



Bulletin No. OT1 Revised  
(Replaces 2005 version)  
File: Overtime

# Bulletin

## How to Estimate the Impacts of Overtime on Labor Productivity

### Introduction

The cost impact of unplanned extended overtime work<sup>1</sup> may exceed the increased costs of the premium pay associated with an overtime work schedule. This impact comes in the form of reduced worker productivity as compared with the productivity of work performed on a straight-time basis. A mechanical contractor confronting significant periods of unplanned extended overtime work must consider the reduced productivity associated with working an overtime schedule.

A number of published studies attempt to quantify the decrease in labor productivity associated with working extended overtime in the construction industry. This chapter will discuss the most frequently cited studies that have been used to quantify overtime labor inefficiency in the construction industry. The chapter also will set forth some general guidelines for a mechanical contractor's consideration in assessing the labor inefficiency impact of unplanned extended overtime. The principles set forth in this chapter can provide meaningful guidance in estimating the loss of labor productivity arising from overtime in the forward pricing of change orders as well as in a retrospective application.

Previous MCAA publications on overtime inefficiency included histograms that depicted loss of labor productivity data based on various overtime schedules. The histograms published in MCAA's Bulletin Nos. 18-A and 20 were based on the 1947 U.S. Department of Labor Bulletin No. 917, a study of prolonged overtime worked in the manufacturing sector. As several courts and commentators have recognized, the 1947 Bulletin No. 917 has limited application in the construction industry.<sup>2</sup> As a result, MCAA Bulletin Nos. 18-A and 20 have now been superseded by this version. This current publication is based on more recent studies that provide a basis of estimating labor inefficiencies utilizing data provided by construction contractors or from quantitative data actually measured on construction projects.

### Background

Often mechanical contractors are directed by an owner or general contractor to accelerate the work for a variety of reasons. Acceleration can be achieved by adding crews, adding shifts, and/or working longer hours over and above 40 hours a week for the primary crew. This latter form of acceleration is known as "overtime," and the direct costs of this process (i.e., the overtime payroll premium costs) are reasonably

easy to compute. However, the indirect effects of working an overtime schedule can be more difficult to quantify. The primary indirect effect of working an overtime schedule is the loss of labor productivity by the workers performing the overtime work. The added cost in terms of the loss of labor productivity may, as noted above, exceed the direct payroll costs of supporting an overtime work schedule. The subject of this chapter is the added inefficiency costs of working overtime. While the MCAA has not prepared an empirical study within this chapter, the better-known overtime inefficiency studies have been revisited herein and compared, thus allowing the contractor to consider several sources of data in one set of tables.

Overtime inefficiency is the most generally accepted category of labor inefficiency within the construction industry. That is true because virtually everyone who has worked extended hours—executives, managers, technical and support personal, as well as the field labor forces—have personally felt the reduced productivity effects of overtime schedules. These effects can include fatigue, increased absenteeism, increased incidence of accidents, reduced morale, and a more negative work attitude.

While many prime contractors and owners may be willing to pay the mechanical contractor's direct cost of overtime if the acceleration was not caused by the mechanical contractor's delay, the mechanical contractor is much more likely to be denied its inefficiency costs for the overtime schedule. It is essential for the mechanical contractor to establish a range of inefficiencies that may arise as a result of embarking on an overtime work schedule such that payment for the direct costs as well as the inefficiency costs can be reimbursed. This chapter

seeks to provide the mechanical contractor with estimated inefficiency rates for various overtime schedules seen most frequently on construction projects. The percent inefficiency values offered herein are reasonable estimates of the inefficiency impacts that can be sustained by mechanical crews working various overtime schedules. The inefficiency percentages are to be applied to *all hours* worked by a crew performing on an overtime schedule and not just the overtime hours.<sup>3</sup>

The construction industry generally uses three terms to describe different overtime scenarios: shutdown or turnaround projects, spot overtime, and extended overtime. Shutdown or turnaround projects are those in which a system or plant is completely shut down for the project duration, and due to the production value of the system or plant, the construction schedule is highly compressed (often working 24/7 with multiple shifts) in order to minimize the duration of the shutdown. These working conditions are clearly understood during the bid/proposal process, and the contractor should include the associated inefficiencies in the mechanical contractor's bid or proposal.<sup>4</sup>

Spot overtime is short in duration (from as little as one day to a week) and is generally not planned in advance—it is usually caused by a delay or other unanticipated event that requires the mechanical contractor to make up quantities or finish work that was not completed during the preceding week.<sup>5</sup> Spot overtime is also normally worked by only a few crews at a time—those responsible for the specific work scope in question. The impact of working periodic and infrequent spot overtime is normally considered negligible in terms of inefficiency effects. As a result, spot overtime is not normally calculated in industry studies that attempt to quantify

the lost labor productivity due to unplanned extended overtime.

Unplanned extended overtime is a condition wherein the entire project, or a significant portion of the project (e.g., all mechanical crews), work an overtime schedule for an extended period of time, sometimes without a planned return to a normal 40-hour week. Experience indicates that a return to a normal 40-hour schedule tends to “reset” the productivity of a crew, such that if the crew returns to an overtime schedule after a week or two of a normal schedule, the productivity loss would “reset” to that of the first week of overtime. Thus, when utilizing any of the data provided herein, it is important to know the work schedule of the crews working overtime. If using a study that shows a progressively increasing loss of productivity over time, should a crew cease overtime and return to a straight time schedule, the crew’s inefficiency upon resuming overtime work must be reset to normal production for the first measured period. Mechanical contractors should ensure that their bid or negotiated proposals clearly state that the base price for the work does not include any overtime, if in fact, no overtime was estimated. If overtime was estimated and its scope exceeds infrequent and limited spot overtime, an inefficiency factor should be included in the price for the work using a prospective estimate of inefficiency described in this chapter.

As previously noted, this chapter does not offer an empirical study based on new overtime loss of productivity data. Rather, this chapter reviews, analyzes, and summarizes four existing studies that have gained recognition in the construction marketplace and have been utilized to prove claims for overtime inefficiency. These studies are:

1) The November 1980 Business

Roundtable publication entitled *Schedule Overtime Effects on Construction Projects* (hereinafter referred to as “BRT”);

- 2) The 1989 study published by the National Electrical Contractors Association (NECA) entitled *Overtime and Productivity in Electrical Construction* (hereinafter referred to as “NECA”);
- 3) The 1997 study published by Dr. H. Randolph Thomas of Penn State University, et al, entitled *Schedule Overtime and Labor Productivity: Quantitative Analysis*, published in the June 1997 *Journal of Engineering and Construction Management*, which was based on data included in a 1994 Report to the Construction Industry Institute entitled *Effects of Scheduled Overtime on Labor Productivity: A Quantitative Analysis* (hereinafter referred to as “Thomas”); and
- 4) The July 1979 United States Army Corps of Engineers publication *Modification Impact Analysis Guide*, Publication No. EP 415-1-3 (hereinafter referred to as “the Corps”).

