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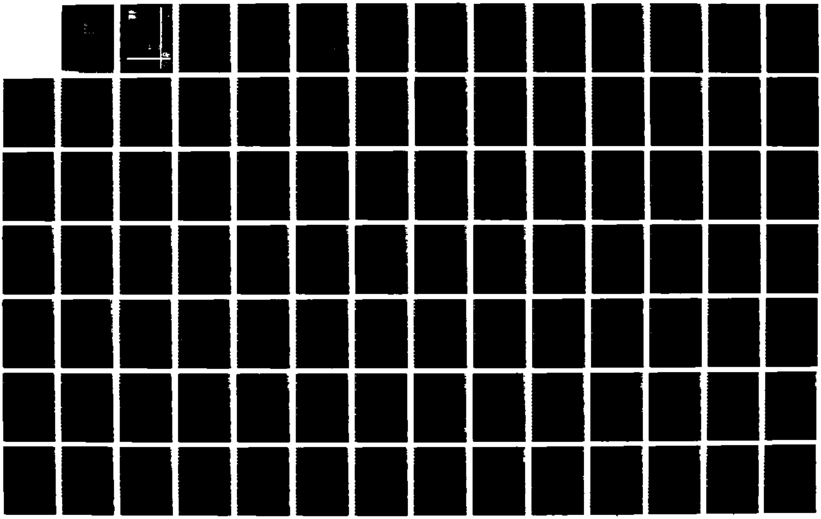

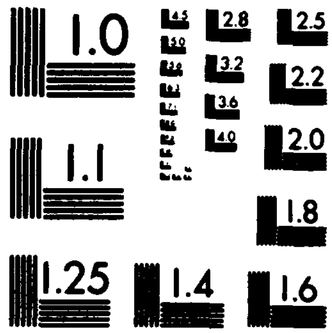
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A STUDY OF CONSTRUCTION CONTRACT DELAY: CAUSES AND IMPACTS

A Special Research Problem

Presented to

The Faculty of the School of Civil Engineering
Georgia Institute of Technology

by

Christian N. Dawkins

In Partial Fulfillment
of the Requirements for the Degree of
Master of Science in Civil Engineering

August, 1987

GEORGIA INSTITUTE OF TECHNOLOGY
A UNIT OF THE UNIVERSITY SYSTEM OF GEORGIA
SCHOOL OF CIVIL ENGINEERING
ATLANTA, GEORGIA 30332

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Chris Dawkins

ABSTRACT

This paper discusses and explores the most recent findings on construction delay. Construction delay touches on many areas of construction management practice and is worthy of in-depth study since it significantly affects costs borne by owners and construction contractors alike.

The paper opens with a section on the causes of construction delay, followed by a section on its costs. These two sections discuss the most recent thoughts on the subject and prepare the reader for the following sections.

The third section is a study of 48 recently completed public building contracts (totalling over $100 million), and their corresponding cost and schedule data. The study analyzes the cause of each contract change order, its corresponding time and cost impact, and a general study of the contracts and their actual completion times versus original planned completion. This section provides quantitative data which supports the first two sections. It also adds a field perspective to the paper's content.

The fourth section discusses management solutions to construction delay based on the preceding three sections and other data gathered from field interviews and the latest professional literature on the subject. This section is followed by conclusions and an assessment of future research needs in this significant area of the construction industry.

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A STUDY OF CONSTRUCTION CONTRACT DELAY;

CAUSES AND IMPACTS

SECTION I

CAUSES OF CONSTRUCTION DELAY

INTRODUCTION

The causal factors which contribute to construction delay are numerous. It is the purpose of this section to discuss these factors and their general impact on construction time and cost. The goal of this study is to provide management with solutions to avoiding delay. This is carefully considered in the fourth section of the paper.

An effective solution must focus directly on the problem source. This section focuses on understanding the problems which lead to costly construction delay.

In 1983, the Business Roundtable concluded a four year study on the construction industry and its practices. The study addressed numerous topics pertinent to construction, of which delay is one. The most striking finding that pointed directly to delay was that over 50% of the time wasted during construction is attributable to poor management practice (Newmann, 1983). The study also concluded that scheduled overtime for the purpose of speeding project completion generally adds to delay rather than improve on it.

Other findings touching on delay included a general lack of training industry-wide, lack of use of state of the art management systems for schedule and cost control, and a general lack of owner attention to contract arrangements and responsibilities. In essence, the study pointed out that the majority of productivity problems lies not with the construction work force, but with management.

Since the 1983 report, much progress has been made in further developing construction management practice. However, there are still many areas requiring management attention. As an example, the most recent literature, as well as field interviews, reveal that contractors' claims, particularly delay claims, are on the rise within the construction industry. This is a symptom of a problem which is extremely costly to contractors and owners alike. This management problem must be abated.

CONSTRUCTION DELAY IN GENERAL

All construction projects are dynamic and unique. Each is site specific to a particular geography and environment. Each has a different mix of owner, designer(s), construction manager(s), contractor(s), sub-contractors, legal contract, financial budget, and time constraints. Furthermore, the life cycle of a project from concept to ribbon cutting can take years, resulting in many personnel and concept changes. Consequently, prediction of delays is generally not possible. However, many lessons can be learned from past experience, and some delays can be generally categorized.

Construction delays can be broken down into three types: classic, serial, and concurrent (O'Brien, 1976).

Classic delay occurs "when a period of idleness or uselessness is imposed upon contractual work". A classic delay can result from a contractor who is not prepared to accomplish work as planned at a given time, by an owner who has not eliminated all barriers contractually required for a contractor to proceed, or by an outside force which neither party can control.

Serial delay is a "linkage" or series of delays one after the other, created by one original delay. This is also referred to as the "ripple effect" of construction delays.

Concurrent delay occurs when both the contractor and owner cause separate delays during the same period of time. In the case of concurrent delays neither party can be held responsible for the time or cost of the resulting delay.

As noted above, responsibility for construction delays can rest with the owner, contractor, both parties simultaneously, or an outside force (neither party).

A PROJECT MANAGER'S VIEW OF WHY DELAYS OCCUR (Shah, 1987)

To ascertain why delays occur and who is responsible, one concept classifies the construction process into four categories: a) related parties, b) owner's intentions, c) project specific, and d) regulatory agencies.

The related parties are comprised of the owner, contractor, designer, and the owner's agent. Experienced, informed, and professionally thorough individuals must fill these roles. Some construction delays result due to inexperience or unprofessional actions on the part of one or more of these individuals.

The owner's intentions are expressed through the contract documents, namely the plans, specifications, and other written and oral communication from the owner or his/her agent to the other related parties. The owner's intentions are reflected in how the construction contract is implemented. An effective communication system established between these parties (generally by the owner) is critical to avoiding delay. Conversely stated, poor communication, through any of these media, contributes a great deal to construction delay.

The entities that make up the project include the site and its availability, the materials, labor, and equipment that contribute to the project, and the project's technical design (not to be confused with the owners intentions). Changes of these entities during the project life cycle significantly affect the degree to which the project is delayed. The environment and subsurface conditions are part of the site and as discussed later have major impacts on delay.

The last factor which affects construction delays is the applicable regulatory agencies or outside parties. These parties vary with a given owner. A private owner may be subject to local building codes as well as the governing political bodies (zoning boards, utility commissions, etc...). The public owner is subject to the some of the above bodies as well as many other government agencies such as OSHA. As an example, the nuclear construction industry is extremely regulated by the Nuclear Regulatory Commission (NRC). When the NRC changes a particular regulation, construction already in progress must adapt to meet the new standard, resulting in redesign, rework, and often extensive delays. Changes in contract scope which occur during construction as a result of regulatory agencies or outside parties are often termed "criteria" changes.

CAUSES OF DELAY DURING CONSTRUCTION

The historical causes of construction delay fall under various categories and responsibilities of the related parties. A list of the most significant delay causes based on numerous publications and field interviews follows.

UNFORESEEN CONDITIONS

The two sub-categories of unforeseen conditions are 'force majeure' causes, or acts of God, and those caused by outside forces. Unforeseen conditions are beyond the control of the related parties, and are not caused or affected by any of the parties' negligence or actions. They result in delays which are excusable on a day for day basis, subject to the duration of the unforeseen event. The most common of these are listed below:

Force Majeure Causes

- Fires
- Floods
- Epidemics
- Unusually severe weather (over and above "normal" weather conditions)
- Other acts of God

Outside Entities Causes

- Acts of the public enemy
- Acts of government or regulatory agencies
- Acts of other contractors
- Labor strikes
- Freight embargoes
- Subcontractor / supplier delays due to similar causes
- Quarantine restrictions

UNFORESEEN WORK

A clear distinction should be made between unforeseen conditions which result in excusable delay to all parties, and unforeseen work which is generally a compensable delay borne by the owner. As an example subsurface and other site conditions are often referred to as unforeseen, however they are different from the above list since their occurrence requires change in work scope and adjustment of contract cost and time.

A more descriptive title for this type of unforeseen work is "differing site conditions". They usually result from poor or limited data made available to contractors during bidding periods.

Contractors' claims relating to differing site conditions account for 20% of all claims submitted, and more importantly, 35% of the dollar amounts paid to contractors in claims final settlements (Thomas et al, 1987). Unforeseen work and differing site conditions contribute immensely to construction delay and present a great challenge to industry management.

OWNER / OWNER AGENT CAUSED DELAYS

Owners and their agents, (designers, construction managers, etc.), contribute significantly to delay by their actions and lack thereof. The owner's astute and active involvement in the construction project life cycle is critical to the final outcome. Often owners impose great difficulties to construction progress and add significant cost and time to their projects by failing to properly plan ahead. A list of owner and owner agent caused delays follows:

Owner Caused Delays

Failure to provide site access, property, right of way
Failure to fund the project
Failure to provide owner furnished equipment
Stopping work progress / unwarranted interference
Creating major scope changes after construction start
Failure to pay contractors on time
Failure to properly schedule and coordinate work of other contractors working in the same area for the same owner

Owner Agent Caused Delays

Failure to get approvals and coordinate with multiple regulatory agencies
Defective plans and specifications
Inadequate information
Differing site conditions
Lack of exact as-builts (resulting in unforeseen work)
Delay in review and approvals of shop drawings and submittals
Delay and improper handling of change orders
Directing contractors' method of construction
Failure to effectively communicate
Inadequate contract supervision / inspection
Failure to provide contractually required utilities

CONTRACTOR CAUSED DELAY

The list of management problems facing contractors is similar to those facing owners. Contractors contribute to construction project delays by their lack of properly planning and executing jobs. Typically contractor caused delays are an accumulation of day to day problems that build into sizable delay over time. Historical causes include:

- Slow to mobilize on site
- Failure to properly estimate, plan, or schedule
- Failure to project cash flow / financial difficulty
- Failure to properly man the project
- Failure to provide and maintain equipment / tools
- Accidents on the work site
- Poor quality assurance / workmanship (resulting in rework)
- Failure to coordinate work of subcontractors
- Failure to have material on site
- Inadequate supervision / inspection
- Inexperience with the particular construction type undertaken
- Failure to read the contract
- Failure to communicate

It should be noted that some delays that seem accountable to one party, may in fact be caused by action on the part of another party. As an example, consider a contractor who is faced with an owner who is slow in making progress payments on one of the contractor's many jobs being worked at the same time. The contractor may deliberately delay work for that particular owner to complete work for other owners who pay more speedily.

Likewise, the same contractor may be faced with two contracts at the same time; one of which is significantly more profitable than the other. The contractor again may deliberately delay the less profitable job to speed completion of the more profitable job to improve his/her financial standing.

These two examples illustrate the sometimes complex problem of determining the "real" cause of construction delay and the necessity of sometimes taking a "closer look" at all issues and facts surrounding the construction situation at hand.

One last intangible cause of construction delay is a poor management relationship between the owner and the contractor. Although it is often hard to define, this issue surfaces over and over in literature and field interviews alike.

The traditional adversarial relationship between contractor and owner is counter productive and promotes wasted cost and time. It is a result of the conflicting goals of each respective party. The owner wants the highest quality facility for the least cost. The contractor wants to provide an acceptable quality facility at the greatest profit. Management initiatives which seek to resolve and compromise these differences will go far in reducing the delays which increase costs, reduce profits and limit utility for all parties.

THE RELATIVITY OF CONSTRUCTION DELAY

The cause and impact of construction delay is relative to which party is being delayed and which party is causing the delay. Furthermore, the occurrences of different types of delay are relative to the type of construction being undertaken by those parties. Lastly, the amount of construction delay realized is also relative to the original schedule of project completion.

These factors make construction delay difficult to generalize as each separate project has its own unique set of parameters which affect its progress development and sometimes delay.

THE RELATED PARTIES

Delay in construction can be defined as the "time overrun either beyond the contract date or beyond the date that the parties agreed upon for delivery of the project" (O'Brien, 1976). In virtually all cases, delay is costly to all parties.

To the owner, delay causes revenue loss due to lack of production facilities, continual dependence on old facilities, or lack of revenue generating space. These revenues can never be recovered by the owner.

To the contractor, the longer delayed construction period results in higher or extended project overhead and often higher production costs due to cost escalation. Furthermore the contractor's financial resources are tied up resulting in reduced bonding and bidding capacity for new jobs. In summr .y 1 parties lose in a delay situation.

THE SCHEDULE

The first and foremost parameter affecting delay is the original planned schedule for completion. This area of responsibility belongs to the owner is some industry sectors, and to the contractor in others. Responsibility for the original schedule is a function of the contractual arrangement between the related parties.

The original schedule provides the "base and time frame for the contractor's work and therefore, the base for any allegation of delay and claims springing therefrom" (O'Brien, 1976).

Typically schedules are tight. They are made this way either intentionally by an owner who is willing to pay a premium price for the final product, or accidentally by an inexperienced owner. In any case, a tight schedule adds greater risk to the contractor who is not in a position to question the contract time frame during the bidding period.

Many experienced contractors expect some changes in work during the construction period which will extend the contract duration and hope that the working relationship with the owner will be such that differences in constructable and planned durations can be resolved. Often contractors include some liquidated damages time in their bids to allow for longer than required construction periods.

In summary, tight schedules reduce the contractor's flexibility in accomplishing construction projects, add to contractor risk, and often result in delays. Attention is required by the responsible parties to set more reasonable durations and practical schedules which better serve all in the construction contract process.

TYPE OF CONSTRUCTION

The repeated occurrence of various construction delay types is also a function of the type of construction being accomplished. Some causes of delay are more prevalent in certain areas of the construction industry.

In 1985 the Federal Highway Commission funded a study of contract claims (which all involve delay to some extent). The purpose of the study was to compare the actual base or root cause of claims on federal highway projects with the alleged causes of the claims as stated by the contractor. The results which provide the relative frequencies of both the contractors' argued reason and the actual base reason are provided below (Thomas et al, 1987):

Relative frequencies of claims and corresponding reasons (as argued by the contractor)

Extra work	38%
Owner delays	17%
Site conditions	14%
Design features	12%
Changed quantities	10%
Other	9%
Total	100%

Relative frequencies of claims and corresponding reasons (based on root causes)

Contract documents	56%
Site conditions	20%
Scheduling problems	16%
Substandard work	5%
Contractual duty	3%
Total	100%

The root causes summary provides some enlightening data for construction managers and points to the most pressing problems. These claims cost both parties a great deal of time and capital expenditure. The mitigation and avoidance of these claims reduce delay, direct construction costs, and administration time (indirect costs). While this summary is for highway projects, the problems are universal to the construction industry.

A similar 1985 study on nuclear power plant construction revealed some interesting points on the causes of its delays. The study revealed an average construction delay per project of 42.7 months (26 plant population) with an average original schedule of approximately 70 months (Radlauer et al, 1985). A listing from this study, of the reasons for delay and their corresponding percentage contribution to total delay time follows on the next page.

Causes and % contribution to total delay time
26 nuclear power plants

Out of original scope work		
Labor / Mat'l / Equipment delays		20%
Unforeseen Conditions (Strikes, Disasters)		5%
Regulatory redesign		50%
Non-regulatory redesign		3%
Out of Scope subtotal	78%	
Deliberate Delays		
Financial problems / Load growth		18%
Rescheduling		4%
Deliberate Delays subtotal	22%	
Total	100%	

This study illustrates the significant impact that redesign and out of scope work have on nuclear power plant construction. Regulatory criteria changes add close to two years to the average project length. There is no other area in the construction industry which is as regulated as this one. Regulation costs the utility commissions, contractors, and rate payers a great deal of money. Contractors in particular must keep this fact in mind when preparing their bids and proposals and when scheduling and planning work.

Public Works type construction is another area of construction which faces different types of delays over other construction. This is primarily due to the great amounts of facilities refurbishment and building conversion projects that are undertaken by public works organizations. The five most frequent causes of claims and delays in public works construction are: soil conditions, "unexpected" occurrences, the "new construction mentality", undiscovered deterioration, and scheduling / weather (Greenberg, 1985).

Soil conditions that bring about unforeseen work as cited earlier in the paper are a universal problem throughout the industry. Disputes over subsurface conditions and changed quantities of work abound in this sector of the industry.

"Unexpected" occurrences refers to the uncovering of previously unknown "historic remains" or old utility lines, etc. Delays and changes of this type stem from poor information provided to contractors through as builts and other media.

The "new construction mentality" problem is one which stems from the historic "mind set" of the related parties in the public works construction process. Most public works parties still view every construction site as a "new job" when in reality most projects in this sector involve modernization and expansion of existing facilities.

Many design problems result from the attitude that renovation and modernization designs are the same as new construction designs. This is not the case. For instance, site access and utilities work are extremely different in existing structures than during original construction. Many design problems and change orders occur in public works renovations due to lack of design constructability and forethought.

Likewise, contractors have a great deal of trouble on public works projects because of the same mentality. In refurbishment work, every job and its scope is unique and must be given a close review. In essence, many contractor caused delays on public works jobs stem from contractors not carefully reading the contract.

Contractor caused problems can also come from contractors who are accustomed to work in one particular market, and are moving into a new market. Publicly funded construction and its standards are much different from private construction standards. Many contractors who are inexperienced in public construction fail to read the contract until they are found to be the low bidder and then realize that they have not properly estimated and planned the work.

Undiscovered deterioration is inevitable in public works type work. The true physical state of a facility is sometimes not known until after construction work has begun. This is another case of an unforeseen work condition.

Lack of site access and weather difficulties present the most cumbersome obstacles to scheduling public works type projects since often construction operations and facility use are ongoing simultaneously. Consequently, these are the two major causes of schedule delays that face the public works related parties. Weather related delays will be discussed later in the paper.

Lack of site availability, as promised contractually, is a problem for which the owner is responsible. This type of delay can cost the contractor money for equipment and labor left unproductive. This is a serious area of delay which results in many costly claims, disputes, and litigation. It is a major cause of delay on public works projects as well as other types of construction.

Public works type construction projects present a different perspective on delay. Some of the delays encountered are universal to all sectors of the industry, and others, (particularly unexpected conditions, undiscovered deterioration, and the "new construction" problem), are more prevalent in public works type projects. It is clear that the root of many of the delays encountered stem from lack of forethought and constructability planning on the parts of owners, designers, and contractors alike (Greenberg, 1985).

THE TYPE OF WORK FORCE

Unionized construction sites add another dimension to delay in construction. On these sites, jurisdictional disputes between various trade unions develop over which union on the job should perform a particular task. This can cause delays for which the contractor is responsible since these types of disputes are a part of the contractor's job of coordinating work. This is a problem that again stems from lack of planning on the part of contractors when planning and scheduling work.

OTHER ASPECTS OF DELAY

It should be pointed out that delay is not completely negative, and sometimes can benefit the related parties, although this is the rare case. For instance, a contractor may be delayed on a project, and during the delay time the price of oil or some other building material or commodity drops. When the contractor recommences work, profit after delay (even with impact costs) exceeds that planned originally. Likewise, if a contractor has "work on the shelf" in the same general area, a delay on one job may mean the start of another, thereby increasing the contractor's volume in the short run.

With the right set of circumstances, a contractor can at times turn a costly delay into a profitable time of work. However, this is a rarity and generally does not occur. It is for this reason that delay claims occur.

From the owner's standpoint, delay may be an accepted entity to gain an overall objective. The Georgia Department of Transportation provides a good example of this point. It has been very successful over recent years because it has been able to accelerate the amount of federal funding for Georgia highways. It has done this by speeding its design process so that designs are waiting "on the shelf" for funding. When other states have not been able to obligate allotted federal highway funds due to incomplete design, Georgia has been able to take the additional funding to speed its own highway development.

However, in the course of speeded pre-construction development, some designs have not been as precise as required, and in some cases right of ways have not been acquired. This has resulted in a slightly higher rate of construction delays and claims. However, the state has benefitted from a more developed highway system than original funding would have allowed.

The state, in essence, has taken more risks in its pre-construction development, (resulting in more than the normal amount of delay), but has more quickly achieved its overall goals. This is a case in point of accepting construction delay as part of achieving facilities goals at a faster rate.

In summary, causes of construction delay are affected not only by the four categories of the construction process, (related parties, owners intentions, project, agencies / outside forces), but also are significantly affected by the type of construction being accomplished, the type of work site, and the type of work force. Certainly there are factors not mentioned that are unique to other construction sites.

Delays are not predictable, but some are "foreseeable". One of the most prevalent root causes of many delays is lack of complete planning by all related parties throughout the entire project life cycle. The more one is in contact with all elements of a project, the more that delays are foreseeable. The earlier that problems are resolved, the less costly they are to all parties, and the more effective is the effort of producing a quality final product.

WEATHER AND ITS EFFECTS ON CONSTRUCTION

Weather is a common cause of construction delay. It has significant effects on productivity and construction methods. But, often is the case when it is not fully considered by owners and their agents during design, or by contractors during execution planning.

The major weather parameters that affect construction include reduced daylight hours during winter months (which is especially a problem in deep foundation structures due to less indirect light), heavy precipitation, high winds, and low temperatures (Page, 1971).

A recent study illustrated the significant combined effect of humidity and temperature on construction productivity (Koehn, Brown, 1985). It found that productivity began to drop at temperatures below 50 degree F and above 80 degrees F and 45% humidity.

To the extent that it is out of the ordinary or "unusually severe", weather is an excusable delay allowed the contractor. The contractor is entitled to a day for day extension of time for based on the length of the weather delay. Traditionally contractors receive no monetary consideration for weather delays since they fall under the force majeure classification of unforeseen conditions.

To prove a weather delay, a contractor must show that the weather conditions in question were more severe than the historical average and that the contract operation was impacted during the bad weather (Loulakis, 1984). Contractors who, during planning and estimating, do not check historical weather records for expected lost days during a contract period, increase their risk of delay and liquidated damages liability.

Likewise, owners bring added costs upon themselves by not checking local weather records when they establish contract durations during the project design phase. This practice can lead to unreasonable durations which will require a premium price. Owners who do not recognize a contractor's valid weather delay adjustment request, and do not grant equitable time to the contractor, can very easily find themselves subject to an acceleration claim.

Weather delays are inevitable in construction, which is so dependent upon good weather for a great percentage of its activities. Many weather delays are totally unforeseeable and legitimate causes for delay. Others can be avoided, and others mitigated by sound management practice, which is the source of most weather delay related problems.

CONSTRUCTION DELAYS CREATED DURING DESIGN

As noted earlier, one construction claims study concluded that 56% of claims can be traced to defective contract documents and another 20% to site conditions (Thomas et al, 1987). One concludes from this finding that many delays encountered in construction stem not from the construction site itself, but from the conceptual planning and design phase. These delays are clearly the owner's responsibility, and result from poor quality plans and specifications.

Design deficiencies have increased over recent years due to the greater complexity of facilities and the faster pace of the project life cycle. Cut and paste methods of specification writing, rushed time periods of final design, and last minute decisions are the primary reasons that contradictory and ambiguous contracts are issued. The designs which contribute to delay lack constructability, clarity, and completeness. (Vlatas, 1986). The time, initially thought saved by the owner, in rushing through design to expedite the project, is lost during construction delays, and paid for in change orders, negotiated settlements, and in the worst case, litigation.

Other problems with construction specifications is an over-use by owners of "boiler plate" specifications and lack of a quantifiable basis for approving or rejecting substitute products under "brand name or equal" specifications (Kagan, 1985). In addition, designs which are re-issued for clarification after construction start and revised in response to contractors' shop drawings submittal are major causes of claims and delay. Another coordination problem in the design phase is resolving conflicts between the architectural, structural and mechanical drawings. Many designs are released for construction with these problems which are ultimately solved through costly change orders and delays.

Another major problem which contributes significantly to delay is lack of contract specifications which establish a sequence of contractor shop drawing submittal in conjunction with the construction schedule. Lack of such planning increases procurement lead times for materials which are often critical to the schedule (Kagan, 1985).

In summary, designs must be well thought out, and time is often not taken to consider all of the issues at hand before releasing critical decisions which determine the project's final outcome. Too much time designing and planning, on the other hand, is costly to the owner as well. Architect and engineering time costs the owner, and the longer the project life cycle, generally the more expensive the final cost, particularly during times when cost escalation abounds. A balance must be achieved between these two extremes to provide designs which minimize changes and construction delay.

Closely related to design of construction projects is the product procurement cycle that provides facilities with materials, equipment and engineered systems. It is estimated that 58% of the $265 billion of construction value put in place in 1983 was devoted to the product procurement phase of project management (Ibbs, 1985). Certainly this percentage is close to a an annual norm for the construction industry, and points to the necessity for sound materials management techniques as part of the project management function.

A study of the procurement phase and product specifications practice of 224 publicly funded water and waste water treatment construction projects was undertaken in 1985 to more fully understand the problems associated with materials management and its impacts on project schedule and cost (Ibbs, 1985).

The first significant finding was that 45% of the projects reviewed had some form of dispute with regards to the submittal process and 5% of the projects experienced formal claims. Average project delays resulting from these disputes ranged from 9 days for the most informal disputes to 53 days for the formal claims, with an overall 14 day average delay per dispute. The study also concluded that all projects, regardless of size, are equally susceptible to submittal disputes, although most high value, formal protests occur on the larger dollar value projects where more capital is at stake.

Another significant finding was that "brand name or equal" or proprietary specifications were responsible for most (56%) of product related disputes as compared with performance specifications (36%) and reference specifications (8%). Corresponding average length of project delay for each of these were 16.3 days per proprietary disputes, 7.8 days, performance, and 9.3 days reference. This substantiates the earlier cited problem of lack of quantifiable bases for rejection of proprietary material specifications submittal (Kagan, 1985).

A major finding of this study with regard to construction delay was statistical results supporting the idea that the earlier a dispute is settled, the less overall impact it has on project costs and schedules. In addition, it was found that "resolving a product dispute as early as possible saved, on average, some two days additional administration time". Also noted was the finding that the owner's probability of prevailing in a dispute was highest at the earlier stages, and the contractor's probability of prevailing was highest at the later stages (which ultimately ends at the formal claims level).

Finally, the study concludes that the impact of the most serious disputes had more than just an effect on the contract schedule and budget. That is, "the more serious the level of product dispute, the less likely the whole project is functioning satisfactorily at this time". This final point again stresses that there are no clear winners in formal disputes. It also points to the fact that projects which are plagued with cost and schedule over-run, are very likely to suffer in final product quality. This study, funded by the National Science Foundation, provided a wealth of information related to product specification problems which contribute to increased project cost and delay (Ibbs, 1985).

In summary, the design and pre-construction phase of the project life cycle contributes to well over 50% of delays encountered during construction. The numerous problems cited above have serious effects on construction cost, scheduling, and quality of the final product. Resolution of this problem clearly rests on the shoulders of the owner as noted in the following excerpt from a construction dispute trial, U. S. v. Spearin, 1918:

> If the contractor is bound to build according to plans and specifications by the owner, the contractor will not be responsible for the consequences of defects in the plans and specifications....This responsibility of the owner is not overcome by the usual clauses requiring builders to visit the site, to check the plans, and to inform themselves of the requirements of the work. The duty to check the plans did not impose the obligation to pass upon their adequacy to accomplish the purpose in view (O'Brien, 1976).

