entire work for Substantial Completion in accordance with contract documents, no later than six hundred seventy five (675) days after NTP.

Milestone #3

The contractor shall complete all work associated with and have operational the interim Power Facilities, no later than two hundred forty (240) days after NTP

Figure (III -4)



Milestone #4

The contractor shall demolish the existing Leverett Circle/I-93 on-ramp connector from Leverett Circle to Bent F25, about 400 feet, no later than four hundred fifty (450) days after NTP to allow the C19E1 contractor to construct a tunnel and boat section segment of Ramp S-N in that area.

Milestone #5

The contractor shall finish all work in the North station Track area, completing all piers and erection of box girders, no later than five hundred (500) days after NTP.

Access Restraint #1

The contractor will be restricted from access to the area of the Minot Steam Plant for a period of one hundred and fifty (150) days after NTP

Access Restraint #2

The contractor shall have access to areas for lay down shown on figure (III -5) during the periods as follows:

Area	Duration
D	September 1997 - August 1999
E	September 1997 - December 1998
F	September 1997 - December 1998
G	September 1997 - May 1998
I	September 1997 - December 1998

Access Restraint #3

The contractor will have access to areas A, B, C, and H shown on figure (III - 5), during the entire duration of construction.

Access Restraint #4

The contractor shall not construct the span from bents NS6/SN6, to bents CR/NS1 and CR/SN1, until the later are constructed by the adjacent contractor for C19D3. This is expected to be approximately three hundred (300) days after NTP

Access Restraint #5

The contractor shall not have access to any area located within 30 feet of the C19D3 Bents CR/NS1 and CR/SN1 until three hundred (300) days after NTP, without prior approval of the engineer, in order to allow the C19D3 contractor to complete construction of these bents.

Access Restraint #6

The contractor will be prohibited from constructing Temporary Lomasney Loop until the adjacent contractor for C19E1 has completed the tunnel of Ramp S-N in the area. This is expected to be six hundred fifty (650) days after NTP.

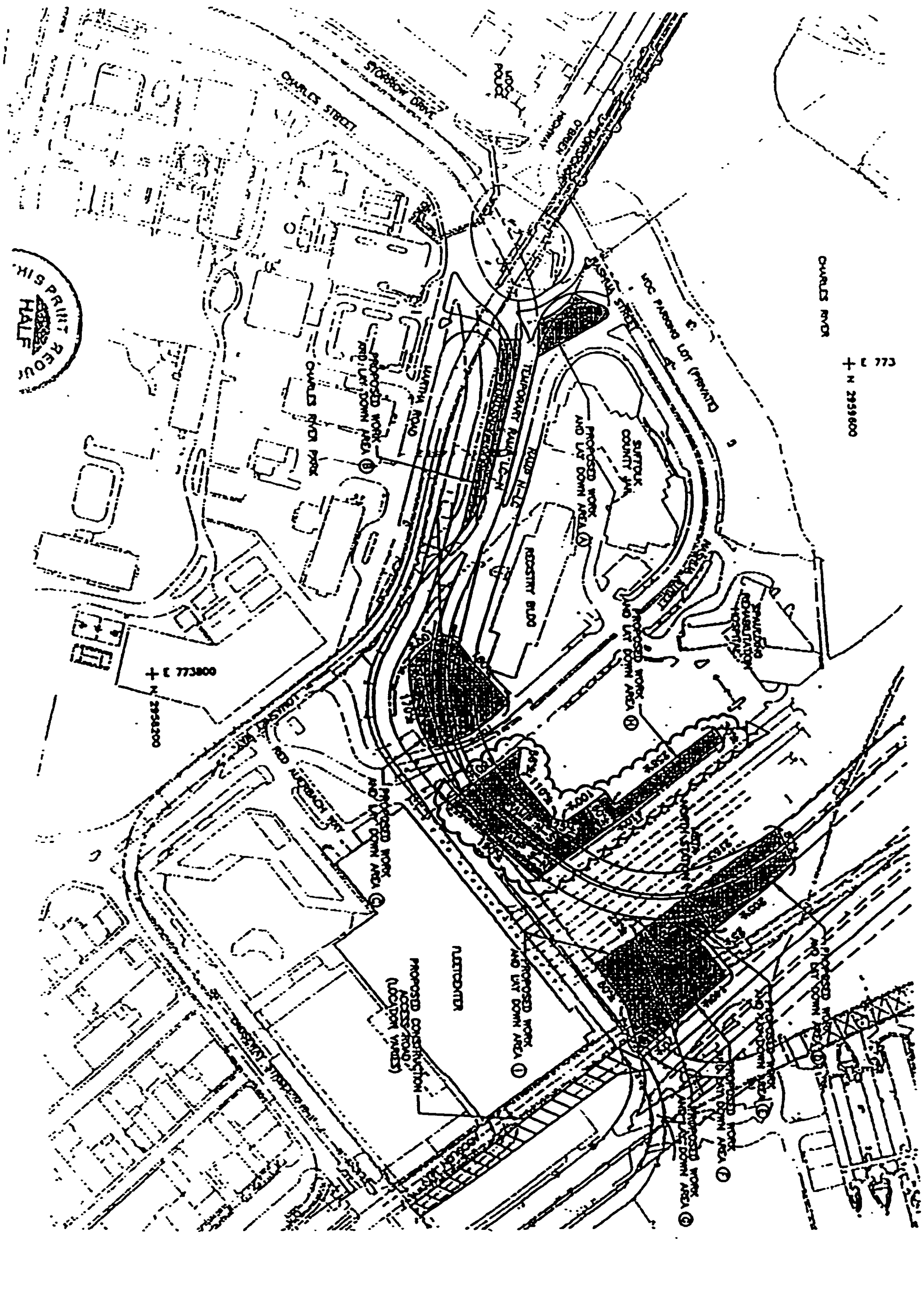
Access Restraint #7

The contractor shall not have access to all right-of-way parcels until sixty (60) days after NTP.

Access Restraint #8

For a period of one hundred (100) days after NTP, the contractor shall not proceed on any work for viaducts Bents NS1/SN1, NS2/SN2, SN3, the Nashua Street Abutment, F24 Underpinning, or the slurry walls without the approval of the engineer.

Figure (III -5)


CHARLES STREET
STORROW DRIVE
CHARLES RIVER
SUFFOLK COUNTY JAIL
REGISTRY BLDG
FLEETCENTER
+ E 773800

E. Estimating liquidated damages for the subject contract milestone #4

1. Introduction

As stated earlier, milestone #4 is critical to the follow-on contract C19E1. It requires the subject contractor to build a temporary ramp from Leverett Circle on top of the existing Storrow drive westbound underpass and tie it to the existing I-93 on-ramp. This will require underpinning work of two bents of the existing on-ramp. After the temporary ramp is built and open to traffic, the contractor then demolish the existing on ramp portion which has been replaced by the new ramp. This work needs to be completed in 450 days after NTP. The contractor then turns over the area to the follow-on contract C19E1, which will build a tunnel segment for ramp S-N in this area. This work for both contracts is on the critical path for a project wide milestone to open Leverett Circle, and therefore failure of the contractor to meet this milestone will result in additional cost to the follow-on to recover the delay.

2. Assumptions and Contracts information

The liquidated damage amounts were calculated during bid documents formation with the assumptions and data about the subject and follow-on contracts as detailed in table (III -6). The data are from the contracts documents, schedules, and cost estimates as well as assumptions made by the Cost/Schedule Analyst.

