Appendix 6 Determination of Contract Time

A6-1 Background

A6-1(1) Contract Time

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, and so on. 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 operations.

A6-1(2) Duration of Construction Projects

The duration of highway construction projects in many instances is more critical today than it was in the past. Some of the reasons are:

1. Traffic volumes on most highways are generally continuing to increase. This is creating a greater impact on the motoring public in both safety considerations and costs.
2. Proper selection of contract time allows for optimizing construction engineering costs and other resources.

A6-2 Elements in Determining Contract Time

A6-2(1) Written Procedures

Written procedures for the determination of contract time are important so that production rates and other considerations are applied uniformly throughout the state. These procedures should account for significant geographic and climatic differences throughout the state, which could affect contractor productivity rates. The fact that some types of work can be undertaken during certain times of the year while other types of work cannot should be addressed. Where applicable, the effects of working under traffic also need to be considered.

A6-2(2) Reasonableness of Contract Time

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. If, on the other hand, the time allowed is excessive, there may be inefficiencies (costs) by both the state and the contractor. Also, the public may be inconvenienced unnecessarily and subjected to traveling on roadways where safety is less than desirable for an extended period of time. In establishing contract time, the state should strive for the shortest feasible 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. There may be some exceptions, as indicated in "Factors That Influence Contract Time" and "Other Factors That Influence Contract Time" below.

A6-2(3) Reasonableness of Contract Time

For most projects, the essential elements in determining contract time are:

1. Establishing production rates for each controlling item.
2. Adapting production rates to a particular project.
3. Computing of contract time with a progress schedule.

EXPERIENCE AND JUDGMENT SHOULD BE USED IN THE FINAL DETERMINATION OF CONTRACT TIME.

A6-3 Establishing Production Rates

A6-3(1) Production Rate

A production rate is the amount or quantity produced/constructed over a specific time period. The application of realistic production rates is key in setting an appropriate contract completion time. Production rates for the same item of work will vary considerably across the state, from small to large construction projects and from rural to urban areas. Production rate ranges should be established based on project size, type (such as grading and structures), and location (urban or rural) for controlling items of work.

Typical production rates follow this text.

A6-4 Factors That Influence Contract Time

A6-4(1) Determining Contract Time

In addition to production rates, the following items should be considered when determining contract time:

1. Effects of the 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 need to be considered when determining both the number of days the contractor will be able to work and the production rates.
4. Conflicting operations of adjacent projects, both public and private.
5. Review time for falsework plans, shop drawings, post-tensioning plans, mix designs, and so on.
6. Time for fabrication of structural steel and other specialty items.

7. Time for fabrication and procurement of signal and illumination equipment.
8. Coordination with utilities.
9. Time to obtain permits.
10. Effects of permit conditions and/or restrictions.
11. Restrictions for nighttime and/or weekend operations.
12. Time of year of the letting as well as duration of the project.
13. Special local area events (such as parades, festivals, athletics, fairs, and races).
14. Canadian and neighboring states' holidays.
15. Location.
16. Work hour/noise restrictions.
17. Other pertinent items as determined by the designer.

A6-4(2) Working Days

Zero working days may be indicated during the winter months, while 20 to 22 working days per month are common during the summer. Bridge work is generally assigned the greatest number of working days in a month. If historical working day data are not available, historical rain and temperature data are available from the National Weather Service to develop average working days per month.

A6-5 Adapting Production Rates to a Particular Project

A6-5(1) Management Decisions

Before time durations for individual work items can be computed, certain project-specific information should be determined, and some management decisions made. A determination should be made relative to the urgency of the completion of the proposed project. The traffic volumes affected, and the effect of detours should be analyzed. The size and location of the project should be reviewed as well as the effects of staging, working double shifts, the feasibility of night work, and the restrictions on closing lanes. Also, 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.

A6-5(2) Accelerating Project Completion

Procedures that would 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 that have high traffic volumes. Realizing that public inconvenience needs to be minimized, the production rates applied in setting the contract time for these types of projects should be based on that of an efficient contractor working more than 8 hours per day, more than 5 days per week, and possibly with additional workers. The development and application of a separate set of production rates for these critical types of projects is recommended.