THE LEGAL ASPECTS OF DELAY

Since some delays lead to litigation, it is important for the construction manager to have a basic understanding of the legal implications of claims or disputes where a negotiated settlement is no longer possible.

In litigation, and to a certain extent, arbitration, both parties lose. Statistical claims studies substantiate the fact that the dollar amounts of formal claims settlements are much higher than those settled through negotiation. One construction manager recently pointed out that when claims are settled by litigation or arbitration, the end result is "both sides are equally unhappy" (Scott, 1987).

Since construction projects are a function of so many variables, it is very difficult to apply legal precedents from common law that perfectly apply to the case in question. Furthermore, those who make the final decisions in a court of law may not be experienced in construction or familiar with the industry norms. For these reasons, litigation is equally risky to both sides even when a case is clear in the eyes of the litigating parties.

Claims result from changes that occur after an original course of action, (in construction, the original contract scope), has been set. Such changes include extra work, differing site conditions, defective designs, damage to completed work, owner interference, schedule interruption / changes, poor quality, and delays. The roots of claims can be classified into six categories: constructive change, acceleration, changed conditions, schedule changes, contractual obligation, and delay claims (Callahan, 1986).

Constructive change claims result from owner's actions that result in more contractor work and time, but for which the owner refuses to execute change orders. This type of claim might include disputes over design deficiencies and owner "over-inspection" (demands by the owner for higher standards than specified).

Acceleration claims can be caused by an owner overtly demanding that a project be completed ahead of the originally scheduled completion, or from an owners insistence that the original contract completion date be met, in spite of scope changes that would normally entitle the contractor to time extensions.

Changed conditions claims occur due to differing site conditions and unforeseen work encountered.

Schedule change claims arise from suspensions, changes in sequence, or terminations of contract work. Claims of this sort include owner interference and interruptions, and owner termination of contracts due to contractor default or for the owner's convenience.

Contractual obligation claims are the miscellaneous category which include refusal by the owner to take over completed work by the contractor, or early beneficial occupancy by the owner which interferes with work progress.

Delay claims are the most prevalent of formal construction claims in the business. This is because virtually every scope change and contractual action that occurs during the course of construction has the capacity to delay the contractor in some form. Delay claims can be caused by owners or their agents, contractors, or acts of nature. Management caused delays can include non-availability of work site, interference on site by other contractors, owner directed work "slow downs", and slow approval of shop drawings or submittals. Contractor caused delays can include poor quality workmanship requiring rework, and failure to procure construction materials.

All of the above claims involve construction delay to some extent, and claims which reach the formal level are extremely costly to owners and contractors. On large construction jobs, it is not uncommon for claims to be in the millions of dollars, and many take years to settle.

One distinction to be made between claims and normal change orders is that claims generally seek compensation for the impact of a delay or unsettled change. Normal change orders are settled by negotiation and generally the parties agree to an equitable change in cost and time.

Formal claims are basically rare in occurrence but very costly when they do occur. As an example, one recent study of contract change orders and claims revealed that normal change orders accounted for 96% of the change requests and over 99% of all time extensions, but only 81% of additional compensation. In other words, formal claims accounted for only 4% of change requests and less than 1% of time extensions (3 of 1,583 days), but astonishingly 19% of additional costs ($1.2 million of $6.1 million) (Deikmann et al, 1985).

The report does not discuss the additional administration and legal costs spent by the parties settling these claims. Even the parties who win in litigation, lose. The case preparation and legal fees required on either side of a claim is an enormous expenditure of time and resources. This finding is typical of the industry-wide problem of construction litigation and claims.

Construction law as related to delay and delay claims is a specialized field which this paper cannot begin to cover. However, it should be noted that many actions on the part of the related parties can and do impact the outcome of litigation.

First, contractual disclaimers of liability or "exculpatory" clauses, often used by parties in contract general provisions to avoid liability, are often over-ruled in litigation (Loulakis, 1986). In other words, the courts look more at the facts, proceedings, and management practices of the case at hand, than at the contract language.

Second, sound documentation, or lack thereof, has a very significant impact on the positive or negative outcome of litigation. Use of CPM to show schedule impact before and after delays or changes has been found to be a useful tool in litigation because it depicts the construction processes inter-relationships. Because bar charts do not show inter-relationships, their use in formal proceedings has not been helpful to those using them. In one cited case, a contractor lost a delay claim because the firm's bar chart schedules could not substantiate evidence or impact of the alleged claim (Loulakis, 1984). In addition, CPM and similar scheduling techniques are tremendous management tools which, if used properly, can help avoid litigation. Above all, the actions of the parties involved have the most bearing on the outcome of formal proceedings.

In legal proceedings one must be able to show that his/her actions were in good faith and that sound communication was used. Contractors in claims litigation must prove that additional compensation is warranted by the contract and the facts and, more importantly, the true impact costs of the claim. The owner must generally prove otherwise. Contractors who win claims receive an equitable compensation determined by the courts. Owners who are unjustly delayed by contractors, recoup their losses through contractually set liquidated damages. The amount of liquidated damages is determined in accordance with the owner's daily contract administration cost and costs of delay in the new facility's operation.

In summary, construction litigation is risky, complex, and costly to both winners and losers. Many delay and other types of claims result in litigation and formal claims proceedings which are cumbersome and lengthy. Claims are a function of contractual and management breakdowns that certainly are less expensive to solve than to continue legal settlements. Claims are the "worst case" outcome of delays. Management solutions to delays and contractual difficulties are strongly needed to avoid the time and money wasted in construction litigation.

SECTION II

COSTS OF CONSTRUCTION DELAY

INTRODUCTION

This paper has discussed the causes and legal aspects of construction delay providing the foundation for the remaining sub-topics associated with management of delay problems. This section discusses the quantitative aspects of delay; its costs.

BUDGET, TIME, AND QUALITY

The costs of delay can be classified in terms of financial resources, time, and quality. The timing and duration of construction delay significantly impacts all of these areas.

MONEY

The financial costs of delay are borne by both the contractor and owner depending on which party is accountable for the particular delay in question. The owner pays for his/her delays through additional compensation to the contractor for contract change orders and claims. Contractors pay the additional delay costs attributable to their own actions. In addition, a contractor may be liable to the owner for liquidated damages due to delay in contract completion.

The costs (or damages) of delay can be categorized as "liquidated" and "actual" (O'Brien, 1976). Liquidated damages are used as a special means of quantifying delay costs to expedite settlement without litigation. They are set in the contract to which both the owner and contractor agree. Actual damages can be either "direct" or "consequential".

Direct costs can include additional contract field management resulting from extended project duration, extended field and home office overhead, extended durations of equipment use, labor and material cost escalation, and any other costs which are directly tied to the project delay.

Consequential costs "result from the delay, but are not a direct cost to it." They include such items as loss of bonding capacity, limitations on work load due to limited working capital, and opportunity costs of lost additional business resulting in profit and income loss.

From the owner's perspective, the three types of delays which can occur on a typical construction contract are compensable, excusable, and non-compensable (Scott, 1987).

Compensable delays are delays for which the contractor can recover damages and be granted a time extension. They are caused by circumstances beyond the contractor's control. Typical compensable delays include owner or owner agent caused changes and differing site conditions.

Excusable delays are delays for which the contractor can be granted a time extension, but no additional compensation. Excusable delays are beyond the control of both contractor and owner. The most common cause of excusable delay is unforeseen conditions (strikes, force majeure causes, etc.).

Non-compensable delays are delays which are within the control of the contractor, and for which neither time or compensation are granted. These delays may result in liquidated damages assessment by the owner if the contractor fails to meet the contract completion date.

Concurrent delay occurs when compensable and non-compensable delays occur at the same points in time. When this is the case, the contractor is due a time extension only and no additional compensation.

Financial costs of delay are relative to the volume of work in progress at the time of delay, the relative position of the delayed construction activity in the overall project schedule, and numerous other variables including costs of capital, labor, materials, and equipment.

TIME

The cost of construction delay, in terms of time, again costs both owner and contractor. The delay to the owner means a longer wait for the new or modernized facility. This may mean less revenues, less efficient operations, or any number of other benefits which may be lost due to lack of a complete facility. To the contractor, time delays mean extended project overhead costs, cost escalation, and loss of future work.

In many respects, delay is an opportunity cost to the contractor. This is because the amount of uncompleted work in progress limits a contractor's bonding capacity. If that outstanding work is delayed, the contractor is not making money on the delayed job, and the delayed work at the same time is a limit to present and future bonding capacity. A significant delay, in a sense, costs the contractor twice. Furthermore, the delay makes certain operations underway unproductive, thus limiting the contractor's cash flow on the job, and the contractor's financial capacity to fund other work.

QUALITY

The quality costs of construction delay are more qualitative than the time and financial resources costs. However, one recent study, as noted in the first section, concluded that those projects which were plagued with construction delay problems were the most likely projects to be suffering from operational problems in the post-construction, or "user" phase of the facility life cycle (Diekmann et al, 1985). Some of the factors which contribute to quality losses during delay include installed materials suffering from environmental exposure, poor workmanship due to longer "learning curves", low morale, errors and omissions in work due to sporadic schedules and lack of continuity, and numerous other types of quality losses specific to the projects suffering from delay.

In summary, many of the delay quality losses are intangible. Others, which are discernable and require rework, contribute to more delay and higher costs of completion. Quality costs of delay are related to the overall project management skills employed by both owners and contractors, and both parties benefit from sound construction management relationships and practice.

A CASE STUDY OF TYPICAL COSTS (Diekmann et al. 1985)

One recent study of contract change orders and claims and their corresponding root causes and costs in terms of additional compensation and time, adds some perspective to the subject of delay and its costs. The results of this study's additive change order analysis on 22 federally funded construction projects (total original award amount $103,900,000) is listed below:

	CHANGES		MONEY		TIME	
CHANGE ORDER TYPE	#	%	$000	%	DYS	%
Design errors	145	46	2,452	40	290	18
Changes						
Mandatory	41	13	662	11	55	3
Discretionary	40	13	1,042	17	135	9
Differing Site Conditions	46	15	772	13	140	9
Weather	29	9	0	0	560	35
Strike	5	2	0	0	400	25
Others	7	2	1,202	19	3	0
Totals	313	100	6,130	100	1,583	100

Statistics drawn from this data set include: Each additive change order averaged $19,900 (skewed somewhat by the "Others" category which involved 7 formal claims totalling $1,202,000). 25% of additive change orders requested additional time which amounted to 20 days per time-extending change order. Unforeseen conditions ("Weather" and "Strikes") accounted for 60% of the additional time granted. It is interesting to note that design and changes, which are totally beyond the control of the contractor, accounted for 72% of the changes, 68% of additional costs, and 30% of additional time on these contracts. The additive change order rate for this data set was approximately 6%. Other conclusions can be drawn from this data which quantifies some of the costs and causes of contract delay and changes. The above data set is relatively small and only pertains to the federally funded sector of the construction industry (Diekmann et al, 1985).

ACCOUNTING FOR COSTS

Accounting for specific delay costs is one of the most important construction management functions. From the contractor's perspective, cost accounting is clearly related to receiving equitable compensation for time and cost on projects when original contract scope differs from field conditions.

To recover on a construction claim or change order, a contractor must prove both the "entitlement and quantum aspects" of the claim (Loulakis, 1985). Entitlement refers to proving the contractor's theory of recovery within the confines of the contract (i.e. differing site conditions, delay, etc.). Many contractors devote substantial attention to proving entitlement and then fail to properly quantify the costs with an "accurate and organized quantum presentation".

Quantum presentation refers to how costs are shown and proven for the change or claim in question. This presentation, through records and other written media, determines the contractor's claim price. The related parties or courts, whichever the case, use the quantum presentation and other contributing facts to resolve an equitable claim settlement.

The most accurate method of pricing a change order or claim is by establishing a separate set of accounts for the work in question, which demonstrates the actual cost of work performance.

Another method, commonly favored by contractors, but not as often by courts and formal contract appeals boards, is the "total cost" method. "Total cost" refers to the difference between the original estimate and the final project cost. Contractors like this approach since it, in essence, converts a fixed-fee contract into a cost plus fixed-fee arrangement, thereby allowing contractors to recover all project costs (whether owner-caused or not).

Four conditions, established by common law, that must be met before the total cost method can be used in claims proceedings are: "1) the nature of the losses make it impossible or highly impractical to determine them with a reasonable degree of accuracy, 2) the contractor's bid or estimate was realistic, 3) the contractor's actual costs were reasonable, and 4) the contractor was not responsible for the added expenses" (Loulakis, 1985). These four conditions safeguard the owner from contractors who would like to use the total cost method when it is not justified.

Accurate and valid cost accounting, and proof of prudent expenditures by the contractor, add to his/her credibility during settlement proceedings. This expedites settlement and reduces tensions which stem from the traditional adversarial relationship between owner and contractor. A balanced approach, with both sides considering the goals and needs of the other side, will go a long way towards resolving cumbersome and lengthy negotiations and avoiding litigation. Cost accounting which provides management with the information it needs, is crucial to the management of change and claims.

ACTUAL COSTS ASSOCIATED WITH DELAY

The costs of delay are a function of many variables including the timing of the delay, the type of construction, the impacts in terms of idle resources, the costs of resources, extended overhead expenses, and many other similar variables. Because of the uniqueness of each construction site, there is no way to quantify an industry-wide daily general cost of delay.

From the contractor's perspective, common compensable, (recoverable), delay expenses include "the costs of idle personnel and equipment, losses of efficiency from the "impact" or "ripple effect" of the delay, additional overhead, cost escalation, and under certain circumstances, the costs of extra efforts to accelerate completion of the project" (Denniston, 1985).

The costs of idle personnel and equipment stem often from the inability of the contractor to transfer idled workers or on-site equipment to another job. An owner caused classic delay or work disruption will usually result in this type of cost.

Losses of efficiency costs may include costs which result from the contractor having to perform the delayed work (when recommenced) under less favorable conditions. Typical problems associated with inefficiency include reduced worker morale, breakdowns in the normal flow of work, crew reductions, learning curve losses, over-manning or crowding, demobilization and remobilization, adverse weather, and site conditions when work is re-started (O'Brien, 1985). Other efficiency losses may include certain portions of work having to be performed in a different or less efficient sequence, or use of less efficient construction methods than those based on the contractor's original bid, work plan, or CPM schedule (Denniston, 1985).

Escalation effects are most costly in an inflationary economy, and are a result of the delayed work having to be performed during a later time when labor, materials, and equipment are more costly.

Acceleration costs have been discussed earlier. This type of cost generally occurs due to unreasonable and inequitable treatment of the contractor's situation by the owner or owner's agent.

In addition to the direct costs of delay cited above, the indirect or overhead costs also increase with the length of delay. Overhead expense rates generally are the same whether a job is progressing or delayed. Overhead consists of field supervision, field expenses, bonding expenses, and home office overhead (O'Brien, 1985). Field supervision is the personnel expense the contractor must pay to manage the contract on site. Field expenses or "general conditions" are the on site contract support expenses other than personnel. Items in this category include trailers, office equipment, light trucks and cars, temporary utilities, and other similar support items. Bonding expenses, typically 1% of total cost, are the costs of bonding during the additional delayed period. In addition, the contractor may claim interest as an expense during a delay due to the cost of capital while maintaining an unproductive job. Home office expenses are typically 3 to 5% of the contract value and many methods are used to calculate this item. The most widely accepted method for calculating home office expenses is the "Eichleay" formula, which uses the project revenues vs. company revenues ratio for allocating home office overhead to the contract in question (O'Brien, 1985).

The most important aspect of delay costs is the capability of each party to identify quantifiable and separable impacts resulting from the delay. Where a dispute situation is identifiable early on, both parties should maintain time and material records in anticipation of the proceedings which will settle the dispute. This action will benefit all parties as resolution will be faster and more concrete.

THE TIMING OF DELAY

The most critical determinant of the cost of delay may be the time in the project life cycle when the delay occurs. A 1984 publication on the project management of the Metropolitan Atlanta Rapid Transit Authority's construction of the rail and subway system serving the greater Atlanta area, revealed some noteworthy statistics concerning the work efforts during a typical project life cycle. These are listed in the table below (Shah and Lammie, 1984):

Cycle Phase	Time	Avg man-month/month
Concept	Month 0 to 3	3.75
Preliminary Design	Month 3 to 8	6.25
Detailed Design	Month 8 to 20	10.75
Construction	Month 20 to 42	101.25

This table illustrates the relative impact of the same delay during various phases of the project life cycle. The direct impact costs (not including escalation) of a classic delay in the construction phase is on the average almost 10 times greater than the same delay during the detailed design phase.

As the report noted: "It becomes quite evident that in terms of schedule acceleration or compression, a small staff increase in the initial stage of a project will provide much more gain than that same force applied toward the end of the project in construction." It is also evident that costs of construction are best controlled in the early stages of the project life cycle when savings can be achieved through design decisions and by resolving coordination problems that could crop up during construction, leading to much more costly delay in terms of impacts costs. A balanced approach must be taken, as too much excessive planning results in the same day-for-day cost escalation as does a delay in the construction phase.

In summary, delays become more and more costly as the project progresses through construction. The costs of delay in construction can be categorized into three areas; direct, indirect and the "value of lost revenues and benefits" (Zack, 1985). An additional month of concerted effort during the planning and design stage in some cases might be well worth the investment when one considers the greater costs associated with delays during the later stages of the project construction cycle.

SECTION III

A FIELD STUDY OF CONSTRUCTION DELAY

INTRODUCTION

This section adds a field perspective to this study by providing data drawn from 48 recently completed construction contracts. The purpose of this field study was to review a sample population of construction contracts and ascertain the frequency and causes of contract changes and to assess their respective impacts in terms of cost and delay.

THE DATA

The sample population chosen is a group of 48 general building construction contracts administered by the Southern Division, Naval Facilities Engineering Command, in Charleston, South Carolina. The Southern Division is responsible for all U. S. Navy (and some U. S. Air Force) construction in the Southeastern United States and consequently this sample population includes many Southeastern U. S. locations. The contracts were completed between October 1984 and April 1987.

It was decided to limit this study to forms of general building construction so there would be some commonality in the construction scopes of the studied projects. It would be difficult to compare results, for example, of an aircraft pavement project with a high voltage electrical system upgrade.

Even still, there were variations in the data as building construction types included aircraft hangars, military personnel housing, instructional facilities, laboratories, modification / conversion / building addition projects, office buildings, and warehouse facilities. These variations, however, are not deemed significant enough to nullify the results. In addition, much of the analysis has taken the various building types into consideration.

Specific data for each construction contract was collected by reviewing each respective contract file and recording all pertinent contractual data including original cost and completion times, change orders with corresponding time and cost adjustments, and their reasons for occurring. All data collected for each contract and its corresponding change orders is shown by sample contract number in Appendix B.

DATA MANIPULATION

Data was entered into 2 separate data bases, one for contracts, and the second for change orders. The file manager programs PFS File and PFS Report were used to store and sort the two data bases. The contracts data base has a total of 48 contracts and the changes data base has 432 change orders.

Data was sorted in numerous ways to achieve the results and to ascertain the amounts of delay and additional costs encountered. This is illustrated and explained in "results and analysis", of this section. Applicable data sorts are shown with the results. Other data sorts not specifically used in the results and analysis, but which may provide the reader with a better background of the data bases, are provided in Appendix A.

RESULTS AND ANALYSIS

This part of the field study will be broken into two parts. The results of the contracts data base will be discussed first, and then will be followed by discussions on the results of the changes data base.

THE CONTRACTS DATA BASE

TABLES 1 AND 2

The contracts data base consists of 48 contracts totalling $100,156,635. A general summary of the data base is provided in Table 1, which provides some of the basic data for each contract including contract number, title, building type, liquidated damages daily rate, and abbreviated cost and time data.

The total contracts data base had additional costs totalling $6,864,839 with a total final cost of $107,021,474. Some sensitivity analysis is required in that sample contract #46 has $1,896,595 in change orders or a full 27.6% of the total additional cost. Therefore parts of this analysis have been accomplished without taking contract #46 into consideration. Table 2 provides a totals only summary of all reviewed contracts excluding contract #46.

Two of the factors which have been sought from these two tables include the cost factor (CSTF) and the final delay factor (based upon original completion time), (FDF(O)). The CSTF, which is calculated by dividing final cost by original cost,is an indicator of cost over-run over the original bid. The FDF(O) is calculated by dividing final contract duration by original time of completion, and is an indicator of total time over-run for the project. The CSTF and FDF(O) for the two general summaries provided in Tables 1 and 2 are provided below:

CSTF (all contracts) = 1.069
FDF(O) (all contracts) = 1.373

CSTF (excluding #46) = 1.052
FDF(O) (excluding #46) = 1.368

The two cost factors are, in essence, the dollar value change order rate (6.9% and 5.2% respectively) for these contracts. The delay factor is somewhat more significant (37.3% and 36.8% respectively). A delay factor estimated at 1.37 results in a contract originally scheduled for 365 days finally being completed in 500 days. These tables provide a "macro" view of the contracts data base.

TIME FACTORS

Key time factors for use during review of the data include the original contract time established at contract award (ORCT), the additional contract time granted by change orders to the contract (ADCT), the final contract time (FNCT) which is the sum of the ORCT and ADCT, and the final contract duration (FDUR). The FDUR may be less than the FNCT if the contractor completed the job early, and may be greater than the FNCT if the contractor was late, in which case liquidated damage days (LDDY) represent the number of days the contractor was late and was assessed liquidated damages.

TABLE 1

SUMMARY OF ALL REVIEWED BUILDING CONSTRUCTION CONTRACTS

#	CONTR#	TITLE/LOC	TYPE	ORIG COST	FNL COST	ORCT	FDUR	$LD	CSTF	FDF(0)
01	810910	Applied Instruction Bldg, NAS Memphis TN	INST	3,676,000	3,933,923	420	747	405	1.070	1.779
02	800242	Ocean Research Lab NORDA St. Louis MS	LAB	5,064,644	5,432,923	630	1,422	515	1.073	2.257
03	830436	Grp Trng Bldg Barksdale AFB Shreveport LA	INST	2,189,000	2,275,018	365	500	265	1.039	1.370
04	811112	F18 Support Facilities MCAS Beaufort SC	MODS	3,865,000	4,669,575	400	535	195	1.208	1.338
05	800477	UEPH Modernization MCRD Parris Island SC	MODS	2,760,900	2,807,341	330	532	265	1.017	1.612
06	810578	UEPH NCBC Gulfport MS	HSG	2,828,000	2,858,737	420	759	315	1.011	1.807
07	810425	UEPH NCBC Gulfport MS	HSG	4,623,154	4,641,377	700	707	1,296	1.004	1.010
08	811016	Chapel NAS Dallas TX	INST	1,467,405	1,479,339	420	531	175	1.008	1.264
09	820084	UEPH Barksdale AFB Shreveport LA	HSG	4,731,000	4,773,880	450	562	1,382	1.009	1.2[illegible]
10	790472	Cons. Support Ctr. England AFB	OFFC	1,490,000	1,537,241	455	551	185	1.032	1.211
11	830709	Alts to Rsv. Ctr. Savannah GA	MODS	199,447	213,750	120	267	35	1.072	2.225
12	830365	Alterations to EDF NCBC Gulfport MS	MODS	1,039,139	1,111,586	395	667	155	1.070	1.689
13	830449	PSD Bldg NSA New Orleans LA	OFFC	1,015,000	1,026,605	365	384	115	1.011	1.052
14	830502	Ops Trng Bldg NAS New Orleans LA	INST	1,776,000	1,825,906	480	524	185	1.028	1.092
15	830240	Env./Med. Facility Shreveport LA	LAB	433,399	436,380	270	282	65	1.007	1.044
16	810924	Maintenance Hanger NAS Cecil Field FL	HNGR	4,888,000	5,082,662	540	597	625	1.040	1.106
17	810809	Family Svc Ctr NAS Kingsville TX	OFFC	393,000	401,087	300	309	65	1.021	1.030
18	810855	Family Svc Ctr NAS Cecil Field FL	OFFC	482,569	490,076	270	403	65	1.016	1.493
19	810412	UEPH MCRD Parris Island SC	HSG	5,247,000	5,272,903	540	710	3,600	1.005	1.315
20	810408	Alterations to UEPH Shaw AFB Sumter SC	MODS	1,864,000	2,049,017	540	620	792	1.099	1.148
21	820291	Gym Addition Shaw AFB Sumter SC	MODS	1,798,000	1,911,284	365	513	205	1.063	1.405
22	830269	Waterfront Svcs bldg NS Charleston SC	OFFC	912,163	902,014	270	505	225	0.989	1.870
23	830180	Child Care Ctr NAS Pensacola FL	HSG	794,000	860,021	440	485	105	1.083	1.102
24	830187	PSD Bldg NAS Kingsville TX	OFFC	635,000	651,204	360	380	85	1.026	1.056
25	830135	HQTRS Bldg Charleston AFB	OFFC	2,935,227	2,991,078	455	598	315	1.019	1.314
26	820324	UEPH Improvements MCRD Parris Island SC	MODS	1,035,679	1,024,469	270	377	215	0.989	1.396
27	811014	UEPH NAS Dallas TX	HSG	3,012,700	3,028,041	420	654	1,020	1.005	1.557
28	810894	Ops Trng Facility MCAS Beaufort SC	INST	827,777	845,777	212	221	1,600	1.022	1.042
29	830516	Crew Bldg Barksdale AFB Shreveport LA	MODS	2,107,250	2,146,579	365	449	235	1.019	1.230
30	850529	Logistics Bldg NAS Dallas TX	WHSE	614,092	621,281	180	395	75	1.012	2.194
31	830400	Training Bldg NAS Dallas TX	INST	390,261	390,261	240	280	55	1.000	1.167
32	830185	PW Shops NAS Kingsville TX	WHSE	1,407,000	1,417,589	365	379	135	1.008	1.038
33	830091	Gen'l Warehouse NCBC Gulfport MS	WHSE	3,213,958	3,234,844	400	579	420	1.006	1.206
34	800355	Rel Ed Facility NAS Jacksonville FL	OFFC	727,000	737,559	300	328	95	1.015	1.093
35	840872	Hqtrs Facility NAS Key West FL	MODS	949,860	1,080,055	240	302	115	1.137	1.258
36	850126	Family Svc Ctr NAS Beeville TX	OFFC	396,000	416,072	300	376	65	1.051	1.253
37	850099	Child Care Ctr Barksdale AFB Shreveport LA	MODS	740,000	746,981	270	303	75	1.009	1.122
38	830183	Ops Trng Facility NAS Corpus Christi TX	MODS	574,000	580,860	300	342	90	1.012	1.140
39	830194	Fleet Trng Facility NS Mayport FL	INST	703,920	740,704	270	327	150	1.052	1.211
40	810983	Gen'l Warehouse NAF Mayport FL	WHSE	3,791,000	3,918,447	450	566	419	1.034	1.258
41	840446	Avionics Shop Addition NARF Jacksonville FL	WHSE	667,203	679,971	300	445	95	1.019	1.483
42	810109	AC Maint. Facilities NAS Cecil Field FL	MODS	1,392,500	1,961,929	365	770	135	1.409	2.110
43	810440	Base CE Facility Shaw AFB Sumter SC	OFFC	4,453,000	4,778,153	520	891	535	1.073	1.713
44	800403	AC Maint Hanger NAS Dallas TX	HNGR	3,065,466	3,350,165	455	634	305	1.093	1.393
45	820245	Applied Inst. Bldg NTC Orlando FL	INST	4,894,000	5,235,684	520	640	415	1.070	1.231
46	810346	Ops Trng Facility NS Mayport FL	INST	5,219,022	7,115,617	540	797	565	1.363	1.476
47	810800	Family Svc Ctr NAS Corpus Christi TX	OFFC	410,900	405,052	280	315	65	0.986	1.125
48	810020	Maint Hanger Addition MCAS Beaufort SC	HNGR	2,457,000	2,930,457	360	641	305	1.193	1.781
			Average:	2,086,597	2,229,614	381	523	392		
			Total:	100,156,635	107,021,474					
			Count:	48						

TABLE 2

SUMMARY OF ALL REVIEWED CONTRACTS (EXCLUDING #46)

#	CONTR#	TITLE/LOC	TYPE	ORIG COST	FNL COST	ORCT	FDUR	$LD	CSTF	FDF(O)
		Average:		2,019,949	2,125,657	378	517	388		
		Total:		94,937,613	99,905,857					
		Count:	47							

TABLES 3 THROUGH 12

Tables 3 through 12 provide a more detailed look at the contracts by building type. The building types and their corresponding abbreviations are:

Building type	Abbreviation
Aircraft Hangar	HNGR
Personnel Housing	HSG
Instructional buildings	INST
Laboratory facilities	LAB
Modification / Conversion / Addition projects	MODS
Office buildings	OFFC
Warehouse facilities	WHSE

Tables 3 and 4 are totals only summaries of all contracts by building type, Table 3 includes #46, and Table 4 excludes #46. Tables 5 through 12, (in Appendix A), provide the reader with a contracts summary and cost and time analysis of each building type and its corresponding contractual data. Table 7 provides data for all of the instructional buildings including #46 and Table 8 for all instructional buildings excluding #46. Two new factors are introduced; the contract time delay factor (CTDF) and the final delay factor (based upon the final completion time set by the contract change orders), FDF(F).

