How Much Does Overtime Really Cost?

INTRODUCTION

It has become well-recognized that the costs of overtime are far higher than the extra wage rates, calculated on a one and one-half or double time basis. In instances where a schedule of 60 hours a week continues for more than about two months, productivity plunges so dramatically that the project completion date stretches beyond what it would have been with the same crew working a 40-hour week. Absenteeism increases, injuries rise, and as much as twice the time may be taken to do a normal hour of work. (See Guideline on Overtime, Construction Costs and Productivity at http://www.constructionguidelines.org/pdf-prot/OVERTIME_PDF).

The guideline cited above noted that “studies on productivity losses due to prolonged overtime conducted by the Bureau of Labor Statistics of the U.S. Department of Labor, the Procter and Gamble Company, the Business Roundtable, the National Electrical Contractors Association, and the Mechanical Contractors Association of America produced similar results. All showed that continuing scheduled overtime has a strong negative effect on productivity which increases in magnitude proportionate to the amount and duration of overtime. Abandonment of the overtime schedule appears to be the only effective remedy. Construction projects in which prolonged overtime occurs also disrupt the economy of an area by creating a “bidding” atmosphere, whereby other projects are forced to go on overtime to retain their labor (See Figure 1).

EFFECT ON WORKERS AND PROJECTS

Overtime has been shown to lower both work output and efficiency through physical fatigue and poor mental attitude. Proving that overtime has caused a decrease in productivity could help contractors recoup losses incurred in running a job at less than normal standards of work output.

Studies made in this country and abroad on physical and psychological slowdown due to overwork reveal that each individual has a fixed number of “energy units,” which he or she is able and willing to devote to a job each day. Workers automatically, and quite unconsciously, adjust their pace to expend that full quota of energy units over the total number of hours worked. For example, assume a worker is capable of expending 12 units in the course of a day. Some energy is devoted to output producing activities. Other energy is consumed by merely being present on the job, walking, standing, sitting, etc., regardless of
whether productivity is being achieved or not.

A PERIOD OF READINGJUSTMENT

To illustrate, if a worker is on the job for 8 hours—assuming 12 energy units—8 are consumed productively and 4 are dissipated in nonproductive activity. When the same worker is on the 10-hour job, 5 units will be consumed unproductively. This leaves only 7 units of productive activity. Thus, according to the studies, less productivity will be incurred in 10 hours than in 8.

Studies also point out that upon return to shorter hours, several days will be needed for workers to readjust their pace and output rate. In other words, they will continue productive output at the slower 10-hour rate, even though they have returned to an 8-hour schedule. Furthermore, a worker called upon to work on a 10-hour, instead of an 8-hour, shift is likely to work at a rate adapted to the 10-hour period. This would happen not only on longer work days, but all the time. For this reason, when overtime is anticipated, it is advisable to spread it out evenly throughout the week rather than concentrating it all in one- or two-day periods.

ECONOMIC FACTORS

Whatever the number of hours normally worked—even if they are reduced to 36 a week—overtime has one dangerous effect: the balance between output and hours of work is upset. Overtime has a gradually increasing effect on such efficiency “killers” as fatigue and attitude. It may take a worker a long time to regain equilibrium.

How does this phenomenon affect mechanical contractors? Where does it hurt them the most? The obvious answer is that the real cost of overtime is far more considerable than the immediate hours worked. Therefore, when mechanical contractors enter into contracts that provide reimbursement for only a net dollar cost of any overtime required, they are losing money. The loss occurs through reduction of labor productivity, both on the overtime period itself and on the normal hours or days immediately following such overtime.

A CASE IN POINT

To strengthen his position in justifying a request for additional compensation on future contracts, a Midwestern mechanical contractor used a graphic composite analysis, which dramatically illustrates the full impact of the efficiency loss under various conditions (see Figure 2). According to a Bureau of Labor Statistics official, the study was conducted during and immediately after World War II, but “the findings on the relation between various types of daily and weekly schedules of hours and output and absenteeism are probably still valid.”

Using the chart, the contractor was able to file a claim, justifying his demand for $140,000 additional compensation on one single project.

