

FHWA GUIDE FOR CONSTRUCTION CONTRACT TIME DETERMINATION PROCEDURES

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1. **PURPOSE.** To provide procedures for determining contract time for construction projects.
 2. **POLICY.** State Transportation Agencies (STAs) should have adequate written procedures for the determination of contract time. The FHWA's policy for contract time and contract time extensions is codified in 23 Code of Federal Regulations 635.121.
 3. **BACKGROUND.**
 - A. Contract time is the maximum time allowed in the contract for completion of all work contained in the contract documents. Contract time often arises as an issue when the traveling public is being inconvenienced and the contractor does not appear to be aggressively pursuing the work. There may be a number of reasons for a project to appear dormant, such as weather limitations, concrete curing times, materials arriving late, etc. However, all too often the causes are traceable to excessive time originally established by the contracting agency to complete the project or poor contractor scheduling of construction operations.
 - B. In many instances, the duration of highway construction projects is more critical today than it was in the past. Several of the reasons are listed below:
 1. There are an increasing number of resurfacing, restoration, and rehabilitation type projects being constructed under traffic, resulting in an increase in the exposure of construction workers and motorists.
 2. Traffic volumes on most highways are significantly greater and are continuing to increase, thereby creating a greater impact on the motoring public in both safety considerations and cost.
 3. Proper selection of contract time allows for optimization of construction engineering costs and other resources.
 - C. In addressing the need for completing critical construction projects where it is important to minimize traffic inconvenience and delay, many States have applied non-traditional contracting methods including time-based contractual provisions for early completion.

4. ELEMENTS IN DETERMINING CONTRACT TIME.

- A. The application of written procedures for the determination of contract time is important so that production rates and other considerations are applied uniformly throughout the State. Written procedures should address how to classify projects based upon appropriate factors such as high traffic volumes, projects with incentive/disincentive clauses, etc. Experience and judgment should be used in the final determination for which projects are critical. Written procedures should have specific provisions that address the determination of contract time for critical projects. These procedures should also account for significant geographic and climatic differences throughout the State, which could affect contractor productivity rates. The fact that some types of work can or cannot be undertaken during certain times of the year should also be addressed. Where applicable, the affect of working under traffic also needs to be considered.
- B. The reasonableness of the contract time included in contracts is important. If time is insufficient, bid prices may be higher and there may be an unusual number of time overruns and contractor claims. The agency needs to take into consideration the available contractors and their workload. Contractors should be provided the ability to schedule work to maximize equipment and labor, and if contract time is too short, these efficiencies are more difficult to obtain resulting in higher prices. If the time allowed is excessive, there may be cost inefficiencies by both the STA and the contractor. The public may be inconvenienced unnecessarily and subjected to traveling on a roadway where safety is less than desirable for an extended period of time. In establishing contract time, all highway agencies should strive for the shortest practical traffic interruptions to the road user. If the time set is such that all work on a project may be stopped for an extended period (not including necessary winter shutdowns) and the contractor can still complete the project on schedule, it means the contract time allowed was excessive.
- C. For most projects the essential elements in determining contract time include: (1) establishing production rates for each controlling item; (2) adopting production rates to a particular project; (3) understanding potential factors such as business closures, environmental constraints; and (4) computation of contract time with a progress schedule.

5. ESTABLISHING PRODUCTION RATES.

- A. A production rate is the quantity produced or constructed over a specified time period. Estimating realistic production rates is important when determining appropriate contract completion time. Production rates may vary considerably depending on project size, geographic location, and rural or urban setting, even for the same item of work. Production rate ranges should be established in the State's written procedures based on project type (grading, structures, etc.), size, and location for controlling items of work.
- B. In establishing production rates to be used for determining contract time, an accurate database should be established by using normal historical rates of efficient contractors. One method of establishing production rates is to divide the total quantity of an item on previously completed projects by the number of days/hours the contractor used to complete the item. Production rates based upon eight-hour crew days or per piece of equipment are recommended. Production rates developed by reviewing total quantities and total time are not recommended as they may result in misleading rates which tend to be low since they may include startup, cleanup, interruptions, etc.
- C. The most accurate data will be obtained from site visits or review of project records (i.e., field diaries and other construction documents) where the contractor's progress is clearly documented based on work effort, including work crew make up, during a particular time frame. A data file based on three to five years of historical data (time, weather, production rates, etc.) should be maintained.