The CTDF is calculated by dividing the final contract time (after change orders) by the original contract time. It represents the amount of delay which is allowed by the contract and change orders.

The FDF(F) is calculated by dividing the final duration by the final contract time. It is an indicator of whether the contractor completed the job within the contract time as set by the contract and change orders. If the contractor finished the job early the FDF(F) is less than 1.000. If he/she completes the job after the final completion date, the FDF(F) is greater than 1.000.

A summary of key cost and time factors for each building type is listed below.

BLDG TYPE	CSTF	CTDF	FDF(F)	FDF(O)
HNGR	1.092	1.451	0.951	1.381
HSG	1.009	1.251	1.044	1.305
INST	1.128	1.317	0.996	1.322
INST(EX #46)	1.050	1.292	0.996	1.287
LAB	1.068	1.893	1.000	1.893
MODS	1.108	1.433	1.000	1.433
OFFC	1.035	1.278	1.018	1.301
WHSE	1.018	1.214	1.097	1.332
ALL CONTRACTS	1.069	1.361	1.020	1.388

It should be noted that the high CTDF and FDF(O) values for the LAB category are somewhat misleading since there were only two laboratory projects, one of which had 792 days added to its original duration of 630 days. This also increases the overall delay factors. One can quickly see the impact upon cost factors that contract #46 has on both the instructional category as well as the overall contract total. Another point of interest is that the modifications (MODS) and aircraft hangar (HNGR) categories have the highest cost and delay factors of all the building types.

TABLE 3

SUMMARY OF ALL CONTRACTS BY BUILDING TYPE

TYPE	ORIG COST	ADDCOST	FNL COST	#
HNGR				
Total:	10,410,466	952,818	11,363,284	
Count:				3
HSG				
Total:	21,235,854	199,105	21,434,959	
Count:				6
INST				
Total:	21,143,385	2,698,844	23,842,229	
Count:				9
LAB				
Total:	5,498,043	371,260	5,869,303	
Count:				2
MODS				
Total:	18,325,775	1,977,651	20,303,426	
Count:				12
OFFC				
Total:	13,849,859	486,282	14,336,141	
Count:				11
WHSE				
Total:	9,693,253	178,879	9,872,132	
Count:				5
Total:	100,156,635	6,864,839	107,021,474	
Count:				48

TABLE 4

SUMMARY OF ALL CONTRACTS BY BUILDING TYPE (EXCLUDING #46)

TYPE	ORIG COST	ADDCOST	FNL COST	#
HNGR				
Total:	10,410,466	952,818	11,363,284	
Count:				3
HSG				
Total:	21,235,854	199,105	21,434,959	
Count:				6
INST				
Total:	15,924,363	802,249	16,726,612	
Count:				8
LAB				
Total:	5,498,043	371,260	5,869,303	
Count:				2
MODS				
Total:	18,325,775	1,977,651	20,303,426	
Count:				12
OFFC				
Total:	13,849,859	486,282	14,336,141	
Count:				11
WHSE				
Total:	9,693,253	178,879	9,872,132	
Count:				5
Total:	94,937,613	4,968,244	99,905,857	
Count:				47

TABLES 13 THROUGH 15

These tables present the contracts data base sorted by dollar value of the original contract price. The 3 categories for sorting purposes are: contracts greater than $3 million, contracts between $1 million and $3 million, and contracts less than $1 million. The upper echelon comprises 57.4% of the total contract dollar volume (54.4% with #46). The middle echelon comprises 31.1% (29.5% with #46), and the lower echelon 11.4% (10.8% with #46). The following is a summary of the key cost and delay factors for each dollar value segment of this analysis.

DOLLAR VALUE	CSTF	CTDF	FDF(F)	FDF(O)
> $3M	1.079	1.455	1.000	1.455
> $3M(EX #46)	1.052	1.453	1.000	1.453
$1M TO $3M	1.061	1.368	1.029	1.407
< $1M	1.032	1.216	1.048	1.275

One can conclude from this data summary that the cost and contracted time factors were higher for the higher priced contracts than for the lower priced contracts. However, completion within specified times was more evident on the higher dollar contracts primarily due to the higher corresponding liquidated damages. From the standpoint of cost factor, this data summary does not support the theory of economies of scale on larger dollar volume contracts. However, the only factor being considered in this analysis is dollar volume in and of itself.

TABLE 13

NUMERIC DOLLAR SORT - > $3M - TIME ANALYSIS

ORIG COST	ORCT	ADCT	FNCT	LDDY	FDUR	CTDF	FDF(F)	FDF(O)
3012700	420	234	654	0	654	1.557	1.000	1.557
	60	0	60	111	156	1.000	2.600	2.600
3065466	455	274	729	0	634	1.602	0.870	1.393
3213958	480	99	579	0	579	1.206	1.000	1.206
3676000	420	317	737	10	747	1.755	1.014	1.779
3791000	450	102	552	14	566	1.227	1.025	1.258
3865000	400	135	535	0	535	1.338	1.000	1.338
	400	350	750	0	750	1.875	1.000	1.875
4453000	520	371	891	0	891	1.713	1.000	1.713
4623154	700	7	707	0	707	1.010	1.000	1.010
4731000	450	112	562	0	562	1.249	1.000	1.249
4888000	540	57	597	0	597	1.106	1.000	1.106
4894000	520	190	710	0	640	1.365	0.901	1.231
5064644	630	792	1,422	0	1,422	2.257	1.000	2.257
5219022	540	257	797	0	797	1.476	1.000	1.476
5247000	540	129	669	41	710	1.239	1.061	1.315
Average:	470	214	684	11	684			

NUMERIC DOLLAR SORT - > $3M (INCLUDES 046) - COST ANALYSIS

	ORIG COST	ADDCOST	FNL COST	#
Average:	4,267,425	337,446	4,604,871	
Total:	59,743,944	4,724,250	64,468,194	
Count:				14

TABLE 14

NUMERIC DOLLAR SORT - > $1M TO < $3M - TIME ANALYSIS

ORIG COST	ORCT	ADCT	FNCT	LDDY	FDUR	CTDF	FDF(F)	FDF(O)
1015000	365	19	384	0	384	1.052	1.000	1.052
1035679	270	107	377	0	377	1.396	1.000	1.396
1039139	395	272	667	0	667	1.689	1.000	1.689
1392500	365	405	770	0	770	2.110	1.000	2.110
1407000	365	14	379	0	379	1.038	1.000	1.038
	60	14	74	102	176	1.233	2.378	2.933
	30	14	44	0	44	1.467	1.000	1.467
1467405	420	102	522	9	531	1.243	1.017	1.264
1490000	455	96	551	0	551	1.211	1.000	1.211
1776000	480	44	524	0	524	1.092	1.000	1.092
1798000	365	120	485	28	513	1.329	1.058	1.405
1864000	540	80	620	0	620	1.148	1.000	1.148
2107250	365	98	463	0	449	1.268	0.970	1.230
2189000	365	135	500	0	500	1.370	1.000	1.370
2457000	360	281	641	0	641	1.781	1.000	1.781
2760900	330	202	532	0	532	1.612	1.000	1.612
2828000	420	219	639	120	759	1.521	1.188	1.807
2935227	455	143	598	0	598	1.314	1.000	1.314
Average:	356	131	487	14	501			

NUMERIC DOLLAR SORT - > $1M TO < $3M - COST ANALYSIS

	ORIG COST	ADDCOST	FNL COST	#
Average:	1,847,631	112,005	1,959,636	
Total:	29,562,100	1,792,075	31,354,175	
Count:				16

TABLE 15

NUMERIC DOLLAR SORT - < $1M - TIME ANALYSIS

ORIG COST	ORCT	ADCT	FNCT	LDDY	FDUR	CTDF	FDF(F)	FDF(O)
0199447	120	147	267	0	267	2.225	1.000	2.225
0390261	240	0	240	40	280	1.000	1.167	1.167
0393000	300	9	309	0	309	1.030	1.000	1.030
0396000	300	62	362	14	376	1.207	1.039	1.253
0410900	280	275	555	0	315	1.982	0.568	1.125
0433399	270	12	282	0	282	1.044	1.000	1.044
0482569	270	10	280	123	403	1.037	1.439	1.493
0574000	300	42	342	0	342	1.140	1.000	1.140
0614092	180	22	202	193	395	1.122	1.955	2.194
0635000	360	28	388	0	380	1.078	0.979	1.056
0667203	300	145	445	0	445	1.483	1.000	1.483
0703920	270	57	327	0	327	1.211	1.000	1.211
0727000	300	28	328	0	328	1.093	1.000	1.093
0740000	270	33	303	0	303	1.122	1.000	1.122
0794000	440	45	485	0	485	1.102	1.000	1.102
0827777	212	15	227	0	221	1.071	0.974	1.042
0912163	270	30	300	197	505	1.141	1.640	1.870
0949860	240	78	318	0	302	1.325	0.950	1.258
Average:	273	58	332	32	348			

NUMERIC DOLLAR SORT - < $1M - COST ANALYSIS

	ORIG COST	ADDCOST	FNL COST	#
Average:	602,811	19,362	622,173	
Total:	10,850,591	348,514	11,199,105	
Count:				18

TABLES 16 THROUGH 18

These tables provide numeric sorts of the contracts data base by dollar amount of liquidated damages per day. The results are as expected; that as liquidated damages rise, completion of the contract within the final time allotted is more likely. This is illustrated below with a summary of the key time factors of this sort.

DELAY FACTORS AND LIQUIDATED DAMAGES RATES

$LD/DAY	AVG $LD/DAY	CTDF	FDF(F)	FDF(O)
> $300	$800	1.455	1.001	1.457
$100 TO 300	$180	1.320	1.025	1.354
< $100	$ 62	1.228	1.071	1.316

This summary basically supports the traditional thoughts on liquidated damages and their effect on contract completion within prescribed time limits. The summary suggests that as the contract price and liquidated damages rise, so does the contract time delay factor. This may be because contractors negotiate for more time on change orders when more capital is at risk, while on the lower dollar volume (and lower liquidated damages) contracts, they are willing to assume more risk.

A review of these three tables will provide the reader with much more information on this sort than is presented in this summary.

TABLE 16

LIQUIDATED DAMAGES NUMERIC SORT - > $300 - TIME ANALYSIS

$LD	ORCT	ADCT	FNCT	CTDF	LDDY	FDUR	FDF(O)	FDF(F)	ATDF	LDDF	ORIG COST
3,600	540	129	669	1.239	41	710	1.315	1.061	0.94	0.06	5,247,000
1,600	212	15	227	1.071	0	221	1.042	0.974	1.00	0.00	827,777
1,382	450	112	562	1.249	0	562	1.249	1.000	1.00	0.00	4,731,000
1,296	700	7	707	1.010	0	707	1.010	1.000	1.00	0.00	4,623,154
1,020	420	234	654	1.557	0	654	1.557	1.000	1.00	0.00	3,012,700
792	540	80	620	1.148	0	620	1.148	1.000	1.00	0.00	1,864,000
625	540	57	597	1.106	0	597	1.106	1.000	1.00	0.00	4,888,000
565	540	257	797	1.476	0	797	1.476	1.000	1.00	0.00	5,219,022
535	520	371	891	1.713	0	891	1.713	1.000	1.00	0.00	4,453,000
515	630	792	1,422	2.257	0	1,422	2.257	1.000	1.00	0.00	5,064,644
420	480	99	579	1.206	0	579	1.206	1.000	1.00	0.00	3,213,958
419	450	102	552	1.227	14	566	1.258	1.025	0.98	0.02	3,791,000
415	520	190	710	1.365	0	640	1.231	0.901	1.00	0.00	4,894,000
405	420	317	737	1.755	10	747	1.779	1.014	0.99	0.01	3,676,000
380	400	350	750	1.875	0	750	1.875	1.000	1.00	0.00	3,865,000
315	455	143	598	1.314	0	598	1.314	1.000	1.00	0.00	2,935,227
315	420	219	639	1.521	120	759	1.807	1.188	0.84	0.16	2,828,000
305	455	274	729	1.602	0	634	1.393	0.870	1.00	0.00	3,065,466
305	360	281	641	1.781	0	641	1.781	1.000	1.00	0.00	2,457,000
Average: 800	476	212	688	1.446	10	689			0.99	0.01	3,710,734

TABLE 17

LIQUIDATED DAMAGES NUMERIC SORT - >$100 TO <$300 - TIME ANALYSIS

$LD	ORCT	ADCT	FNCT	CTDF	LDDY	FDUR	FDF(O)	FDF(F)	ATDF	LDDF	ORIG COST
265	365	135	500	1.370	0	500	1.370	1.000	1.00	0.00	2,189,000
265	330	202	532	1.612	0	532	1.612	1.000	1.00	0.00	2,760,900
235	365	98	463	1.268	0	449	1.230	0.970	1.00	0.00	2,107,250
225	270	38	308	1.141	197	505	1.870	1.640	0.61	0.39	912,163
215	270	107	377	1.396	0	377	1.396	1.000	1.00	0.00	1,035,679
205	365	120	485	1.329	28	513	1.405	1.058	0.95	0.05	1,798,000
195	400	135	535	1.338	0	535	1.338	1.000	1.00	0.00	3,865,000
185	480	44	524	1.092	0	524	1.092	1.000	1.00	0.00	1,776,000
185	455	96	551	1.211	0	551	1.211	1.000	1.00	0.00	1,498,000
175	420	102	522	1.243	9	531	1.264	1.017	0.98	0.02	1,467,405
155	395	272	667	1.689	0	667	1.689	1.000	1.00	0.00	1,039,139
150	270	57	327	1.211	0	327	1.211	1.000	1.00	0.00	703,920
135	365	14	379	1.038	0	379	1.038	1.000	1.00	0.00	1,407,000
135	365	405	770	2.110	0	770	2.110	1.000	1.00	0.00	1,392,500
115	365	19	384	1.052	0	384	1.052	1.000	1.00	0.00	1,015,000
115	240	78	318	1.325	0	302	1.258	0.950	1.00	0.00	949,860
105	440	45	485	1.102	0	485	1.102	1.000	1.00	0.00	794,000
Average:180	362	116	470	1.325	14	490			0.97	0.03	1,570,754

TABLE 18

LIQUIDATED DAMAGES NUMERIC SORT - < $100 - TIME ANALYSIS

%LD	ORCT	ADCT	FNCT	CTDF	LDDY	FDUR	FDF(O)	FDF(F)	ATDF	LDDF	ORIG COST
95	300	20	320	1.093	0	320	1.093	1.000	1.00	0.00	727,000
95	300	145	445	1.483	0	445	1.483	1.000	1.00	0.00	667,203
90	300	42	342	1.140	0	342	1.140	1.000	1.00	0.00	574,000
85	360	20	380	1.078	0	380	1.056	0.979	1.00	0.00	635,000
75	270	33	303	1.122	0	303	1.122	1.000	1.00	0.00	740,000
75	180	22	202	1.122	193	395	2.194	1.955	0.51	0.49	614,092
65	300	62	362	1.207	14	376	1.253	1.039	0.96	0.04	396,000
65	300	9	309	1.030	0	309	1.030	1.000	1.00	0.00	393,000
65	280	275	555	1.982	0	315	1.125	0.568	1.00	0.00	410,900
65	270	12	282	1.044	0	282	1.044	1.000	1.00	0.00	433,399
65	270	10	280	1.037	123	403	1.493	1.439	0.69	0.31	482,569
55	240	0	240	1.000	40	280	1.167	1.167	0.86	0.14	390,261
35	120	147	267	2.225	0	267	2.225	1.000	1.00	0.00	199,447
25	60	14	74	1.233	102	176	2.933	2.378	0.42	0.58	1,407,000
20	60	0	60	1.000	111	156	2.600	2.600	0.29	0.71	3,012,700
10	30	14	44	1.467	0	44	1.467	1.000	1.00	0.00	1,407,000
Average: 62	220	53	280	1.266	36	300			0.86	0.14	780,598

TABLES 19 AND 20

The final and most interesting sorts of the contracts data base are those of the contracts which did and did not have liquidated damages assessed (Tables 19 and 20 respectively). A summary of the key cost and time factors for these two tables is listed below.

	CSTF	CTDF	FDF(F)	FDF(O)
LD's assessed (13)	1.024	1.287	1.192	1.534
No LD's assessed (35)	1.084	1.372	0.976	1.338
All Contracts (48)	1.069	1.361	1.020	1.388

The most striking point as shown in the summary is that the cost factor is much higher on the contracts with no liquidated damages assessed than on those that did have them assessed. Furthermore, the contract time delay factor is greater on the contracts with no liquidated damages.

This indicates that contractors on the lower cost factor jobs possibly had less incentive to complete them on time, and were more likely to seek more income on other jobs. This is a significant finding. Closer review of Table 19 will show that with a few exceptions most of the jobs with assessed liquidated damages assessed had relatively low liquidated damage rates, and thus besides the low cost factor which suggests low profit margin, the cost of delay to the contractor was minimal, and incentive to complete the job was low.

TABLE 19

ALL CONTRACTS WITH LIQUIDATED DAMAGES ASSESSED

#	ORCT	ADCT	FNCT	LDDY	FDUR	$LD	TOT $LD	ATDF	LDDF	ORIG COST	FNL COST	CSTF
06	420	219	639	120	759	315	37,800	0.84	0.16	2,828,000	2,858,737	1.011
19	540	129	669	41	710	3,600	147,600	0.94	0.06	5,247,000	5,272,903	1.005
27A	60	0	60	111	156	20	2,220	0.29	0.71	3,012,700	3,028,041	1.005
01	420	317	737	10	747	405	4,050	0.99	0.01	3,676,000	3,933,923	1.070
08	420	102	522	9	531	175	1,575	0.98	0.02	1,467,405	1,479,339	1.008
31	240	0	240	40	280	55	2,200	0.86	0.14	390,261	390,261	1.000
21	365	120	485	28	513	205	5,740	0.95	0.05	1,798,000	1,911,284	1.063
18	270	10	280	123	403	65	7,995	0.69	0.31	482,569	490,076	1.016
22	270	38	308	197	505	225	44,325	0.61	0.39	912,163	902,014	0.989
36	300	62	362	14	376	65	910	0.96	0.04	396,000	416,072	1.051
30	180	22	202	193	395	75	14,475	0.51	0.49	614,092	621,281	1.012
32B	60	14	74	102	176	25	2,550	0.42	0.58	1,407,000	1,417,589	1.008
40	450	102	552	14	566	419	5,866	0.98	0.02	3,791,000	3,918,447	1.034
age:	307	87	395	77	471	435	21,331					
l:							277,306			26,022,190	26,639,967	
t: 13												

TABLE 20
ALL CONTRACT WITH NO LIQUIDATED DAMAGES ASSESSED

TYPE	#	ORCT	ADCT	FNCT	FDUR	$LD	ORIG COST	FNL COST	CSTF
HNGR	16	540	57	597	597	625	4,880,000	5,082,662	1.040
	44	455	274	729	634	305	3,065,466	3,350,165	1.093
	48	360	281	641	641	305	2,457,000	2,930,457	1.193
HSG	07	700	7	707	707	1,296	4,623,154	4,641,377	1.004
	09	450	112	562	562	1,382	4,731,000	4,773,000	1.009
	23	440	45	485	485	105	794,000	860,021	1.083
INST	03	365	135	500	500	265	2,189,000	2,275,018	1.039
	14	480	44	524	524	185	1,776,000	1,825,906	1.028
	28	212	15	227	221	1,600	827,777	845,777	1.022
	39	270	57	327	327	150	703,920	740,704	1.052
	45	520	190	710	640	415	4,894,000	5,235,684	1.070
	46	540	257	797	797	565	5,219,022	7,115,617	1.363
LAB	02	630	792	1,422	1,422	515	5,064,644	5,432,923	1.073
	15	270	12	282	282	65	433,399	436,380	1.007
MODS	04	400	135	535	535	195	3,865,000	4,669,575	1.208
	05	330	202	532	532	265	2,760,900	2,807,341	1.017
	11	120	147	267	267	35	199,447	213,750	1.072
	12	395	272	667	667	155	1,039,139	1,111,586	1.070
	20	540	80	620	620	792	1,864,000	2,049,017	1.099
	26	270	107	377	377	215	1,035,679	1,024,469	0.989
	29	365	98	463	449	235	2,107,250	2,146,579	1.019
	35	240	78	318	302	115	949,860	1,080,055	1.137
	37	270	33	303	303	75	740,000	746,981	1.009
	38	300	42	342	342	90	574,000	580,860	1.012
	42	365	405	770	770	135	1,392,500	1,961,929	1.409
OFFC	10	455	96	551	551	105	1,490,000	1,537,241	1.032
	13	365	19	384	384	115	1,015,000	1,026,605	1.011
	17	300	9	309	309	65	393,000	401,007	1.021
	24	360	28	388	380	85	635,000	651,204	1.026
	25	455	143	598	598	315	2,935,227	2,991,078	1.019
	34	300	28	328	328	95	727,000	737,559	1.015
	43	520	371	891	891	535	4,453,000	4,778,153	1.073
	47	280	275	555	315	65	410,900	405,052	0.986
WHSE	33	480	99	579	579	420	3,213,958	3,234,844	1.006
	41	300	145	445	445	95	667,283	679,971	1.019
Average:		390	145	535	522	345			
Total:							74,134,445	80,381,507	
Count:	35								

THE CHANGE ORDERS DATA BASE

TABLES 21 THROUGH 30

The changes data base consists of 432 change orders which correspond with the contracts analyzed above. These changes with their corresponding contracts can be reviewed in Appendix B. The changes total $6,864,839 with contract #46 included, and $4,968,244 (390 change orders) without contract #46. The analysis has been accomplished, mostly not considering contract #46, since its much higher change order rate and dollar volume significantly affects the outcome of the analysis.

Tables 21 through 30 are summaries of the contract change orders by building type, similar to some of the contracts data base summaries. These tables show both summaries with and without the effect of contract #46. A summary of the data is listed below. Tables 21 and 22 follow the summary. Tables 23 through 30, found in Appendix A, provide more extensive information on the changes as related to building type.

BLDG TYPE	% ORIG COST	% ADDL COST	% # OF CONTR	% # OF CHNGS
HNGR	11.0	19.2	6.4	8.2
HSG	22.3	4.0	12.8	11.3
INST(EX #46)	16.8	16.1	17.0	13.8
LAB	5.8	7.5	4.3	5.6
MODS	19.3	39.8	25.5	33.8
OFFC	14.6	9.8	23.4	18.5
WHSE	10.2	3.6	10.6	8.8

The above summary presents elements from both the contracts and changes data bases. It illustrates how per-cent original contract costs compare with per-cent additional change order costs for each respective building type. For example the aircraft hangar projects account for 11% of the original bid amounts, but a higher 19.2% of the change order amounts. Likewise, the modifications projects account for 19.3% of the original contracts but a very high 39.8% of change order costs. This summary shows where the most costly building types are in terms of additional cost.

REASON CODES

Reason codes are used throughout this analysis to identify a root cause for each change order. Change orders are often cited in terms of these reason codes. The reason codes and their corresponding causes are listed below.

Root cause of change order	Reason code
Formal claims settlement	CLMR
Discretionary owner change	CREQ
Mandatory owner change	CRIT
Design error change	DSGN
Extra work change	SCPE
Time Extension	TIME
Differing Site / Unforeseen work	UNFO
Value Engineering change	VALE

In addition to reason codes, sub-reason codes have also been included in the data base to ascertain to a greater extent the cause of the change. For example an UNFO change may have a sub-reason of ASBESTOS or FOUNDATION. A DSGN change may have sub-reasons such as ELEC or INT ARCH. These sub-reason codes may assist the reader in further change cause identification.

TABLE 21

CHANGE ORDERS SUMMARY BY BUILDING CONSTRUCTION TYPE

#	COST	TIME	CHG#
HNGR			
Total:	952,818	612	
Count:			32
HSG			
Total:	199,105	746	
Count:			44
INST			
Total:	2,698,844	1,117	
Count:			96
LAB			
Total:	371,260	804	
Count:			22
MODS			
Total:	1,977,651	2,069	
Count:			132
OFFC			
Total:	486,282	1,079	
Count:			72
WHSE			
Total:	178,879	382	
Count:			34
Total:	6,864,839	6,809	
Count:			432

TABLE 22

CHANGE ORDERS BY BUILDING CONSTRUCTION TYPE (EXCLUDING #46)

#	COST	TIME	CHG#
HNGR			
Total:	952,818	612	
Count:			32
HSG			
Total:	199,105	746	
Count:			44
INST			
Total:	802,249	860	
Count:			54
LAB			
Total:	371,260	804	
Count:			22
MODS			
Total:	1,977,651	2,069	
Count:			132
OFFC			
Total:	486,282	1,079	
Count:			72
WHSE			
Total:	178,879	382	
Count:			34
Total:	4,968,244	6,552	
Count:			390

TABLES 31 THROUGH 40

These tables present a great deal of data by illustrating the changes by their respective reason codes (and by their sub-reason codes in some tables). Tables 31 and 32 are summaries of change orders by reason code. Tables 33 through 40 provide more detailed information and are found in Appendix A. These tables provide the reader with some idea of the frequency of occurrence of these changes and their costs in relation to other causes. A summary of the reason codes with corresponding percentages of cost, time, and frequencies of occurrence is listed below.

REASON CODES CONTRIBUTION TO TIME AND COST (EXCLUDING #46)

REASON CODE	% OF COST	% OF TIME	% OF CHNGS	# OF CHNGS
CLMR	9.1	1.1	0.3	1
CREQ	22.8	18.7	12.8	50
CRIT	6.3	5.4	5.4	21
DSGN	36.8	33.3	40.3	157
SCPE	0.0	0.0	0.0	0
TIME	0.1	14.3	6.9	27
UNFO	25.1	27.2	33.3	130
VALE	-0.2	0.0	1.0	4
TOTALS	100.0	100.0	100.0	390

This is a most significant summary since it illustrates where the causes and costs of changes exist in this particular data set. Design error changes are significant. When added to mandatory and discretionary changes, the three reason codes account for 65.9% of additional cost, 57.4% of additional time, and 58.5% of the number of change orders.

Inspection of Table 38 reveals that 33% of time only changes are attributable to the owner or 4.8% of total additional time. Therefore 62.2% of construction delay for this data set is directly attributable to the owner. The remaining delay is caused by differing site conditions, material delays and strikes, and resolution of one claim. Furthermore, the additional cost percentage is even greater. This is a significant finding.