Table (III – 6)

Contract No. C19E7 Milestone: 04

Part 1: "Subject Contract" Info	C19E7	Notes
Contract Title	Ramp NS-SN Viaduct	
Approx. Contract Value	$53,539,800	May 31, 97 "All-In cost"
Projected Contract Duration	675	calendar days
Forecasted NTP	29-Aug-97	
Days from NTP to Milestone	450	calendar days
Date of Milestone	22-Nov-98	
Assumed Maximum Milestone Overrun (20% Overrun)	90	calendar days
% Non-Material Related Costs in Subject Contract	52.0%	
Percent Complete	77.0%	
Percent Duration	67.0%	
Float with Follow-on Contract	0	calendar days
Do you want to compare self-acceleration cost?	yes	Yes or No
Assumed Acceleration Cost for "Subject" Contract	$15,170	per day

Part 2: Primary Follow-on Contract Info	C19E1	
Contract Title	I-93 Leverett Cir/Storrow Dr Connectors	
Approx. Contract Value	$72,753,123	May 31, 97 "All-In cost"
Contract Start Date (Actual or projected)	05-May-98	
Contract Completion Date (Actual or projected)	28-Nov-2002	
Overall Contract Duration (calendar days)	1668	
% Impacted	7.2%	
Value of Impacted Work	$5,272,600	
Labor % of Impacted Work	27.0%	
Equipment % of Impacted Work	10 0%	
Overhead % of Impacted Work	21.0%	
Value of Labor for Impacted Work	$1,423,602	
Value of Equip. for Impacted Work	$527,260	
Value of Overhead for Impacted Work	$1,107,246	
Early Start Date for Follow-on Contract	22-Nov-98	Access date
Follow-on Contract Required Completion Date	01-Jun-99	(Need-by date)
Days Available to Complete Work	191	calendar days
Expected Duration for Accelerated Work	115	calendar days
Are there secondary follow-on contracts to consider?	no	Yes or No

Part 3: Secondary Follow-on Contract Info		
Method Used	Quick	Quick or Detailed
Quick Method (Escalation only)		
Enter value of all secondary contracts:		
Detailed Method (Use largest contract if more than one)		
Contract Title		
Approx. Contract Value	$0	Apr 30, 97 "All-In cost"
Contract Start Date (Actual or projected)	01-Jan-99	
Contract Completion Date (Actual or projected)	31-Oct-2003	
Overall Contract Duration (calendar days)	1763 6	
% Impacted	NA	
Value of Impacted Work		

Part 4: Schedule Interaction Info (for Primary)		
Can we delay follow-on contract?	no	Enter Yes or No
What is type of Overtime Acceleration?	Normal	Enter Normal or Severe

3. The Disruption Model

Table (III -7)

Overrun Low	Days High	Percent of additional Resources	Labor Inefficiency (%)	Disrupted Labor Cost	Disrupted Equipment Cost	Over-head	Total Cost	Total Per Day	Mark Up	Grand Total per Day
C	D	E	F	G	H	I	J	K	L	M
0	11.25	10.89	2	$28,472	$28,697	$30,132	$87,301	$7,760	$1,707	$9,467
11.25	22.5	24.43	4.5	$64,062	$64,405	$67,625	$196,092	$8,715	$1,917	$10,632
22.5	33.75	41.74	7.8	$111,041	$110,050	$115,552	$336,643	$9,975	$2,195	$12,170
33.75	45	64.66	13	$185,068	$170,450	$178,973	$534,492	$11,878	$2,613	$14,491
45	67.5	143.31								
67.5	90	365.85								
90	112.5	5357.14								
112.5										

Column C and column D converts the low and high overrun ranges in the first two columns of table (III - 2) into days by multiplying each value by the milestone total duration from table (III - 6), (450 days).

Column E calculates the percent of increase in resources to recover delay by applying equation (III-1), using the high range of delay from column D and the original duration to finish the follow on work from table (III - 6) (115 days).

Column F contains values from table (III - 1) which correspond to values in column E.

Column G is the multiplication of the labor cost of the impacted contract ($1,423,602), which is obtained from table (III - 6), times the labor inefficiency factors in column F.

Column H is the multiplication of the equipment cost of the impacted work ($527,260), from table (III - 6), by the inefficiency factors in column F.

Column I calculates disruption costs for overhead by multiplying the value of overhead work for the follow on (1,107,246), from table (III - 6), by an estimated inefficiency factor of 0.25 of the corresponding percent additional resources in column F.

Column J adds disruption costs for labor (column G), equipment (column H), and overhead (column I).

Column K divides the total cost in column j by the number of overrun days in column D to calculate the per day costs.

Column L calculates a mark up of 22% of the per day cost in column K

Column M calculates the grand total per day by adding columns K and L

It is important to notice that the disruption model is not considered feasible when the percent increase in resources is more that 100% - notice that no calculations were made for the last four rows.

The last step is to use the probability of overrun from table (III - 2) and the corresponding disruption per diem cost from column M, table (III - 7) to calculate the expected value for disruption cost as shown in equation (1):

Disruption cost = 0.12 x 9,467 + 0.12 x 10,632 + 0.33 x 12,170 + 0.17 x 14,491 = $8,891 per day .....(1)

4. The Acceleration Model

Column C and D in the acceleration model table (III - 8) are similar to these in the disruption model table (III -7)

Column E calculates the average days of overrun by averaging low and high values in columns C and D.

Column F uses the overrun days in column E, and table (III - 3) to fill in the inefficiency factors.

Column G uses the overrun days in column E and table (III - 4) to fill in the cost factors.
Column H multiplies the value of labor cost of the impacted work (1,423,602), from table (III - 6), by (the inefficiency factor in column F, table (III -8) minus one) times (the cost factor in column G, table (III - 8) minus one) to calculate the additional labor cost of overtime inefficiency and premium payment.

Column I multiplies the value of equipment cost of the impacted work ($527,260), from table (III - 6), by the (cost factor in column G minus one) to calculate the additional equipment cost.
Table (III – 9)

Table (III –8)

Acceleration Model

Overrun Days			Inefficiency	Cost	Additional	Additional	Additional	Total Cost	Probability of	Expected
Low	High	Avg.	Factor	Factor	Labor Costs	Equip Costs	Overhead Costs	Per Day	Overerun	Value
C	D	E	F	G	H	I	J	K	L	M
0	11.25	5.625	1.05	1.10	$220,658	$52,726	$110,725	$3,340	0.12	$400.81
11.25	22.5	16.875	1.10	1.10	$298,956	$52,726	$110,725	$4,021	0.12	$482.51
22.5	33.75	28.125	1.10	1.10	$298,956	$52,726	$110,725	$4,021	0.33	$1,326.91
33.75	45	39.375	1.20	1.10	$455,553	$52,726	$110,725	$5,383	0.17	$915.05
45	67.5	56.25	1.30	1.10	$612,149	$52,726	$110,725	$6,744	0.13	$876.76
67.5	90	78.75	1.40	1.10	$768,745	$52,726	$110,725	$8,106	0.09	$729.54
90	112.5	101.25	1.40	1.10	$768,745	$52,726	$110,725	$8,106	0.03	$243.18
112.5		112.5	1.40	1.10	$768,745	$52,726	$110,725	$8,106	0.01	$81.06
									1.00	$5,055.83

Mark-up:	22%	$1,112.28
Total:		$6,168.11
Call:	⟹	$6,200.00

Similarly, column J multiplies the value of overhead cost of the impacted work ($1,107,246) by the (cost factor minus one) to calculate the additional overhead cost.

Column K adds the labor, equipment and overhead costs and divides the total by the number of delay days of expected duration of accelerated work (115), from table (III - 6), to calculate the total additional costs per day.

Column L contains the overrun probability values which are obtained from table (III - 2).

The final step is to multiply each probability value in column L by each corresponding value in column K (the results are calculated in column M) and add all the results to come up with the expected value for the acceleration model, which is shown in table (III - 8) to be $6,200 per day.