- D. The production rates used should be based on the desired level of resource commitment (labor, equipment, etc.) deemed practical given the physical limitations of the project. Representatives of the construction industry are also usually willing to assist in developing rates and time schedules. Rates should be updated regularly to assure they accurately represent the statistical average rate of production in the area.
- E. Some jurisdictions apply production rate data taken from some of the published rate guides. This data may be useful as guidance; however, the relationship of these production rates to actual highway construction projects may be difficult to correlate.

6. OTHER FACTORS WHICH INFLUENCE CONTRACT TIME.

- A. In addition to production rates, the following items should be considered when determining contract time:
 - 1. Effects of maintenance of traffic requirements on scheduling and the sequence of operations;
 - 2. Curing time and waiting periods between successive paving courses or between concrete placement operations, as well as specified embankment settlement periods;
 - 3. Seasonal limitations for certain items when determining both the number of days the contractor will be able to work as well as production rates;
 - 4. Conflicting operations of adjacent projects, both public and private;
 - 5. Time for reviewing false-work plans, shop drawings, post-tensioning plans, mix designs, etc.;
 - 6. Time for fabrication of structural steel and other specialty items;
 - 7. Coordination with utilities;
 - 8. Time to obtain necessary permits;
 - 9. The effect of permitting conditions and/or restrictions;
 - 10. Restrictions for nighttime and weekend operations;
 - 11. Time of the year of the letting as well as duration of the project;
 - 12. Additional time for obtaining specialty items or materials with long-lead requirements;
 - 13. Other pertinent items as determined by the STA.
- B. In setting contract time it is recommended that calendar days or a completion date be applied when project completion is critical or when a large volume of traffic is affected. Only on those projects where completion time is not a major factor should working days be considered. The significant advantage of applying calendar days or a calendar date for completion is the ease of time charge administration once the contract has begun.
- C. If the time is based on production rates per hour or per day on a working day basis, a conversion factor from working days to calendar days should be established. Conversion factors will vary by geographic location and by work type. Many contracting agencies use zero working days per month during the winter months while 20 to 25 working days per month are common during the summer. Bridgework is generally assigned the greatest number of working days per month. If historical working day data is not available, historical rain and temperature data is available from the National Weather Service to develop average working days per month.

- D. Since completion date and calendar day contracts are based on a specified award date or notice to proceed date, these types of contracts should contain a provision for adjusting the completion date if the anticipated notice to proceed date is changed.

7. ADAPTING PRODUCTION RATES TO A PARTICULAR PROJECT.

- A. Before time durations for individual work items can be computed, certain project specific information should be determined and some management decisions made. The relative urgency for the completion of a proposed project should be determined. The traffic volumes affected as well as the effect of detours should be analyzed. The size and location of the project should be reviewed, in addition to the effects of staging, working double shifts, nighttime operations, and restrictions on closing lanes. The availability of material for controlling items of work should be investigated. For example, it might be appropriate to consider the need for multiple crews on a specific item to expedite the completion when there are exceptionally large quantities or when there is a large impact on traffic.
- B. Procedures to accelerate project completion should be considered when construction will affect traffic substantially or when project completion is crucial. This is especially important in urban areas with high traffic volumes. When accelerating contract time for time sensitive projects, production rates should be based on an efficient contractor working more than eight hours per day, more than five days per week and possibly with additional workers. The development and application of a separate set of production rates for critical projects is recommended.