These studies have been in use in the construction industry for many years and have been generally accepted as reliable measures of lost productivity due to unplanned extended overtime.<sup>6</sup> Each has its strengths and weaknesses, including criticisms ranging from the use of limited data sources to the withdrawal of reports from publication.<sup>7</sup> However, the baseline data in any of these studies have never been proven to be inaccurate. Moreover, the concept that a contractor’s work force becomes less efficient as unplanned extended overtime is worked is generally recognized and has never been disproved as an underlying fact.

The four studies presented in this chapter as a basis for estimating a contractor's loss of labor productivity show striking similarities in their results. These studies and the resulting curves are not offered as precise or exact forecasts of impacts. Rather, they are reasonable guidelines to be used to estimate a loss of labor productivity caused by overtime. The courts and boards of contract appeals have clearly set forth the principle that a contractor does not have to prove its loss of labor productivity with mathematical precision, but can offer a reasonable estimate of its damages.<sup>8</sup> These studies offer just that—a source from which to prepare a reasonable estimate of inefficiency damages arising from unplanned extended overtime.

In some cases a measured mile analysis can be performed that will compute, by use of the contractor's project payroll and field records of installed material, a comprehensive loss of labor productivity comparing actual impacted and non-impacted production on the jobsite. When a measured mile analysis can be performed, such an analysis usually subsumes all types of inefficiency categories on a project. Therefore, if a measured mile labor productivity study is utilized, there is no need for a separate inefficiency analysis for overtime loss of productivity using industry studies.

### **Discussion of the Four Studies**

#### **Business Round Table (BRT)**

The BRT is a study of a Proctor & Gamble construction project that experienced overtime during the course of the work. The BRT has been frequently cited as a reasonable guideline to predict loss of labor productivity. While the BRT is sometimes criticized because it is based on only one project, its critics have not

undermined its underlying data. A positive facet of this study is that its data were based upon payroll records of the workers compared to actual units of material installed on the project by those workers. This study provided overtime loss of productivity data over a 12-week period at various overtime intensity levels and demonstrated that, in general, inefficiency increases as the overtime schedule extends in duration.

#### **National Electrical Contractors Association (NECA)**

NECA provides the user with various overtime models measured over a 16-week period. The underlying data for NECA was gathered by surveying electrical contractors who were members of the association.<sup>9</sup> The survey data was compiled and presented as tables and graphs showing expected overtime productivity losses as "Low," "Average," and "High" for each one-week period. These categories allow the user to factor the weekly inefficiency by gradients defining more precise levels of impacts. For instance, if the contractor had been given substantial notice of the implementation of overtime to allow some pre-planning to lessen the effects of the overtime, the contractor could select a "Low" or "Average" impact. Alternatively, if the overtime schedule imposed upon the contractor created havoc on the project site, or if there was stiff competition for overtime on nearby projects, the contractor could select a "High" impact category. Like BRT, NECA demonstrates decreasing labor productivity as the overtime schedule extends in duration.

#### **Dr. H. Randolph Thomas, P.E. (Thomas)<sup>10</sup>**

Thomas compared various overtime inefficiency data with those independently derived from studies prepared under his supervision. Interestingly, Thomas opined that: "...it

is concluded that the BRT curve is a reasonable estimate of the minimum loss of productivity. For projects experiencing worsening degrees of distress and disruption, the loss of productivity will probably be greater.”<sup>11</sup> Thomas tracked labor inefficiency caused by overtime in the mechanical and electrical trades. In order to attempt to accurately isolate the effects of overtime on labor productivity, Thomas removed projects where overtime occurred at the outset of the work, projects that suffered from adverse labor action, and projects on which there were an “inordinate” number of changes in scope or other conditions that would exacerbate the inefficiencies arising strictly from overtime.

Thomas’ comparative curve utilized in *EP 415-1-3*, which contained the Corps’ overtime study, has never been repudiated by the Army Corps of Engineers, but was withdrawn without any criticism of the underlying data used in the overtime inefficiency graph. Thus, the Corps study and curve are included herein to compare its findings with those of other overtime charts.

### **Presentation of Data**

The following charts present the loss of productivity as determined by the four referenced studies. The loss of productivity is presented in terms of a Productivity Index, or PI, such that

$$PI = \frac{\text{Planned Activity}}{\text{Actual Activity}}$$

where Productivity is in terms of work hours expended per unit of work installed. In this case, a PI of 1.0