5. The Delay Model

Table (III –9)

Delay Model

		Comments		
Primary Follow-on				
Impacted Contract Value of Primary Contract	$72,753,123	From Key Data sheets		
% of Contract Subcontracted	50.0%			
% of Subcontracts Impacted	50.0%			
Assumed Contract Duration	1,668 days			
Time-Dependent Jobsite Costs				$/10 million
Prime Contractor	$10,913 per/day			$1,500
Subcontractors	$2,183 per/day			$1,200
Home Office Overheads				%
Prime Contractor	$2,181 per/day			5.0%
Subcontractors	$1,090 per/day			10.0%
Escalation	$6,677 per/day		Escalation Rate:	3.35%
Mark-up, Bonds & Insurance	$2,304 per/day		Bonds	0.5%
			Insurance	0.5%
Subtotal Primary Follow-on.	$25,348 per/day		Profit	9.0%
				10.0%
Escalation of Secondary Contracts (Quick Method)				
Value of Secondary Contracts	$0			
Escalation rate:	3.35%			
Escalation per diem	$0 per/day			
Total:	$25,348 per/day			
Call:	$25,300 per/day			

Table (III -9) assumes that the subcontracted value of the follow on contract will be 50% of the total contract value, that 50% of the subcontracted work will be impacted by time extension, and that the mark up is 10%.

The time-dependent job site overhead cost is calculated using data from table (III - 5).
The value used for the general contractor overhead cost is
1,500 per 10 million or 1,500 x 72,753,123/10,000,000 = $10,913 per day

The value for subcontractor is 1,200 x 0.5 x 0.5 x 72,753,123/10,000,000 = $2,183 per day

Home office overhead is assumed to be 5% for the general contractor, and 10% for the subcontracted work.

General contractor Home office overhead = 72,753,123*.05/1668 days = $2,180 per day.

Subcontractors home office overhead = 72,753,123 x 0.5 x 0.5 x 0.10/1668 days = $1,090 per day.

Escalation = 72,753,123 x 0.0335/365 = $6,677 per day

Adding 10% mark-up on top of all additional costs to calculate total delay costs:
Total cost per day for the delay model = 1.1 x (10,913 + 2,183 + 2,180 + 1,090 + 6,677) = $25,348 .....(3)

The Cost estimator compares the forecasted costs of the three models (the disruption cost of $8,891, equation (1); the acceleration cost of $6,200 per day; and delay cost of $25,348, equation (3)), along with the assumed self acceleration cost for the subject contract (table (III - 6), and the nature and criticality of the two contracts to the whole project to decide the value to be incorporated in the liquidated damages clause for the subject contract.

As Of OCTOBER 1997

* Excluding Police details, and other commitments

CONTRACT PACKAGE	CURRENT ESCALATE BUDGET a	ORIGINAL BID VALUE a	MODIFICATIONS b	PAY ITEM OVERUN <UNDERUN c	APPROVED/ AUTHORIZED TRENDS d	CURRENT * FORECAST f=sum(a..d) e	CLAIMS UNDER REVIEW/ PENDING ISSUES f	FUTURE ALLOWANCE g	POTENTIAL FORECAST h=e+f+g	TOTAL CHANGE (AS % of BID VALUE)
100	11,653,996	10,691,582	17,100		-71,973	10,636,709	100,634	748,411	11,485,754	7%
101	49,181,633	45,947,788				45,947,788		3,216,345	49,164,133	7%
102	149,635,990	101,456,070	38,669,733	398,734	10,823,028	151,347,565	-369,612	2,004,947	152,982,900	51%
103	1,761,025	1,645,818	35,400		20,000	1,701,218	10,016	115,207	1,826,441	11%
104	63,976,080	50,869,770	13,560,783		1,284,213	65,714,766	691,035	1,946,910	68,352,711	34%
105	3,047,585	2,848,210	181,985		313,015	3,343,210	645,252		3,988,462	40%
106	8,064,854	7,307,818	265,595		50,001	7,623,414		463,304	8,086,718	11%
107	1,601,776	1,496,987	1,095,569		530,239	3,122,795	155,000		3,277,795	119%
108	164,410,952	152,422,783	-145,987	840,711	5,045,731	158,163,238	3,924,220	10,580,565	172,686,597	13%
109	61,413,851	57,987,115	5,085,465	2,500	6,900,905	69,975,985	1,697,683	2,368,420	74,305,093	28%
110	114,229,503	76,778,000	21,078,918	335,367	11,426,719	109,619,004	1,486,636	361,908	111,583,054	45%
111	117,034,259	108,576,515	-135,825		4,853,646	113,294,336	1,397,900	5,337,297	121,020,445	11%
112	424,522,127	377,933,000	35,308,819	2,062,416	15,572,636	430,876,871	22,856,530	10,375,413	466,672,640	23%
113	177,210,494	159,979,256	7,442,977	47,180	1,506,222	168,975,635	6,404	8,651,785	179,439,444	12%
114	46,172,876	37,921,740	7,048,361	116,903	1,957,394	47,044,398	5,442,487	1,447,171	55,484,932	46%
115	16,063,520	12,473,976	2,493,238	-330,313	702,161	15,339,062	655,021		16,673,102	34%
116	404,776,399	377,340,990	482,719		1,571,578	379,395,287	-258,042	25,513,869	405,672,655	8%
117	117,138,846	106,972,972	4,921,841	24,952	439,329	112,359,094	2,715,914	5,271,834	120,587,561	13%
118	259,358,343	241,457,711	9,225		993,833	242,460,769	1,892,284	16,036,760	261,801,558	8%
119	165,265,315	147,239,356	7,973,701	3,789,486	-835,109	158,167,434	1,580,114	6,773,183	167,327,044	14%
120	85,652,717	72,430,000	4,935,853		4,717,786	82,083,639	2,331,310	7,191,103	91,612,669	26%
121	357,985,242	339,487,273	703,046	-13	3,676,227	343,866,533	763,215	17,277,653	362,338,447	7%
122	53,970,064	50,420,621	400,746	9,690	408,267	51,239,324	380,565	2,626,190	54,266,078	8%
123	23,903,072	22,270,766	-21,471		500,000	22,749,295	238,280	858,793	23,919,720	7%
124	4,175,971	3,898,044	-41,030	11,760	502	3,869,276	-3,000		3,871,339	-1%
125	17,099,193	13,469,000	3,676,966		700,000	17,845,966	253,509		18,102,179	34%
126	34,796,748	17,430,000	14,155,421		6,628,485	38,213,906	72,778		38,340,665	120%
127	356,320	374,010	-2,380	-15,310		356,320			356,320	-5%
128	1,701,396	1,590,000	107,477			1,697,477			1,699,785	7%
129	14,674,572	11,944,000	2,730,939	-1		14,674,938			14,674,939	23%
130	8,399,723	7,573,000	736,762	1,000	56,590	8,367,352	9,892		8,394,554	11%
131	899,920	556,443	92,825		239,988	889,256	-3,114		886,142	59%
132	2,662,586	2,163,564	547,184	-61,890		2,648,858			2,662,586	23%
133	2,729,767	2,657,385	253,144	-182,920		2,727,609			2,729,767	3%