8. COMPUTATION OF CONTRACT TIME - DEVELOPING A PROGRESS SCHEDULE.

- A. The contract time for most construction projects can be determined by developing a progress schedule. A progress schedule shows the production durations associated with the chosen production rates for the items of work. The time to complete each controlling item of work included in the progress schedule is computed based on the production rates applicable to that project. Items should be arranged by chronological sequence of construction operations. Minor items that may be performed concurrently should be shown as parallel activities.
- B. In determining a progress schedule it should be remembered that the start and end dates for each controlling item need to be based on the earliest date for which work on that item will begin and how long it will take to complete. The earliest start date for each activity will be determined by the completion of preceding activities, and should allow for the fact that some activities can begin before the preceding activity is entirely completed. Additional time should be also allowed in the contract for initial mobilization.

9. CONTRACT TIME DETERMINATION TECHNIQUES.

Contract time determination techniques generally fall into the categories of bar charts and critical path techniques. These techniques are described below:

A. Bar Charts

1. Bar charts or Gantt charts are graphical representations of projects with specific completion dates and activities. Bars or lines are drawn proportional to the planned duration of each activity.
2. A brief description of the procedure used to develop a bar chart to determine contract time is as follows:

- a. The first step in developing a bar chart is to break a project down into separate activities or operations necessary for project completion.
 - b. Once all the activities necessary to complete a project have been listed, the duration and completion date of each activity needs to be determined based on production rates.
 - c. With this data established, the bar chart can be prepared. A line or bar is drawn on the chart showing the time when work will be performed for each activity. The resulting diagram will represent a project, showing when each activity will be undertaken and completed.
 - d. With bar charts, the progress of a project may be monitored for each activity by drawing a bar or line below the original scheduled performance to show the actual duration for each activity as it is completed.
3. Bar charts are advantageous in that they are simple to develop and easy to understand, and they offer a good method of determining contract time. Some disadvantages are that they do not show the interrelationship and inter-dependency among the various phases of work. Bar charts are difficult to properly evaluate when construction changes occur. Also, controlling items are shown in the same manner as minor items, thus making it more difficult to determine which items actually control the overall time progress of the project. The use of bar charts are not recommended for contract administration and project management of large or complex construction projects.

B. Estimated Cost Method

The Estimated Cost Method of contract time determination utilizes a comparison of dollar value to time. Based on historical information, tables illustrating project cost versus project time are developed for different project types, traffic volume, and geographic location. Examples of such project types include new construction, reconstruction, overlay and widening projects, pavement repair, and bridge construction. Contract time is essentially determined based solely on the amount of the engineer's estimate. For non-complex projects and projects affecting small volumes of traffic, this procedure may be appropriate. The estimated cost method is not recommended for use on projects where completion time is a major factor. Many items affecting the completion of a project are not taken into consideration when applying this method. Any special features that are unique to a specific project cannot easily be accounted for when using this very simplistic procedure.

C. Critical Path Method (CPM)

The Critical Path Method (CPM) focuses on the relationship of the critical activities, specifically, those which must be completed before other activities are started. Working from the project's beginning and defining individual project tasks and the number of days to perform each task, a logical diagrammatic representation of the project is developed. A CPM depicts which tasks of a project will change the completion date if they are not completed on time. The evaluation of critical tasks allows for the determination of the time to complete projects. Because of the size and complexity of most projects, this method is most often applied using a computer software program. Within the CPM software, the ability to use a Program Evaluation Review Technique (PERT) provides a breakdown of each activity to boxes. This enables the user to view the connection of relationships to each activity. CPM software also has the ability to display the contract time in a bar chart view as well.

1. The first step in applying the CPM method is to break a project down into separate tasks or operations necessary for project completion. Each of these

separate operations or processes is called an activity. The completion of an activity is called an event.