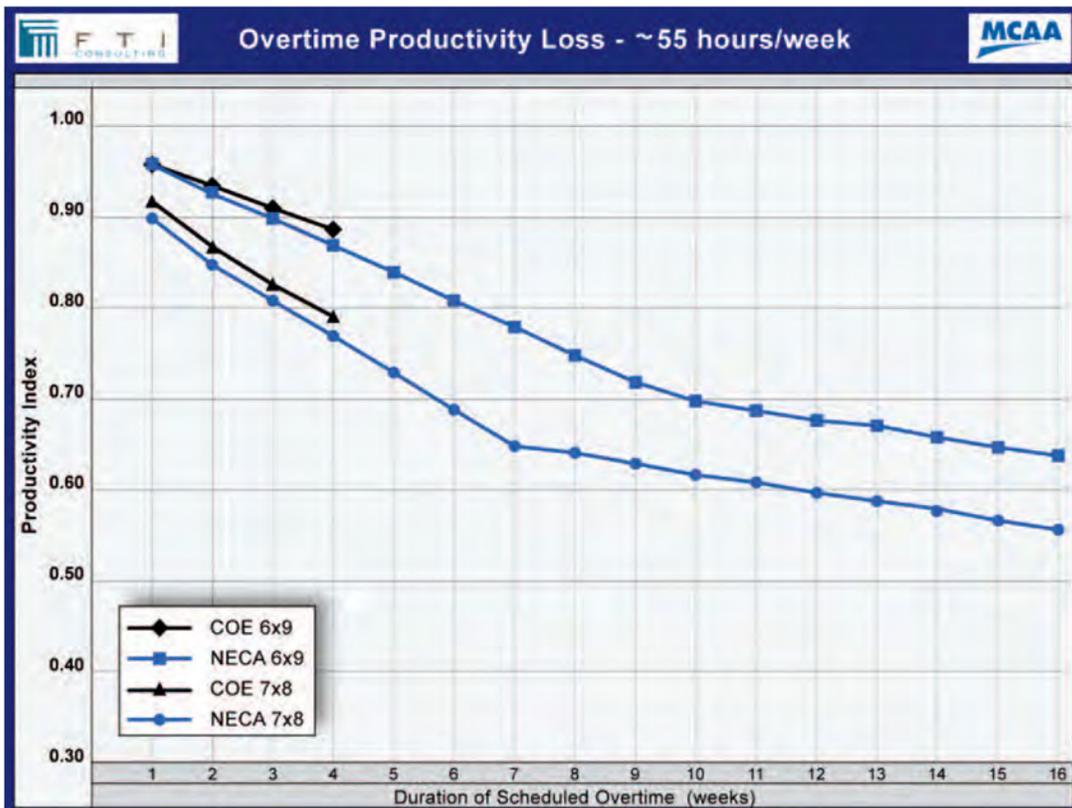
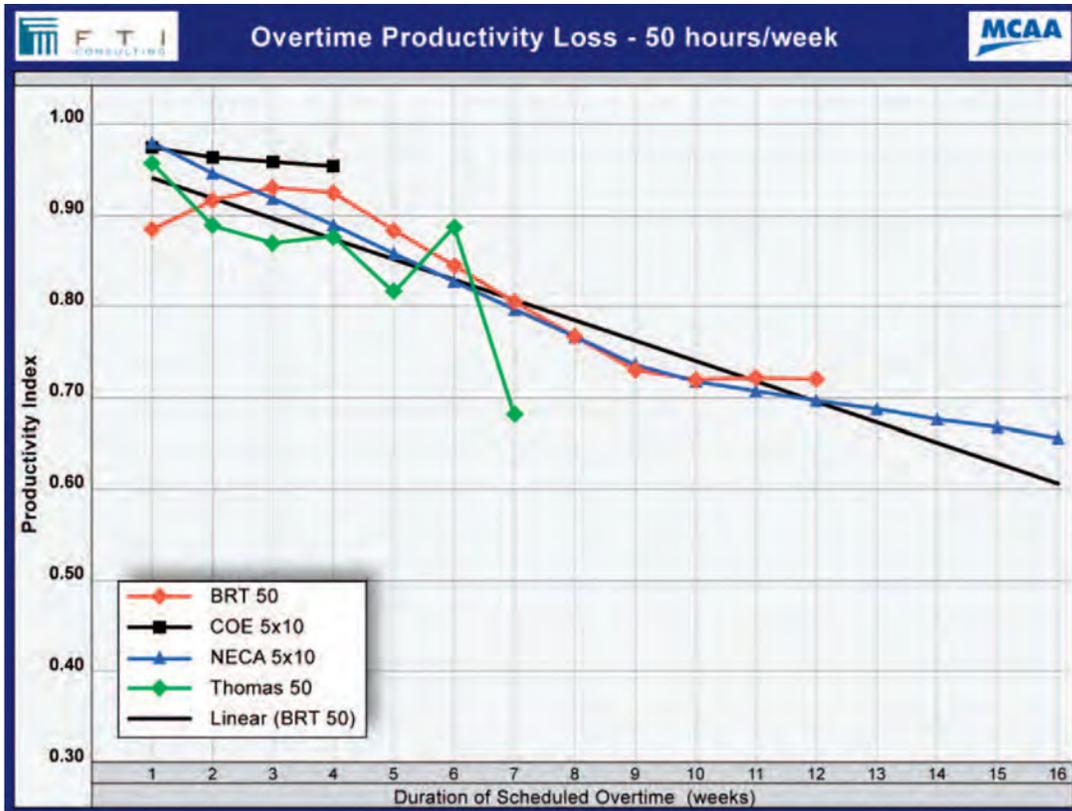
the aforementioned study was based on data collected on the project site by site personnel.