LOSS OF EFFICIENCY CLAUSE

Since then, the contractor includes a “loss of efficiency” clause in his contracts. This clause reads:

“The noted price (labor cost) is based on all work being performed on a straight time basis. Should overtime be required to compete with other local projects in order to attract sufficient manpower, these overtime hours, interpreted as all hours worked, shall be invoiced at cost, plus a loss of efficiency factor of 17 percent, based on a schedule of
six 10-hour days; and 28 percent, based on seven 12-hour days.”

This clause was used only for scheduled overtime, not “spot” overtime. The efficiency factor varies, depending upon the predetermined amount of overtime work to be performed, the number of men required, and the deadline set for completion of a given project. However, the basis for that factor remains constant, as shown by the curves on the chart.

PRACTICAL CONSIDERATIONS

Overtime cannot be eliminated. However, the cost of operating beyond scheduled overtime periods can be compensated. This can be achieved by:

- Understanding the relationship between overtime and inefficiency
- Insisting that contracts include a clause providing for compensation based on an inefficiency factor
- Applying the inefficiency factor to bare labor costs only and appropriate factors for payroll taxes and insurance
- Adding overhead and profit

Inclusion of a standardized clause, similar to the one mentioned above, should offer some relief to contractors who either foresee or are actually engaged in extensive overtime work on any project.

Reliable studies prove that the inefficiency factor in any given overtime period more than offsets a worker’s productivity. The studies also prove that money is lost during the course of a job unless that factor is taken into account as the contract is being written.

Attached are examples of the relationship between overtime and the increasing ratio of inefficiency during consecutive overtime periods (Figure 3). Tables for calculation of premium time and inefficiency on overtime work are also shown (Tables 1 and 2).
Figure 1

Cumulative Effect of Overtime on Productivity—50 & 60 Hour Workweeks

Cumulative Cost of Overtime—Successive Weeks Productivity Loss Plus Overtime Reruns

Effect of Premium Pay for Overtime on Cost of Labor
Figure 2

Schedule of Efficiency Loss for Various Lengths of Workweeks

This chart was drawn with information compiled from statistics contained in Bureau of Labor Statistics Bulletin No. 917 entitled "Hours of Work and Output."

Editor's Note: The data shown in Figure 2 were derived from a 1947 publication of the Bureau of Labor Statistics, Bulletin No. 917. While these inefficiency percentages have been used for decades by contractors preparing estimates of inefficiencies arising from overtime, there are other, more recent and broadly based studies that have been published on this subject. As such, the user should review other studies on overtime inefficiencies and consider which data best represents the user's inefficiency impacts.

The Bureau of Labor Statistics inefficiency percentages arising from working overtime found in Figure 2 have been transferred into column D within Tables 1 and 2 (page 4 of this insert). The inefficiency percentages shown in column D are then used in the application examples contained in pages 94–96 of this publication. The user may elect to apply an inefficiency percentage derived from a different industry study than the Bureau of Labor Statistics Bulletin No. 917. In such cases, the user may simply replace the percent value identified as "inefficiency" in each example with a percent "inefficiency" derived from a different study or curve. The methodology of computing the inefficiency and premium costs shown in the examples remains unchanged.
Editor's Note: The U.S. Army Corps of Engineers has formally withdrawn its publication entitled “Modification Impact Evaluation Guide” EP 415-1-3. However the graphs and charts contained in the publication have not been repudiated or found to be unreliable. The user should compare the data contained in Figure 3 with other industry studies on overtime inefficiency to determine the usefulness and applicability of the forecast inefficiency percentages contained in Figure 3.
### Table 1
**Calculation Table of Premium Time and Inefficiency on Overtime Work—Overtime Multiplier (1-1/2 Time)**