2. Once all the activities necessary to complete a project have been listed, the relationship of these activities to one another needs to be determined. In some instances, several activities can be undertaken concurrently, and at other times, certain activities cannot be undertaken until others have been completed. Generally, when determining the sequence of operations, some questions need to be asked such as: "What needs to be done before proceeding with this activity" or "what can be done concurrently?" Every activity has a definite event to mark its relationship with others with respect to completing a task.
3. In working with this procedure, a diagrammatic representation of the project is developed showing the correct sequence and relationship of activities and events. Each activity is shown as an arrow leading to a node, which indicates the completion of an event or the passage of time. The start of all activities leaving a node depends on the completion of all activities entering a node. Therefore, the event represented by any node is not achieved until all activities leading to the node have been completed. The resulting diagram will be a schematic representation of a project, showing all the relevant activities and events in correct sequence.
4. An actual time can be set to each activity based on production rates and other appropriate factors. The time to complete each activity is then shown on each arrow to indicate the duration. The "early start" for each activity is the earliest point in time that an activity can start, provided that all activities before it have finished. This is not necessarily the point in time that it will start; however, it is the earliest time that it can start. The "early finish" for an activity is merely the duration of the activity after its early start. As is the case with the "early start," this is not necessarily the point in time that the work represented by the activity will be over, but is the earliest point in time that it can occur. A "finish" date in CPM is the first day after the physical completion of the activity. The completion time of a project is the sum of the longest time path leading to completion of the project.
5. The optimum time and cost for performing the project can be evaluated by assigning resources i.e. equipment, labor hours, and materials to each activity. The diagrammatic representation of the project then provides a means to evaluate the costs incurred with respect to the completion of specified activities.
6. Advantages of using the CPM include:
 - It is an accurate technique for determining contract time and verifying that the project can be constructed as designed and with identified construction sequences;
 - It is a useful tool for project managers in monitoring a project, especially when dealing with relationships of work items with respect to time; and
 - Activities responsible for delays can be identified and corrective measures to keep a project on schedule can be determined.

Disadvantages of using the CPM include:

- The CPM requires experienced and knowledgeable staff to be used effectively;
- They require regular updates to assure that the contractor's operation is accurately represented.

10. OTHER PROJECT CONSIDERATIONS.

Construction time on certain projects such as lighting or signalization, may be governed by the long lead-time necessary to obtain materials. To minimize traffic disruption, the contract may specify a completion date several months after the notice to proceed, but the contractor should be limited to a relatively short on-site time. This may be accomplished by including in the contract a "conditional notice to proceed" clause which would allow a specified amount of time to purchase and assemble materials followed by issuance of a full work order which would be issued upon expiration of the assembly period or sooner, upon the contractor's request.

Delayed or flexible notice-to-proceed dates may be appropriate for certain projects where the ultimate completion date is not critical. The contracting agency may wish to provide a notice-to-proceed window in order to increase the probability of a competitive bid where only a limited number of contractors are available to perform the work. Such projects may include:

- Projects that consist of specialized work (seal coats, highway planting, pavement grooving or bridge painting) where a large number of these projects are being advertised within a short time period;
- Projects with a very limited number of working days;
- Building projects.

This allows the contractor to schedule this contract with consideration of other work he/she may have in the same paving season. Net benefits include lower project inspection cost and a minimal disruption to traffic.

An option that may be applicable to some projects is dividing a project into phases with each phase having its own completion date. This may be applicable when coordinating with other projects or activities in the area in order to meet tight deadlines.

11. CONCLUSION.

An essential element of every State's written contract time procedures should be the monitoring of existing projects to determine that the contract times being specified are appropriate. As a part of this process, updates and changes should be made as determined to be necessary.

12. REFERENCES.

1. Herbsman, Zohar J. and Ralph Ellis, "Determination of Contract Time for Highway Construction Projects," NCHRP Synthesis Report 21, Transportation Research Board, Washington, D.C., 1995.
2. Copas, Thomas L. and Pennock, Herbert A., "Contract Time Determination," National Cooperative Highway Research Program Synthesis of Highway Practice, (NCHRP) No. 79, October 1981.
3. Hancher, Donn E. and Werkmeister, Jr., Raymond F., P.E. "Kentucky Contract Time Determination System", June 30, 2000.
<http://ntl.bts.gov/data/KY-CTDS.pdf> (3.5 MB PDF. Requires the [Adobe Acrobat Reader](#) plugin.)

13. Training.

"Critical Path Method for Estimating, Scheduling, and Timely Completion,"
FHWA National Highway Institute, Course No. 134049
<http://www.nhi.fhwa.dot.gov/coursedescript.asp?courseenum=1001>