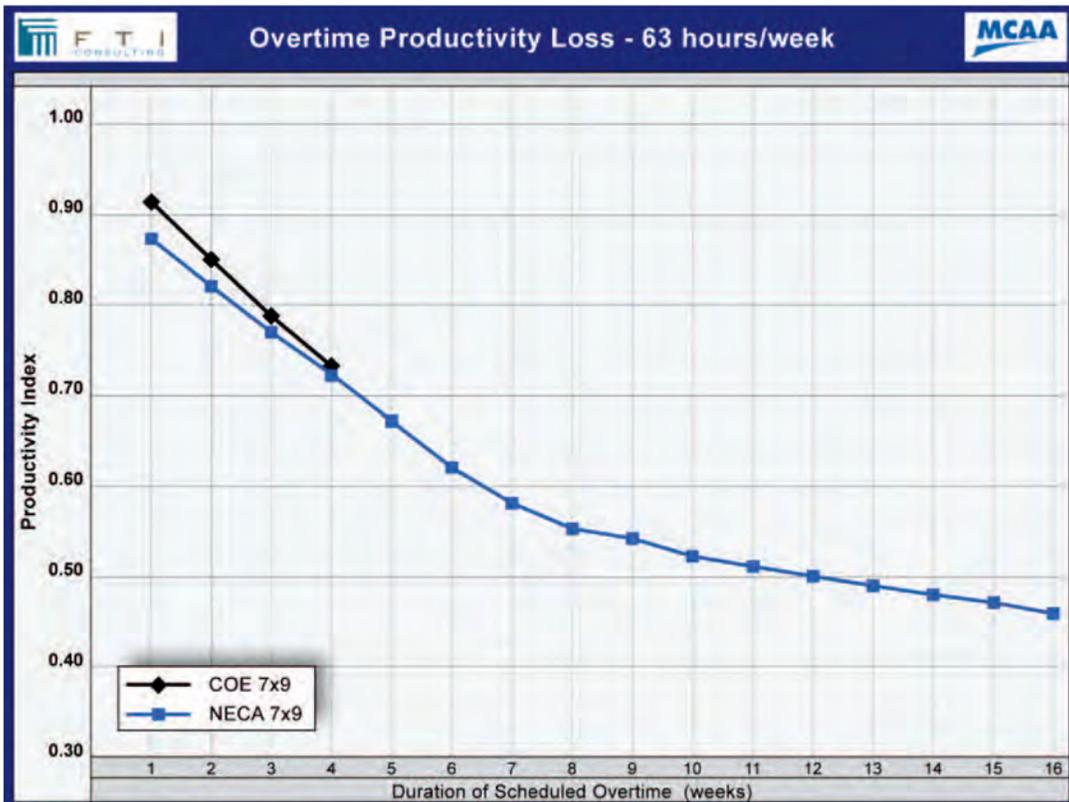
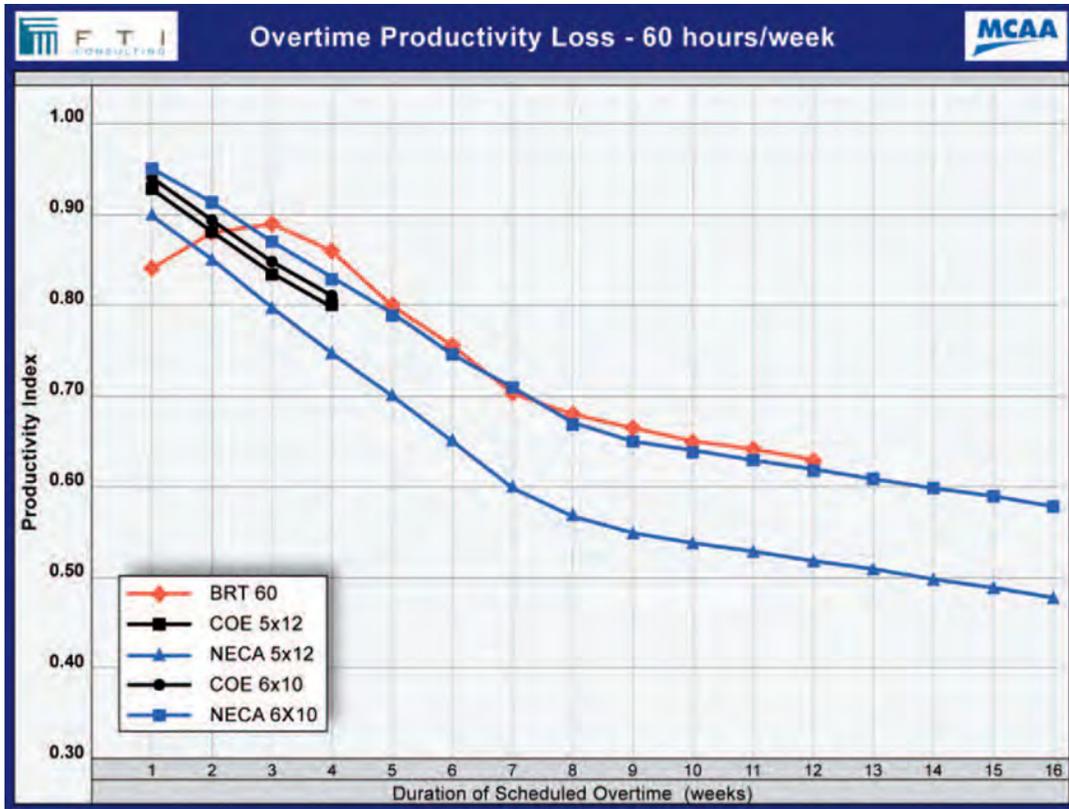
### **The U.S. Army Corps of Engineers (“the Corps”)**