<table>
<thead>
<tr>
<th>Hours</th>
<th>Hours Work (A)</th>
<th>Hours Pay (B)</th>
<th>Overtime (C)</th>
<th>Inefficiency (D)</th>
<th>Multiplier of Str. Time (E)</th>
<th>Premium &amp; Ineff. Factor (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5–9</td>
<td>45</td>
<td>47.50</td>
<td>1.06</td>
<td>5%</td>
<td>1.12</td>
<td>.12</td>
</tr>
<tr>
<td>5–10</td>
<td>50</td>
<td>55.00</td>
<td>1.10</td>
<td>8%</td>
<td>1.20</td>
<td>.20</td>
</tr>
<tr>
<td>5–11</td>
<td>55</td>
<td>62.50</td>
<td>1.14</td>
<td>11%</td>
<td>1.28</td>
<td>.28</td>
</tr>
<tr>
<td>5–12</td>
<td>60</td>
<td>70.00</td>
<td>1.17</td>
<td>14%</td>
<td>1.36</td>
<td>.36</td>
</tr>
<tr>
<td>6–8</td>
<td>48</td>
<td>52.00</td>
<td>1.08</td>
<td>3-1/3%</td>
<td>1.12</td>
<td>.12</td>
</tr>
<tr>
<td>6–9</td>
<td>54</td>
<td>61.00</td>
<td>1.13</td>
<td>13%</td>
<td>1.30</td>
<td>.30</td>
</tr>
<tr>
<td>6–10</td>
<td>60</td>
<td>70.00</td>
<td>1.17</td>
<td>17%</td>
<td>1.41</td>
<td>.41</td>
</tr>
<tr>
<td>6–11</td>
<td>66</td>
<td>79.00</td>
<td>1.20</td>
<td>21%</td>
<td>1.52</td>
<td>.52</td>
</tr>
<tr>
<td>6–12</td>
<td>72</td>
<td>88.00</td>
<td>1.22</td>
<td>25%</td>
<td>1.63</td>
<td>.63</td>
</tr>
<tr>
<td>7–8</td>
<td>56</td>
<td>64.00</td>
<td>1.14</td>
<td>8%</td>
<td>1.24</td>
<td>.24</td>
</tr>
<tr>
<td>7–9</td>
<td>63</td>
<td>74.50</td>
<td>1.18</td>
<td>16%</td>
<td>1.40</td>
<td>.40</td>
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<tr>
<td>7–10</td>
<td>70</td>
<td>85.00</td>
<td>1.21</td>
<td>21%</td>
<td>1.53</td>
<td>.53</td>
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<tr>
<td>7–11</td>
<td>77</td>
<td>95.50</td>
<td>1.24</td>
<td>25%</td>
<td>1.65</td>
<td>.65</td>
</tr>
<tr>
<td>7–12</td>
<td>84</td>
<td>106.00</td>
<td>1.26</td>
<td>29%</td>
<td>1.77</td>
<td>.77</td>
</tr>
</tbody>
</table>

Overtime Factor (C) = (B)/(A) Overtime Multiplier (E) = (C)/(1.00-D)

### Table 2
**Calculation Table of Premium Time and Inefficiency on Overtime Work—Overtime Multiplier (Double Time)**

<table>
<thead>
<tr>
<th>Hours</th>
<th>Hours Work (A)</th>
<th>Hours Pay (B)</th>
<th>Overtime (C)</th>
<th>Inefficiency (D)</th>
<th>Multiplier of Str. Time (E)</th>
<th>Premium &amp; Ineff. Factor (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5–9</td>
<td>45</td>
<td>50.00</td>
<td>1.11</td>
<td>5%</td>
<td>1.168</td>
<td>.168</td>
</tr>
<tr>
<td>5–10</td>
<td>50</td>
<td>60.00</td>
<td>1.20</td>
<td>8%</td>
<td>1.304</td>
<td>.304</td>
</tr>
<tr>
<td>5–11</td>
<td>55</td>
<td>70.00</td>
<td>1.27</td>
<td>11%</td>
<td>1.427</td>
<td>.427</td>
</tr>
<tr>
<td>5–12</td>
<td>60</td>
<td>80.00</td>
<td>1.33</td>
<td>14%</td>
<td>1.547</td>
<td>.547</td>
</tr>
<tr>
<td>6–8</td>
<td>48</td>
<td>56.00</td>
<td>1.17</td>
<td>3-1/3%</td>
<td>1.210</td>
<td>.210</td>
</tr>
<tr>
<td>6–9</td>
<td>54</td>
<td>68.00</td>
<td>1.26</td>
<td>13%</td>
<td>1.448</td>
<td>.448</td>
</tr>
<tr>
<td>6–10</td>
<td>60</td>
<td>80.00</td>
<td>1.33</td>
<td>17%</td>
<td>1.602</td>
<td>.602</td>
</tr>
<tr>
<td>6–11</td>
<td>66</td>
<td>92.00</td>
<td>1.39</td>
<td>21%</td>
<td>1.759</td>
<td>.759</td>
</tr>
<tr>
<td>6–12</td>
<td>72</td>
<td>104.00</td>
<td>1.44</td>
<td>25%</td>
<td>1.920</td>
<td>.920</td>
</tr>
<tr>
<td>7–8</td>
<td>56</td>
<td>72.00</td>
<td>1.29</td>
<td>8%</td>
<td>1.402</td>
<td>.402</td>
</tr>
<tr>
<td>7–9</td>
<td>63</td>
<td>86.00</td>
<td>1.37</td>
<td>16%</td>
<td>1.631</td>
<td>.631</td>
</tr>
<tr>
<td>7–10</td>
<td>70</td>
<td>100.00</td>
<td>1.43</td>
<td>21%</td>
<td>1.810</td>
<td>.810</td>
</tr>
<tr>
<td>7–11</td>
<td>77</td>
<td>114.00</td>
<td>1.48</td>
<td>25%</td>
<td>1.973</td>
<td>.973</td>
</tr>
<tr>
<td>7–12</td>
<td>84</td>
<td>128.00</td>
<td>1.52</td>
<td>29%</td>
<td>2.141</td>
<td>1.141</td>
</tr>
</tbody>
</table>