A6-6 Computation of Contract Time: Developing a Progress Schedule

A6-6(1) Progress Schedule

The contract time for most construction projects can be determined by developing a progress schedule. The progress schedule basically shows the production durations associated with the chosen production rates for the items of work. The time to complete each critical item (those items essential to total project completion) of work included in the progress schedule is computed based on the production rates applicable to that project. Critical items should be arranged by chronological sequence of construction operations. Minor items that may be performed concurrently with critical items do not need to be analyzed.

A6-6(2) Starting and Ending Time

In determining a progress schedule, it should be remembered that the starting and ending time for each critical item needs to be based on the earliest time in which work on that item will begin and how long it will take to complete. The earliest start time for each activity will be determined by the completion of the activities that precede it, allowing for the fact that some activities can begin before the preceding activity is entirely completed. Along with the time established for all critical items, additional time should be allowed in the contract for initial mobilization.

A6-7 Critical Path Method (CPM)

A6-7(1) Using CPM to Determine Number of Working Days

The CPM must be used to determine the number of working days. The CPM used to determine working days for a project shall be transmitted to the Plans Office with the Plans, Specifications, and Estimates (PS&E) transmittal.

A6-7(2) Using CPM to Determine Contract Time

A brief description of the application of the CPM technique to determine contract time is as follows:

1. The first step in applying the CPM method is to separate a project into the 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 cases, several activities can be undertaken concurrently. At other times, certain activities cannot be undertaken until others have been completed. In determining the sequence of operations, the question needs to be asked: "What needs to be done before proceeding with this activity, and what

can be done concurrently?" Every activity has a definite event to mark its relationship with others, with respect to completing a project.

3. In working with this procedure, a network (a diagrammatic representation of the project to be undertaken) is developed. The network shows the correct sequence and relationship to activities and events. Each separate activity is shown by its own arrow and 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 activates 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 shown on each arrow to indicate the duration. The "early start" for each activity is the earliest point in time that it will start, provided that all activities before it have finished. This is not necessarily the point in time it will start; however, it is the earliest time 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 the work represented by the activity will be over, but is the earliest point in time it can occur. A "finish" date in CPM is defined as the first day upon which no further work is to be done for an activity; it is the first day after the physical completion of the activity. The completion time of a project is, therefore, the sum of the longest time path through the network leading to completion of the project.
5. The optimum time and cost for performing the project can be evaluated by assigning resources (such as 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.

A6-7(3) Advantages of Using the CPM

This brief summary gives an indication of how this method can be applied to each project. Several advantages of using such a schedule are:

1. It is an accurate technique for determining contract time and verifying that the project can be constructed as designed and with identified construction sequences.
2. It is a useful tool for project managers in monitoring a project, especially when dealing with relationships of work items with respect to time.
3. Activities responsible for delays can be identified and corrective measures to keep a project on schedule can be determined.

A6-7(4) Drawbacks of Using the CPM

Several drawbacks of CPM schedules are:

1. They need to be developed by someone knowledgeable in using CPM scheduling.

2. They need to be updated regularly to ensure the contractor's operation is accurately represented.

A6-7(5) WSDOT Classes in Design Scheduling

WSDOT online training courses for project scheduling are available in Learning Management System (LMS).

Search: “WSDOT PM: Introduction to Project Scheduling”. This online course provides ten (10) modules starting with the beginner level to more advanced training in various scheduling details and user tools.

Courses may change, so designers should always check with trainers for the latest courses offered.

A6-8 Other Factors That Influence Contract Time

A6-8(1) Conditional Notice to Proceed

Construction time on some projects, such as illumination 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. This would be followed by issuance of a full work order, which would be issued upon expiration of the assembly period or sooner, at the contractor's request.