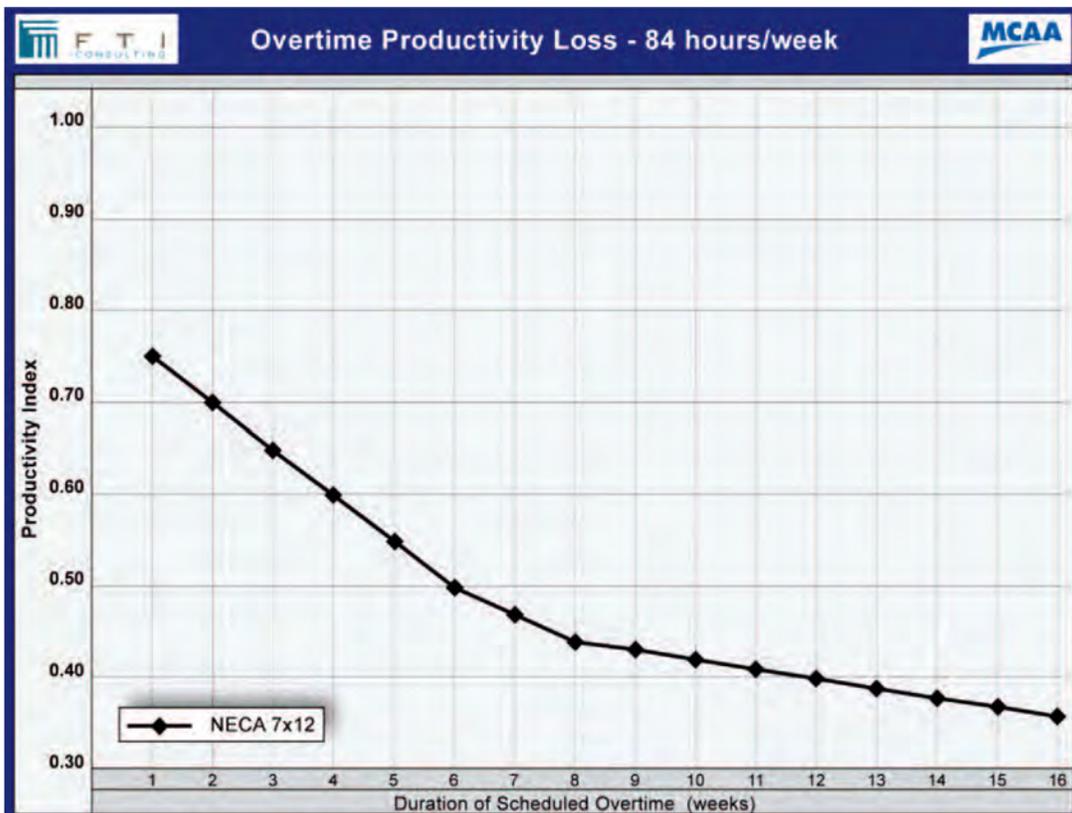
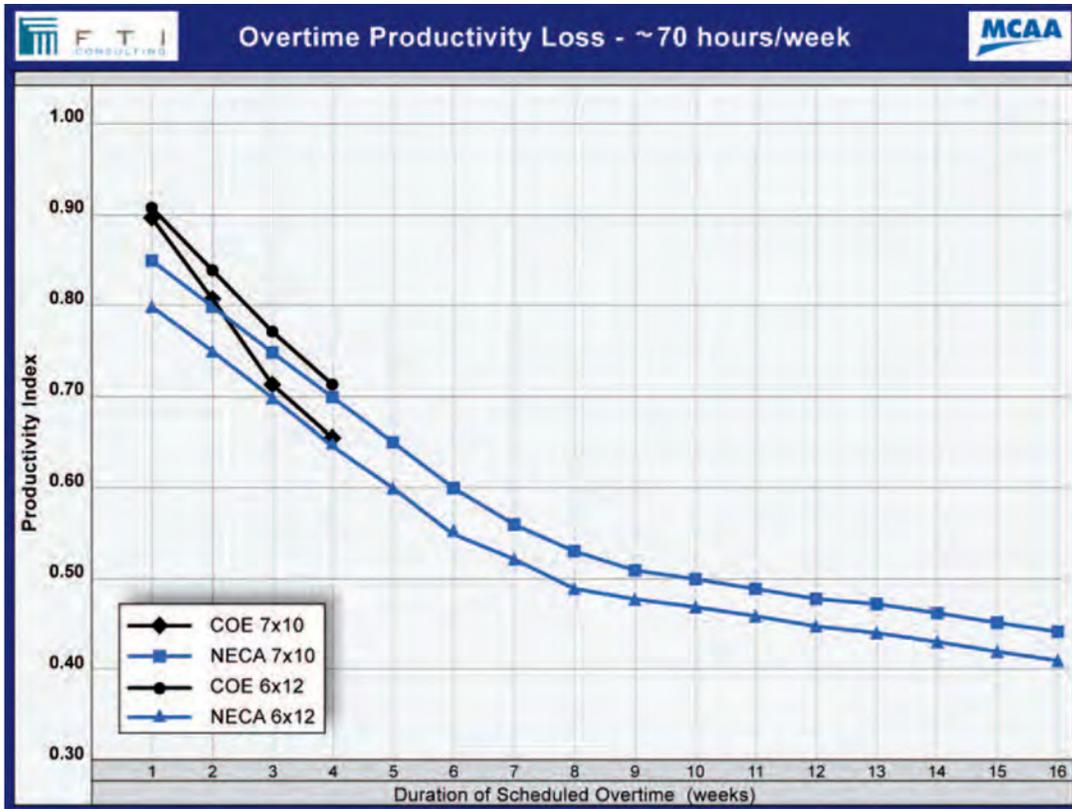
The United States Army Corps of Engineers (“the Corps”) study included an overtime loss of productivity graph showing predicted losses of labor productivity for various work schedules over a four-week period. Similar to the other reports cited herein, the Corps showed declining productivity as the overtime schedule was extended. The Corps’ overtime inefficiency graph was widely used to calculate impact and inefficiency claims until the Corps formally withdrew this publication several years ago for unspecified reasons. It is noteworthy that *Publication* indicates that the actual productivity was equal to the planned productivity; a PI > 1.0 indicates that the actual productivity exceeded (was better than) the planned productivity; and a PI < 1.0 indicates that the actual productivity was less than (worse than) the planned productivity.

In all cases, the PI during a normal 40-hour work week is assumed to be 1.0. The PI during a given overtime schedule is then indicated on the chart over a number of weeks of consecutive overtime. If a chart indicates a PI of 0.90 for a given week, that shows a 10% loss of productivity for that week ( $1.00 - 0.90 = 0.10$ , and  $0.10 \div 1.00 = 10\%$ ).

As noted above, the curves were generally within the same relative order of magnitude. Using the average of the four studies, the table of PI at the bottom of this page was developed.







**Application**

## The Prospective Application

When the period(s) of extended overtime have been determined, the mechanical contractor can find the chart for the applicable work schedule and determine a reasonable range of productivity loss by reading the PI for the given week of consecutive extended overtime and subtracting it from the “normal” value of 1.0. For instance, a PI of 0.60 equates to a inefficiency estimate of 40% ( $1.00 - 0.60 = .40 \times 100\% = 40\%$ ). In a *prospective*, or forward priced analysis, the resulting percentage of productivity loss is multiplied against the estimated number of hours to be worked during that week

to identify the estimated impact of working extended overtime. In a *retrospective* analysis (i.e., an analysis prepared after the fact using actual labor hours), the formula for computing a conservative inefficiency estimate is discussed in a following subsection.

As described herein, the NECA tables list three impact intensity levels for each overtime schedule: “Low,” “Average,” and “High.” For the PI values shown in the following table, the “Average” values listed in the NECA tables were utilized. Where two different work weeks resulted in the same number of total hours (e.g., a 60-hour work week resulting from a 12-hour per day five-day schedule versus a 10-hour per day six-day schedule), the PI values derived from the source data were averaged between the two working schedules. Further, from weeks 13 through 16, only the NECA PI values were available.

When inefficiency factors are applied to estimated hours in a forward priced or prospective analysis, the user multiplies the factor percentage against the estimated hours for the overtime and for the straight time worked by the overtime crews. For instance, if a contractor expects to work a 50-hour work week with 25 mechanics for five weeks, the computation appears in the forward

Week of Extended OT	50 hrs/wk	54-56 hrs/wk	60 hrs/wk	63 hrs/wk	70-72 hrs/wk	84 hrs/wk
1	0.95	0.94	0.91	0.89	0.86	0.75
2	0.93	0.90	0.88	0.84	0.80	0.70
3	0.92	0.86	0.85	0.78	0.73	0.65
4	0.91	0.83	0.81	0.73	0.68	0.60
5	0.85	0.79	0.76	0.67	0.63	0.55
6	0.86	0.75	0.72	0.62	0.58	0.50
7	0.76	0.72	0.67	0.58	0.54	0.47
8	0.77	0.70	0.64	0.55	0.51	0.44
9	0.74	0.68	0.62	0.54	0.50	0.43
10	0.72	0.66	0.61	0.52	0.49	0.42
11	0.72	0.65	0.60	0.51	0.48	0.41
12	0.71	0.64	0.59	0.50	0.47	0.40
13	0.69	0.63	0.56	0.49	0.46	0.39
14	0.68	0.62	0.55	0.48	0.45	0.38
15	0.67	0.61	0.54	0.47	0.44	0.37
16	0.66	0.60	0.53	0.46	0.43	0.36

**FORWARD PRICING TABLE**

Week Ending	Act Hrs Worked	# Mechanics working over 40 hrs	Total Hours Subject to Loss Productivity	Loss (pct) from 5/10 Table	Inefficient Hours
6-Feb-10	50	25	1,250	5%	63
13-Feb-10	50	25	1,250	7%	88
20-Feb-10	50	25	1,250	8%	100
27-Feb-10	50	25	1,250	9%	113
6-Mar-10	50	25	1,250	15%	188
TOTAL					552

pricing table above.