TABLE 31

SUMMARY OF CHANGES BY REASON CODE (COUNTS AND TOTALS)

MAJ REAS		COST	TIME	CHG#
CLMR				
	Total:	891,[illegible]99	69	
	Count:			3
CREQ				
	Total:	1,174,921	1,224	
	Count:			52
CRIT				
	Total:	1,281,668	379	
	Count:			33
DSGN				
	Total:	1,776,481	2,191	
	Count:			176
SCPE				
	Total:	139,468	121	
	Count:			1
TIME				
	Total:	3,180	935	
	Count:			27
UNFO				
	Total:	1,613,566	1,890	
	Count:			136
VALE				
	Total:	-15,574	0	
	Count:			4
	Total:	6,864,839	6,809	
	Count:			432

TABLE 32

SUMMARY OF CHANGE ORDERS (EXCLUDING #46)

MAJ REAS		COST	TIME	CHNG #
CLMR				
	Total:	452,524	69	
	Count:			1
CREQ				
	Total:	1,138,416	1,224	
	Count:			50
CRIT				
	Total:	310,941	353	
	Count:			21
DSGN				
	Total:	1,830,650	2,191	
	Count:			157
TIME				
	Total:	3,180	935	
	Count:			27
UNFO				
	Total:	1,240,107	1,780	
	Count:			130
VALE				
	Total:	-15,574	0	
	Count:			4
	Total:	4,960,244	6,552	
	Count:			390

TABLES 41 THROUGH 46 (TIME AND NO TIME CHANGES)

These tables show the additional-time and the no-additional-time changes separately, sorted by reason codes and building types. Using the data base, (without contract #46), the results indicate that additional time changes account for 51.3% (200 of 390) of the changes and 73.5% of additional costs. The average contract time addition by each change order is 32.8 days. When all changes are considered, the average becomes 16.8 days.

Average cost of each time-adding change is $18,244, and for each change not affecting time, $6,945. Distribution of the changes with and without additional time by reason codes and building types do not differ significantly from previous summaries. These tables are found in Appendix A.

TABLES 47 THROUGH 53

These tables, (in Appendix A), depict the data base (without contract #46) sorted by the dollar value of the change orders. A table which summarizes the results follows.

CHANGE ORDER $ VALUE %CONTRIBUTION TO ADD'L TIME AND COST
(excluding contract #46)

DOLLAR RANGE	% OF COST	% OF TIME	% OF CHNGS	# OF CHNGS
>$100K	40.9	24.5	2.6	10
$75-100K	3.2	2.7	0.5	2
$50-75K	12.4	5.3	2.6	10
$25-50K	15.1	10.6	5.6	22
< $25K	28.4	56.9	88.7	346
TOTALS	100.0	100.0	100.0	390

This summary illustrates the relative low occurrence of changes exceeding $25,000 (11.3% of all changes), but the magnitude of the dollar volume these changes add to contract value (71.7% of additional costs). The lower dollar value change orders occur much more frequently, and account for the majority of additional time, but only 28.4% of additional costs.

Tables 52 and 53 show all change orders exceeding $100,000 and by reason code, for the full data base and for contract #46 respectively. It is noteworthy that seven of the #46 changes exceeded $100,000 and in all, these seven changes totalled $1,657,247. This the primary reason that it has been left out of much of the analysis.

TABLES 54 THROUGH 58

These tables, (in Appendix A), are similar to those that sorted the changes by dollar value. These however, illustrate per-cent contributions to total additional time and cost, based on each change order time duration. The summary below excludes all changes from contract #46 and all changes which did not add contract time.

CHANGE ORDER TIME %CONTRIBUTION TO ADD'L TIME AND COST

(excluding contract #46 and cost only changes)

TIME RANGE	% OF COST	% OF TIME	% OF CHNGS	# OF CHNGS
>100 DAYS	37.2	47.3	7.5	15
75-100 DAYS	2.5	9.3	3.5	7
50-74 DAYS	17.9	9.3	5.0	10
25-49 DAYS	8.6	15.7	14.0	28
< 25 DAYS	33.8	18.4	70.0	140
TOTALS	100.0	100.0	100.0	200

This summary adds some perspective to large additional time change orders which, as the summary illustrates, account for a significant amount of dollar value, over half of additional time (56.6% for changes involving 75 or more days), and low relative frequency. 84% of the change orders granted much shorter time durations (1 to 49 days).

Observation of the above summaries and tables reveals that the most costly causes of change orders are design errors (DSGN), discretionary owner changes (CREQ), mandatory changes (CRIT), and differing site conditions / unforeseen work (UNFO). These four causes along with time only changes (TIME) significantly affect construction contract delay.

The last two summaries below, depict the per-cent cost and time attributable to these more frequent causes, by corresponding building construction type. This enables the reader to discern the time and financial impact of each change order root cause with any of the particular building types studied.

% DOLLAR VOLUME OF EACH CHANGE ROOT CAUSE BY BLDG TYPE
(ALL CONTRACT CHANGES)

BLDG TYPE	DSGN	CREQ	CRIT	UNFO
HNGR	19.4	2.1	5.0	4.1
HSG	6.9	4.4	-0.9	2.9
INST	26.1	13.3	0.3	11.0
INST (#46)	-3.1	3.1	75.7	22.7
LAB	8.0	15.8	0.0	2.7
MODS	36.8	38.7	17.3	40.1
OFFC	4.2	16.2	-0.2	13.9
WHSE	1.7	6.4	2.8	2.6
TOTALS	100.0	100.0	100.0	100.0

The next summary table presents the same type of data, except percentage of additional time for each change root cause is listed by building type. Also included in this summary is the root cause TIME for time only changes.

% ADD'L TIME FOR EACH CHANGE ROOT CAUSE BY BLDG TYPE
(ALL CONTRACT CHANGES)

BLDG TYPE	DSGN	CREQ	CRIT	UNFO	TIME
HNGR	11.2	1.6	7.9	11.6	2.9
HSG	10.4	11.8	0.0	1.0	38.0
INST	16.5	11.3	2.6	7.2	22.9
INST (#46)	0.0	0.0	6.9	5.8	0.0
LAB	34.3	3.4	0.0	0.3	0.6
MODS	13.3	48.1	76.3	33.2	29.1
OFFC	5.1	20.9	0.0	34.4	6.5
WHSE	9.2	2.9	6.3	6.5	0.0
TOTALS	100.0	100.0	100.0	100.0	100.0

These two tables mirror the earlier summaries in that the modification projects take the greatest share of additional time and money over the other building types. It is evident that design improvements and greater owner restraint, in the modifications construction area alone, would save a significant amount of time and money on future construction projects of this type.

In summary, all of the above data base manipulations have revealed some interesting points concerning typical construction delays encountered and their corresponding costs. This section has clearly quantified the impacts of delay on real construction projects.

SECTION IV

MANAGEMENT SOLUTIONS TO CONSTRUCTION DELAY

GENERAL DISCUSSION

This paper's first section discussed in detail the causes of construction delay. The second section focused on the costs of delay, and the third section discussed both causes and costs as related to recently completed construction contracts.

When particular management problems have been determined, and their impacts quantified, solutions can achieved in an easier and more workable fashion. By knowing where the most costly problem areas are, management solutions can be directed in priority fashion, resolving the greater magnitude problems first.

This section discusses some possible solutions to construction delay, drawing on the earlier sections of this paper and some new material from available literature and field interviews.

CONSTRUCTION DELAY IN GENERAL

The first conclusion that is easily drawn from review of this subject is that none of the related parties benefit from delay. This is a "common thread" among the related parties and their widely different goals. This common thread should be exploited to the maximum possibility, and should provide the parties with some incentive to protect one another's interests, to coordinate, and to cooperate while accomplishing the construction project objectives.

The traditional adversary relationship between owners and contractors is counter-productive to the most effective accomplishment of construction. Owners must take the leadership role in changing this perceived relationship. It is an established fact that the owner who exhibits the laissez-faire management style during the construction life cycle, can certainly expect to assume control of the constructed facility at a later date than expected, and at a final cost over budget. Furthermore, this management style significantly contributes to projects plagued with formal claims.

The knowledgeable owner "recognizes that he must be involved in his project, either through his own staff or by retaining a construction manager if he does not have the staff available" (O'Brien, 1976).

As noted in both prior studies and the section III primary field study, 65 to 75 percent of all changes in cost and time are directly attributable to the owner or owner's agent. The roots of these changes are design errors, discretionary changes, and to some extent, unforeseen conditions and mandatory changes.

Therefore a great deal of effort is needed, particularly during the project life cycle design and planning stages, when the owner's control of the outcome is at its peak. The planning stages are also the most opportune times to achieve project cost savings. The rate of project cost savings opportunities steeply declines as the project cycle progresses to construction (Shah and Lammie, 1984).

PROJECT PLANNING AND DESIGN

The project planning and design phases, like any first activities in a chain of events, significantly direct the construction life cycle path. Owners should focus heavily on this part of a project since most delays and additional costs can be traced to errors, omissions, or ambiguity in plans and specifications. The following paragraphs provide thoughts on improvement of this crucial part of the project life cycle.

SITE ACCESS

Site access delays are one of the owner-caused delays that lead to claims and costly changes. The owner's planning team should have this problem resolved before releasing the design and contract for bidding. This is sometimes not the case, and in very large volume projects with different prime contractors this is difficult to avoid.

One effective method used by MARTA on its large projects, to minimize contractor site access delay claims, was establishing time duration "windows" for site availability. Work areas were promised to contractors on a "not earlier than - not later than" basis, which was generally a 90 to 120 day period (Shah and Lammie, 1984). This greatly reduced the impact of right-of-way acquisition delays and other contractor delays, affecting follow-on contractors in the same work area. This was an innovative and effective management solution to an age-old construction problem.

CONSTRUCTABILITY AND DESIGN QUALITY CONTROL

Designs typically suffer from many problems including ambiguity, contradictions, poor constructability forethought, and incompleteness. This is often a function of hurried design schedules which result in disjointed and uncoordinated designs.

Where possible, particularly in the private sector, designs can be enhanced tremendously by bringing in the contractor as part of the construction team during the design phase.

The IBM Tower at Atlantic Center in Atlanta, Georgia is a perfect example of this practice and illustrates the positive effect that early project and construction team establishment and coordination can have on project performance.

Henry C. Beck (HCB), the prime contractor on the IBM job, was brought into the planning phases of the project almost as the design began (Webb, 1987). This allowed construction methods to be worked out early during the planning phases which contributed to the project's visible success during a fast paced construction schedule on a very tight work site.

In the public sector, constructability reviews by the contractor are usually not possible. Alternative solutions are pre-bid conferences before construction begins and sound quality control during design.

The owner's commitment to quality control requires "careful monitoring and internal discipline" which will not happen without intense effort (Lakamp, 1987). The cost of the added effort during the design phase is likely to be far less than the "ultimate cost of completing the design in the field" (Ibid).

One recent Construction Industry Institute study on improvements in design constructability presented the following conclusions on how designs can be improved resulting in less delay and additional costs (O'Connor et al, 1987):

Designs should be construction driven. This means the design is enhanced and more effective when it considers the construction schedule and materials procurement sequence.

Designs should be simplified to the maximum extent possible. This includes specifying locally available materials in readily available sizes and configurations and minimization of construction task inter-dependencies.

Designs should be standardized. This results in continuance of designs which are effective in the field and has the effect of not "re-inventing the wheel" on every new design.

Designs should encourage maximum use of pre-assembly. Off-site work lessens the crowding effect on work sites and speeds on-site construction activity. This enables contractors to take maximum advantage of productive time available on the work site.

Designs should be site specific. This means the accessibility, geography, and size of the site should be considered during design decisions. Also the type of facility being constructed and its interface with the work site factors should also be considered.

Designs should consider adverse weather. The owner and owner's agents should consider the climate of the local area when establishing durations and types of work to be accomplished to achieve project milestones.

Specifications should be tailored to each respective project. The use of "boiler plate" specifications contributes significantly to contradictions in plans and general paragraphs of contracts. An added effort in specifications writing is money saved in negotiated settlements and claims.

Two principles that are noted in this study which specifically address some of the problems discussed in earlier sections include the following thoughts. Decision making policy in construction should utilize a "bottom-up approach" and should always involve the "doers". Furthermore, managers should recognize that engineering problems "are often addressed in parts". Management must take the extra step of integrating those parts into a holistic solution (O'Connor et al, 1987).

Another concept in improving design is to ensure that the only exculpatory clauses used in the contract are specifically written to the actual project conditions. "Blanket" exculpatory disclaimers do not generally protect the owner from liability during litigation and are counterproductive since they increase tensions at the working level between the related parties (Lakamp, 1987).

Specifications should be clear on change order procedures, and should provide criteria for approval and rejection of "or equal" submittals. Furthermore, a realistic submittals and shop drawings sequence and procedure should be established in the specifications so that critical procurement items are not delayed due to misunderstandings of the working parties (Kagan, 1985).

In summary, project designs are the source of most construction delay and project cost over-runs. A concerted effort is necessary by owners to improve this phase of the construction life cycle. These efforts certainly will save both time and money and will result in an improved "team" approach between the related parties, resulting in avoidance of costly construction claims.

MANAGEMENT DURING THE CONSTRUCTION PHASE

For management to be effective in the field, during the construction phase, it must be active. The following paragraphs focus on management practice during the construction phase.

COMMUNICATION AND LEADERSHIP

Clearly the most important factors contributing to effective management of construction projects are the communication and leadership skills of the related parties. The owner must clearly communicate his/her intentions, and the contractor must quickly communicate any problems encountered to the owner so that these problems can be resolved.

A great deal can be written on this subject, but in essence, if any of the related parties employ management personnel who are poor communicators with others, they generally increase their risk of claims, management delays, and litigation.

The ability of those involved in construction management to "communicate, coordinate, and integrate" is paramount to the successful outcome of a project (Shah, 1987). Communication has been discussed. Coordination is the ability to work with various parties simultaneously and to direct the successful outcome of an activity. Integration is the ability to plan ahead and know what activities follow the current activity so that follow-on activities commence without delay. This essentially is the foundation of construction planning.

In addition to the abilities to communicate orally and to direct work, the related parties must document their actions. Written communication skills are also essential qualities of construction management personnel.

Both parties should document the job as it progresses, so that if disputes arise, they can be settled with the evidence in hand, and so that facts are not forgotten or misconstrued. The contractor should quickly communicate with the owner concerning delays encountered, so that problems can be resolved in time... fashion. The owner also must respond in an expeditious [illegible]

All of the communication and leadership skills [illegible] above contribute immensely to the success or failure [illegible] All related parties should staff their [illegible]

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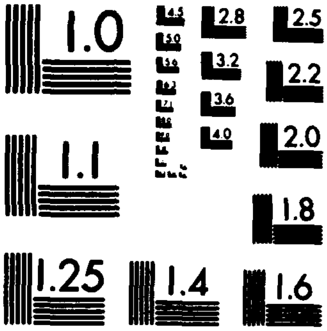

MICROCOPY RESOLUTION TEST CHART
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teams with quality people that have the ability to work with others.

CONSTRUCTION PLANNING

Cost estimating and effective planning are also foremost of the factors which "make or break" the success of construction in the field. Contractors should have planners and estimators on their staffs, with field experience. Just as designs must be constructable, so should construction work plans. The most successful contractors have a very high quality personnel in the positions of planning and estimating.

In addition, sound monitoring of projects from the office and in the field is most important. Contractors and owners alike should have in place some monitoring system which tracks project milestones and provides management with the data required to assess progress and make decisions. The most successful project teams have effective decision support systems and cost accounting systems in place, which can quickly point out the strengths and weaknesses of project development. 'Management by exception' is enhanced by such systems.

One such information gathering system which is easy and inexpensive to implement is the Foreman-Delay Survey (Tucker et al, 1982). This monitoring system has been used successfully by some contractors to determine the amount of time their work forces are delayed on site, and for what reasons. Results are tabulated and provide management with quantitative data as to the impact of these delays (in terms of lost man-hours). Management can then seek out the problem source to eliminate the waste of labor. One test of the FDS system on a group of construction sites concluded that productivity performance factors were improved and the cost of implementing the FDS was minimal, thus the program saved the contractor a great deal of time and money.

The use of some form of scheduling which shows inter-dependencies of work tasks is essential to sound project management. This is particularly true in the case of complex projects or heavy construction.

CPM has proven to be an effective construction management tool. Often, it is used more as a legal document in claims proceedings, than as an on-site management tool. On projects which involve multiple contractors on the same site, the owner should maintain an "overall project" CPM to account for delay impacts of each of the respective contracts on the others.

The contractor and owner should both use the CPM as a tool to discuss the project as it progresses. Both parties should use the "as-planned" CPM to plan and schedule work, and as changes come about the schedule should be updated and upon work completion the schedule will have transformed into the "as-built" CPM (O'Brien, 1984).

These two schedules can be used effectively to settle negotiations and changes. The CPM schedule and other schedules like it, are management tools which the industry should exploit.

PROBLEM SOLVING

Immediate resolution of problems or the "settle as you go" approach will go a long way towards claims avoidance and less costly projects (Shah, 1987). Other studies cited earlier in the paper have also substantiated the cost effectiveness of this management policy.

The owner's on-site representative must be given ample authority to act and make decisions on-site. Often claims are a function of the owner's on-site staff either not being staffed to handle submittals approvals, or not having authority to make field decisions. Such deficiencies lead to delay and claims.

The owner's on-site representative must deal even handedly with the contractor. It should be emphasized to field sta*f that their job is to "facilitate completion of the project in general conformance with the intent of design" and not to enforce the construction project (Lakamp, 1987). This attitude enhances the team approach and helps the related parties focus on commonality of purpose.

All of the above thoughts on improved management techniques are, in essence, techniques to avoid formal claims proceedings which are costly and lengthy. Claims mitigation is another subject altogether and is not within the scope of this paper.

When managing disputes and unforeseen conditions, management's goal should be to equitably allocate risks and minimize the cost and schedule impacts on the overall project (Thomas et al, 1987).

Besides better site condition descriptions as a management action to avoid disputes, a proven policy in minimizing disputes costs, particularly in the case of unforeseen conditions, is prompt resolution of such problems (Ibid).

The management practice at the field level is the most critical determinant of change and dispute costs. It is noteworthy that in cases which have been litigated, courts generally have looked at how unforeseen conditions have been managed by the related parties, rather than at the disclaimers of liability in the contract.

In summary, the management practice on-site, carries much more weight in formal proceedings, than does contract language. Construction managers who remember this will be more successful in avoiding construction delay and budget over-runs, and in achieving their goals and objectives.

SECTION V

CONCLUSIONS AND THOUGHTS FOR FUTURE RESEARCH

DISCUSSION AND CONCLUSIONS

This study has discussed the many causes of construction delay. It has also quantified the time and financial costs of delay, based on prior studies, and within the limits of the data base presented in Section III. The specific results of the study cannot be generalized to the entire construction industry. However, the principles discussed can definitely be applied to improve overall management of delay.

THE DATA BASE STUDY - SECTION III

The contract time and final duration delay factors discussed are most revealing. The results indicate that an originally scheduled year-long project, after change orders and delays, takes an additional 4.5 months to complete.

Also, owners who try to solve delay problems with high liquidated damages are generally delayed even longer. Results indicate that higher valued contracts (over $3 million), with higher liquidated damage rates, are delayed an average of 5.5 months on a year-long project.

Furthermore, there is a large gap between the cost escalation factors of those projects that have liquidated damages assessed, and those that do not. The explanations for this finding is a place for future research.

The changes data base is helpful in determining the building types which are most prone to cost increase and delay. Modifications projects are the most costly and delay-prone building type. This is actually no surprise.

The reason code analysis provides a great deal of information on the change order causes and their corresponding costs and delays.

The data base study shows the ease with which management can quantify the causes and costs of delay. In summary, this exercise has illustrated the use of a decision support system (DSS). It has sorted data into the required forms to answer specific questions with quantitative data. A DSS such as this adds a dimension to problem solving and can be used by management to better direct efforts toward improving its activities' effectiveness.

OTHER SECTIONS

The literary sections of the paper and the data base study in Section III are complimentary. Both point to the fact that the majority of construction delay problems are owner caused. The owner is responsible for approximately 70% of additional contract costs and delays. Differing site and unforeseen conditions account for most of the remainder of these factors. One can argue that many differing site conditions problems are also an owner responsibility. This would result in closer to 85% of delay responsibility resting with the owner.

Owners must seize the initiative to correct these significant and costly problems. The many costs of delay are ample incentive. As owners take the first step, so will contractors also take steps to improve their construction management practice.

In summary, construction delay, to some degree, is inevitable. The management approach which seeks to eradicate all delay will fail, and will not be cost effective. Every day wasted in over-planning contributes the same amount to cost escalation and schedule delay as difficulties encountered during construction.

A prudent, balanced management approach which seeks improved design constructability and improved coordination and integration of construction activities, will go far in improving the current state of the industry.

Most construction delays result from flaws in the pre-construction planning process. Elimination of just half of these flaws will have enormous impact, significantly reducing cost and time over-runs. The planning phase of the construction life cycle is the area where most delays can be eliminated and where the greatest amount of construction delay costs can be avoided.

FUTURE RESEARCH

Most of the construction delay studies to date come from the many sections of the industry which are publicly funded. The most fruitful possibilities for future research, would be studies that explore the private sector's performance in construction delay management.

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APPENDIX A

FIELD DATA RESULTS

ADDITIONAL TABLES FROM FIELD STUDY DATA BASE
(see Section III)

TABLE 5

AIRCRAFT HANGAR CONSTRUCTION - TIME ANALYSIS

TYPE	#	ORCT	ADCT	FNCT	LDDY	FDUR	$LD	TOT $LD	CTDF	FDF(O)	FDF(F)	ATDF	LDDF
HNGR	16	540	57	597	0	597	625	0	1.106	1.106	1.000	1.00	0.00
	44	455	274	729	0	634	305	0	1.602	1.393	0.870	1.00	0.00
	48	360	281	641	0	641	305	0	1.781	1.781	1.000	1.00	0.00
Average:		452	204	656	0	624	412	0					
Total:								0					
Count:	3												

AIRCRAFT HANGAR CONSTRUCTION - COST ANALYSIS

TYPE	#	ORIG COST	ADDCOST	FNL COST	CSTF	$LD
HNGR	16	4,888,000	194,662	5,082,662	1.040	625
	44	3,065,466	284,699	3,350,165	1.093	305
	48	2,457,000	473,457	2,930,457	1.193	305
Average:		3,470,155	317,606	3,787,761		412
Total:		10,410,466	952,818	11,363,284		
Count:	3					

TABLE 6

HOUSING CONSTRUCTION - TIME ANALYSIS

TYPE	#	ORCT	ADCT	FNCT	LDDY	FDUR	$LD	TOT $LD	CTDF	FDF(O)	FDF(F)	ATDF	LDDF
[illegible]	06	420	219	639	120	759	315	37,000	1.521	1.007	1.100	0.84	0.16
	07	700	7	707	0	707	1,296	0	1.010	1.010	1.000	1.00	0.00
	09	450	112	562	0	562	1,382	0	1.249	1.249	1.000	1.00	0.00
	19	540	129	669	41	710	3,600	147,600	1.239	1.315	1.061	0.94	0.06
	23	440	45	485	0	485	105	0	1.102	1.102	1.000	1.00	0.00
	27	420	234	654	0	654	1,020	0	1.557	1.557	1.000	1.00	0.00
Average:		495	124	619	27	646	1,286	30,900					
Total:								185,400					
Count:	6												

HOUSING CONSTRUCTION - COST ANALYSIS

TYPE	#	ORIG COST	ADDCOST	FNL COST	CSTF	$LD
HSG	06	2,828,000	30,737	2,858,737	1.011	315
	07	4,623,154	18,223	4,641,377	1.004	1,296
	09	4,731,000	42,880	4,773,880	1.009	1,382
	19	5,247,000	25,903	5,272,903	1.005	3,600
	23	794,000	66,021	860,021	1.083	105
	27	3,012,700	15,341	3,028,041	1.005	1,020
Average:		3,539,309	33,184	3,572,493		1,286
Total:		21,235,854	199,105	21,434,959		
Count:	6					

TABLE 7 7

INSTRUCTIONAL BUILDING CONSTRUCTION - TIME ANALYSIS

E	#	ORCT	ADCT	FNCT	LDDY	FDUR	$LD	TOT $LD	CTDF	FDF(O)	FDF(F)	ATDF	LDDF
T	01	420	317	737	10	747	405	4,050	1.755	1.779	1.014	0.99	0.01
	03	365	135	500	0	500	265	0	1.370	1.370	1.000	1.00	0.00
	08	420	102	522	9	531	175	1,575	1.243	1.264	1.017	0.98	0.02
	14	480	44	524	0	524	185	0	1.092	1.092	1.000	1.00	0.00
	28	212	15	227	0	221	1,600	0	1.071	1.042	0.974	1.00	0.00
	31	240	0	240	40	280	55	2,200	1.000	1.167	1.167	0.86	0.14
	39	270	57	327	0	327	150	0	1.211	1.211	1.000	1.00	0.00
	45	520	190	710	0	640	415	0	1.365	1.231	0.901	1.00	0.00
	46	540	257	797	0	797	565	0	1.476	1.476	1.000	1.00	0.00
rage:		385	124	509	7	507	424	869					
tal:								7,825					
nt:	9												

INSTRUCTIONAL BUILDING CONSTRUCTION - COST ANALYSIS

TYPE	#	ORIG COST	ADDCOST	FNL COST	CSTF	$LD
INST	01	3,676,000	257,923	3,933,923	1.070	405
	03	2,189,000	86,018	2,275,018	1.039	265
	08	1,467,405	11,934	1,479,339	1.008	175
	14	1,776,000	49,906	1,825,906	1.028	185
	28	827,777	18,000	845,777	1.022	1,600
	31	390,261	0	390,261	1.000	55
	39	703,920	36,784	740,704	1.052	150
	45	4,894,000	341,684	5,235,684	1.070	415
	46	5,219,022	1,896,595	7,115,617	1.363	565
Average:		2,349,265	299,872	2,649,137		424
Total:		21,143,385	2,698,844	23,842,229		
Count:	9					

TABLE 8

INSTRUCTIONAL BUILDING CONSTRUCTION (EX. #46) - TIME ANALYSIS

TYPE	#	ORCT	ADCT	FNCT	LDDY	FDUR	$LD	TOT $LD	CTDF	FDF(O)	FDF(F)	ATDF	LDDF
INST	01	420	317	737	10	747	405	4,050	1.755	1.779	1.014	0.99	0.01
	03	365	135	500	0	500	265	0	1.370	1.370	1.000	1.00	0.00
	08	420	102	522	9	531	175	1,575	1.243	1.264	1.017	0.98	0.02
	14	480	44	524	0	524	185	0	1.092	1.092	1.000	1.00	0.00
	28	212	15	227	0	221	1,600	0	1.071	1.042	0.974	1.00	0.00
	31	240	0	240	40	280	55	2,200	1.000	1.167	1.167	0.86	0.14
	39	270	57	327	0	327	150	0	1.211	1.211	1.000	1.00	0.00
	45	520	190	710	0	640	415	0	1.365	1.231	0.901	1.00	0.00
Average:		366	108	473	7	471	406	978					
Total:								7,825					
Count:	8												

INSTRUCTIONAL BUILDING CONSTRUCTION (EX. #46) - COST ANALYSIS

TYPE	#	ORIG COST	ADDCOST	FNL COST	CSTF	$LD
INST	01	3,676,000	257,923	3,933,923	1.070	405
	03	2,189,000	86,018	2,275,018	1.039	265
	08	1,467,405	11,934	1,479,339	1.008	175
	14	1,776,000	49,906	1,825,906	1.028	185
	28	827,777	18,000	845,777	1.022	1,600
	31	390,261	0	390,261	1.000	55
	39	703,920	36,784	740,704	1.052	150
	45	4,894,000	341,684	5,235,684	1.070	415
Average:		1,990,545	100,281	2,090,827		406
Total:		15,924,363	802,249	16,726,612		
Count:	8					

TABLE 9

LABORATORY CONSTRUCTION - TIME ANALYSIS

TYPE	#	ORCT	ADCT	FNCT	LDDY	FDUR	$LD	TOT $LD	CTDF	FDF(O)	FDF(F)	ATDF	LDDF
LAB	02	630	792	1,422	0	1,422	515	0	2.257	2.257	1.000	1.00	0.00
	15	270	12	282	0	282	65	0	1.044	1.044	1.000	1.00	0.00
Average:		450	402	852	0	852	290	0					
Total:								0					
Count:	2												