As Of OCTOBER 1997

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CONTRACT PACKAGE	CURRENT ESCALATE BUDGET a	ORIGINAL BID VALUE a	MODIFICATIONS b	PAY ITEM OVERUN <UNDERUN c	APPROVED/ AUTHORIZED TRENDS d	CURRENT * FORECAST f=sum(a..d) e	CLAIMS UNDER REVIEW/ PENDING ISSUES f	FUTURE ALLOWANCE g	POTENTIAL FORECAST h=e+f+g	TOTAL CHANGE (AS % of BID VALUE)
134	976,520	950,036	8,670			958,706			965,480	2%
135	11,363,584	4,886,375	5,871,435		2,244,211	13,002,021	1,298,844	107,667	14,420,892	195%
136	12,311,792	10,987,580	948,849	109,841	1,446,171	13,492,441	101,900		13,779,420	25%
137	316,099,007	297,721,731	905,656		8,276,209	306,903,596	1,101,975	18,161,362	326,564,433	10%
138	176,232,178	157,968,871	3,575,774	111,992	1,021,471	162,678,108	3,618,832	7,977,933	176,315,755	12%
139	425,001,555	397,459,140	-185,820		-5,189,002	392,084,318	-1,243,410	27,695,098	418,906,282	5%
140	78,210,224	49,495,000	28,684,263		-31,608	78,147,655	59,500		78,207,155	58%
141	21,757,566	19,165,637	1,781,653	16,500	2,503,000	23,466,790			23,546,357	23%
142	8,260,010	6,737,000	1,105,784		12,886	7,855,670	16,262		7,905,986	17%
143	35,075,354	20,494,476	13,983,389	116,977		34,594,842			35,075,354	71%
144	34,156,778	27,392,820	5,689,253	-83,981	879,944	33,878,036			34,123,450	25%
145	26,490,286	19,983,533	6,150,471	-67,892	167,000	26,233,112	113,956		26,582,907	33%
146	6,225,076	3,797,971	2,254,059	-31,948		6,020,082			6,225,076	64%
147	6,289,479	5,627,200	444,906	45,176		6,117,282			6,289,479	12%
148	28,664,906	23,457,510	4,585,349	-371		28,042,488			28,664,911	22%
149	474,500	405,173	69,327			474,500			474,500	17%
150	3,081,072	2,638,817	442,255			3,081,072			3,081,072	17%
151	10,473,100	10,915,823	-443,026			10,472,797			10,473,100	-4%
152	12,958,794	10,786,820	2,171,974			12,958,794			12,958,794	20%
153	580,963	576,528	4,434			580,962			580,962	1%
154	422,957	410,000	12,957			422,957			422,957	3%
155	565,293	547,500	17,793			565,293			565,293	3%
156	1,637,244	1,631,643	31,602			1,663,245			1,637,244	0%
157	1,654,002	1,788,544	-169,826			1,618,718			1,654,002	-8%
158	1,362,094	1,355,375	-3,168			1,352,207			1,362,094	0%
159	1,542,664	1,379,000	162,312			1,541,312			1,542,664	12%
160	1,830,910	1,770,839	60,071			1,830,910			1,830,910	3%
161	856,294	859,500	-6,976			852,524			856,294	0%
162	755,386	788,575	-36,790			751,785			755,386	-4%
163	5,015,012	4,659,035	450,615	-157,941		4,951,709			5,015,012	8%
164	248,263,398	179,149,600	68,655,077	-1		247,804,676			248,263,398	39%
165	20,701,637	16,706,343	3,993,657			20,700,000			20,701,637	24%
166	2,735,744	2,553,120	161,617			2,714,737			2,718,481	6%
167	10,872,141	8,817,534	2,005,113			10,822,647			10,872,141	23%

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168	1,848,303	1,747,829	70,269			1,818,098			1,848,303	6%
169	250,840,631	226,896,824	23,877,971			250,774,795			250,840,631	11%
170	6,286,934	5,147,750	941,748			6,089,498			6,286,934	22%
171	17,600,581	14,562,419	2,441,618			17,004,037			17,600,581	21%
172	4,177,935	2,260,000	1,755,953			4,015,953			4,177,935	85%
173	5,395,250	5,395,250				5,395,250			5,395,250	0%
174	78,210,224	49,495,000	28,684,263		-31,608	78,147,655	59,500		78,207,155	58%
175	320,939,434	245,964,000	75,444,088	-1,715,972	-75,000	319,617,116	209,715		320,940,265	30%
176	21,757,566	19,165,637	1,781,653	16,500	2,503,000	23,466,790			23,546,357	23%
177	8,260,010	6,737,000	1,105,784		12,886	7,855,670	16,262		7,905,986	17%
178	35,075,354	20,494,476	13,983,389	116,977		34,594,842			35,075,354	71%
179	4,175,971	3,898,044	-41,030	11,760	502	3,869,276	-3,000		3,871,339	-1%

Average Change Percentage ====> 18%

Code No. [ ] Name of Bidder_____

SCHEDULE OF QUANTITIES AND PRICES [NAME OF CONTRACT AND (NUMBER)]

PAYMENT ITEM	ITEM DESCRIPTION	PRICE IN WORDS AND FIGURES	QUANTITY	TOTAL PRICE IN FIGURES
100.00		_____ ($_____)	X	= _____
100.100		_____ ($_____)	X	= _____
100.200		_____ ($_____)	X	= _____
	Total Estimated Contract Price	_____ (Price in Words)		_____ (Price in Figures)
200.000	Milestone 1 Days Saved not to Exceed 93	Forty-Two Thousand, One hundred _____ ($42,100.00)	X ____ Days	= _____
200.100	Milestone 2 Days Saved not to Exceed 120	Twenty-Five Thousand, Eight Hundred _____ ($25,800.00)	X ____ Days	= _____
	TOTAL ADJUSTMENT FOR DAYS SAVED:			= $_____ (Price in Figures)
TOTAL ESTIMATED CONTRACT PRICE MINUS TOTAL ADJUSTMENT FOR DAYS AVED, EQUALS TOTAL PROPOSAL PRICE FOR BIDDER SELECTION:				= $_____ (Price in Figures)

Attachment 2

IV. Alternatives to Liquidated Damages

A. Introduction

This chapter will examine the applicability of the Liquidated Damages Clause to multi-contract projects in general. The pros and cons of liquidated damages, as well as their limitations on the CA/T Project will be also discussed.

Finally, several forms of incentive/disincentive methods will be explored as alternatives to liquidated damages, along with examples of public projects, which have successfully implemented a form of an incentive/disincentive clause on their contracts.

B. Limitations of Liquidated Damages on the CA/T Project

1. Enforceability

Construction projects are generally characterized by uniqueness and therefore uncertainty. Each project is essentially subject to changes due to numerous reasons, such as different site conditions, design changes, Owner's caused delays, changes in regulations and requirements by other agencies. Such changes could potentially affect the project cost and/or duration.

This phenomenon is more evident in multi-contract projects. Because of the interfaces between contracts, a delay caused by a change in one contract could have a domino effect on many other contracts. This increases the likelihood of changes and potential delays in any of the contracts of a multi-contract project more than in a single contract project.

Additionally, multi-contract projects are often mega projects and are affected by many stakeholders, who collectively contribute to changes to its scope of work and subsequently to its duration. Because of the complexity of such projects and the many interfaces each contract usually has, the process of apportioning delays to the parties which caused them becomes extremely difficult. This jeopardizes the enforceability of the liquidated damages clause in multi-contract projects.

The CA/T project is an example of a multi-contract project, which not only contains hundreds of contracts, but also involves many State, City, and Federal agencies, in addition to neighboring businesses, residents, and abutters. All these external forces continuously impact the CA/T project and inevitably cause changes and potential delays to its contracts. This makes the CA/T project vulnerable to delay, and when a delay eventually happens, most of the time at least an external entity is involved, and it is difficult to separate the delay caused by the contractor from that caused by others.

One more factor that makes the CA/T project vulnerable to changes beyond the contractor's control is the nature of its major work. Tunneling, and utilities relocation, which are the majority of the CA/T project's work, accompanied by the project site in downtown Boston, which is

mainly landfill, make differing site conditions the norm. Attachment 1 shows a sample of CA/T contracts with the forecasted percentage of changes in contract price.