Based on a forward priced, or prospective, estimate of overtime inefficiency, the contractor would request compensation for 552 labor hours of lost labor productivity.

**The Retrospective Application**

Retrospective analyses are performed after the overtime hours have been spent. For a retrospective example, let us assume that a contractor was directed to put its mechanical crews on overtime during construction of a

processing plant. The contractor's planned working hours were a 40-hour week, and in an effort to maintain schedule the contractor placed the mechanical crews on a five-day 10-hour shift over an 11-week period. In calculating the retrospective (performed after the fact) loss due to unplanned extended overtime, the contractor should apply the formula and procedures described below.

Most inefficiency tables, such as the

MCAA's labor inefficiency factors, were prepared with the anticipation that these factors would be applied to forward-priced change order requests.<sup>12</sup> Thus, the percent inefficiency factor would be utilized as a multiplier against the estimated hours to provide the forecast loss of productivity. However, when using tables and factors in a retrospective manner (i.e., applying these factor percentages to actual payroll hours), an adjustment must be made in order to eliminate overstating

the inefficient hours. The use of the retrospective formula adjusts for the fact that the inefficient hours are already embedded within the actual labor hours used in the retrospective computation. Multiplying the inefficiency factor against the actual hours that also include the inefficient hours results in an overstatement of the estimated inefficiency.

- 1) Identify the individual craft persons who worked unplanned extended overtime.**

The contractor's payroll records should identify those individual craft labor who worked at least 50 hours a week during the period of unplanned overtime. It

should not be assumed that every worker recorded on the daily craft report actually worked overtime during a given week. Note that the number of workers working over 40 hours declines with each successive week, indicating that some members of the crew did not work 50 hours. The result of such a calculation is shown in the table below.

Note that when the crew moved back to the normal 40-hour week, the "OT week clock" started over at Week 1 on March 27, 2010, and no hours were subject to any lost efficiency in the preceding two weeks. This was due to the fact that the crew was able to recover during the normal work weeks ending March 13 and 20. Thus, when overtime work resumed for the week ending March 27, 2010, the "Week 1" percentages were utilized.

**2) Apply the applicable percentage tables above for the applicable overtime period (in this case 5/10s) to the craft hours subject to lost productivity due to unplanned extended overtime using the *retrospective* formula.**

In this retrospective example using actual payroll data, the result is as shown in the table at the top of the following page.

In this example, the contractor lost 748 craft hours due to working unplanned extended overtime caused by the attendant overtime inefficiency over an 11-week period using a retrospective analysis approach. In order to produce a conservative inefficiency estimate, it is recommended that when actual labor payroll hours are used, as would be the case in a retrospective analysis, the retrospective formula should be utilized, as described below.

OT Week	Week Ending	Hrs Worked	Mechanics Working Over 40 hrs	Total Hrs Subject to Lost Productivity
Week 1	6-Feb-10	50	25	1,250
Week 2	13-Feb-10	50	24	1,200
Week 3	20-Feb-10	50	22	1,100
Week 4	27-Feb-10	50	22	1,100
Week 5	6-Mar-10	50	21	1,050
No OT	13-Mar-10	40	0	0
No OT	20-Mar-10	40	0	0
Week 1	27-Mar-10	50	25	1,250
Week 2	3-Apr-10	50	23	1,150
Week 3	10-Apr-10	50	23	1,150
Week 4	17-Apr-10	50	20	1,000

## RETROSPECTIVE PRICING TABLE

Week Ending	Act Hrs Worked	# Mechanics working over 40 hrs	Total Hours Subject to Loss of Productivity	Loss (pct) from 5/10 Table	Inefficient Hours
6-Feb-10	50	25	1,250	5%	59
13-Feb-10	50	24	1,200	7%	78
20-Feb-10	50	22	1,100	8%	81
27-Feb-10	50	22	1,100	9%	91
6-Mar-10	50	21	1,050	15%	137
13-Mar-10	40	0	0	0%	0
20-Mar-10	40	0	0	0%	0
27-Mar-10	50	25	1,250	5%	59
3-Apr-10	50	23	1,150	7%	75
10-Apr-10	50	23	1,150	8%	85
17-Apr-10	50	20	1,000	9%	83
TOTAL					748

The retrospective formula appears as: actual labor hours - (actual labor hours ÷ (1 + the percent inefficiency factor)), or as an example from the table above: 1,250 - (1,250 ÷ 1.05) = the inefficient hours, or 1,250 - 1,191 [the *efficient* hours] = 59 inefficient hours in a retrospective analysis. This formula solves for the efficient hours [1,191] in the equation and then allows the user to subtract the efficient hours from the total, yielding the inefficient hours [59].

### Preparation of the Request for Equitable Adjustment

It is not unusual for a general contractor or owner to request that a mechanical contractor provide a prospective cost proposal to accelerate a construction project. However, such requests are often limited to the added payroll costs attendant to the overtime schedule. When a mechanical contractor is asked to submit a proposal to engage in overtime on a prospective basis, the attendant estimated labor inefficiencies must be added to the direct payroll costs of the overtime schedule.

Thus, in cases where a mechanical contractor is asked to forward price an overtime change order request, both the direct payroll and the inefficiencies should be included. The content of this chapter provides the guidelines for forward pricing an overtime-inefficiency change order request. In cases where the extent of the overtime is unknown, the mechanical contractor, at a minimum, should include an express reservations clause in the change order proposal.

For example:

This change order proposal represents the direct additional payroll costs arising from the requested overtime schedule. No overtime inefficiencies are included in this proposal. Amalgamated Mechanical Contractors expressly reserves its rights to request compensation for labor efficiencies attendant to the requested overtime schedule. A revision to this change order proposal containing the costs for overtime labor inefficiencies will

be forwarded for processing as soon as these costs can be computed. We estimate that the labor inefficiencies arising from this overtime schedule will not be less than \_\_\_\_%.<sup>13</sup>

There may be occasions when the general contractor or owner denies the opportunity to supplement a change order request based on future events. Such prohibitions also may be a part of the contract or printed on the change order forms themselves as “full accord and satisfaction” clauses. If the mechanical contractor is prohibited from submitting supplemental change order requests, such as for labor inefficiencies arising from an overtime schedule, then forward pricing of the overtime inefficiencies may be the only option.