LABORATORY CONSTRUCTION - COST ANALYSIS

TYPE	#	ORIG COST	ADDCOST	FNL COST	CSTF	$LD
LAB	02	5,064,644	368,279	5,432,923	1.073	515
	15	433,399	2,981	436,380	1.007	65
Average:		2,749,022	185,630	2,934,652		290
Total:		5,498,043	371,260	5,869,303		
Count:	2					

TABLE 10

MODIFICATIONS CONSTRUCTION PROJECTS - TIME ANALYSIS

TYPE	#	ORCT	ADCT	FNCT	LDDY	FDUR	$LD	TOT $LD	CTDF	FDF(0)	FDF(F)	ATDF	LDDF
MODS	04	400	135	535	0	535	195	0	1.338	1.338	1.000	1.00	0.00
	05	330	202	532	0	532	265	0	1.612	1.612	1.000	1.00	0.00
	11	120	147	267	0	267	35	0	2.225	2.225	1.000	1.00	0.00
	12	395	272	667	0	667	155	0	1.689	1.689	1.000	1.00	0.00
	20	540	80	620	0	620	792	0	1.148	1.148	1.000	1.00	0.00
	21	365	120	485	28	513	205	5,740	1.329	1.405	1.058	0.95	0.05
	26	270	107	377	0	377	215	0	1.396	1.396	1.000	1.00	0.00
	29	365	98	463	0	449	235	0	1.268	1.230	0.970	1.00	0.00
	35	240	78	318	0	302	115	0	1.325	1.258	0.950	1.00	0.00
	37	270	33	303	0	303	75	0	1.122	1.122	1.000	1.00	0.00
	38	300	42	342	0	342	90	0	1.140	1.140	1.000	1.00	0.00
	42	365	405	770	0	770	135	0	2.110	2.110	1.000	1.00	0.00
Average:		330	143	473	2	473	209	478					
Total:								5,740					
Count:	12												

MODIFICATIONS CONSTRUCTION PROJECTS - COST ANALYSIS

TYPE	#	ORIG COST	ADDCOST	FNL COST	CSTF	$LD
MODS	04	3,865,000	804,575	4,669,575	1.208	195
	05	2,760,900	46,441	2,807,341	1.017	265
	11	199,447	14,303	213,750	1.072	35
	12	1,039,139	72,447	1,111,586	1.070	155
	20	1,864,000	185,017	2,049,017	1.099	792
	21	1,798,000	113,284	1,911,284	1.063	205
	26	1,035,679	-11,210	1,024,469	0.989	215
	29	2,107,250	39,329	2,146,579	1.019	235
	35	949,860	130,195	1,080,055	1.137	115
	37	740,000	6,981	746,981	1.009	75
	38	574,000	6,860	580,860	1.012	90
	42	1,392,500	569,429	1,961,929	1.409	135
Average:		1,527,148	164,804	1,691,952		209
Total:		18,325,775	1,977,651	20,303,426		
Count:	12					

TABLE II

OFFICE BUILDING CONSTRUCTION - TIME ANALYSIS

TYPE	#	ORCT	ADCT	FNCT	LDDY	FDUR	$LD	TOT $LD	CTDF	FDF(O)	FDF(F)	ATDF	LDDF
OFFC	10	455	96	551	0	551	105	0	1.211	1.211	1.000	1.00	0.00
	13	365	19	384	0	384	115	0	1.052	1.052	1.000	1.00	0.00
	17	300	9	309	0	309	65	0	1.030	1.030	1.000	1.00	0.00
	18	270	10	280	123	403	65	7,995	1.037	1.493	1.439	0.69	0.31
	22	270	30	300	197	505	225	44,325	1.141	1.870	1.640	0.61	0.39
	24	360	28	388	0	388	85	0	1.078	1.056	0.979	1.00	0.00
	25	455	143	598	0	598	315	0	1.314	1.314	1.000	1.00	0.00
	34	300	28	328	0	328	95	0	1.093	1.093	1.000	1.00	0.00
	36	300	62	362	14	376	65	910	1.207	1.253	1.039	0.96	0.04
	43	520	371	891	0	891	535	0	1.713	1.713	1.000	1.00	0.00
	47	280	275	555	0	315	65	0	1.982	1.125	0.568	1.00	0.00
Average:		352	98	450	30	458	165	4,839					
Total:								53,230					
Count:	11												

OFFICE BUILDING CONSTRUCTION - COST ANALYSIS

TYPE	#	ORIG COST	ADDCOST	FNL COST	CSTF	$LD
OFFC	10	1,490,000	47,241	1,537,241	1.032	105
	13	1,015,000	11,605	1,026,605	1.011	115
	17	393,000	8,007	401,007	1.021	65
	18	482,569	7,507	490,076	1.016	65
	22	912,163	-10,149	902,014	0.989	225
	24	635,000	16,204	651,204	1.026	85
	25	2,935,227	55,851	2,991,078	1.019	315
	34	727,000	10,559	737,559	1.015	95
	36	396,000	20,072	416,072	1.051	65
	43	4,453,000	325,153	4,778,153	1.073	535
	47	410,900	-5,048	405,852	0.986	65
Average:		1,259,078	44,207	1,303,286		165
Total:		13,849,859	486,282	14,336,141		
Count:	11					

TABLE 12

WAREHOUSE BUILDING CONSTRUCTION - TIME ANALYSIS

TYPE	#	ORCT	ADCT	FNCT	LDDY	FDUR	%LD	TOT %LD	CTDF	FDF(O)	FDF(F)	ATDF	LDDF
WHSE	30	180	22	202	193	395	75	14,475	1.122	2.194	1.955	0.51	0.49
	32	365	14	379	0	379	135	0	1.038	1.038	1.000	1.00	0.00
	33	480	99	579	0	579	420	0	1.206	1.206	1.000	1.00	0.00
	40	450	102	552	14	566	419	5,866	1.227	1.258	1.025	0.98	0.02
	41	300	145	445	0	445	95	0	1.483	1.483	1.000	1.00	0.00
Average:		355	76	431	41	473	229	4,068					
Total:								20,341					
Count:	5												

WAREHOUSE BUILDING CONSTRUCTION - COST ANALYSIS

TYPE	#	ORIG COST	ADDCOST	FNL COST	CSTF	%LD
WHSE	30	614,092	7,109	621,201	1.012	75
	32	1,407,000	10,509	1,417,509	1.008	135
	33	3,213,958	20,086	3,234,044	1.006	420
	40	3,791,000	127,447	3,918,447	1.034	419
	41	667,203	12,768	679,971	1.019	95
Average:		1,938,651	35,776	1,974,426		229
Total:		9,693,253	178,879	9,872,132		
Count:	5					

TABLE 23

HANGAR CONSTRUCTION CHANGE ORDERS BY REASON CODE

MAJ REAS		COST	TIME	CHG#
CLMR				
	Total:	452,524	69	
	Count:			1
CREQ				
	Total:	24,881	20	
	Count:			4
CRIT				
	Total:	63,655	30	
	Count:			4
DSGN				
	Total:	345,161	246	
	Count:			13
TIME				
	Total:	0	27	
	Count:			2
UNFO				
	Total:	66,597	220	
	Count:			8
	Total:	952,818	612	
	Count:			32

TABLE 24

HOUSING CHANGE ORDERS BY REASON CODE

MAJ REAS		COST	TIME	CHG#
CREQ				
	Total:	51,610	145	
	Count:			4
CRIT				
	Total:	-11,805	0	
	Count:			2
DSGN				
	Total:	123,167	228	
	Count:			14
TIME				
	Total:	696	355	
	Count:			8
UNFO				
	Total:	46,754	18	
	Count:			15
VALE				
	Total:	-11,317	0	
	Count:			1
	Total:	199,105	746	
	Count:			44

TABLE 25

INSTRUCTIONAL BUILDING CHANGE ORDERS BY REASON CODE (EX. #46)

MAJ REAS		COST	TIME	CHG#
CREQ				
	Total:	156,792	138	
	Count:			6
CRIT				
	Total:	3,597	10	
	Count:			3
DSGN				
	Total:	463,982	361	
	Count:			27
TIME				
	Total:	0	214	
	Count:			6
UNFD				
	Total:	177,878	137	
	Count:			12
	Total:	802,249	860	
	Count:			54

TABLE 26

CONTRACT #46 CHANGE ORDERS BY REASON CODE (INSTRUCTIONAL BLDG)

MAJ REAS		COST	TIME	CHNG #
CLNR				
	Total:	438,685	0	
	Count:			2
CREQ				
	Total:	36,505	0	
	Count:			2
CRIT				
	Total:	970,727	26	
	Count:			12
DSGN				
	Total:	-54,249	0	
	Count:			19
SCPE				
	Total:	139,468	121	
	Count:			1
UNFO				
	Total:	365,459	110	
	Count:			6
	Total:	1,896,595	257	
	Count:			42

TABLE 27

LABORATORY CONSTRUCTION CHANGE ORDERS BY REASON CODE

MAJ REAS		COST	TIME	CHG#
CREQ				
	Total:	185,354	41	
	Count:			3
DSGN				
	Total:	142,306	751	
	Count:			14
TIME				
	Total:	0	6	
	Count:			1
UNFO				
	Total:	43,600	6	
	Count:			4
	Total:	371,260	804	
	Count:			22

TABLE 28

MODIFICATION PROJECTS CHANGE ORDERS BY REASON CODE

MAJ REAS		COST	TIME	CHG#
CREQ				
	Total:	454,396	589	
	Count:			12
CRIT				
	Total:	221,208	289	
	Count:			6
DSGN				
	Total:	654,443	292	
	Count:			54
TIME				
	Total:	0	272	
	Count:			7
UNFO				
	Total:	647,604	627	
	Count:			53
	Total:	1,977,651	2,069	
	Count:			132

TABLE 29

OFFICE CONSTRUCTION CHANGE ORDERS BY REASON CODE

MAJ REAS		COST	TIME	CHG#
CREQ				
	Total:	190,153	256	
	Count:			19
CRIT				
	Total:	-1,823	0	
	Count:			3
DSGN				
	Total:	74,379	112	
	Count:			22
TIME				
	Total:	2,484	61	
	Count:			3
UNFO				
	Total:	224,030	650	
	Count:			23
VALE				
	Total:	-2,941	0	
	Count:			2
	Total:	486,282	1,079	
	Count:			72

TABLE 30

WAREHOUSE CONSTRUCTION CHANGE ORDERS BY REASON CODE

MAJ REAS		COST	TIME	CHG#
CREQ				
	Total:	75,230	35	
	Count:			2
CRIT				
	Total:	36,109	24	
	Count:			3
DSGN				
	Total:	27,212	201	
	Count:			13
UNFO				
	Total:	41,644	122	
	Count:			15
VALE				
	Total:	-1,316	0	
	Count:			1
	Total:	178,879	382	
	Count:			34

TABLE 33

FORMAL CLAIMS CHANGE ORDERS

SUB REAS		COST	%ADCOST	TIME	%ADTIME	CONTR #	CHNG #
ACCELERATION		452,524	0.956	69	0.246	48	07
	Total:	452,524		69			
	Count:						1
DEL/IMP (06,18,20)		387,000	0.204	0	0.000	46	49
	Total:	387,000		0			
	Count:						1
STRUCT ELEC		51,685	0.027	0	0.000	46	46
	Total:	51,685		0			
	Count:						1
	Total:	891,209		69			
	Count:						3

TABLE 34

DISCRETIONARY / OWNER REQUESTED CHANGE ORDERS

SUB REAS		COST	TIME	CHNG #
CARPET				
	Total:	14,073	17	
	Count:			2
CEILING				
	Total:	-652	0	
	Count:			1
ELEC				
	Total:	45,202	118	
	Count:			7
EQUIP				
	Total:	27,250	188	
	Count:			1
FENCING				
	Total:	3,258	30	
	Count:			1
FINISH EXT				
	Total:	-9,183	0	
	Count:			1
FINISH INT				
	Total:	20,310	59	
	Count:			3
FLOORING				
	Total:	-4,338	3	
	Count:			1
FP SYS				
	Total:	6,238	0	
	Count:			1
HVAC				
	Total:	6,000	0	
	Count:			1
INT ARCH				
	Total:	737,408	553	
	Count:			16

TABLE 34 (cont)

DISCRETIONARY / OWNER REQUESTED CHANGE ORDERS

SUB REAS		COST	TIME	CHNG #
LANDSCAPE				
	Total:	11,140	0	
	Count:			2
LIGHTING				
	Total:	4,714	0	
	Count:			1
LIGHTING EXT				
	Total:	64,543	21	
	Count:			1
PAVING				
	Total:	73,201	103	
	Count:			2
ROOFING				
	Total:	19,984	7	
	Count:			1
SCHEDULE REV				
	Total:	127,333	115	
	Count:			2
UTIL GEN				
	Total:	5,319	4	
	Count:			5
WINDOWS				
	Total:	23,121	6	
	Count:			3
	Total:	1,174,921	1,224	
	Count:			52

TABLE 35

MANDATORY CHANGE ORDERS

SUB REAS		COST	TIME	CHNG #
CEILING				
	Total:	-11,560	0	
	Count:			1
DOORS				
	Total:	4,281	13	
	Count:			2
EARTHWORK				
	Total:	292,690	14	
	Count:			4
ELEC				
	Total:	27,020	22	
	Count:			8
ELEC HVAC				
	Total:	564,309	0	
	Count:			1
FENCING				
	Total:	2,373	0	
	Count:			1
FINISH INT				
	Total:	235	0	
	Count:			1
FIRE ALARM				
	Total:	-1,556	0	
	Count:			1
FP SYS				
	Total:	7,000	0	
	Count:			1
HV ELEC				
	Total:	-300	0	
	Count:			1
HVAC				
	Total:	190,000	180	
	Count:			1

TABLE 35 (cont)

MANDATORY CHANGE ORDERS

SUB REAS		COST	TIME	CHNG #
INT ARCH				
	Total:	129,536	56	
	Count:			4
LIGHTING				
	Total:	15,199	94	
	Count:			1
LIGHTING EXT				
	Total:	27,000	0	
	Count:			1
STORM SEWER				
	Total:	17,566	0	
	Count:			1
STRUCT				
	Total:	3,592	0	
	Count:			1
UTIL GEN				
	Total:	10,322	0	
	Count:			2
UTIL UG				
	Total:	3,969	0	
	Count:			1
	Total:	1,201,668	379	
	Count:			33

TABLE 36

DESIGN ERRORS CHANGE ORDERS

SUB REAS		COST	TIME	CHNG #
ASBESTOS				
	Total:	11,291	0	
	Count:			1
CARP				
	Total:	54,534	44	
	Count:			11
CEILING				
	Total:	1,223	1	
	Count:			1
CONCRETE				
	Total:	5,115	0	
	Count:			5
DOORS				
	Total:	35,904	18	
	Count:			14
EARTHWORK				
	Total:	57,885	50	
	Count:			4
ELEC				
	Total:	50,966	41	
	Count:			21
EQUIP				
	Total:	225,515	11	
	Count:			4
FINISH EXT				
	Total:	4,958	9	
	Count:			2
FINISH INT				
	Total:	52,850	46	
	Count:			8
FLOORING				
	Total:	19,000	0	
	Count:			1

TABLE 36 (cont)

DESIGN ERRORS CHANGE ORDERS

SUB REAS		COST	TIME	CHNG #
FOUNDATION				
	Total:	55,992	47	
	Count:			3
FP SYS				
	Total:	136,977	46	
	Count:			10
HANGAR DOORS				
	Total:	11,200	0	
	Count:			1
HAUL ROUTE				
	Total:	17,315	0	
	Count:			1
HV ELEC				
	Total:	25,275	48	
	Count:			4
HVAC				
	Total:	73,126	75	
	Count:			15
INT ARCH				
	Total:	582,470	619	
	Count:			24
LANDSCAPE				
	Total:	6,788	0	
	Count:			3
LIGHTING				
	Total:	3,914	12	
	Count:			2
PAVING				
	Total:	11,583	86	
	Count:			1
ROOFING				
	Total:	121,950	617	
	Count:			5

TABLE 36 (cont)

DESIGN ERRORS CHANGE ORDERS

SUB REAS		COST	TIME	CHNG #
SITE ACCESS				
	Total:	5,176	7	
	Count:			1
STORM SEWER				
	Total:	9,241	259	
	Count:			3
STRUCT				
	Total:	79,776	87	
	Count:			8
TELEPHONE				
	Total:	2,784	8	
	Count:			1
UTIL GAS				
	Total:	-2,252	1	
	Count:			1
UTIL GEN				
	Total:	85,511	62	
	Count:			14
UTIL HW				
	Total:	14,857	0	
	Count:			2
UTIL UG				
	Total:	8,399	5	
	Count:			3
WINDOWS				
	Total:	7,078	0	
	Count:			2
	Total:	1,776,401	2,191	
	Count:			176

TABLE 37

EXTRA WORK CHANGE ORDERS

SUB REAS	COST	%ADCOST	TIME	%ADTIME	CONTR #	CHNG #
ADD ARCH SCOPE	139,468	0.074	121	0.471	46	18
Total:	139,468		121			
Count:						1
Total:	139,468		121			
Count:						1

TABLE 38

TIME ONLY CHANGE ORDERS

SUB REAS	COST	%ADCOST	TIME	%ADTIME	CONTR #	CHNG #
ELEC SYS DELAY	0	0.000	78	0.386	05	04
Total:	0		78			
Count:						1
GDEL SITE	2,484	-0.245	10	0.263	22	01
	696	0.016	7	0.063	09	11
	0	0.000	20	0.187	26	04
	0	0.000	30	0.109	47	06
Total:	3,180		67			
Count:						4
GDEL SUBM	0	0.000	49	0.209	27	07
	0	0.000	10	0.036	48	02
	0	0.000	18	0.161	09	06
	0	0.000	37	0.252	11	04
	0	0.000	23	0.523	14	06
	0	0.000	30	0.233	19	05
Total:	0		167			
Count:						6
MATL DEL	0	0.000	34	0.318	26	03
	0	0.000	130	0.556	27	03
	0	0.000	33	0.579	39	05
	0	0.000	7	0.063	09	10
	0	0.000	35	0.313	09	13
Total:	0		239			
Count:						5
MATL STRIKE	0	0.000	53	0.495	26	01
Total:	0		53			
Count:						1
WEATHER	0	0.000	21	0.750	24	03
	0	0.000	33	1.000	37	03
	0	0.000	17	0.062	44	03
	0	0.000	79	0.361	06	06
	0	0.000	46	0.451	08	01
	0	0.000	11	0.108	08	07
	0	0.000	6	0.500	15	03
	0	0.000	17	0.142	21	07
	0	0.000	41	0.129	01	04
	0	0.000	60	0.444	03	10
Total:	0		331			
Count:						10

TABLE 38 (cont)

TIME ONLY CHANGE ORDERS

SUB REAS	COST	%ADCOST	TIME	%ADTIME	CONTR #	CHNG #
Total:	3,180		935			
Count:						27

TABLE 39

UNFORESEEN WORK / DIFFERING SITE CONDITIONS CHANGE ORDERS

SUB REAS		COST	TIME	CHNG #
ASBESTOS				
	Total:	146,021	269	
	Count:			3
CARP				
	Total:	7,789	0	
	Count:			3
CEILING				
	Total:	10,053	7	
	Count:			2
CONCRETE				
	Total:	3,459	46	
	Count:			4
DEL/IMP (06)				
	Total:	113,000	0	
	Count:			1
DEMO				
	Total:	85,425	98	
	Count:			10
DOORS				
	Total:	671	0	
	Count:			1
EARTHWORK				
	Total:	64,179	18	
	Count:			7
ELEC				
	Total:	189,214	35	
	Count:			16
FENCING				
	Total:	5,219	0	
	Count:			1
FINISH EXT				
	Total:	7,480	17	
	Count:			3

TABLE 39 (cont)

UNFORESEEN WORK / DIFFERING SITE CONDITIONS CHANGE ORDERS

SUB REAS		COST	TIME	CHNG #
FINISH INT				
	Total:	27,807	22	
	Count:			4
FLOORING				
	Total:	2,924	5	
	Count:			1
FOUNDATION				
	Total:	357,697	241	
	Count:			11
FP SYS				
	Total:	913	3	
	Count:			5
GDEL UTIL				
	Total:	2,964	0	
	Count:			1
HV ELEC				
	Total:	11,134	47	
	Count:			3
HVAC				
	Total:	61,713	270	
	Count:			10
INT ARCH				
	Total:	186,679	394	
	Count:			6
LANDSCAPE				
	Total:	1,621	3	
	Count:			2
PAVING				
	Total:	25,781	13	
	Count:			2
ROOFING				
	Total:	3,010	5	
	Count:			2

TABLE 39 (cont)

UNFORESEEN WORK / DIFFERING SITE CONDITIONS CHANGE ORDERS

SUB REAS		COST	TIME	CHNG #
STAIRS				
	Total:	59,244	0	
	Count:			1
STORM SEWER				
	Total:	16,821	16	
	Count:			3
STRUCT				
	Total:	9,838	0	
	Count:			1
UTIL GAS				
	Total:	17,258	16	
	Count:			1
UTIL GEN				
	Total:	15,615	36	
	Count:			10
UTIL HW				
	Total:	21,770	12	
	Count:			2
UTIL UG				
	Total:	78,017	235	
	Count:			14
WAGE INC				
	Total:	3,394	0	
	Count:			1
WEATHER DAMAGE				
	Total:	73,260	80	
	Count:			3
WINDOWS				
	Total:	3,596	2	
	Count:			2

TABLE 39 (cont)

UNFORESEEN WORK / DIFFERING SITE CONDITIONS CHANGE ORDERS

SUB REAS	COST	TIME	CHNG #
Total:	1,613,566	1,890	
Count:			136

TABLE 40

VALUE ENGINEERING CHANGE ORDERS

SUB REAS	COST	%ADCOST	TIME	%ADTIME	CONTR #	CHNG #
DEMO	-1,074	-0.019	0	0.000	25	04
Total:	-1,074		0			
Count:						1
PAVING	-1,316	-0.124	0	0.000	32	01
Total:	-1,316		0			
Count:						1
ROOFING	-11,317	-0.264	0	0.000	09	04
Total:	-11,317		0			
Count:						1
STRUCT	-1,867	0.319	0	0.000	47	02
Total:	-1,867		0			
Count:						1
Total:	-15,574		0			
Count:						4

TABLE 41

ADDITIONAL TIME CHANGE ORDERS BY REASON CODE (EXCLUDING #46)

MAJ REAS		COST	TIME	CHNG #
CLNR				
	Total:	452,524	69	
	Count:			1
CREQ				
	Total:	1,030,663	1,224	
	Count:			32
CRIT				
	Total:	307,064	353	
	Count:			9
DSGN				
	Total:	1,051,221	2,191	
	Count:			62
TIME				
	Total:	3,180	935	
	Count:			27
UNFO				
	Total:	804,127	1,780	
	Count:			69
	Total:	3,648,779	6,552	
	Count:			200

TABLE 42

ADDITIONAL TIME CHANGE ORDERS BY BUILDING TYPE (EXCLUDING #46)

#		COST	TIME	CHG#
HNGR				
	Total:	846,787	612	
	Count:			17
HSG				
	Total:	146,516	746	
	Count:			22
INST				
	Total:	536,437	860	
	Count:			24
LAB				
	Total:	299,788	804	
	Count:			6
MODS				
	Total:	1,199,012	2,069	
	Count:			72
OFFC				
	Total:	459,691	1,079	
	Count:			39
WHSE				
	Total:	160,548	382	
	Count:			20
	Total:	3,648,779	6,552	
	Count:			200

TABLE 43

NO ADDITIONAL TIME CHANGE ORDERS BY REASON CODE (EXCLUDING 046)

MAJ REAS		COST	TIME	CHNG #
CREQ				
	Total:	107,753	0	
	Count:			18
CRIT				
	Total:	3,877	0	
	Count:			12
DSGN				
	Total:	779,429	0	
	Count:			95
UNFO				
	Total:	443,980	0	
	Count:			61
VALE				
	Total:	-15,574	0	
	Count:			4
	Total:	1,319,465	0	
	Count:			190

TABLE 44

NO ADDITIONAL TIME CHANGES BY BUILDING TYPE (EXCLUDING #46)

#	COST	TIME	CHG#
HNGR			
Total:	106,031	0	
Count:			15
HSG			
Total:	52,589	0	
Count:			22
INST			
Total:	265,812	0	
Count:			30
LAB			
Total:	71,472	0	
Count:			16
MODS			
Total:	778,639	0	
Count:			60
OFFC			
Total:	26,591	0	
Count:			33
WHSE			
Total:	18,331	0	
Count:			14
Total:	1,319,465	0	
Count:			190

TABLE 45

CHANGE ORDERS INVOLVING ADDITIONAL TIME

MAJ REAS		COST	TIME	CHNG #
CLMR				
	Total:	452,524	69	
	Count:			1
CREQ				
	Total:	1,030,663	1,224	
	Count:			32
CRIT				
	Total:	337,634	379	
	Count:			10
DSGN				
	Total:	1,051,221	2,191	
	Count:			62
SCPE				
	Total:	139,468	121	
	Count:			1
TIME				
	Total:	3,180	935	
	Count:			27
UNFO				
	Total:	1,009,128	1,890	
	Count:			70
	Total:	4,023,818	6,809	
	Count:			203

TABLE 46

CHANGE ORDERS INVOLVING NO ADDITIONAL TIME

MAJ REAS		COST	TIME	CHNG #
CLMR				
	Total:	438,685	0	
	Count:			2
CREQ				
	Total:	144,258	0	
	Count:			20
CRIT				
	Total:	944,034	0	
	Count:			23
DSGN				
	Total:	725,180	0	
	Count:			114
UNFO				
	Total:	604,438	0	
	Count:			66
VALE				
	Total:	-15,574	0	
	Count:			4
	Total:	2,841,021	0	
	Count:			229

TABLE 47

CHANGE ORDERS >$100,000 BY BUILDING TYPE (EX. #46)

#	MAJ REAS	COST	TIME	CHG#
HNGR	CLMR	452,524	69	07
	DSGN	159,131	111	06
	Total:	611,655	180	
	Count:			2
INST	DSGN	275,000	274	02
	Total:	275,000	274	
	Count:			1
LAB	CREQ	111,833	21	09
	DSGN	108,000	501	20
	Total:	219,833	522	
	Count:			2
MODS	CREQ	288,482	180	16
	CRIT	190,000	180	19
	DSGN	214,151	0	12
	Total:	692,633	360	
	Count:			3
OFFC	CREQ	110,000	19	16
	UNFO	125,000	251	17
	Total:	235,000	270	
	Count:			2
	Total:	2,034,121	1,606	
	Count:			10

TABLE 48

CHANGE ORDERS BTWN $75K AND $100K BY BUILDING TYPE

#	MAJ REAS		COST	TIME	CHG#
INST	CREQ		78,133	115	01
		Total:	78,133	115	
		Count:			1
MODS	UNFO		77,120	60	24
		Total:	77,120	60	
		Count:			1
		Total:	155,253	175	
		Count:			2

TABLE 49

CHANGE ORDERS BTWN $50K AND $75K BY BUILDING TYPE

#	MAJ REAS	COST	TIME	CHG#
HNGR	CRIT	55,421	30	10
	DSGN	56,522	21	08
	Total:	111,943	51	
	Count:			2
HSG	DSGN	58,603	45	01
	Total:	58,603	45	
	Count:			1
INST	UNFO	67,358	60	02
	Total:	67,358	60	
	Count:			1
LAB	CREQ	74,521	20	11
	Total:	74,521	20	
	Count:			1
MODS	CREQ	59,985	103	18
	UNFO	58,777	0	17
		59,244	0	09
		60,000	45	04
	Total:	238,006	148	
	Count:			4
WHSE	CREQ	64,543	21	05
	Total:	64,543	21	
	Count:			1
	Total:	614,974	345	
	Count:			10