Another factor is the project's fast track approach for procurement, which allows construction and design to take place concurrently, rather than sequentially, to reduce the overall project duration. The project is divided into hundreds of design packages which interface with each other. The design of the whole project was not completed when construction started. Rather, early and preparatory work were designed, packaged and awarded before the follow on work. As early on contracts were underway, development of design could necessitate changes in the on-going construction.

An example is the design and the issuance of bidding documents for an early construction contract, which contains as part of its scope of work the construction of slurry walls to be used by a follow on contract as support of excavation for a tunnel. At the time of issuance of the early contract, the complete and detailed design of the follow on tunnel was not finalized. As the final design takes shape, changes in the design of the early, now on-going construction contract could be necessary.

Also, because of the repetitive nature of the project contracts, significant lessons learned from substantially complete projects could be incorporated into similar contracts that are still in the early construction stage as change orders.

As many of the court cases presented in Chapter II indicated, the liquidated damages clause is not enforceable when the cause of delay can not be apportioned reasonably between the Owner and the Contractor This raises the question about the enforceability of liquidated damages on the CA/T project, which is vulnerable to changes caused by many forces other than the contractor.

2. Cost Effectiveness

2.1 Adversarial relationship and less competition

When liquidated damages are assessed against a contractor, especially when the cause is in dispute, an adversarial relationship between the Owner and the Contractor is created

The nature of the CA/T project makes it difficult for the government to permit such relationships. Adversarial relationships easily lead to further construction delays. The financial and political impact on the project as well as the impact on traffic, the business community, and roadway users from time delays in construction far outweigh any financial gain by the Department from assessing liquidated damages.

If an adversarial relationship between the project and a contractor develops on one of its contracts, this will affect the subject contract, other contracts that involve the same contractor, as well as future bids by this contractor, and eventually the outcome of its future bids.

Also, Contractors on the subject contract as well as other contracts will be defensive which can make them unwilling, or less cooperative in coordinating work with externals, but rather trying to take advantage and to build evidence in anticipation of inevitable disputes regarding anticipated liquidated damages assessment

Despite the Department many attempts to attract new bidders, only a few contractors repeatedly bid the CA/T contracts. As a matter of fact, more than 30% of all awarded contracts have been won by the same contractor (Modern Continental Construction of Massachusetts alone, or with its Japanese partner Obayashi).

Assessing Liquidated damages against a contractor could affect its cash flow and therefore its performance on the subject contract and on other contracts the contractor has on the project. It will also affect the contractor's ability to bid future jobs in a reasonable price.

If the contractor is financially hurt, it may not bid future jobs and therefore the project will have less competition.

Dispute over assessed liquidated damages and the responsibility of delays will drain scarce resources of the contractor and the Department. It will also damage the reputation the Department pride itself with for having a zero-litigation project. The litigation cost will also prove costly to both parties.

2.2 Higher risk and higher bids

The CA/T estimating model, which was illustrated in Chapter III, does not estimate damages to a contract beyond its immediate follow-on contract. This assumes that all delays will be recovered no later than the completion date of the follow-on contract. This is not necessarily true and the reason for the assumption is that liquidated damages become very expensive if the effect of the delay is considered until the end of the project.

High liquidated damages per diem will be reflected in higher bids, which will mean higher project cost. Another example of high liquidated damages is the ones allocated to significant and strategic milestones. When a milestone can not be delayed, how much liquidated damages should it have? An example is the milestone for the opening of the Third Harbor Tunnel, which was publicized and is expected to result in major traffic relief to the public

The whole world knew that December 15, 1995, is the date on which the Ted Williams Tunnel, also known as The Third Harbor Tunnel (THT), is to be opened to traffic. Any delay was to undermine the credibility of the CA/T officials, its Management Consultant, and therefore the budgeted costs and completion date of the Project. It will also worsen the already delicate image of the Project in the eyes of the residents of Boston and Massachusetts.

Estimating the actual damages to the owner for every invaluable day of delay to the opening of THT will render high cost. However, incorporating such cost in the bidding documents as liquidated damages will make bids very expensive. As a result, an amount of $8,500 per day was

incorporated as liquidated damages for substantial completion milestone in the bid documents of the THT finishes contract, with an understanding that progress will be monitored very carefully and corrective actions will be proactively made to support the publicized milestone's date

Another example will be the milestone dates committed to third parties to complete work in their premises on certain dates. Failure to do so will create friction between the Department and the involved third party, and will spoil the cooperation in the affected contract, present contracts, as well as negotiation for future work.

An example will be the work in North Station Rail yard area. The Project promised MBTA to complete work there in two years. This work involves two sequential contracts. Failure of either contract to finish on time will fail the project's promise. The invaluable cost for breaking this commitment is hard to estimate and was not included in estimating the liquidated damages for the involved contracts.

3. Difficulty

Liquidated damages on the CA/T are hard to estimate and hard to administer. Some of the milestones they are tied to are to implement certain traffic phases on or before a certain date. However, such traffic implementation is meaningless, if not coordinated with neighboring contracts and if the intended scope of work within the area is not complete.

In such cases, full cooperation from all involved contractors is mandatory to successfully implement and switch traffic to the new pattern. In some cases, a contractor may wait beyond its contractual milestone date to achieve that goal. If liquidated damages are assessed blindly in such cases the overall objective of finishing the whole project on time will be undermined.

C. Alternatives to Liquidated Damages on the CA/T

1. Incentive/Disincentive Clauses

Incentive/disincentive provisions provide for extra monetary bonus to the contractor for underrun of selected project milestone(s), as well as penalty in case of overrun.

They are recommended by FHWA to be used where construction needs to be kept to a short duration, as it creates a great deal of inconvenience to traffic, as well as loss of roadway use, and significant revenue loss to businesses. They are also suitable where estimated liquidated damages amount is too high compared to the project value. In such cases, if liquidated damages are to be used, unreasonable high bids could be submitted reflecting the risk of losses in the event of overrun.

When applied effectively, in addition to, or in lieu of liquidated damages, incentive/disincentive provisions can promote high performance standards by the contractor. In this approach, the contractor is motivated not only to meet, but also to beat the contract milestone(s), by allocating resources more efficiently, by using innovative means and methods, and by being proactive in

identifying potential delays and therefore taking preventive and corrective actions.

In contrast, conventional lump sum competitively bid contracts with liquidated damages clauses do not encourage early completion, but rather discourage late completion and create consequence adversarial relationship between the project team players, as the focus is shifted towards avoidance of penalties and potential claims, rather than efficient contract management and performance.

When incentive/disincentive provisions are used in addition to liquidated damages, their monetary values have to be estimated independent of the liquidated damages amount. Failure to do so will cause the incentive/disincentive provision to be considered an unenforceable penalty. This concept was established by the court ruling presented in 2.1 case one in Chapter II.

Incentive/disincentive, as well as liquidated damages, provisions are only as good as the milestones to which they are applied. The Owner must clearly establish logical, realistic, and achievable milestones. A detailed analysis of each milestone logic, intent, and objectives need to be performed carefully before issuing bidding documents, and then clearly communicated to bidders in the bid documents.

A good example of the incentive/disincentive clause is the one that was implemented by Massachusetts Turnpike Authority (MTA) on a 15.5 million contract to renovate the Callahan tunnel. The tunnel transports as many as 3,500 vehicles each hour. MTA allowed work on the tunnel only between midnight and 5:30 AM; with severe liquidated damages if the contractor failed to restore tunnel service by 5:30 AM ready for morning traffic. In addition the contract included an incentive/disincentive clause, which called for a bonus or penalty of 5,000 per day, depending on whether the contractor finishes before or after the contractual date for substantial completion.