For example:

The overtime pricing contained herein includes the added payroll costs for the overtime schedule provided by your office. Furthermore, this change order proposal contains a loss of labor productivity estimate based on the overtime schedule that we have received from your firm. The proposed overtime schedule provided by your office is the basis of our estimate for direct and inefficiency costs associated with this change order request.

Amalgamated Mechanical Contractors expressly reserves the right to submit a separate change order proposal in the event the overtime schedule changes in any manner from that upon which we have relied in the pricing of this proposed change order.

It is recommended that the forward-priced (prospective) overtime change order request be treated, to the fullest extent possible, in the same manner as a “sticks and bricks” change would be priced. In a “sticks and bricks” change

order request, the contractor takes off pipe, fittings, and appurtenances based on a scope of added work provided by the general contractor or owner. The labor is derived there from and the final pricing is added to the change order proposal.

In like fashion to the fullest extent possible, overtime change order requests should be based on a fixed scope. A fixed scope means that the general contractor or owner will provide the mechanical contractor with the number of days of overtime and the number of hours per day that are to be worked in order to form a basis for the forward-priced change order. Once the fixed scope is known, then the mechanical contractor can estimate the added payroll costs and the expected loss of labor productivity using the tables included herein. The tables refer only to estimated overtime inefficiency and do not include inefficiencies arising from other categories of impacts, such as unanticipated trade stacking, reassignment of manpower (“disruption”), lack of site access, or other inefficiency factors. Refer to the chapter titled “How to Use the MCAA Labor Factors” for a more complete listing of potential inefficiency factors to consider when preparing a change order request or a claim.

In summary, it is essential that the mechanical contractor define, in its proposal, what costs are and are not included in its overtime change order request. Obviously, if the general contractor or owner direct an overtime acceleration effort without a requirement for a prospective change order proposal, and with only the requirement to provide the proof of overtime payroll costs for reimbursement, the mechanical contractor must make it clear that in addition to the actual payroll costs, a request for reimbursement of its overtime inefficiency costs will be

submitted for payment.

## Conclusions

A sustained and unplanned overtime schedule can result in a substantial loss of labor productivity. The mechanical contractor may be entitled to recover the associated costs, in addition to the direct overtime premium payroll costs. The current available data on inefficiency resulting from unplanned extended overtime, when properly utilized, provide the mechanical contractor with a reasonable basis to estimate such losses in either the prospective or forward pricing of an original estimate or a scope change, or in a retrospective application. The inefficiency factor will vary depending on the amount of overtime to be performed, the number of mechanics required, and the duration of the unplanned extended overtime. Additionally, other inefficiency factors may occur simultaneously, such as stacking of trades, reassignment of manpower, or site access restrictions. Such additional impacts can be separately estimated using the MCAA inefficiency factors described in this manual.<sup>14</sup>

Crew considerations also can affect overtime inefficiency levels. Such considerations include whether or not to place the entire crew on over time even if only a definable portion of the work requires acceleration (i.e., the critical path activities), whether or not rest intervals can be interspersed into the overtime schedule to allow for one or more weeks of straight time work, or whether certain activities that would be subject to overtime acceleration can be scheduled for a second-shift crew. These sorts of considerations are made on a project-specific basis and can affect the amount of inefficiency sustained by a mechanical contractor resulting from performing the work on an overtime schedule.

Mechanical contractors should not accelerate to mitigate schedule slippage that was not caused by the mechanical contractor's fault or negligence on a *voluntary* basis. If a mechanical contractor is directed by a general contractor or owner to accelerate the work by commencing an extended overtime work schedule in order to overcome delays not caused by the mechanical contractor, a specific notice is necessary. While most construction contracts contain provisions that require the mechanical contractor to follow the direction of a general contractor or owner to accelerate the work,<sup>15</sup> such direction and the ensuing acceleration must be accompanied by clear and timely notice that includes a statement that the mechanical contractor is proceeding under protest and that a claim will be filed for reimbursement of all costs as soon as those costs can be computed. If a mechanical contractor is placed in a position of *constructively accelerating*<sup>16</sup> a project to overcome delay that has not been caused by the acts or omissions of the mechanical contractor, the review of these conditions by the contractor's upper management and counsel is highly advisable.

A schedule time impact analysis may be an essential factor in demonstrating that the mechanical contractor is not critically delaying a project. This is important in properly deflecting responsibility for the costs of acceleration in that the party controlling the critical path in a delayed schedule is usually the party that is found responsible for the costs to mitigate the delay. One primary means of delay mitigation is overtime. If the mechanical contractor is being charged with the acceleration costs, or the payment for the direct and indirect costs of acceleration are being withheld on the basis that the mechanical contractor was the responsible party, the contractor can employ a schedule time

impact analysis to identify the party causing the critical path delay.

A schedule analysis also may be helpful in demonstrating, to the extent that the mechanical contractor's activities are not controlling the critical path of the current project schedule, that overtime demanded by a general contractor or owner will have no mitigating effect on the forecast end date of the project. It is an accepted axiom of construction Critical Path Method (CPM) scheduling that reducing the duration (i.e., by way of overtime acceleration) of a path of logic that does not control the critical path has no effect whatsoever on the end date of the overall project. Put another way, the end date of a CPM schedule can only be foreshortened by accelerating work on the controlling critical path. If the mechanical contractor can demonstrate that its work is not on, or even near, the controlling critical path, accelerating those non-critical activities will have no mitigating effects on a project that is behind schedule and will represent potentially substantial economic waste.

The mechanical contractor should clearly note in its bid or change order proposal whether or not overtime has been included in its lump-sum pricing, and if so, to what extent it was included. If a contractor includes extended periods of overtime in a lump-sum bid or change proposal, the attendant loss of labor productivity should be evaluated and if deemed appropriate, the costs should be included in the lump-sum price for the work. At a minimum, the contractor's right to claim for such cost impacts should be preserved.