TABLE 50

CHANGE ORDERS BTWN $25K AND $50K BY BUILDING TYPE

#	MAJ REAS	COST	TIME	CHG#
HNGR	DSGN	31,109	7	09
	UNFO	26,731	21	04
	Total:	57,840	28	
	Count:			2
INST	CREQ	49,200	0	07
		49,990	21	08
	DSGN	30,773	0	04
		45,057	0	06
	UNFO	31,487	20	11
	Total:	206,507	41	
	Count:			5
LAB	UNFO	34,650	0	01
	Total:	34,650	0	
	Count:			1
MODS	CREQ	27,250	188	08
	DSGN	26,052	0	07
		39,584	0	08
		40,133	0	13
		27,580	0	25
		33,136	30	02
		33,591	10	04
		26,427	14	06
	UNFO	27,734	0	10
		45,615	0	15
		28,302	258	27
		27,819	24	01
	Total:	383,223	524	
	Count:			12
OFFC	CREQ	43,207	90	03
	Total:	43,207	90	
	Count:			1
WHSE	CRIT	25,998	14	09
	Total:	25,998	14	
	Count:			1
	Total:	751,425	697	
	Count:			22

TABLE 51

CHANGE ORDERS LESS THAN $25,000 BY BUILDING TYPE

#	COST	TIME	CHG#
HNGR			
Total:	171,380	353	
Count:			26
HSG			
Total:	140,582	701	
Count:			43
INST			
Total:	175,251	370	
Count:			46
LAB			
Total:	42,256	262	
Count:			18
MODS			
Total:	586,669	977	
Count:			112
OFFC			
Total:	208,075	719	
Count:			69
WHSE			
Total:	88,338	347	
Count:			32
Total:	1,412,471	3,729	
Count:			346

TABLE 52

CHANGE ORDERS EXCEEDING $100,000

MAJ REAS	COST	%ADCOST	TOT ADCOST	TIME	%ADTIME	TOT ADCT	CONTR #	CHNG #
CLMR	452,524	0.956	473,457	69	0.246	281	48	07
	387,000	0.204	1,896,595	0	0.000	257	46	49
Average:		0.580			0.123			
Total:	839,524			69				
Count:								2
CREQ	288,482	0.507	569,429	180	0.444	405	42	16
	111,833	0.304	368,279	21	0.027	792	02	09
	110,000	0.338	325,153	19	0.051	371	43	16
Average:		0.383			0.174			
Total:	510,315			220				
Count:								3
CRIT	564,309	0.298	1,896,595	0	0.000	257	46	29
	190,000	0.334	569,429	180	0.444	405	42	19
	130,427	0.069	1,896,595	0	0.000	257	46	26
	118,042	0.062	1,896,595	0	0.000	257	46	34
Average:		0.191			0.111			
Total:	1,002,778			180				
Count:								4
DSGN	275,000	1.066	257,923	274	0.864	317	01	02
	214,151	0.266	804,575	0	0.000	135	04	12
	159,131	0.559	284,699	111	0.405	274	44	06
	108,000	0.293	368,279	501	0.633	792	02	20
Average:		0.546			0.476			
Total:	756,282			886				
Count:								4
SCPE	139,468	0.074	1,896,595	121	0.471	257	46	18
Average:		0.074			0.471			
Total:	139,468			121				
Count:								1
UNFO	205,001	0.108	1,896,595	110	0.428	257	46	06
	125,000	0.384	325,153	251	0.677	371	43	17
	113,000	0.060	1,896,595	0	0.000	257	46	37
Average:		0.184			0.368			
Total:	443,001			361				
Count:								3
Average:		0.346			0.276			
Total:	3,491,368			1,837				
Count:								17

TABLE 53

CHANGE ORDERS EXCEEDING $100,000 CONTRACT #46

MAJ REAS	COST	%ADCOST	TOT ADCOST	TIME	%ADTIME	TOT ADCT	CONTR #	CHNG #
CLNR	387,000	0.204	1,896,595	0	0.000	257	46	49
Average:		0.204			0.000			
Total:	387,000			0				
Count:								1
CRIT	564,309	0.298	1,896,595	0	0.000	257	46	29
	130,427	0.069	1,896,595	0	0.000	257	46	26
	118,042	0.062	1,896,595	0	0.000	257	46	34
Average:		0.143			0.000			
Total:	812,778			0				
Count:								3
SCPE	139,468	0.074	1,896,595	121	0.471	257	46	18
Average:		0.074			0.471			
Total:	139,468			121				
Count:								1
UNFO	205,001	0.108	1,896,595	110	0.428	257	46	06
	113,000	0.060	1,896,595	0	0.000	257	46	37
Average:		0.084			0.214			
Total:	318,001			110				
Count:								2
Average:		0.125			0.128			
Total:	1,657,247			231				
Count:								7

TABLE 54

ADDITIONAL TIME CHANGE ORDERS >100 DAYS BY BLDG TYPE

#	MAJ REAS	COST	TIME	CHG#
HNGR	DSGN	159,131	111	06
	UNFO	9,241	197	06
	Total:	168,372	308	
	Count:			2
HSG	DSGN	3,940	116	04
	TIME	0	130	03
	Total:	3,940	246	
	Count:			2
INST	CREQ	78,133	115	01
	DSGN	275,000	274	02
	Total:	353,133	389	
	Count:			2
LAB	DSGN	3,638	250	17
		108,000	501	20
	Total:	111,638	751	
	Count:			2
MODS	CREQ	59,985	103	18
		27,250	188	08
		288,482	180	16
	CRIT	190,000	180	19
	UNFO	28,302	258	27
	Total:	594,019	909	
	Count:			5
OFFC	UNFO	125,000	251	17
		2,569	245	07
	Total:	127,569	496	
	Count:			2
	Total:	1,358,671	3,099	
	Count:			15

TABLE 55

ADDITIONAL TIME CHANGES BTWN 75 AND 100 DAYS

#	MAJ REAS	COST	TIME	CHG#
HSG	CREQ	19,962	90	04
	TIME	0	79	06
	Total:	19,962	169	
	Count:			2
MODS	CRIT	15,199	94	01
	TIME	0	78	04
	Total:	15,199	172	
	Count:			2
OFFC	CREQ	43,207	90	03
	Total:	43,207	90	
	Count:			1
WHSE	DSGN	11,583	86	05
		1,592	90	07
	Total:	13,175	176	
	Count:			2
	Total:	91,543	607	
	Count:			7

TABLE 56

ADDITIONAL TIME CHANGES BTWN 50 AND 75 DAYS

#	MAJ REAS	COST	TIME	CHG#
HNGR	CLMR	452,524	69	07
	DSGN	8,291	60	05
	Total:	460,815	129	
	Count:			2
INST	TIME	0	60	10
	UNFO	67,358	60	02
	Total:	67,358	120	
	Count:			2
MODS	TIME	0	53	01
	UNFO	77,120	60	24
		9,650	70	03
	Total:	86,770	183	
	Count:			3
OFFC	CREQ	9,179	55	07
		5,146	52	03
	DSGN	23,369	70	05
	Total:	37,694	177	
	Count:			3
	Total:	652,637	609	
	Count:			10

TABLE 57

ADDITIONAL TIME CHANGES BTWN 25 AND 50 DAYS

#	MAJ REAS	COST	TIME	CHG#
HNGR	CRIT	55,421	30	10
	DSGN	20,394	26	02
	Total:	75,815	56	
	Count:			2
HSG	CREQ	15,242	45	14
	DSGN	58,603	45	01
		9,046	45	06
	TIME	0	35	13
		0	30	05
		0	49	07
	Total:	82,891	249	
	Count:			6
INST	TIME	0	41	04
		0	46	01
		0	33	05
	UNFO	13,095	34	10
	Total:	13,095	154	
	Count:			4
MODS	CREQ	3,300	35	01
		3,258	30	04
		2,851	35	02
	DSGN	3,012	42	07
		958	30	10
		17,030	32	14
		4,728	40	07
		33,136	30	02
	TIME	0	37	04
		0	34	03
		0	33	03
	UNFO	60,000	45	04
	Total:	128,273	423	
	Count:			12
OFFC	TIME	0	30	06
	UNFO	6,908	29	08
	Total:	6,908	59	
	Count:			2
WHSE	UNFO	7,439	45	12
		450	43	08
	Total:	7,889	88	
	Count:			2

TABLE 57 (cont)

ADDITIONAL TIME CHANGES BTWN 25 AND 50 DAYS

#	MAJ REAS	COST	TIME	CHG#
	Total:	314,871	1,029	
	Count:			28

TABLE 58

ADDITIONAL TIME CHANGES LESS THAN 25 DAYS

#	COST	TIME	CHG#
HNGR			
Total:	141,785	119	
Count:			11
HSG			
Total:	39,723	82	
Count:			12
INST			
Total:	102,851	197	
Count:			16
LAB			
Total:	188,150	53	
Count:			4
MODS			
Total:	374,751	382	
Count:			50
OFFC			
Total:	244,313	257	
Count:			31
WHSE			
Total:	139,484	118	
Count:			16
Total:	1,231,057	1,208	
Count:			140

TABLE 59

CHANGE ORDERS CONTRIBUTING >50% OF ADDITIONAL COST

MAJ REAS	COST	%ADCOST	TOT ADCOST	TIME	%ADTIME	TOT ADCT	CONTR #	CHNG #
CLMR	452,524	0.956	473,457	69	0.246	281	48	07
Average:		0.956			0.246			
Total:	452,524			69				
CREQ	288,482	0.507	569,429	180	0.444	405	42	16
	64,543	0.506	127,447	21	0.206	102	40	05
	43,207	0.915	47,241	90	0.938	96	10	03
	19,962	0.771	25,903	90	0.698	129	19	04
	10,687	1.009	10,589	14	1.000	14	32	03
	10,267	0.634	16,204	7	0.250	28	24	01
	9,422	0.812	11,605	14	0.737	19	13	02
	4,651	0.575	8,087	3	0.333	9	17	02
	-9,183	0.905	-10,149	0	0.000	38	22	08
Average:		0.737			0.512			
Total:	442,038			419				
CRIT	7,000	1.003	6,981	0	0.000	33	37	04
Average:		1.003			0.000			
Total:	7,000			0				
DSGN	275,000	1.066	257,923	274	0.864	317	01	02
	159,131	0.559	284,699	111	0.405	274	44	06
	58,603	0.888	66,021	45	1.000	45	23	01
	30,773	0.617	49,906	0	0.000	44	14	04
	11,583	0.555	20,886	86	0.869	99	33	05
	9,046	0.590	15,341	45	0.192	234	27	06
	6,614	0.554	11,934	0	0.000	102	08	04
	-3,000	0.513	-5,848	0	0.000	275	47	03
Average:		0.668			0.416			
Total:	547,750			561				
UNFO	67,358	0.783	86,018	60	0.444	135	03	02
	60,000	0.530	113,284	45	0.375	120	21	04
	12,523	0.624	20,072	10	0.161	62	36	02
	9,650	0.675	14,303	70	0.476	147	11	03
	4,420	0.615	7,189	14	0.636	22	30	01
	4,009	0.584	6,860	7	0.167	42	38	01
	1,796	0.602	2,981	6	0.500	12	15	02
	-11,210	1.000	-11,210	0	0.000	107	26	02
Average:		0.677			0.345			
Total:	148,546			212				
Average:		0.717			0.405			
Total:	1,597,858			1,261				

TABLE 60

CHANGE ORDERS CONTRIBUTING >50% OF ADDITIONAL CONTRACT TIME

MAJ REAS		COST	%ADCOST	TOT ADCOST	TIME	%ADTIME	TOT ADCT	CONTR #	CHNG #
CREQ		70,133	0.229	341,684	115	0.605	190	45	01
		59,985	0.075	804,575	103	0.763	135	04	18
		43,207	0.915	47,241	90	0.938	96	10	03
		27,250	0.376	72,447	188	0.691	272	12	08
		19,962	0.771	25,903	90	0.698	129	19	04
		10,687	1.009	10,589	14	1.000	14	32	03
		9,422	0.812	11,605	14	0.737	19	13	02
		5,146	0.256	20,072	52	0.839	62	36	03
		2,851	0.416	6,860	35	0.833	42	38	02
	Average:		0.540			0.789			
	Total:	256,643			701				
CRIT		55,421	0.285	194,662	30	0.526	57	16	10
	Average:		0.285			0.526			
	Total:	55,421			30				
DSGN		275,000	1.066	257,923	274	0.864	317	01	02
		100,000	0.293	368,279	501	0.633	792	02	20
		58,603	0.888	66,021	45	1.000	45	23	01
		11,583	0.555	20,886	86	0.869	99	33	05
		3,940	0.128	30,737	116	0.530	219	06	04
		1,592	0.125	12,760	90	0.621	145	41	07
		1,241	0.165	7,507	10	1.000	10	18	03
	Average:		0.460			0.788			
	Total:	459,959			1,122				
TIME		0	0.000	15,341	130	0.556	234	27	03
		0	0.000	6,981	33	1.000	33	37	03
		0	0.000	36,784	33	0.579	57	39	05
		0	0.000	49,906	23	0.523	44	14	06
		0	0.000	16,204	21	0.750	28	24	03
	Average:		0.000			0.682			
	Total:	0			240				
UNFO		125,000	0.384	325,153	251	0.677	371	43	17
		28,302	0.035	804,575	258	0.737	350	04A	27
		9,241	0.020	473,457	197	0.701	281	48	06
		6,653	-0.656	-10,149	23	0.605	38	22	02
		4,420	0.615	7,189	14	0.636	22	30	01
		4,106	0.225	18,223	4	0.571	7	07	07
		2,569	-0.439	-5,848	245	0.891	275	47	07
	Average:		0.026			0.688			
	Total:	180,291			992				
	Average:		0.295			0.737			
	Total:	952,314			3,005				

TABLE 61

LIQUIDATED DAMAGES NUMERIC SORT - COST ANALYSIS

$LD	ORIG COST	ADDCOST	FNL COST	CSTF
3,600	5,247,000	25,903	5,272,903	1.005
1,600	827,777	18,000	845,777	1.022
1,382	4,731,000	42,880	4,773,880	1.009
1,296	4,623,154	18,223	4,641,377	1.004
1,020	3,012,700	15,341	3,028,041	1.005
792	1,864,000	185,017	2,049,017	1.099
625	4,888,000	194,662	5,082,662	1.040
565	5,219,022	1,896,595	7,115,617	1.363
535	4,453,000	325,153	4,778,153	1.073
515	5,064,644	368,279	5,432,923	1.073
420	3,213,958	20,886	3,234,844	1.006
419	3,791,000	127,447	3,918,447	1.034
415	4,894,000	341,684	5,235,684	1.070
405	3,676,000	257,923	3,933,923	1.070
315	2,935,227	55,851	2,991,078	1.019
315	2,828,000	30,737	2,858,737	1.011
305	3,065,466	284,699	3,350,165	1.093
305	2,457,000	473,457	2,930,457	1.193
265	2,760,900	46,441	2,807,341	1.017
265	2,189,000	86,018	2,275,018	1.039
235	2,107,250	39,329	2,146,579	1.019
225	912,163	-10,149	902,014	0.989
215	1,035,679	-11,210	1,024,469	0.989
205	1,798,000	113,284	1,911,284	1.063
195	3,865,000	804,575	4,669,575	1.208
185	1,776,000	49,906	1,825,906	1.028
185	1,490,000	47,241	1,537,241	1.032
175	1,467,405	11,934	1,479,339	1.008
155	1,039,139	72,447	1,111,586	1.070
150	703,920	36,784	740,704	1.052
135	1,407,000	10,589	1,417,589	1.008
135	1,392,500	569,429	1,961,929	1.409
115	1,015,000	11,605	1,026,605	1.011
115	949,860	130,195	1,080,055	1.137
105	794,000	66,021	860,021	1.083
95	727,000	10,559	737,559	1.015
95	667,203	12,768	679,971	1.019
90	574,000	6,860	580,860	1.012
85	635,000	16,204	651,204	1.026
75	740,000	6,981	746,981	1.009
75	614,092	7,189	621,281	1.012
65	482,569	7,507	490,076	1.016
65	433,399	2,981	436,380	1.007
65	410,900	-5,848	405,052	0.986
65	396,000	20,072	416,072	1.051
65	393,000	8,087	401,087	1.021
55	390,261	0	390,261	1.000
35	199,447	14,303	213,750	1.072
Average: 392	2,086,597	143,017	2,229,614	

TABLE 62

LIQUIDATED DAMAGES NUMERIC SORT - TIME ANALYSIS

$LD	ORCT	ADCT	FNCT	CTDF	LDDY	FDUR	FDF(O)	FDF(F)	ATDF	LDDF	ORIG COST
3,600	540	129	669	1.239	41	710	1.315	1.061	0.94	0.06	5,247,000
1,600	212	15	227	1.071	0	221	1.042	0.974	1.00	0.00	827,777
1,382	450	112	562	1.249	0	562	1.249	1.000	1.00	0.00	4,731,000
1,296	700	7	707	1.010	0	707	1.010	1.000	1.00	0.00	4,623,154
1,020	420	234	654	1.557	0	654	1.557	1.000	1.00	0.00	3,012,700
792	540	80	620	1.148	0	620	1.148	1.000	1.00	0.00	1,864,000
625	540	57	597	1.106	0	597	1.106	1.000	1.00	0.00	4,888,000
565	540	257	797	1.476	0	797	1.476	1.000	1.00	0.00	5,219,022
535	520	371	891	1.713	0	891	1.713	1.000	1.00	0.00	4,453,000
515	630	792	1,422	2.257	0	1,422	2.257	1.000	1.00	0.00	5,064,644
420	480	99	579	1.206	0	579	1.206	1.000	1.00	0.00	3,213,958
419	450	102	552	1.227	14	566	1.258	1.025	0.98	0.02	3,791,000
415	520	190	710	1.365	0	640	1.231	0.901	1.00	0.00	4,894,000
405	420	317	737	1.755	10	747	1.779	1.014	0.99	0.01	3,676,[illegible]00
380	400	350	750	1.875	0	750	1.875	1.000	1.00	0.00	3,865,000
315	455	143	598	1.314	0	598	1.314	1.000	1.00	0.00	2,935,227
315	420	219	639	1.521	120	759	1.807	1.188	0.84	0.16	2,828,000
305	455	274	729	1.602	0	634	1.393	0.870	1.00	0.00	3,065,466
305	360	281	641	1.781	0	641	1.781	1.000	1.00	0.00	2,457,000
265	365	135	500	1.370	0	500	1.370	1.000	1.00	0.00	2,189,000
265	330	202	532	1.612	0	532	1.612	1.000	1.00	0.00	2,760,900
235	365	98	463	1.268	0	449	1.230	0.970	1.00	0.00	2,107,250
225	270	38	308	1.141	197	505	1.870	1.640	0.61	0.39	912,163
215	270	107	377	1.396	0	377	1.396	1.000	1.00	0.00	1,035,679
205	365	120	485	1.329	28	513	1.405	1.058	0.95	0.05	1,798,000
195	400	135	535	1.338	0	535	1.338	1.000	1.00	0.00	3,865,000
185	480	44	524	1.092	0	524	1.092	1.000	1.00	0.00	1,776,000
185	455	96	551	1.211	0	551	1.211	1.000	1.00	0.00	1,490,000
175	420	102	522	1.243	9	531	1.264	1.017	0.98	0.02	1,467,405
155	395	272	667	1.689	0	667	1.689	1.000	1.00	0.00	1,039,139
150	270	57	327	1.211	0	327	1.211	1.000	1.00	0.00	703,920
135	365	405	770	2.110	0	770	2.110	1.000	1.00	0.00	1,392,500
135	365	14	379	1.038	0	379	1.038	1.000	1.00	0.00	1,407,000
115	365	19	384	1.052	0	384	1.052	1.000	1.00	0.00	1,015,000
115	240	78	318	1.325	0	302	1.258	0.950	1.00	0.00	949,860
105	440	45	485	1.102	0	485	1.102	1.000	1.00	0.00	794,000
95	300	145	445	1.483	0	445	1.483	1.000	1.00	0.00	667,203
95	300	28	328	1.093	0	328	1.093	1.000	1.00	0.00	[illegible],000
90	300	42	342	1.140	0	342	1.140	1.000	1.00	0.00	574,000
85	360	20	380	1.070	0	380	1.056	0.979	1.00	0.00	635,000
75	270	33	303	1.122	0	303	1.122	1.000	1.00	0.00	740,000
75	180	22	202	1.122	193	395	2.194	1.955	0.51	0.49	614,092
65	300	62	362	1.207	14	376	1.253	1.039	0.96	0.04	396,000
65	300	9	309	1.030	0	309	1.030	1.000	1.00	0.00	393,000
65	280	275	555	1.982	0	315	1.125	0.568	1.00	0.00	410,900
65	270	10	280	1.037	123	403	1.493	1.439	0.69	0.31	482,569
65	270	12	282	1.044	0	282	1.044	1.000	1.00	0.00	433,399
55	240	0	240	1.000	40	280	1.167	1.167	0.86	0.14	390,261
35	120	147	267	2.225	0	267	2.225	1.000	1.00	0.00	199,447
25	60	14	74	1.233	102	176	2.933	2.378	0.42	0.58	1,407,000
20	60	0	60	1.000	111	156	2.600	2.600	0.29	0.71	3,012,700
10	30	14	44	1.467	0	44	1.467	1.000	1.00	0.00	1,407,000

TABLE 62 (cont)

LIQUIDATED DAMAGES NUMERIC SORT - TIME ANALYSIS

	$LD	ORCT	ADCT	FNCT	CTDF	LDDY	FDUR	FDF(O)	FDF(F)	ATDF	LDDF	ORIG COST
Average:	370	363	131	494	1.351	19	504			0.94	0.06	2,112,468

APPENDIX B

RAW FIELD DATA INPUT

ORIGINAL COLLECTED DATA FROM FIELD STUDY AS ENTERED IN DATA BASE

(see Section III)

UNIT NO: 01 CONTRACT NO: 810910
TITLE/LOC: Applied Instruction Bldg, NAS Memphis TN
BLDG TYPE: INST $LD/DY: 405

ORIGINAL COST: 3676000
FINAL COST: 3933923
COST FACTOR: 1.070

ORIGINAL CT: 420
ADDITIONAL CT: 317
FINAL CT: 737
CT DELAY FACTOR: 1.755

FINAL DURATION: 747
LD DAYS: 10
FINAL DF (OCT): 1.779
FINAL DF (FCT): 1.014

ALLOWED TIME DF: 0.99
LD'S TIME DF: 0.01

ADDITIONAL COST: 257923

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
01	01	CRE0	INT ARCH	-32,486	-0.126	2	0.006
	02	DOGS	INT ARCH	275,000	1.066	274	0.864
	03	DSGN	INT ARCH	15,409	0.060	0	0.000
	04	TIME	WEATHER	0	0.000	41	0.129
			Total:	257,923	1.000	317	0.999

UNIT NO: 02 CONTRACT NO: 800242
TITLE/LOC: Ocean Research Lab NORDA St. Louis MS
BLDG TYPE: LAB $LD/DY: 515

ORIGINAL COST: 5064644
FINAL COST: 5432923
COST FACTOR: 1.073

ORIGINAL CT: 630
ADDITIONAL CT: 792
FINAL CT: 1422
CT DELAY FACTOR: 2.257

FINAL DURATION: 1422
LD DAYS: 0
FINAL DF (OCT): 2.257
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00

ADDITIONAL COST: 368279

CONTRACT CHANGES SUMMARY

#	CHGO	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
02	01	UNFO	EARTHWORK	34,650	0.094	0	0.000
	02	DSGN	UTIL GEN	2,609	0.007	0	0.000
	03	DSGN	CARP	1,153	0.003	0	0.000
	04	DSGN	ELEC	4,556	0.012	0	0.000
	05	CREQ	UTIL GEN	-1,000	-0.003	0	0.000
	06	DSGN	EQUIP	403	0.001	0	0.000
	07	UNFO	PAVING	6,011	0.016	0	0.000
	08	DSGN	CARP	3,275	0.009	0	0.000
	09	CREQ	INT. ARCH	111,033	0.304	21	0.027
	10	DSGN	ELEC	1,301	0.004	0	0.000
	11	CREQ	INT. ARCH	74,521	0.202	20	0.025
	12	UNFO	UTIL GEN	1,143	0.003	0	0.000
	13	DSGN	CARP	14,775	0.040	0	0.000
	14	DSGN	CARP	9,995	0.027	0	0.000
	15	DSGN	CARP	860	0.002	0	0.000
	16	DSGN	DOORS	393	0.001	0	0.000
	17	DSGN	STORM SEWER	3,630	0.010	250	0.316
	18	DSGN	UTIL GEN	-9,917	-0.027	0	0.000
	20	DSGN	ROOFING	100,000	0.293	501	0.633
			Total:	368,279	0.998	792	1.001

UNIT NO: 03 CONTRACT NO: 830436
TITLE/LOC: Grp Trng Bldg Barksdale AFB Shreveport LA
BLDG TYPE: INST $LD/DY: 265

ORIGINAL COST: 2189000
FINAL COST: 2275018
COST FACTOR: 1.039

ORIGINAL CT: 365
ADDITIONAL CT: 135
FINAL CT: 500
CT DELAY FACTOR: 1.370

FINAL DURATION: 500
LD DAYS: 0
FINAL DF (OCT): 1.370
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 86018

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
03	01	UNFO	UTIL UG	1,860	0.022	0	0.000
	02	UNFO	FOUNDATION	67,358	0.783	60	0.444
	03	CRIT	FIRE ALARM	-1,556	-0.018	0	0.000
	04	CREQ	INT ARCH	10,028	0.117	0	0.000
	05	UNFO	UTIL UG	2,325	0.027	0	0.000
	06	DSGN	STRUCT	3,549	0.041	15	0.111
	07	DSGN	FINISH INT	2,243	0.026	0	0.000
	08	DSGN	ELEC	1,178	0.014	0	0.000
	09	UNFO	UTIL UG	-967	-0.011	0	0.000
	10	TIME	WEATHER	0	0.000	60	0.444
			Total:	86,018	1.001	135	0.999

UNIT NO: 04 CONTRACT NO: 811112
TITLE/LOC: F18 Support Facilities MCAS Beaufort SC
BLDG TYPE: MODS $LD/DY: 195

ORIGINAL COST: 3865000
FINAL COST: 4669575
COST FACTOR: 1.208

ORIGINAL CT: 400
ADDITIONAL CT: 135
FINAL CT: 535
CT DELAY FACTOR: 1.338

FINAL DURATION: 535
LD DAYS: 0
FINAL DF (OCT): 1.338
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 804575

UNIT NO: 04A CONTRACT NO: 811112
TITLE/LOC: F18 Support Facilities MCAS Beaufort SC
BLDG TYPE: MODS $LD/DY: 380

ORIGINAL COST: 3865000
FINAL COST: 4669575
COST FACTOR: 1.208

ORIGINAL CT: 400
ADDITIONAL CT: 350
FINAL CT: 750
CT DELAY FACTOR: 1.875

FINAL DURATION: 750
LD DAYS: 0
FINAL DF (OCT): 1.875
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 804575

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
04	01	UNFO	DEMO	21,230	0.026	15	0.111
	02	DSGN	DOORS	3,100	0.004	0	0.000
	03	UNFO	ELEC	9,439	0.012	14	0.104
	04	UNFO	UTIL UG	8,472	0.011	3	0.022
	05	DSGN	ELEC	12,907	0.016	0	0.000
	06	UNFO	EARTHWORK	1,506	0.002	0	0.000
	07	DSGN	STRUCT	26,052	0.032	0	0.000
	08	DSGN	INT ARCH	39,584	0.049	0	0.000
	09	DSGN	INT ARCH	4,991	0.006	0	0.000
	10	UNFO	ELEC	27,734	0.034	0	0.000
	11	UNFO	ELEC	163	0.000	0	0.000
	12	DSGN	EQUIP	214,151	0.266	0	0.000
	13	DSGN	FP SYS	40,133	0.050	0	0.000
	14	UNFO	ELEC	24,121	0.030	0	0.000
	15	UNFO	ELEC	45,615	0.057	0	0.000
	16	UNFO	ELEC	4,772	0.006	0	0.000
	17	UNFO	INT ARCH	58,777	0.073	0	0.000
	18	CREQ	PAVING	59,985	0.075	103	0.763
	19	UNFO	ELEC	10,011	0.012	0	0.000
	20	UNFO	ELEC	1,789	0.002	0	0.000
	21	DSGN	ELEC	13,446	0.017	0	0.000
	22	UNFO	CARP	13,391	0.017	0	0.000
	23	UNFO	FP SYS	3,206	0.004	0	0.000
	25	DSGN	STRUCT	27,500	0.034	0	0.000
	26	UNFO	ELEC	17,961	0.022	0	0.000
	30	UNFO	ELEC	11,864	0.015	0	0.000
	31	DSGN	CARP	-3,027	-0.004	0	0.000
	32	UNFO	CARP	200	0.000	0	0.000
			Total:	699,153	0.868	135	1.000
04A	01	UNFO	DEMO	0	0.000	15	0.043
	03	UNFO	ELEC	0	0.000	14	0.040
	04	UNFO	UTIL UG	0	0.000	3	0.009
	24	UNFO	INT ARCH	77,120	0.096	60	0.171
	27	UNFO	INT ARCH	28,302	0.035	258	0.737
			Total:	105,422	0.131	350	1.000
			Total:	804,575	0.999	485	2.000