The following is a script of the incentive/disincentive clause, followed by a script of the liquidated damages clause:

> "In the event of an underrun or overrun of the time allowed for the completion of the contract, final payment otherwise due the contractor shall be adjusted from the specified completion date plus any time extensions approved under contract provisions, as follows:
>
> *(1) For each day underrun up to 30 calendar days, payment shall be increased by $5,000 per calendar day.*
>
> *(2) For each day overrun up to 30 calendar days, payment shall be decreased by $5,000 per calendar day.*
>
> *Maximum amount to apply to incentive and disincentive shall be $150,000.*
>
> Payment for underruns shall be added to payments to the contractor.

Charges for overrun will be deducted from payments to the contractor.

There shall be no further adjustment for overrun or underrun exceeding 30 days.

The incentive/disincentive clause shall be tied to the established substantial completion date.

Substantial Completion shall be defined as the completion of all elements of this contract, such that the work is complete, usable, operational, tested, approved, and accepted by the MTA. Further, substantial completion shall include all punch list items that must be completed in the tunnel proper (i.e. roadway area) or approach areas, however minor in scope. Any contract work or punch list work requiring a full tunnel closure or single lane closure shall be considered outside of the scope of substantial completion.

In addition, all work in this contract which takes place in ventilation or other tunnel division structures, supply or exhaust plenums, pump chambers or any other MTA property other than the tunnel proper or approaches shall be completed in its entirety as outlined in the preceding paragraph, with the exception that minor punch list items in these areas may be completed after substantial completion and prior to actual completion. Minor punch list items are defined as rudimentary or final cleanup, touch-up work or minor adjustments requiring no more than the use of hand tools.

"Each day, liquidated damages will be assessed to the contractor for each half hour or part thereof he fails to vacate the Callahan tunnel roadway and its attendant approaches by 5:30 A.M. The assessed liquidated damages will be in accordance with the following schedule:

Failure to Vacate by	*Total Daily Liquidated Damages Assessed*
5:30:01 A.M.	*$5,000*
6:00:01 A.M.	*$25,000*
6:30:01 A.M.	*$65,000*

Whatever sum of money may become due and payable to the Authority by the Contractor under provisions of this paragraph may be retained out of the monies due or become due to the contractor in the possession of the Authority. The provision shall be construed or treated by the parties of the contract not as imposing a penalty upon the contractor for failure to vacate."

Incentive/disincentive estimates need to abide by the same rules as liquidated damages are; otherwise they can be challenged in Court On the above example, the $5,000 per day amount was the estimated cost to the MTA for administering the nightly bore closing, which was required to permit the work in the tunnel.

The contractor on this job, Kiewit Eastern/Mass. Electric, completed the job 30 days ahead of schedule and was awarded a $150,000 bonus for early completion of the work.

2. A + B Bid

This bidding system has been used by the U.S. Army Corps of Engineers for about 20 years under the name "bidding on cost/time". In this method, the total cost of the project to the owner, not only construction cost is taking into account. As such, contractors bid on the construction cost as part A and also on the total duration of the job as part B, and the lowest responsible combined bidder is awarded the project.

Construction cost (Part A) is bid like any other conventional bidding system The prices of bid items included in part A are used to pay the contractor's requisitions. To calculate part B, the Owner first estimates the value of a time unit (usually a day). That is the cost to the owner for every day that goes by and the project is not complete, or in other words how much the owner is willing to pay to have the job completed one day earlier. Each bidder bid the number of days they need to construct the project. Part B is then calculated as the product of the cost per day as provided by the Owner by the project duration as bid by each contractor. The total bid price is the total cost of the project to the owner; that is the construction cost (part A), plus the time cost to the Owner (part B). The responsible bidder with the lowest total cost to the owner is then awarded the bid.

The legal aspects of the A+B method were investigated by Harp (1990), who concluded that the method does not violate the competitive bidding concept and therefore is applicable to public projects. Also, 101 projects that have been awarded using the A + B method were studied by Herbsman (1995), who compared them to similar projects that were bid using conventional methods and concluded that substantial savings in construction time have been achieved when using the A + B method with almost no addition in cost. The research also concluded that the method is most suitable to rehabilitation and replacement of roadways and bridges. These projects are normally built in urban areas usually under heavy traffic volume. Construction under such circumstances creates major inconveniences to the public, in terms of lost time, revenue and also lost value of life as a result of environmental pollution. Therefore, reducing construction duration becomes a major priority, which warrants the need for a bidding strategy, which accounts for construction duration as well as construction, cost.

An incentive/disincentive provision is usually applied to the dates set in part B by the bidder. All of the case studies, which were reviewed, used an incentive/disincentive provision to enforce and motivate contractor performance to meet or beat the bid construction duration.

3. A + B Bid with Incentive/Disincentive Clauses

This is a combination of the A + B approach with incentive/disincentive clause to encourage performance. This method is typically used when the expedition of construction process is extremely important to the Owner, because of high costs and inconvenience resulting from construction and loss of facility use.

This approach gives the contractor a motivation to beat the Engineer's schedule by reducing the construction duration and therefore the B portion of its bid. This gives the contractor a better chance to win the bid. Once construction starts, the incentive/disincentive clause motivates the contractor to beat its own schedule as bid, or at least to meet said date.

A project example, which had successfully implemented this method, is the Santa Monica Freeway Bridge Reconstruction in California. This job was bid using A + B bid with incentive/disincentive clause to motivate the contractor to reduce the construction duration. This bridge was damaged by the Northridge earthquake in 1994. Loss of use of the bridge caused a lot of inconvenience, delays, as well as revenue losses to businesses. The California Trucking Association reported that opening the freeway early will save their commercial operators more than $500,000 per day in trucking cost (Carr 1994).

The contractor's duration estimate in part B was 140 days. The incentive/disincentive fee was $200,000 per day for every day the contractor finishes the project ahead off/behind the estimate provided for in its part B bid (the 140 days). The $200,000 incentive/disincentive fee was calculated by the Owner, California Department of Transportation (CALTRANS) obviously did not account for revenue loss by businesses such as the trucking Association.

The contractor completed the job in 66 days, 74 days ahead of schedule, and was therefore awarded $14,800,000 in bonus for the early completion of the project. The bonus fee was approximately equal to the total contractor's bid price for the whole job ($14,904,275).

4. A - B Bid

This is a form of A + B bidding that has been studied by the CA/T Project officials to be used on one of its utilities contracts. However, due to a protest from the Construction Industries of Massachusetts, Inc., the provisions to use A-B bidding process had been removed from the bidding documents and the contract was awarded the conventional way to the lowest bidder in February, 1997, and the use of A-B bidding on the CA/T has been postponed.

On this method, as in A+B, A is the Bid Price, however B is the number of days the contractor bid to save against the contract milestone, instead of the total duration to complete the milestone. The awarded contract will reflect the reduced duration, if any, as proposed by the lowest responsible bidder in its bid, and the dates of milestones will be modified in the Contract Documents to reflect the shortened duration to which the contractor has committed itself. The liquidated damages contained in the contract documents would commence upon expiration of those adjusted milestones duration.

The following is the (A – B) bidding process script which was later deleted from one of the CA/T utilities contract bidding documents.

"Special Instructions to bidders

Introduction

A Schedule Optimization Program is incorporated into the bidding process of this Contract to allow each Bidder to best implement its means and methods, within the terms and conditions of the contract documents, for completion of the work at the earliest feasible opportunity, to the advantage of both the successful Bidder and the Department.

An incentive is provided to bidders to bid "Days Saved" to Milestone 2, Substantial Completion. Bidders may bid from 0 to a maximum of 100 Days saved.

The "Total Estimated Contract Price," is the sum of Bid Items 101.1 through 996.010, contained in the Schedule of Quantities and Prices in the Itemized Proposal submitted as a bid? This Total Estimated Contract Price remains unchanged whether or not the Bidder chooses to bid days Saved more than 0. The Total Estimated Contract Price is referred to as "part A", for convenience.