Overtime Factor (C) = (B)/(A) Overtime Multiplier (E) = (C)/(1.00-D)

**NOTES TO TABLES 1 AND 2:**

The following are some practical ways to use this information in preparing estimates or change orders.

Note 1: You may take the straight time hours figured for the job, and multiply by the appropriate number in column E. The project will include the straight time hours, the premium costs and the inefficiency.

Note 2: You may take the straight time hours figured for the job, and multiply by the appropriate number in column F. The project will include the premium costs and inefficiency costs, but will not include the straight time costs.

Note 3: The products arrived at in Notes 1 and 2 would then be multiplied by the prevailing hourly rate, including fringes, taxes, and insurance, in order to determine the dollar value of the labor.
OVERTIME AND INEFFICIENCY

The following four examples illustrate the relationship between overtime and the increasing ratio of inefficiency during consecutive overtime periods.

EXAMPLE A

ASSUME:
1) 20,000 man-hours straight time (5,8's) estimated for job.
2) $20,000 per man-hour is combined crew rate before taxes and insurance.
3) Overtime is at double time.

PROBLEM:
1) With above assumption, what is additional cost to the job on basis of (6, 10's) instead of (5, 8's)?

SOLUTION:
6, 10's = 60 man-hours = 40 straight time = 40 hours pay
20 overtime = 40 hours pay
60 hours worked = 80 hours pay

80/60 = 1.33 multiplier if no loss of efficiency
However, 6, 10's = 17% inefficiency
Therefore, 1.33/.83 = 1.6 multiplier

20,000 man hours @ $20.00/man-hour = $400,000
640,000 1.6 multiplier
Less 400,000 Original cost
$240,000 Increased cost

Therefore, $240,000 is the additional cost of (6, 10's) in lieu of (5, 8's); also increases in taxes and insurance must be added to labor cost.

EXAMPLE A - SUB. 1

Another way to calculate Example A.

ASSUME:
1) 20,000 man-hours straight time (5, 8's) estimated for job.
2) $20.00 per man-hour is combined crew rate before taxes and insurance.
3) Overtime is at double time.

PROBLEM:
1) With above assumptions, what is additional cost to the job on basis of (6, 10's) instead of (5, 8's)?
SOLUTION:

6, 10’s = 60 man-hours = 40 straight time = 40 hours pay
20 overtime = 40 hours pay
60 hours worked = 80 hours pay

\[
\frac{80}{60} = 1.33 \text{ multiplier if no loss of efficiency}
\]
Therefore, $20.00 \times 1.33 = $26.60 per man-hour adjusted rate
However, 6, 10’s = 17% inefficiency
Therefore, must work 20,000/.83 or 24,096 man-hours to equal 20,000 man-hours production.

\[
\frac{24,096 \times 26.60}{400,000} = \frac{640,954}{400,000} = \frac{240,954}{640,954} \text{Increased labor cost.}
\]

Therefore, $240,954 is the additional cost of (6, 10’s) in lieu of (5, 8’s); also increases in taxes and insurance must be added to labor cost.