Preservation of the contractor's right to be reimbursed for its overtime inefficiency costs, on projects where the other party refuses to pay for such overtime inefficiency costs, is of paramount importance. As described in

greater detail in the chapter on "Time Impact Analysis—Measuring Project Delay," many general contractors and owners are including broad waiver language on change order forms and on the monthly payment applications. The contractor should take great care to limit this waiver language to matters that it deems have been settled and take express exception to each unsettled item, such as a pending inefficiency claim.

Overtime inefficiency costs for extended periods of unanticipated overtime may exceed the payroll costs of overtime premium. The mechanical contractor should employ every reasonable management tool including issuing proper and timely notice, keeping comprehensive records, performing schedule analyses, taking exception to broad waiver language, and timely submittal of change order requests to help ensure that the contractor's right to recover all of its overtime costs are preserved and that payment will be forthcoming.

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<sup>1</sup> We are unaware of any data showing the difference in impact, if any, between "planned" and "unplanned" overtime. Generally, planned overtime has been included in the base contract estimate and was accounted for in the baseline CPM schedule. Unplanned overtime, which is the subject of this chapter, occurs when no overtime, or only very limited overtime for equipment setting or start-up tasks, was contemplated under the terms of the base contract and is implemented during the course of construction.

<sup>2</sup> See, e.g. *Appeal of J.A. Jones Constr. Co.*, 00-2 BCA ¶ 31000, ENGBCA Nos. 6386, 6387, 6390; 2000 WL 1044011 (Eng. BCA 2000) ("The study itself states that it was based upon prolonged overtime schedules in manufacturing plants and that it may not be applicable to construction projects.")

<sup>3</sup> The well-accepted axiom is that the inefficiency effects of overtime affect the

worker while he or she works the straight-time schedule as well as the overtime schedule.

<sup>4</sup> Similarly, on a non-overtime-based project estimate, the mechanical contractor should qualify in its bidding documents if the bid excludes overtime work.

<sup>5</sup> The delay or event causing the mechanical contractor to engage in spot overtime may not arise from the fault or negligence of the mechanical contractor. For instance, the mechanical crews may be required to work spot overtime installing sleeves in slab pours because the concrete contractor was delayed and was required to accelerate, thus requiring the sleeving crew to work alongside on an overtime basis.

<sup>6</sup> See, e.g., *Ace Constructors v. United States*, 70 Fed.Cl. 253, 281-283 (Cl.Ct. 2006), *aff'd*, 499 F.3d 1357 (Fed.Cir. 2007)(contractor entitled to recover lost productivity due to overtime based on BRT); *Appeal of Harbison & Mahony*, 68-1 BCA ¶ 6880, ENGBCA Nos. 2819, 2820, 1968 WL 436 (Eng. BCA 1968)(allowing claim for overtime inefficiency based on NECA); *Appeal of States Roofing Co.*, 10-1 BCA ¶ 34356, ASBCA No. 54860, 2010 WL 292732 (ASBCA 2010)(Thomas study recognized); *Appeal of Sante Fe Engineers, Inc.*, 86-3 BCA P 19092, ASBCA No. 29362, ASBCA No. 28058, 1986 WL 20062 (ASBCA 1986), *aff'd*, 818 F.2d 856 (Fed.Cir. 1986)(allowing inefficiency claim using the Corps study).

<sup>7</sup> See, e.g., *Hensel Phelps Const. Co. v. General Services Admin*, 01 BCA ¶ 31249, GSBCA No. 14744, GSBCA No. 14877, 2001 WL 43961 (General Services BCA 2001)(“the Modification Impact Evaluation Guide of the Corps of Engineers is not recognized by GSA and, indeed, no longer used by the Corps.”) While the Corps has removed its *Modification Impact Evaluation Guide* EP 415-1-3 from publication, it has not repudiated any of the data contained in that publication.

<sup>8</sup> See, e.g., B.Bramble, et al, *Construction Delay Claims*, §5.07, p. 5-53(3d ed. 2000) (“Where the damages are directly attributable to the breach, they are often recoverable even though they are uncertain

in amount. ‘Thus, courts have recognized that a plaintiff may recover even where it is apparent that the quantum of damage is unavoidably uncertain...or difficult to ascertain.’ The courts have recognized that ascertainment of damages, especially lost productivity, is not an exact science. When the responsibility for damages is proven, it is not essential that the amount of damages be ‘ascertainable with absolute exactness or mathematical precision.’” (and cases cited therein).

<sup>9</sup> It is a generally accepted axiom in the construction industry that inefficiency impacts sustained by the mechanical trades are similar in nature to the inefficiency impacts sustained by the electrical trades given reasonably comparative adverse conditions.

<sup>10</sup> Dr. H. Randolph Thomas, P.E. is a professor of civil engineering at Penn State University, author or co-author of a series of well recognized published papers on labor inefficiency, and frequent expert witness on the subjects of labor productivity and construction management.

<sup>11</sup> Thomas, et al, “Scheduled Overtime and Labor Productivity: Quantitative Analysis” *Journal of Construction Engineering and Management*, June 1997.

<sup>12</sup> As a conservative approach, it has been assumed that the NECA overtime tables, as well as other published tables designed for use as forward-pricing guides, require the use of the retrospective formula when applying such factors to actual labor hours.

<sup>13</sup> The estimated inefficiency percent can be derived from the data and tables contained in this chapter.

<sup>14</sup> The “Overtime” component (Item No. 15) listed on the MCAA inefficiency factors table in the chapter on “Factors Affecting Labor Productivity” herein was designed to give general guidance in forward-pricing overtime inefficiency. It is recommended that the more specific estimates of impacts contained in this chapter be applied to overtime inefficiency analyses due simply to the increased level of specificity offered by the studies and tables contained in this

chapter.

<sup>15</sup> A subcontractor's refusal to comply with an acceleration directive provided by a general contractor or owner, in the presence of contractual authority to issue such a directive, may result in a termination for default. Before a direct, contractually proper acceleration order from a general contractor or owner is disregarded, the mechanical contractor should consult with construction counsel to evaluate the various courses of action.

<sup>16</sup> *Constructive acceleration* is a condition wherein a contractor is directed to accelerate to mitigate a delay not caused by the contractor at no additional cost. In anticipation of a claim to recover the costs of the constructive acceleration, the contractor takes express exception to the acceleration directive, provides notice of a claim, and then executes the acceleration as directed. The submission of the claim for added costs occurs as soon as the contractor can compute the added costs either while the acceleration is taking place, or after the acceleration has concluded. The steps that should be taken to perfect a constructive acceleration claim are best set forth by the contractor's counsel.

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