The Adjustment for Days Saved is a number of Days Saved bid for Milestone 2 (from 0 to a maximum of 100 Days) multiplied by a value of $4,000 per Day. The Adjustment for Days Saved is referred to as "part B", for convenience.

The Proposal Price shall be determined by subtracting the Adjustment for Days saved from the Total Estimated Contract Price; that is part A minus part B. Contract Award shall be made to the Bidder who submits the lowest Proposal Price with its bid, and satisfies all other requirements for Contract Award, as provided for in the Contract Documents, who shall be considered the lowest responsible Bidder.

Milestone 2 duration in any executed contract will be decreased from the base duration appearing in Division I, Special Provision 8.03, by the number of Days Saved bid by the lowest responsible Bidder. Milestone 1 duration will also be decreased by the same number of days, since Final Acceptance is intended to be 60 Days after Substantial Completion.

During the Contract, the basis for payment to the Contractor will be the bid prices for Bid Items 101.1 through 996.010 in the Schedule of Quantities and Prices submitted by the Contractor in its Itemized Proposal.

Add Bid Items 101.1 through 996.010 in the Schedule of Quantities and Prices, and insert this figure on the line marked A. TOTAL ESTIMATED CONTRACT PRICE.

Insert the number of Days Saved to Milestone 2 (from 0to a maximum of 100) you intend to bid in B. ADJUSTMENT FOR DAYS SAVED.

Multiply the Days Saved by $4,000 and insert the product on "Total in Figures" on line B.

Subtract the figure representing the AJUSTMENT FOR DAYS SAVED from the figure representing the TOTAL ESTIMATED CONTRACT PRICE and insert the result on the line marked PRPOSAL PRICE. This result will be the PROPOSAL PRICE for Bidder selection, which will be evaluated for contract award purposes.

EXAMPLE

A. TOTAL ESTIMATED CONTRACT PRICE		*$1,000,000*
B. ADJUSTMENT FOR DAYS SAVED	*$4,000 X 30 Days =*	*$120,000*
PROPOSAL PRICE (A-B)		*$880,000"*

Attachment 2 is a sample of the Schedule of Quantities and Prices of a CA/T contract which was intended to use the A – B Bidding approach.

5. Mobilization Bid Item

In this method, the payment structure is used to motivate contractor's performance. On the CA/T project, 50 % of Mobilization (bid item number 748.) is usually paid with the first pay requisition. 25% is then paid when the contract is 5% complete, and the remaining 25% is paid when the contract is 10% complete.

On January 1997, the author of this paper suggested to the Management Consultant of the CA/T project to change the payment structure of the Mobilization Bid Item to encourage contractor performance towards achieving milestones instead of using percentages. The idea is still to pay 50% of Mobilization (about 2.5% of the total contract value) with the first payment requisition. This will encourage bidders (as they currently do) to fully bid the maximum allowed amount for this bid item (5%). By doing that, the Mobilization Bid Item becomes a significant payment item to the contractor's cash flow. The remaining of this bid item could be then tied to the achievement of selected interim milestones, instead of project percentage of completion. An example would be to pay 30% when milestone A is substantially complete, and the remaining 20% when milestone B is substantially complete.

The approach had never been implemented as suggested; however, a similar approach was used to promote performance by making payment of the remaining 50% of mobilization subject to

completion of certain tasks by the contractor, such as approval of selected critical submittals, and approval of the preliminary schedule.

6. Demobilization Bid Item

This method was studied on the CA/T project to be used to as an incentive for contractors to achieve project's substantial completion.

The method uses demobilization bid item, which is included in the Schedule of Quantities and Prices, and therefore is bid for by contractors. The payment of this bid item is made once the contractor achieves substantial completion. This was thought to be a motivation for the contractor to allocate and plan its resources efficiently to achieve substantial completion, and therefore be eligible to receive the demobilization payment.

The assumption was that the fair value of demobilizing the site would be significant enough to motivate performance. However, the significance of such bid item will depend on the price the contractor is willing to bid for it. This raised a concern among project officials that contractors could be tempted to unbalance their bids by low-bid this pay item since its payment takes place at the end of the job, and therefore becomes insignificant cash producer to the contractor and defies its purpose.

As a result this method was not implemented and no further options were experimented to prevent from unbalancing this bid item (for instance to set a minimum price that the contractors are instructed not to bid lower than it for the Demobilization Bid Item).

7. Retention

Another method in which payments structure can be used to motivate the contractor's performance. The idea is to reduce retention percentage as major interim milestones are achieved. This will increase the contractor's cash flow which is a major advantage to the contractor specially in mega projects such as the CA/T, and therefore becomes a motivation to the contractor to plan its work and resources more efficiently to achieve the Owner Strategic milestone(s).

On the CA/T, 5% of the total value of executed work is retained from each progress payment. This retainage ceases to be applied when the project is 25% complete, regardless of the contractor's performance schedule wise. Using retention as an incentive to achieve a milestone, the 5% retention provision shall be stopped once a significant milestone is substantially complete.

8. Fee Milestone

This is a form of the incentive/disincentive approach. However, it is established after the job is awarded and therefore relies on successful negotiation between the Owner and the Contractor.

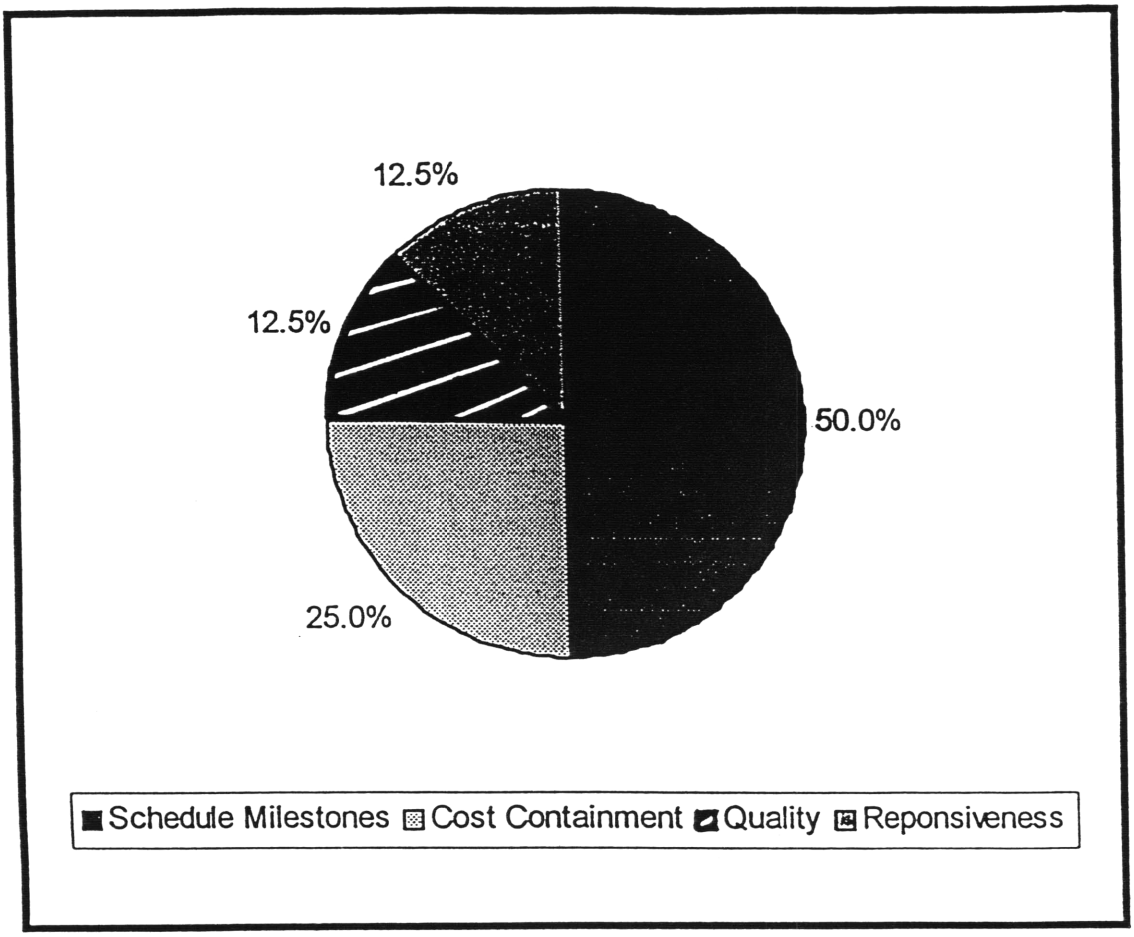
In this method, after the contract is underway, the Owner due to unanticipated changes and or circumstances requires a certain milestone to be achieved earlier, or to create a new milestone. This requires modifying the contract documents.