EXAMPLE B

ASSUME:

1) 20,000 man-hours straight time (5, 8’s) estimated for job.
2) $20.00 per man-hour is combined crew rate before taxes and insurance.
3) Overtime is at time and a half.

PROBLEM:

1) With above assumptions, what is additional cost to the job on basis of (6, 10’s) instead of (5, 8’s)?

SOLUTION:

6, 10’s = 60 man-hours = 40 straight time = 40 hours pay
20 overtime = 30 hours pay
60 hours worked = 70 hours pay

\[
\frac{70}{60} = 1.17 \text{ multiplier if no loss of efficiency}
\]
Therefore, $20.00 \times 1.17 = $23.40 per man-hour adjusted rate
However, 6, 10’s = 17% inefficiency
Therefore, must work 20,000/.83 or 24,096 man-hours to equal 20,000 man-hours production.

\[
\frac{24,096 \times 23.40}{400,000} = \frac{563,846}{400,000} = \frac{163,846}{563,846} \text{Increased labor cost.}
\]

Therefore, $163,846 is the additional cost of (6, 10’s) in lieu of (5, 8’s); also increase in taxes and insurance must be added to labor cost.
EXAMPLE C

ASSUME:

1) 20,000 man-hours straight time (5, 8’s) estimated for job.
2) $20.00 per man-hour is combined crew rate before taxes and insurance.
3) Overtime is at double time during the week and double time on Saturday and Sunday.

PROBLEM:

1) With above assumptions, what is additional cost to the job on basis of (6, 10’s) instead of (5, 8’s)?

SOLUTION:

\[
\begin{align*}
6, \text{ 10’S} = 60 \text{ man-hours} &= 40 \text{ straight time} = 40 \text{ hours pay} \\
&= 10 \frac{1}{2} \text{ overtime} = 15 \text{ hours pay} \\
&= 10 \text{ double time} = 20 \text{ hours pay} \\
&= 60 \text{ hours worked} = 75 \text{ hours pay} \\
\end{align*}
\]

\[
\frac{75}{60} = 1.25 \text{ multiplier if no loss of efficiency} \\
Therefore, $20.00 \times 1.25 = $25.00 \text{ per man-hour adjusted rate} \\
However, 6, 10's = 17\% \text{ inefficiency} \\
Therefore, must work 20,000/.83 or 24,096 man-hours to equal 20,000 man-hours production.
\]

\[
\begin{align*}
\text{Therefore, } 24,096 \times $25.000 &= \text{ $602,400 Total cost @ 6, 10's} \\
\text{Less } 400,000 \text{ Total cost @ 5, 8's} &= \text{ $202,400 Increased labor cost.} \\
\end{align*}
\]

Therefore, $202,400 is the additional cost of (6, 10’s) in lieu of (5, 8’s); also increases in taxes and insurance must be added to labor cost.

EXAMPLE D

ASSUME:

1) 20,000 man-hours straight time (5, 8’s) estimated for job.
2) $20.00 per man-hour is combined crew rate before taxes and insurance.
3) Overtime is at double time.

PROBLEM:

1) With above assumptions, what is additional cost to the job on basis of (5, 10’s) and (1, 8) instead of (5, 8’s)?
SOLUTION:

5, 10’s and 1, 8 = 58 man-hours = 40 straight time = 40 hours pay
18 overtime = 36 hours pay
58 hours worked = 76 hours pay

76/58 = 1.31 multiplier if no loss of efficiency
Therefore, $20.00 x 1.31 = $26.20 per man-hour adjusted rate
However, 6, 8’s = 3-1/3% inefficiency and 6, 10’s = 17% inefficiency

Therefore, approximate inefficiency rate is 5/6 of the difference between 3-1/3% and 17% + 3-1/3% = 14-5/6%.

Therefore, must work 20,000/.8527 or 23,455 man-hours to equal 20,000 man-hours production.

Therefore, 23,455 x $26.20= 614,521 Total cost @5, 10’s and 1, 8
Less 400,000 Total cost @ 5, 8’s
214,521

Therefore, $214,521 is the additional cost of (5,10’s) and (1, 8’s) in lieu of (5, 8’s); also increase in taxes and insurance must be added to labor cost.