UNIT NO: 05 CONTRACT NO: 800477
TITLE/LOC: UEPH Modernization MCRD Parris Island SC
BLDG TYPE: MODS $LD/DY: 265

ORIGINAL COST: 2760900
FINAL COST: 2807341
COST FACTOR: 1.017

ORIGINAL CT: 330
ADDITIONAL CT: 202
FINAL CT: 532
CT DELAY FACTOR: 1.612

FINAL DURATION: 532
LD DAYS: 0
FINAL DF (OCT): 1.612
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 46441

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
05	01	CRIT	LIGHTING	15,199	0.327	94	0.465
	02	UNFO	DEMO	9,987	0.215	15	0.074
	03	UNFO	FINISH INT	21,255	0.458	15	0.074
	04	TIME	ELEC SYS DELAY	0	0.000	78	0.386
			Total:	46,441	1.000	202	0.999

UNIT NO: 06 CONTRACT NO: 810578
TITLE/LOC: UEPH NCBC Gulfport MS
BLDG TYPE: HSG $LD/DY: 315

ORIGINAL COST: 2828000
FINAL COST: 2858737
COST FACTOR: 1.011

ORIGINAL CT: 420
ADDITIONAL CT: 219
FINAL CT: 639
CT DELAY FACTOR: 1.521

FINAL DURATION: 759
LD DAYS: 120
FINAL DF (OCT): 1.807
FINAL DF (FCT): 1.188

ALLOWED TIME DF: 0.84
LD'S TIME DF: 0.16 ADDITIONAL COST: 30737

CONTRACT CHANGES SUMMARY

#	CNG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
06	01	UNFO	DEMO	8,533	0.278	5	0.023
	02	DSGN	DOORS	7,440	0.242	0	0.000
	03	DSGN	STRUCT	4,181	0.136	5	0.023
	04	DSGN	ROOFING	3,940	0.128	116	0.530
	05	DSGN	FINISH INT	6,643	0.216	14	0.064
	06	TIME	WEATHER	0	0.000	79	0.361
			Total:	30,737	1.000	219	1.001

UNIT NO: 07 CONTRACT NO: 810425
TITLE/LOC: UEPH NCBC Gulfport MS
BLDG TYPE: HSG $LD/DY: 1296

ORIGINAL COST: 4623154
FINAL COST: 4641377
COST FACTOR: 1.004

ORIGINAL CT: 700
ADDITIONAL CT: 7
FINAL CT: 707
CT DELAY FACTOR: 1.010

FINAL DURATION: 707
LD DAYS: 0
FINAL DF (OCT): 1.010
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 18223

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
07	01	UNFO	UTIL UG	2,156	0.118	0	0.000
	02	DSGN	HV ELEC	1,221	0.067	0	0.000
	03	DSGN	STRUCT	4,845	0.266	3	0.429
	04	DSGN	HVAC	2,729	0.150	0	0.000
	05	UNFO	CONCRETE	1,195	0.066	0	0.000
	06	UNFO	EARTHWORK	1,971	0.108	0	0.000
	07	UNFO	UTIL UG	4,106	0.225	4	0.571
			Total:	18,223	1.000	7	1.000

UNIT NO: 08 CONTRACT NO: 811016
TITLE/LOC: Chapel NAS Dallas TX
BLDG TYPE: INST $LD/DY: 175

ORIGINAL COST: 1467405
FINAL COST: 1479339
COST FACTOR: 1.008

ORIGINAL CT: 420
ADDITIONAL CT: 102
FINAL CT: 522
CT DELAY FACTOR: 1.243

FINAL DURATION: 531
LD DAYS: 9
FINAL DF (OCT): 1.264
FINAL DF (FCT): 1.017

ALLOWED TIME DF: 0.98
LD'S TIME DF: 0.02 ADDITIONAL COST: 11934

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
08	01	TIME	WEATHER	0	0.000	46	0.451
	02	DSGN	DOORS	2,061	0.173	10	0.098
	03	DSGN	INT ARCH	1,569	0.131	14	0.137
	04	DSGN	WINDOWS	6,614	0.554	0	0.000
	05	DSGN	WINDOWS	464	0.039	0	0.000
	06	DSGN	ELEC	1,506	0.126	21	0.206
	07	TIME	WEATHER	0	0.000	11	0.108
	08	DSGN	HVAC	-280	-0.023	0	0.000
			Total:	11,934	1.000	102	1.000

UNIT NO: 09 CONTRACT NO: 820084
TITLE/LOC: UEPH Barksdale AFB Shreveport LA
BLDG TYPE: HSG $LD/DY: 1382

ORIGINAL COST: 4731000
FINAL COST: 4773880
COST FACTOR: 1.009

ORIGINAL CT: 450
ADDITIONAL CT: 112
FINAL CT: 562
CT DELAY FACTOR: 1.249

FINAL DURATION: 562
LD DAYS: 0
FINAL DF (OCT): 1.249
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 42880

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
09	01	DSGN	UTIL HW	5,340	0.125	0	0.000
	02	DSGN	DOORS	8,425	0.196	0	0.000
	03	UNFO	CEILING	2,256	0.053	0	0.000
	04	VALE	ROOFING	-11,317	-0.264	0	0.000
	05	UNFO	UTIL HW	14,270	0.333	0	0.000
	06	TIME	GDEL SUBM	0	0.000	18	0.161
	07	DSGN	TELEPHONE	2,784	0.065	0	0.000
	08	CRIT	CEILING	-11,560	-0.270	0	0.000
	09	DSGN	CONCRETE	552	0.013	0	0.000
	10	TIME	MATL DEL	0	0.000	7	0.063
	11	TIME	GDEL SITE	696	0.016	7	0.063
	12	CREQ	ELEC	11,628	0.271	0	0.000
	13	TIME	MATL DEL	0	0.000	35	0.313
	14	CREQ	FINISH INT	15,242	0.355	45	0.402
	15	UNFO	GDEL UTIL	2,964	0.069	0	0.000
	16	UNFO	HVAC	1,600	0.037	0	0.000
			Total:	42,880	0.999	112	1.002

UNIT NO: 10 CONTRACT NO: 790472
TITLE/LOC: Cons. Support Ctr. England AFB
BLDG TYPE: OFFC $LD/DY: 185

ORIGINAL COST: 1490000
FINAL COST: 1537241
COST FACTOR: 1.032

ORIGINAL CT: 455
ADDITIONAL CT: 96
FINAL CT: 551
CT DELAY FACTOR: 1.211

FINAL DURATION: 551
LD DAYS: 0
FINAL DF (OCT): 1.211
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00

ADDITIONAL COST: 47241

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
10	01	UNFO	UTIL UG	2,397	0.051	3	0.031
	02	UNFO	UTIL UG	2,853	0.060	3	0.031
	03	CREQ	INT ARCH	43,207	0.915	90	0.938
	04	CREQ	ELEC	224	0.005	0	0.000
	05	CRIT	UTIL GEN	-1,940	-0.041	0	0.000
	06	DSGN	DOORS	75	0.002	0	0.000
	07	CRIT	ELEC	425	0.009	0	0.000
			Total:	47,241	1.001	96	1.000

UNIT NO: 11 CONTRACT NO: 830709
TITLE/LOC: Alts to Rsv. Ctr. Savannah GA
BLDG TYPE: MODS $LD/DY: 35

ORIGINAL COST: 0199447
FINAL COST: 0213750
COST FACTOR: 1.072

ORIGINAL CT: 120
ADDITIONAL CT: 147
FINAL CT: 267
CT DELAY FACTOR: 2.225

FINAL DURATION: 267
LD DAYS: 0
FINAL DF (OCT): 2.225
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 14303

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
11	01	CREQ	INT ARCH	3,300	0.231	35	0.238
	02	UNFO	FINISH EXT	1,353	0.095	5	0.034
	03	UNFO	INT ARCH	9,650	0.675	70	0.476
	04	TIME	GDEL SUBN	0	0.000	37	0.252
			Total:	14,303	1.001	147	1.000

UNIT NO: 12 CONTRACT NO: 830365
TITLE/LOC: Alterations to EDF NCBC Gulfport MS
BLDG TYPE: MODS $LD/DY: 155

ORIGINAL COST: 1039139
FINAL COST: 1111586
COST FACTOR: 1.070

ORIGINAL CT: 395
ADDITIONAL CT: 272
FINAL CT: 667
CT DELAY FACTOR: 1.689

FINAL DURATION: 667
LD DAYS: 0
FINAL DF (OCT): 1.689
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00

ADDITIONAL COST: 72447

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
12	01	DSGN	UTIL UG	3,854	0.053	3	0.011
	02	DSGN	UTIL UG	2,480	0.034	2	0.007
	03	DSGN	SITE ACCESS	5,176	0.071	7	0.026
	04	UNFO	ASBESTOS	6,991	0.096	0	0.000
	05	CREQ	LIGHTING	4,714	0.065	0	0.000
	06	DSGN	ASBESTOS	11,291	0.156	0	0.000
	07	DSGN	UTIL GEN	3,012	0.042	42	0.154
	08	CREQ	EQUIP	27,250	0.376	188	0.691
	09	DSGN	HVAC	721	0.010	0	0.000
	10	DSGN	CARP	958	0.013	30	0.110
	11	CREQ	HVAC	6,000	0.083	0	0.000
			Total:	72,447	0.999	272	0.999

UNIT NO: 13 CONTRACT NO: 830449
TITLE/LOC: PSD Bldq NSA New Orleans LA
BLDG TYPE: OFFC $LD/DY: 115

ORIGINAL COST: 1015000
FINAL COST: 1026605
COST FACTOR: 1.011

ORIGINAL CT: 365
ADDITIONAL CT: 19
FINAL CT: 384
CT DELAY FACTOR: 1.052

FINAL DURATION: 384
LD DAYS: 0
FINAL DF (OCT): 1.052
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 11605

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
13	01	UNFO	FOUNDATION	1,183	0.102	5	0.263
	02	CREQ	CARPET	9,422	0.812	14	0.737
	03	DSGN	ELEC	1,000	0.086	0	0.000
			Total:	11,605	1.000	19	1.000

UNIT NO: 14 CONTRACT NO: 830502
TITLE/LOC: Ops Trng Bldg NAS New Orleans LA
BLDG TYPE: INST $LD/DY: 185

ORIGINAL COST: 1776000
FINAL COST: 1825906
COST FACTOR: 1.028

ORIGINAL CT: 480
ADDITIONAL CT: 44
FINAL CT: 524
CT DELAY FACTOR: 1.092

FINAL DURATION: 524
LD DAYS: 0
FINAL DF (OCT): 1.092
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 49906

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
14	01	DSGN	UTIL UG	2,065	0.041	0	0.000
	02	DSGN	FOUNDATION	4,823	0.097	21	0.477
	03	DSGN	INT ARCH	6,000	0.120	0	0.000
	04	DSGN	FOUNDATION	30,773	0.617	0	0.000
	05	DSGN	UTIL GEN	6,235	0.125	0	0.000
	06	TIME	GDEL SUBM	0	0.000	23	0.523
			Total:	49,906	1.000	44	1.000

UNIT NO: 15 CONTRACT NO: 830240
TITLE/LOC: Env./Med. Facility Shreveport LA
BLDG TYPE: LAB $LD/DY: 65

ORIGINAL COST: 0433399
FINAL COST: 0436380
COST FACTOR: 1.007

ORIGINAL CT: 270
ADDITIONAL CT: 12
FINAL CT: 282
CT DELAY FACTOR: 1.044

FINAL DURATION: 282
LD DAYS: 0
FINAL DF (OCT): 1.044
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00

ADDITIONAL COST: 2981

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
15	01	DSGN	CONCRETE	1,185	0.398	0	0.000
	02	UNFO	FOUNDATION	1,796	0.602	6	0.500
	03	TIME	WEATHER	0	0.000	6	0.500
			Total:	2,981	1.000	12	1.000

UNIT NO: 16 CONTRACT NO: 810924
TITLE/LOC: Maintenance Hanger NAS Cecil Field FL
BLDG TYPE: HNGR $LD/DY: 625

ORIGINAL COST: 4888000
FINAL COST: 5082662
COST FACTOR: 1.040

ORIGINAL CT: 540
ADDITIONAL CT: 57
FINAL CT: 597
CT DELAY FACTOR: 1.106

FINAL DURATION: 597
LD DAYS: 0
FINAL DF (OCT): 1.106
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 194662

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
16	01	UNFO	FENCING	5,219	0.027	0	0.000
	02	CRIT	UTIL UG	3,969	0.020	0	0.000
	03	DSGN	FP SYS	10,152	0.052	0	0.000
	04	CREQ	UTIL GEN	6,493	0.033	0	0.000
	05	CRIT	ELEC	1,892	0.010	0	0.000
	06	DSGN	HAUL ROUTE	17,315	0.089	0	0.000
	07	CRIT	FENCING	2,373	0.012	0	0.000
	08	DSGN	HANGAR DOORS	11,200	0.058	0	0.000
	09	DSGN	FP SYS	31,109	0.160	7	0.123
	10	CRIT	INT ARCH	55,421	0.285	30	0.526
	11	DSGN	INT ARCH	12,797	0.066	15	0.263
	12	DSGN	HVAC	12,552	0.064	0	0.000
	13	CREQ	FP SYS	6,238	0.032	0	0.000
	14	DSGN	INT ARCH	3,651	0.019	5	0.088
	15	UNFO	FOUNDATION	9,982	0.051	0	0.000
	16	DSGN	FP SYS	4,299	0.022	0	0.000
			Total:	194,662	1.000	57	1.000

UNIT NO: 17 CONTRACT NO: 810809
TITLE/LOC: Family Svc Ctr NAS Kingsville TX
BLDG TYPE: OFFC $LD/DY: 65

ORIGINAL COST: 0393000
FINAL COST: 0401087
COST FACTOR: 1.021

ORIGINAL CT: 300
ADDITIONAL CT: 9
FINAL CT: 309
CT DELAY FACTOR: 1.030

FINAL DURATION: 309
LD DAYS: 0
FINAL DF (OCT): 1.030
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 8087

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
17	01	DSGN	FINISH EXT	2,076	0.257	2	0.222
	02	CRED	CARPET	4,651	0.575	3	0.333
	03	DSGN	DOORS	1,360	0.168	4	0.444
			Total:	8,087	1.000	9	0.999

UNIT NO: 18 CONTRACT NO: 810855
TITLE/LOC: Family Svc Ctr NAS Cecil Field FL
BLDG TYPE: OFFC $LD/DY: 65

ORIGINAL COST: 0482569
FINAL COST: 0490076
COST FACTOR: 1.016

ORIGINAL CT: 270
ADDITIONAL CT: 10
FINAL CT: 280
CT DELAY FACTOR: 1.037

FINAL DURATION: 403
LD DAYS: 123
FINAL DF (OCT): 1.493
FINAL DF (FCT): 1.439

ALLOWED TIME DF: 0.69
LD'S TIME DF: 0.31 ADDITIONAL COST: 7507

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
18	01	DSGN	INT ARCH	3,434	0.457	0	0.000
	02	DSGN	INT ARCH	2,832	0.377	0	0.000
	03	DSGN	INT ARCH	1,241	0.165	10	1.000
			Total:	7,507	0.999	10	1.000

UNIT NO: 19 CONTRACT NO: 810412
TITLE/LOC: UEPH MCRD Parris Island SC
BLDG TYPE: HBG $LD/DY: 3600

ORIGINAL COST: 5247000
FINAL COST: 5272903
COST FACTOR: 1.005

ORIGINAL CT: 540
ADDITIONAL CT: 129
FINAL CT: 669
CT DELAY FACTOR: 1.239

FINAL DURATION: 710
LD DAYS: 41
FINAL DF (OCT): 1.315
FINAL DF (FCT): 1.061

ALLOWED TIME DF: 0.94
LD'S TIME DF: 0.06 ADDITIONAL COST: 25903

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
19	01	UNFO	DEMO	7,630	0.295	5	0.039
	02	UNFO	FP SYS	-5,061	-0.195	1	0.008
	03	UNFO	UTIL GEN	3,372	0.130	3	0.023
	04	CRE8	INT ARCH	19,962	0.771	90	0.698
	05	TIME	SDEL SUBM	0	0.000	30	0.233
			Total:	25,903	1.001	129	1.001

UNIT NO: 20 CONTRACT NO: 810408
TITLE/LOC: Alterations to UEPH Shaw AFB Sumter SC
BLDG TYPE: MODS $LD/DY: 792

ORIGINAL COST: 1864000
FINAL COST: 2049017
COST FACTOR: 1.099

ORIGINAL CT: 540
ADDITIONAL CT: 80
FINAL CT: 620
CT DELAY FACTOR: 1.148

FINAL DURATION: 620
LD DAYS: 0
FINAL DF (OCT): 1.148
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 185017

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
20	01	UNFO	FOUNDATION	27,019	0.150	24	0.300
	02	UNFO	FINISH EXT	1,273	0.007	0	0.000
	03	UNFO	WINDOWS	3,196	0.017	2	0.025
	04	UNFO	INT ARCH	11,894	0.064	2	0.025
	05	DSGN	ELEC	2,555	0.014	0	0.000
	06	CRED	WINDOWS	23,778	0.129	6	0.075
	07	UNFO	UTIL GEN	4,516	0.024	0	0.000
	08	DSGN	MV ELEC	10,750	0.058	0	0.000
	09	UNFO	STAIRS	59,244	0.320	0	0.000
	10	UNFO	UTIL GEN	5,224	0.028	4	0.050
	11	UNFO	WINDOWS	400	0.002	0	0.000
	12	UNFO	CEILING	7,797	0.042	7	0.088
	13	UNFO	MV ELEC	2,695	0.015	0	0.000
	14	DSGN	FINISH INT	17,030	0.092	32	0.400
	15	UNFO	HVAC	545	0.003	0	0.000
	16	UNFO	UTIL UG	3,992	0.022	3	0.038
	17	UNFO	HVAC	2,309	0.012	0	0.000
			Total:	185,017	0.999	80	1.001

UNIT NO: 21 CONTRACT NO: 820291
TITLE/LOC: Gym Addition Shaw AFB Sumter SC
BLDG TYPE: MODS $LD/DY: 205

ORIGINAL COST: 1798000
FINAL COST: 1911284
COST FACTOR: 1.063

ORIGINAL CT: 365
ADDITIONAL CT: 120
FINAL CT: 485
CT DELAY FACTOR: 1.329

FINAL DURATION: 513
LD DAYS: 28
FINAL DF (OCT): 1.405
FINAL DF (FCT): 1.058

ALLOWED TIME DF: 0.95
LD'S TIME DF: 0.05

ADDITIONAL COST: 113284

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
21	01	UNFO	DEMO	539	0.005	2	0.017
	02	UNFO	DEMO	1,537	0.014	4	0.033
	03	DSGN	DOORS	1,356	0.012	4	0.033
	04	UNFO	WEATHER DAMAGE	60,000	0.530	45	0.375
	05	UNFO	WEATHER DAMAGE	165	0.001	1	0.008
	06	DSGN	UTIL GEN	3,747	0.033	12	0.100
	07	TIME	WEATHER	0	0.000	17	0.142
	08	DSGN	FINISH INT	390	0.004	0	0.000
	09	CREQ	ROOFING	19,984	0.176	7	0.058
	10	DSGN	CEILING	1,223	0.011	1	0.008
	11	DSGN	FINISH EXT	2,802	0.025	7	0.058
	12	DSGN	HVAC	3,500	0.031	10	0.083
	13	CREQ	FINISH INT	1,578	0.014	5	0.042
	14	CREQ	PAVING	13,216	0.117	0	0.000
	15	UNFO	FLOORING	2,924	0.026	5	0.042
	16	CRIT	FINISH INT	235	0.002	0	0.000
			Total:	113,284	1.001	120	0.999

UNIT NO: 22 CONTRACT NO: 830269
TITLE/LOC: Waterfront Svcs bldg NS Charleston SC
BLDG TYPE: OFFC $LD/DY: 225

ORIGINAL COST: 0912163
FINAL COST: 0902014
COST FACTOR: 0.989

ORIGINAL CT: 270
ADDITIONAL CT: 38
FINAL CT: 308
CT DELAY FACTOR: 1.141

FINAL DURATION: 505
LD DAYS: 197
FINAL DF (OCT): 1.870
FINAL DF (FCT): 1.640

ALLOWED TIME DF: 0.61
LD'S TIME DF: 0.39

ADDITIONAL COST: -10149

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
22	01	TIME	0DEL SITE	2,484	-0.245	10	0.263
	02	UNFO	DEMO	6,653	-0.656	23	0.605
	03	CREQ	WINDOWS	-1,594	0.157	0	0.000
	04	CREQ	UTIL GEN	-1,563	0.154	0	0.000
	05	CREQ	CEILING	-652	0.064	0	0.000
	06	CREQ	UTIL GEN	-1,956	0.193	2	0.053
	07	CREQ	FLOORING	-4,338	0.427	3	0.079
	08	CREQ	FINISH EXT	-9,183	0.905	0	0.000
			Total:	-10,149	0.999	38	1.000

UNIT NO: 23 CONTRACT NO: 830180
TITLE/LOC: Child Care Ctr NAS Pensacola FL
BLDG TYPE: HSG $LD/DY: 105

ORIGINAL COST: 0794000
FINAL COST: 0860021
COST FACTOR: 1.083

ORIGINAL CT: 440
ADDITIONAL CT: 45
FINAL CT: 485
CT DELAY FACTOR: 1.102

FINAL DURATION: 485
LD DAYS: 0
FINAL DF (OCT): 1.102
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00

ADDITIONAL COST: 66021

CONTRACT CHANGES SUMMARY

#	CNG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
23	01	DSGN	EARTHWORK	58,603	0.888	45	1.000
	02	DSGN	EQUIP	7,418	0.112	0	0.000
			Total:	66,021	1.000	45	1.000

UNIT NO: 24 CONTRACT NO: 830187
TITLE/LOC: PSD Bldg NAS Kingsville TX
BLDG TYPE: OFFC $LD/DY: 85

ORIGINAL COST: 0635000
FINAL COST: 0651204
COST FACTOR: 1.026

ORIGINAL CT: 360
ADDITIONAL CT: 28
FINAL CT: 388
CT DELAY FACTOR: 1.078

FINAL DURATION: 380
LD DAYS: 0
FINAL DF (OCT): 1.056
FINAL DF (FCT): 0.979

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 16204

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
24	01	CRED	INT ARCH	10,267	0.634	7	0.250
	02	CRED	LANDSCAPE	5,000	0.309	0	0.000
	03	TIME	WEATHER	0	0.000	21	0.750
	04	CRED	WINDOWS	937	0.058	0	0.000
			Total:	16,204	1.001	28	1.000

UNIT NO: 25 CONTRACT NO: 830135
TITLE/LOC: HQTRS Bldg Charleston AFB
BLDG TYPE: OFFC $LD/DY: 715

ORIGINAL COST: 2935227
FINAL COST: 2991078
COST FACTOR: 1.019

ORIGINAL CT: 455
ADDITIONAL CT: 143
FINAL CT: 598
CT DELAY FACTOR: 1.314

FINAL DURATION: 598
LD DAYS: 0
FINAL DF (OCT): 1.314
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00

ADDITIONAL COST: 55851

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
25	01	UNFO	ASBESTOS	14,030	0.251	18	0.126
	02	DSGN	DOORS	6,535	0.117	0	0.000
	03	CRIT	HV ELEC	-308	-0.006	0	0.000
	04	VALE	DEMO	-1,074	-0.019	0	0.000
	05	DSGN	INT ARCH	23,369	0.418	70	0.490
	06	DSGN	ELEC	4,120	0.074	0	0.000
	07	CREQ	ELEC	9,179	0.164	55	0.385
			Total:	55,851	0.999	143	1.001

UNIT NO: 26 CONTRACT NO: 820324
TITLE/LOC: UEPH Improvements MCRD Parris Island SC
BLDG TYPE: MODS $LD/DY: 215

ORIGINAL COST: 1035679
FINAL COST: 1024469
COST FACTOR: 0.989

ORIGINAL CT: 270
ADDITIONAL CT: 107
FINAL CT: 377
CT DELAY FACTOR: 1.396

FINAL DURATION: 377
LD DAYS: 0
FINAL DF (OCT): 1.396
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00

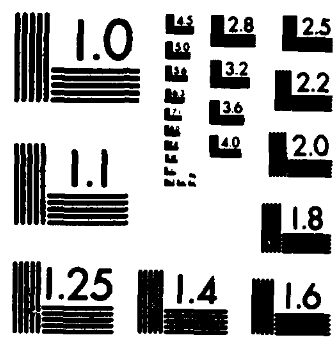
ADDITIONAL COST: -11210

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
26	01	TIME	MATL STRIKE	0	0.000	53	0.495
	02	UNFO	UTIL GEN	-11,210	1.000	0	0.000
	03	TIME	MATL DEL	0	0.000	34	0.318
	04	TIME	GDEL SITE	0	0.000	20	0.187
			Total:	-11,210	1.000	107	1.000

AD-A185 003 A STUDY OF CONSTRUCTION CONTRACT DELAY; CAUSES AND IMPACTS(U) GEORGIA INST OF TECH ATLANTA SCHOOL OF CIVIL ENGINEERING C N DAWKINS AUG 87 N00228-85-G-3247 3/3

UNCLASSIFIED F/G 5/1 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

UNIT NO: 27 CONTRACT NO: 811014
TITLE/LOC: UEPH NAS Dallas TX
BLDG TYPE: HSG $LD/DY: 1020

ORIGINAL COST: 3012700
FINAL COST: 3028041
COST FACTOR: 1.005

ORIGINAL CT: 420
ADDITIONAL CT: 234
FINAL CT: 654
CT DELAY FACTOR: 1.557

FINAL DURATION: 654
LD DAYS: 0
FINAL DF (OCT): 1.557
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 15341

UNIT NO: 27A CONTRACT NO: 811014
TITLE/LOC: UEPH NAS Dallas TX
BLDG TYPE: HSG $LD/DY: 20

ORIGINAL COST: 3012700
FINAL COST: 3028041
COST FACTOR: 1.005

ORIGINAL CT: 60
ADDITIONAL CT: 0
FINAL CT: 60
CT DELAY FACTOR: 1.000

FINAL DURATION: 156
LD DAYS: 111
FINAL DF (OCT): 2.600
FINAL DF (FCT): 2.600

ALLOWED TIME DF: 0.29
LD'S TIME DF: 0.71 ADDITIONAL COST: 15341

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
27	01	CREQ	ELEC	4,778	0.311	10	0.043
	02	UNFO	DOORS	671	0.044	0	0.000
	03	TIME	MATL DEL	0	0.000	130	0.556
	04	UNFO	FP SYS	2,191	0.143	0	0.000
	05	UNFO	HVAC	-1,100	-0.072	0	0.000
	06	DSGN	HVAC	9,046	0.590	45	0.192
	07	TIME	SDEL SUBM	0	0.000	49	0.209
	08	CRIT	INT ARCH	-245	-0.016	0	0.000
			Total:	15,341	1.000	234	1.000