To ensure performance, the contractor is usually offered an incentive to reach the new milestone date. Also a disincentive is applied if the contractor fails to meet that date.

9. Fee at Risk

An example of the incentive/disincentive approach used by the CA/T is the performance-based variable percentage, which is used to pay the Management Consultant fee.

Under its contract with the Department, the Management Consultant fee is 10%. An incentive/disincentive clause was then amended to the contract. The base fee is 10%. And there is a 2% at risk fee and a 2% incentive fee. Based on the Management Consultant performance, the fee could be adjusted downward, up to 8%; or upward, up to 12%.
The performance is measured using a matrix, which takes into account schedule, cost, and quality of the Management Consultant's work. The following pie chart illustrates the criteria used to evaluate performance along with the weight used against each criterion.



The criteria to measure performance are adjusted once every six months. The intention is to keep such criteria more objective than subjective, in order to be easier to be measured and to reduce the negotiation effort and make the exercise less painful and not personal.

V. Conclusions and Recommendations

A. Conclusions

The contractor, as well as the Owner, is interested in a complete project as soon as possible, or at least not behind its contractual dates. For reasons attributed to both parties, either party, or neither party, construction contracts and their interim milestones often finish behind schedule.

Liquidated damages clauses are the most common mechanism used in public projects to compensate the public Owner for losses caused by delays that are the fault of the contractor.

Liquidated damages provisions are not enforceable if the disputed delay is caused by other forces beyond, or concurrent with delays caused by, the contractor.

Multi contract projects are usually complicated projects with many stakeholders, and as such are usually more vulnerable to changes. This phenomenon increases the likelihood of any contract of a multi contract project to fall behind schedule.

Liquidated damages clauses are not effective in multi contract projects because:

They can be challenged in court since it is unlikely to prove that a delay is not attributed to factors other than the contractor.

The success of such complex projects in part relies on the full cooperation of a limited number of large contractors who can bid its contracts; and assessment of liquidated damages could ruin the relationship between the project and its contractors.

The estimated liquidated damages amounts for most contracts, especially those on the overall project critical path, can be huge. Incorporating these amounts in the contract bidding documents could result in higher bids and higher total cost.

Other incentive/disincentive provisions have been successfully used on some public projects.

These provisions promote the contractor's performance and penalize its lack of performance. They can be applied during bid period and they can also be applied post bid award.

On a multi contract project, since changes are inevitable, the successful application of incentive/disincentive provisions is limited. When a delay happens, the dispute will not be only about the enforceability of liquidated damages, but it will be also about whether the contractor is eligible to receive the incentive amount. The contractor can argue that if it were not to the forces beyond its control, it would have finished ahead of schedule and therefore be eligible to receive the incentive payment.

Post bid award incentives depend on successful negotiations with the contractor and are usually not beneficial to the Owner. Pre bid award incentives/disincentive provisions require the contractor to develop and study carefully a detailed CPM schedule for the project. This is a lengthy and time-consuming project, especially for multi-million dollar contracts. If the Owner does not allow enough time for bidders to do such analysis, the benefits of the incentive/disincentive process will not be achieved in the bid results.

As such, applying these provisions without modifications to a multi-contract project may even increase the number of claims, create friction between the project and its contractors, and increase the project total cost.

Some initiatives are introduced to the CA/T Project to promote performance. They use payment mechanisms to implicitly reward the contractor's performance. Tying payments of certain milestone(s) such as Mobilization and reducing the retention amount when certain milestone(s) are achieved are examples of these initiatives.

Incentives based on payment mechanism can work in multi-contract Projects, however there is no proven record of their effectiveness to encourage the contractor's timely performance of its contractual milestone(s).

The CA/T Project has successfully used the Mobilization payment to force the contractor to comply with timely performance of early, critical submittals.

B. Recommendations

The following recommendations are offered to overcome the shortfalls of liquidated damages and incentive/disincentive provisions when applied in a complicated multi-contract project such as the CA/T Project:

For the liquidated damages clause, or any other mechanism, to be effective, the Owner must first minimize post contract award changes. This could be achieved by:

Invite the contract stakeholders to the early stages of the design to get and incorporate their input as feasible into the design. If the stakeholders buy into the contract design, they are less likely to require changes afterwards.

Perform as many soil exploration and test pits as possible during design. The money and time spent during this process are much cheaper than modifying the contract's design during construction.

Allow more time and money for the design process. If the time is not available, innovative ideas and brainstorming sessions need to be presented to repackage bid documents to allow the complete design packages to be bid earlier and allow more time for the other packages to be completely designed.

The Owner needs to allocate its management resources more efficiently. The more skillful and experienced staff needs to be involved in drafting the contracts before they are awarded, rather than during construction to deal with spiraling problems caused by errors, omissions, ambiguity and poor judgements made in the contract language.

Hold more pre-bid meetings with the bidders, during which questions and open discussions are encouraged. More attention then needs to be paid to the bidders questions as they usually offer clues about what is not clear in the contract. Finally, the answers to the bidders questions must be clear, simple, identifying the intent of the contract language, and must not dance around the issues. Unclear, unresolved issues would still have to be resolved later, much more costly, during construction.

Liquidated damages clauses should be used in contracts that are less exposed to changes caused by forces external to them, and contracts with a less dynamic nature, and a less uncertain scope of work (i.e., underground construction).

Use incentive/disincentive clauses for projects that are more critical and need to be expedited for the Owner (i.e., rebuilding a destroyed bridge). However, the project scope still has to be static and less vulnerable to changes. Also, incentive/disincentive clauses shall be used only when the Owner allows enough time for the bidders to prepare their bid price and analyze the project to find the optimum schedule for it.

The Owner of a complex multi-contract project must be innovative in using alternatives to liquidated damages provisions. The Owner may consider an implicit process to motivate the contractor's performance without undermining its relationship with it contractors, or increasing the project overall cost.

Examples of mechanisms that can mitigate liquidated damages and incentive/disincentive provisions shortfalls are:

Restrict payments of certain bid items (i.e. the Mobilization bid item) to achieving certain milestone(s).

Apply retention to interim milestone(s) the same way it is applied to substantial completion. The percentages applied to milestones may vary based on the importance of each milestone.

Reduce and refund the retention that is applied to substantial completion as certain milestones are achieved.

If these options fail or can not be applied, empower the Authorized Owner Representative to direct the contractor to accelerate construction activities that are critical to the project. To reduce potential claims and long negotiation time, this must be done on a time and material basis. Also, the bid documents should include provisions to establish guidelines for calculating productivity loss and efficiency factors due to acceleration, disruption, and crew overloading. Thus, reduce the amount of time and efforts in negotiating and establishing these factors if the contractor is directed by the Owner to accelerate construction tasks.

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