UNIT NO: 28 CONTRACT NO: 810894
TITLE/LOC: Ops Trng Facility MCAS Beaufort SC
BLDG TYPE: INST $LD/DY: 1600

ORIGINAL COST: 0827777
FINAL COST: 0845777
COST FACTOR: 1.022

ORIGINAL CT: 212
ADDITIONAL CT: 15
FINAL CT: 227
CT DELAY FACTOR: 1.071

FINAL DURATION: 221
LD DAYS: 0
FINAL DF (OCT): 1.042
FINAL DF (FCT): 0.974

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 18000

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
28	01	UNFO	UTIL UG	4,001	0.222	5	0.333
	02	UNFO	ELEC	1,716	0.095	7	0.467
	03	DSGN	INT ARCH	760	0.042	3	0.200
	04	UNFO	ELEC	6,433	0.357	0	0.000
	05	DSGN	ELEC	1,263	0.070	0	0.000
	06	DSGN	ELEC	2,077	0.115	0	0.000
	07	DSGN	ROOFING	1,750	0.097	0	0.000
			Total:	18,000	0.998	15	1.000

UNIT NO: 29 CONTRACT NO: 830516
TITLE/LOC: Crew Bldg Barksdale AFB Shreveport LA
BLDG TYPE: MODS $LD/DY: 235

ORIGINAL COST: 2107250
FINAL COST: 2146579
COST FACTOR: 1.019

ORIGINAL CT: 365
ADDITIONAL CT: 98
FINAL CT: 463
CT DELAY FACTOR: 1.268

FINAL DURATION: 449
LD DAYS: 0
FINAL DF (OCT): 1.230
FINAL DF (FCT): 0.970

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 39329

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
29	01	DSGN	LANDSCAPE	2,000	0.051	0	0.000
	02	DSGN	CONCRETE	670	0.017	0	0.000
	03	UNFO	UTIL GAS	17,258	0.439	16	0.163
	04	CREQ	FENCING	3,250	0.083	30	0.306
	05	UNFO	ROOFING	2,017	0.051	0	0.000
	06	UNFO	HVAC	8,390	0.214	2	0.020
	07	DSGN	HV ELEC	4,728	0.120	40	0.408
	08	DSGN	HVAC	1,000	0.025	10	0.102
			Total:	39,329	1.000	98	0.999

UNIT NO: 30 CONTRACT NO: 850529
TITLE/LOC: Logistics Bldg NAS Dallas TX
BLDG TYPE: WHSE $LD/DY: 75

ORIGINAL COST: 0614092
FINAL COST: 0621281
COST FACTOR: 1.012

ORIGINAL CT: 180
ADDITIONAL CT: 22
FINAL CT: 202
CT DELAY FACTOR: 1.122

FINAL DURATION: 395
LD DAYS: 193
FINAL DF (OCT): 2.194
FINAL DF (FCT): 1.955

ALLOWED TIME DF: 0.51
LD'S TIME DF: 0.49 ADDITIONAL COST: 7189

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
30	01	UNFO	FOUNDATION	4,420	0.615	14	0.636
	02	UNFO	FOUNDATION	-1,225	-0.170	1	0.045
	03	UNFO	WAGE INC	3,394	0.472	0	0.000
	04	DSGN	LIGHTING	600	0.083	7	0.318
			Total:	7,189	1.000	22	0.999

UNIT NO: 31 CONTRACT NO: 830488
TITLE/LOC: Training Bldg NAS Dallas TX
BLDG TYPE: INST $LD/DY: 55

ORIGINAL COST: 0390261
FINAL COST: 0390261
COST FACTOR: 1.000

ORIGINAL CT: 240
ADDITIONAL CT: 0
FINAL CT: 240
CT DELAY FACTOR: 1.000

FINAL DURATION: 280
LD DAYS: 40
FINAL DF (OCT): 1.167
FINAL DF (FCT): 1.167

ALLOWED TIME DF: 0.86
LD'S TIME DF: 0.14 ADDITIONAL COST: 0

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
31	00	####	NO CHANGES	0	0.000	0	0.000
			Total:	0	0.000	0	0.000

UNIT NO: 32 CONTRACT NO: 830185
TITLE/LOC: PW Shops NAS Kingsville TX
BLDG TYPE: WHSE $LD/DY: 135

ORIGINAL COST: 1407000
FINAL COST: 1417589
COST FACTOR: 1.008

ORIGINAL CT: 365
ADDITIONAL CT: 14
FINAL CT: 379
CT DELAY FACTOR: 1.038

FINAL DURATION: 379
LD DAYS: 0
FINAL DF (OCT): 1.038
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 10589

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
32	01	VALE	PAVING	-1,316	-0.124	0	0.000
	02	DSGN	LANDSCAPE	1,210	0.115	0	0.000
	03	CREQ	INT ARCH	10,687	1.009	14	1.000
			Total:	10,589	1.000	14	1.000

UNIT NO: 32A CONTRACT NO: 830185
TITLE/LOC: PW Shops NAS Kingsville TX
BLDG TYPE: WHSE $LD/DY: 10

ORIGINAL COST: 1407000
FINAL COST: 1417589
COST FACTOR: 1.008

ORIGINAL CT: 30
ADDITIONAL CT: 14
FINAL CT: 44
CT DELAY FACTOR: 1.467

FINAL DURATION: 44
LD DAYS: 0
FINAL DF (OCT): 1.467
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 10589

UNIT NO: 32B CONTRACT NO: 830185
TITLE/LOC: PW Shops NAS Kingsville TX
BLDG TYPE: WHSE $LD/DY: 25

ORIGINAL COST: 1407000
FINAL COST: 1417589
COST FACTOR: 1.008

ORIGINAL CT: 60
ADDITIONAL CT: 14
FINAL CT: 74
CT DELAY FACTOR: 1.233

FINAL DURATION: 176
LD DAYS: 102
FINAL DF (OCT): 2.933
FINAL DF (FCT): 2.378

ALLOWED TIME DF: 0.42
LD'S TIME DF: 0.58 ADDITIONAL COST: 10589

UNIT NO: 33 CONTRACT NO: 830091
TITLE/LOC: Gen'l Warehouse NCBC Gulfport MS
BLDG TYPE: WHSE $LD/DY: 420

ORIGINAL COST: 3213958
FINAL COST: 3234844
COST FACTOR: 1.006

ORIGINAL CT: 480
ADDITIONAL CT: 99
FINAL CT: 579
CT DELAY FACTOR: 1.206

FINAL DURATION: 579
LD DAYS: 0
FINAL DF (OCT): 1.206
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00

ADDITIONAL COST: 20886

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
33	01	UNFO	EARTHWORK	-2,371	-0.114	0	0.000
	02	UNFO	EARTHWORK	8,954	0.429	7	0.071
	03	UNFO	STORM SEWER	2,030	0.097	6	0.061
	04	DSGN	ELEC	690	0.033	0	0.000
	05	DSGN	PAVING	11,583	0.555	86	0.869
			Total:	20,886	1.000	99	1.001

UNIT NO: 34 CONTRACT NO: 800355
TITLE/LOC: Rel Ed Facility NAS Jacksonville FL
BLDG TYPE: OFFC $LD/DY: 95

ORIGINAL COST: 0727000
FINAL COST: 0737559
COST FACTOR: 1.015

ORIGINAL CT: 300
ADDITIONAL CT: 28
FINAL CT: 328
CT DELAY FACTOR: 1.093

FINAL DURATION: 328
LD DAYS: 0
FINAL DF (OCT): 1.093
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00

ADDITIONAL COST: 10559

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
34	01	DSGN	UTIL GEN	306	0.029	0	0.000
	02	UNFO	LANDSCAPE	502	0.048	1	0.036
	03	UNFO	LANDSCAPE	1,119	0.106	2	0.071
	04	CREQ	INT ARCH	1,776	0.168	2	0.071
	05	UNFO	INT ARCH	936	0.089	4	0.143
	06	DSGN	ELEC	1,066	0.101	7	0.250
	07	UNFO	FINISH EXT	4,854	0.460	12	0.429
			Total:	10,559	1.001	28	1.000

UNIT NO: 35 CONTRACT NO: 840872
TITLE/LOC: Hqtrs Facility NAS Key West FL
BLDG TYPE: MODS $LD/DY: 115

ORIGINAL COST: 0949860
FINAL COST: 1080055
COST FACTOR: 1.137

ORIGINAL CT: 240
ADDITIONAL CT: 78
FINAL CT: 318
CT DELAY FACTOR: 1.325

FINAL DURATION: 302
LD DAYS: 0
FINAL DF (OCT): 1.258
FINAL DF (FCT): 0.950

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00

ADDITIONAL COST: 130195

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
35	01	UNFO	DEMO	20,412	0.157	14	0.179
	02	DSGN	FP SYS	33,136	0.255	30	0.385
	03	DSGN	ELEC	11,087	0.085	10	0.128
	04	DSGN	HVAC	33,591	0.258	10	0.128
	06	DSGN	CARP	26,427	0.203	14	0.179
		DSGN	UTIL GEN	11,344	0.087	0	0.000
	07	UNFO	CARP	-5,802	-0.045	0	0.000
			Total:	130,195	1.000	78	0.999

UNIT NO: 36 CONTRACT NO: 850126
TITLE/LOC: Family Svc Ctr NAS Beeville TX
BLDG TYPE: OFFC $LD/DY: 65

ORIGINAL COST: 0396000
FINAL COST: 0416072
COST FACTOR: 1.051

ORIGINAL CT: 300
ADDITIONAL CT: 62
FINAL CT: 362
CT DELAY FACTOR: 1.207

FINAL DURATION: 376
LD DAYS: 14
FINAL DF (OCT): 1.253
FINAL DF (FCT): 1.039

ALLOWED TIME DF: 0.96
LD'S TIME DF: 0.04 ADDITIONAL COST: 20072

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
36	01	UNFO	EARTHWORK	2,403	0.120	0	0.000
	02	UNFO	STORM SEWER	12,523	0.624	10	0.161
	03	CREQ	INT ARCH	5,146	0.256	52	0.839
			Total:	20,072	1.000	62	1.000

UNIT NO: 37 CONTRACT NO: 850099
TITLE/LOC: Child Care Ctr Barksdale AFB Shreveport LA
BLDG TYPE: MODS $LD/DY: 73

ORIGINAL COST: 0740000
FINAL COST: 0746981
COST FACTOR: 1.009

ORIGINAL CT: 270
ADDITIONAL CT: 33
FINAL CT: 303
CT DELAY FACTOR: 1.122

FINAL DURATION: 303
LD DAYS: 0
FINAL DF (OCT): 1.122
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00

ADDITIONAL COST: 6981

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
37	01	DSGN	EARTHWORK	-1,471	-0.211	0	0.000
	02	DSGN	CONCRETE	780	0.112	0	0.000
	03	TIME	WEATHER	0	0.000	33	1.000
	04	CRIT	FP SYS	7,000	1.003	0	0.000
		DSGN	DOORS	672	0.096	0	0.000
			Total:	6,981	1.000	33	1.000

UNIT NO: 38 CONTRACT NO: 830183
TITLE/LOC: Ops Trng Facility NAS Corpus Christi TX
BLDG TYPE: MODS $LD/DY: 90

ORIGINAL COST: 0574000
FINAL COST: 0580860
COST FACTOR: 1.012

ORIGINAL CT: 300
ADDITIONAL CT: 42
FINAL CT: 342
CT DELAY FACTOR: 1.140

FINAL DURATION: 342
LD DAYS: 0
FINAL DF (OCT): 1.140
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00

ADDITIONAL COST: 6860

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
38	01	UNFO	FINISH INT	4,009	0.584	7	0.167
	02	CREQ	ELEC	2,851	0.416	35	0.833
			Total:	6,860	1.000	42	1.000

UNIT NO: 39 CONTRACT NO: 830194
TITLE/LOC: Fleet Trng Facility NS Mayport FL
BLDG TYPE: INST $LD/DY: 150

ORIGINAL COST: 0703920
FINAL COST: 0740704
COST FACTOR: 1.052

ORIGINAL CT: 270
ADDITIONAL CT: 57
FINAL CT: 327
CT DELAY FACTOR: 1.211

FINAL DURATION: 327
LD DAYS: 0
FINAL DF (OCT): 1.211
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00

ADDITIONAL COST: 36784

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
39	01	DSGN	UTIL GEN	15,246	0.414	3	0.053
	02	UNFO	EARTHWORK	17,066	0.464	11	0.193
	03	CRED	INT ARCH	1,927	0.052	0	0.000
	04	CRIT	ELEC	1,561	0.042	10	0.175
	05	TIME	MATL DEL	0	0.000	33	0.579
	06	DSGN	HVAC	984	0.027	0	0.000
			Total:	36,784	0.999	57	1.000

UNIT NO: 40 CONTRACT NO: 810983
TITLE/LOC: Gen'l Warehouse NAF Mayport FL
BLDG TYPE: WHSE $LD/DY: 419

ORIGINAL COST: 3791000
FINAL COST: 3918447
COST FACTOR: 1.034

ORIGINAL CT: 450
ADDITIONAL CT: 102
FINAL CT: 552
CT DELAY FACTOR: 1.227

FINAL DURATION: 566
LD DAYS: 14
FINAL DF (OCT): 1.258
FINAL DF (FCT): 1.025

ALLOWED TIME DF: 0.98
LD'S TIME DF: 0.02

ADDITIONAL COST: 127447

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
40	01	UNFO	STRUCT	9,838	0.077	0	0.000
	02	DSGN	STORM SEWER	3,160	0.025	7	0.069
	03	CRIT	ELEC	7,000	0.055	7	0.069
	04	CRIT	DOORS	3,111	0.024	3	0.029
	05	CREQ	LIGHTING EXT	64,543	0.506	21	0.206
	06	DSGN	FINISH INT	936	0.007	0	0.000
	07	DSGN	HVAC	1,024	0.008	0	0.000
	08	DSGN	EARTHWORK	2,714	0.021	5	0.049
	09	CRIT	EARTHWORK	25,998	0.204	14	0.137
	10	UNFO	ELEC	1,634	0.013	0	0.000
	11	UNFO	ELEC	1,362	0.011	0	0.000
	12	UNFO	HV ELEC	7,439	0.058	45	0.441
	13	DSGN	FP SYS	-3,500	-0.027	0	0.000
	14	UNFO	UTIL GEN	2,188	0.017	0	0.000
			Total:	127,447	0.999	102	1.000

UNIT NO: 41 CONTRACT NO: 840446
TITLE/LOC: Avionics Shop Addition NARF Jacksonville FL
BLDG TYPE: WHSE $LD/DY: 95

ORIGINAL COST: 0667203
FINAL COST: 0679971
COST FACTOR: 1.019

ORIGINAL CT: 300
ADDITIONAL CT: 145
FINAL CT: 445
CT DELAY FACTOR: 1.483

FINAL DURATION: 445
LD DAYS: 0
FINAL DF (OCT): 1.483
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 12768

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
41	01	DSGN	DOORS	966	0.076	0	0.000
	02	UNFO	ROOFING	993	0.078	5	0.034
	03	UNFO	STORM SEWER	2,268	0.178	0	0.000
	04	DSGN	STRUCT	3,786	0.297	4	0.028
	05	DSGN	STORM SEWER	2,443	0.191	2	0.014
	06	UNFO	CONCRETE	270	0.021	1	0.007
	07	DSGN	INT ARCH	1,592	0.125	90	0.621
	08	UNFO	CONCRETE	450	0.035	43	0.297
			Total:	12,768	1.001	145	1.001

UNIT NO: 42 CONTRACT NO: 810109
TITLE/LOC: AC Maint. Facilities NAS Cecil Field FL
BLDG TYPE: MODS $LD/DY: 135

ORIGINAL COST: 1392500
FINAL COST: 1961929
COST FACTOR: 1.409

ORIGINAL CT: 365
ADDITIONAL CT: 405
FINAL CT: 770
CT DELAY FACTOR: 2.110

FINAL DURATION: 770
LD DAYS: 0
FINAL DF (OCT): 2.110
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 569429

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
42	01	DSGN	ELEC	10,509	0.018	0	0.000
	02	DSGN	ROOFING	6,149	0.011	0	0.000
	03	DSGN	FP SYS	3,763	0.007	2	0.005
	04	DSGN	ROOFING	2,111	0.004	0	0.000
	05	DSGN	UTIL GEN	8,087	0.014	5	0.012
	06	DSGN	CARP	1,707	0.003	0	0.000
	07	DSGN	INT ARCH	1,444	0.003	0	0.000
	08	DSGN	ELEC	779	0.001	3	0.007
	09	UNFO	CONCRETE	1,544	0.003	2	0.005
	10	DSGN	INT ARCH	1,686	0.003	5	0.012
	11	DSGN	FP SYS	17,107	0.030	7	0.017
	12	DSGN	FINISH INT	929	0.002	0	0.000
	13	DSGN	LIGHTING	3,314	0.006	5	0.012
	14	DSGN	INT ARCH	1,216	0.002	0	0.000
	15	DSGN	INT ARCH	1,134	0.002	1	0.002
	16	CREQ	INT ARCH	288,482	0.507	180	0.444
	17	DSGN	ELEC	17,388	0.031	0	0.000
	18	DSGN	ELEC	3,306	0.006	0	0.000
	19	CRIT	HVAC	190,000	0.334	180	0.444
	20	CRIT	ELEC	7,604	0.013	5	0.012
	21	CRIT	DOORS	1,170	0.002	10	0.025
			Total:	569,429	1.002	405	0.997

UNIT NO: 43 CONTRACT NO: 810440
TITLE/LOC: Base CE Facility Shaw AFB Sumter SC
BLDG TYPE: OFFC $LD/DY: 535

ORIGINAL COST: 4453000
FINAL COST: 4778153
COST FACTOR: 1.073

ORIGINAL CT: 520
ADDITIONAL CT: 371
FINAL CT: 891
CT DELAY FACTOR: 1.713

FINAL DURATION: 891
LD DAYS: 0
FINAL DF (OCT): 1.713
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 325153

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
43	01	UNFO	UTIL UG	13,535	0.042	14	0.038
	02	DSGN	FLOORING	19,000	0.058	0	0.000
	03	DSGN	DOORS	400	0.001	0	0.000
	04	UNFO	UTIL GEN	-8,098	-0.025	0	0.000
	05	UNFO	UTIL GEN	2,050	0.006	0	0.000
	06	UNFO	UTIL HW	7,500	0.023	12	0.032
	07	CREQ	FINISH INT	3,490	0.011	9	0.024
	08	UNFO	UTIL GEN	6,908	0.021	29	0.078
	09	UNFO	FINISH INT	-690	-0.002	0	0.000
	10	UNFO	PAVING	19,770	0.061	13	0.035
	11	DSGN	HV ELEC	8,576	0.026	8	0.022
	12	DSGN	EQUIP	3,543	0.011	11	0.030
	13	UNFO	HVAC	1,800	0.006	3	0.008
	14	UNFO	HV ELEC	1,000	0.003	2	0.005
	15	DSGN	UTIL GEN	350	0.001	0	0.000
	16	CREQ	INT ARCH	110,000	0.338	19	0.051
	17	UNFO	ASBESTOS	125,000	0.384	251	0.677
	18	DSGN	FP SYS	1,646	0.005	0	0.000
	19	CREQ	LANDSCAPE	6,140	0.019	0	0.000
	20	UNFO	FINISH INT	3,233	0.010	0	0.000
			Total:	325,153	0.999	371	1.000

UNIT NO: 44 CONTRACT NO: 800403
TITLE/LOC: AC Maint Hanger NAS Dallas TX
BLDG TYPE: HNGR $LD/DY: 305

ORIGINAL COST: 3065466
FINAL COST: 3350165
COST FACTOR: 1.093

ORIGINAL CT: 455
ADDITIONAL CT: 274
FINAL CT: 729
CT DELAY FACTOR: 1.602

FINAL DURATION: 634
LD DAYS: 0
FINAL DF (OCT): 1.393
FINAL DF (FCT): 0.870

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00

ADDITIONAL COST: 284699

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
44	01	UNFO	FOUNDATION	5,325	0.019	0	0.000
	02	DSGN	FOUNDATION	20,394	0.072	26	0.095
	03	TIME	WEATHER	0	0.000	17	0.062
	04	UNFO	FOUNDATION	26,731	0.094	21	0.077
	05	DSGN	STRUCT	8,291	0.029	60	0.219
	06	DSGN	INT ARCH	159,131	0.559	111	0.405
	07	CRE#	ELEC	8,805	0.031	18	0.066
	08	DSGN	INT ARCH	56,522	0.199	21	0.077
	09	UNFO	FP SYS	-500	-0.002	0	0.000
			Total:	284,699	1.001	274	1.001

UNIT NO: 45 CONTRACT NO: 820245
TITLE/LOC: Applied Inst. Bldg NTC Orlando FL
BLDG TYPE: INST $LD/DY: 415

ORIGINAL COST: 4894000
FINAL COST: 5235684
COST FACTOR: 1.070

ORIGINAL CT: 520
ADDITIONAL CT: 190
FINAL CT: 710
CT DELAY FACTOR: 1.365

FINAL DURATION: 640
LD DAYS: 0
FINAL DF (OCT): 1.231
FINAL DF (FCT): 0.901

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00

ADDITIONAL COST: 341684

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
45	01	CREQ	SCHEDULE REV	78,133	0.229	115	0.605
	02	UNFO	DEMO	8,904	0.026	0	0.000
	03	DSGN	CONCRETE	1,928	0.006	0	0.000
	04	DSGN	DOORS	2,371	0.007	0	0.000
	05	DSGN	INT ARCH	10,077	0.030	0	0.000
	06	DSGN	UTIL GEN	45,057	0.132	0	0.000
	07	CREQ	SCHEDULE REV	49,200	0.144	0	0.000
	08	CREQ	INT ARCH	49,990	0.146	21	0.111
	09	UNFO	ELEC	24,600	0.072	0	0.000
	10	UNFO	WEATHER DAMAGE	13,095	0.038	34	0.179
	11	UNFO	HVAC	31,487	0.092	20	0.105
	12	CRIT	STRUCT	3,592	0.011	0	0.000
	13	DSGN	FINISH INT	23,230	0.068	0	0.000
			Total:	341,684	1.001	190	1.000

UNIT NO: 46 CONTRACT NO: 810346
TITLE/LOC: Ops Trng Facility NS Mayport FL
BLDG TYPE: INST $LD/DY: 565

ORIGINAL COST: 5219022
FINAL COST: 7115617
COST FACTOR: 1.363

ORIGINAL CT: 540
ADDITIONAL CT: 257
FINAL CT: 797
CT DELAY FACTOR: 1.476

FINAL DURATION: 797
LD DAYS: 0
FINAL DF (OCT): 1.476
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 1896595

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
46	01	DSGN	UTIL GEN	600	0.000	0	0.000
	02	DSGN	UTIL WW	9,517	0.005	0	0.000
	03	DSGN	ELEC	935	0.000	0	0.000
	04	DSGN	STRUCT	1,492	0.001	0	0.000
	05	UNFO	FOUNDATION	9,307	0.005	0	0.000
	06	UNFO	FOUNDATION	205,001	0.108	110	0.428
	08	CRIT	INT ARCH	43,790	0.023	0	0.000
	09	DSGN	FINISH INT	1,441	0.001	0	0.000
	10	CRIT	ELEC	3,469	0.002	0	0.000
	11	DSGN	UTIL GEN	1,755	0.001	0	0.000
	12	DSGN	HVAC	10,616	0.006	0	0.000
	13	CRIT	EARTHWORK	18,223	0.010	0	0.000
	15	UNFO	UTIL UG	24,046	0.013	0	0.000
	16	CRIT	LIGHTING EXT	27,000	0.014	0	0.000
	17	DSGN	FP SYS	-868	-0.000	0	0.000
	18	SCPE	ADD ARCH SCOPE	139,468	0.074	121	0.471
	19	CREQ	ELEC	7,737	0.004	0	0.000
	20	CRIT	INT ARCH	30,570	0.016	26	0.101
	21	CRIT	ELEC	2,522	0.001	0	0.000
	22	DSGN	DOORS	750	0.000	0	0.000
	23	DSGN	INT ARCH	510	0.000	0	0.000
	26	CRIT	EARTHWORK	130,427	0.069	0	0.000
	27	CRIT	UTIL GEN	12,262	0.006	0	0.000
	28	CREQ	INT ARCH	28,768	0.015	0	0.000
	29	CRIT	ELEC HVAC	564,309	0.298	0	0.000
	31	DSGN	HVAC	1,971	0.001	0	0.000
	32	CRIT	STORM SEWER	17,566	0.009	0	0.000
	33	DSGN	HVAC	1,151	0.001	0	0.000
	34	CRIT	EARTHWORK	118,042	0.062	0	0.000
	36	DSGN	HVAC	746	0.000	0	0.000
	37	UNFO	DEL/IMP (06)	113,000	0.060	0	0.000
	38	UNFO	HVAC	4,906	0.003	0	0.000
	39	DSGN	ELEC	1,217	0.001	0	0.000
	40	CRIT	ELEC	2,547	0.001	0	0.000
	41	DSGN	INT ARCH	962	0.001	0	0.000
	42	DSGN	LANDSCAPE	3,570	0.002	0	0.000
	43	DSGN	HVAC	-6,225	-0.003	0	0.000
	44	UNFO	HVAC	9,199	0.005	0	0.000
	46	CLMR	STRUCT ELEC	51,685	0.027	0	0.000
	47	DSGN	INT ARCH	-42,477	-0.022	0	0.000
	48	DSGN	ELEC	-42,000	-0.022	0	0.000
	49	CLMR	DEL/IMP (06,18,20)	387,000	0.204	0	0.000
			Total:	1,896,595	1.002	257	1.000

UNIT NO: 47 CONTRACT NO: 810800
TITLE/LOC: Family Svc Ctr NAS Corpus Christi TX
BLDG TYPE: OFFC $LD/DY: 65

ORIGINAL COST: 0410900
FINAL COST: 0405052
COST FACTOR: 0.986

ORIGINAL CT: 280
ADDITIONAL CT: 275
FINAL CT: 555
CT DELAY FACTOR: 1.982

FINAL DURATION: 315
LD DAYS: 0
FINAL DF (OCT): 1.125
FINAL DF (FCT): 0.568

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00

ADDITIONAL COST: -5848

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
47	01	DSGN	EARTHWORK	-1,961	0.335	0	0.000
	02	VALE	STRUCT	-1,867	0.319	0	0.000
	03	DSGN	UTIL GEN	-3,000	0.513	0	0.000
	04	DSGN	CARP	-2,277	0.389	0	0.000
	05	DSGN	CARP	688	-0.118	0	0.000
	06	TIME	G0EL SITE	0	0.000	30	0.109
	07	UNFO	HVAC	2,569	-0.439	245	0.891
			Total:	-5,848	0.999	275	1.000

UNIT NO: 48 CONTRACT NO: 810020
TITLE/LOC: Maint Hanger Addition MCAS Beaufort SC
BLDG TYPE: HNGR $LD/DY: 305

ORIGINAL COST: 2457000
FINAL COST: 2930457
COST FACTOR: 1.193

ORIGINAL CT: 360
ADDITIONAL CT: 281
FINAL CT: 641
CT DELAY FACTOR: 1.781

FINAL DURATION: 641
LD DAYS: 0
FINAL DF (OCT): 1.781
FINAL DF (FCT): 1.000

ALLOWED TIME DF: 1.00
LD'S TIME DF: 0.00 ADDITIONAL COST: 473457

CONTRACT CHANGES SUMMARY

#	CHG#	MAJ REAS	SUB REAS	COST	%ADCOST	TIME	%ADCT
48	01	CREQ	UTIL GEN	3,345	0.007	2	0.007
	02	TIME	GDEL SUBM	0	0.000	10	0.036
	03	DSGN	UTIL GAS	-2,252	-0.005	1	0.004
	04	UNFO	FP SYS	1,077	0.002	2	0.007
	05	UNFO	UTIL GEN	9,522	0.020	0	0.000
	06	UNFO	UTIL UG	9,241	0.020	197	0.701
	07	CLMR	ACCELERATION	452,524	0.956	69	0.246
			Total:	473,457	1.000	281	1.001

END

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