A6-8(2) Scheduling the Contract in Consideration of Other Work

Another approach in which greater flexibility may be allowed would be to include in the contract a combination of an overall completion date and a specified number of consecutive available working days, which would be changed once construction had started. It is sometimes advantageous to allow a contractor to set the actual construction dates within a given construction season. An example would be a typical small paving job that may only require the contractor to be on-site for a few weeks. For a project let in the spring, the completion date can be set for the end of the construction season, but the contractor's on-site time may be limited in the contract to a month. This allows the contractor to schedule this contract with consideration of other work the contractor may have in the same paving season. Net benefits include lower project inspection costs and a minimal disruption to traffic.

A6-8(3) Dividing the Project into Phases

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.

A6-9 Production Rate Tables

The following production rates should be used in computing contract completion time. Production rates vary depending on the amount of traffic, the complexity of the project, and/or other restrictions.

Rates have been produced based on data furnished by regions with disregard to the size or complexity of the project or the quantity of a particular item.

Generally, large quantities in a particular project will have high production rates.

An additional resource for production rates is available from USDOT here: https://highways.dot.gov/federal-lands/design/tools-cfl/production-rates

PREPARATION			
Item	**Units**	**Daily Production Rate (based on 8-hour day)**	
		West	**East**
Mobilization	Days	3 to 6	3 to 6
Clearing and Grubbing	Ac.	1	3
Stripping Inc. Haul	C.Y.	1	3
Removing Manhole	Ea.	3	3
Removing Drainage Structure	Ea.	4	4
Removing Conc. Inlet	Ea.	6	6
Removing Bituminous Pavement	S.Y.	1800	3000
Removing Cement Conc. Pavement	S.Y.	600	600
Removing Asphalt Conc. Pavement	S.Y.	2500	3000
Removing Cem. Conc. Curb & Gutter	L.F.	1200	1200
Removing Asphalt Conc. Curb	L.F.	2000	2000
Removing Cement Conc. Sidewalk	S.Y.	250	400
Removing Guardrail	L.F.	1000	1200
Removing Guardrail Anchor	Ea.	8	10
Removing Paint Line	L.F.	2000	2500
Removing Plastic Line	L.F.	900	1000
Removing Paint Traffic Marking	Ea.	200	100
Removing Plastic Traffic Marking	Ea.	150	75
Removing Raised Pavement Markers	Hund.	8	2
Removing Chain Link Fence	L.F.	1000	1000
Removing Wire Fence	L.F.	4000	4000

Preparation Items

1. Clearing and grubbing rates are very dependent on density and type of vegetation.
2. Some of these items may be included in roadway excavation work.
3. If removal items are to be salvaged, the production rate may be less.
4. Proximity of waste site may be a factor.

GRADING			
Item	**Units**	**Daily Production Rate (based on 8-hour day)**	
		West	**East**
Roadway Excavation			
Range	C.Y.	600-3000	1000-4000
Normal	C.Y.	1500	2000
Pavement Repair Excavation Inc. Haul	C.Y.	70-300	300-500
Embankment Compaction			
Range	C.Y.	850-5000	1500-6000
Normal	C.Y.	1700	2000
Gravel Borrow Inc. Haul			
Range	Ton	800-3500	1000-4000
Normal	Ton	1600	2000

Grading Items

1. Pavement repair excavation usually requires backfill and pavement replacement the same day.
2. Consideration must be given as to whether trucks or scrapers will be used.
3. Embankment compaction is usually in conjunction with roadway excavation or gravel borrow.
4. Rock cuts would decrease roadway excavation production rates.
5. Proximity of pit and waste sites may be a factor.

STOCKPILING (Aggregate Production)			
Item	**Units**	**Daily Production Rate (based on 8-hour day)**	
		West	**East**
Ballast	Ton	1200-3000	1200-1500
Crushed Surf. Base Course	Ton	1200-3000	1200-1500
Crushed Surf. Top Course	Ton	1200-2700	1200-2700

Stockpiling Item

1. Aggregate production is dependent on the source. Time must be allowed for drilling and blasting to get ahead of crushing operation in a quarry site.

DRAINAGE			
Item	Units	Daily Production Rate (based on 8-hour day)	
		West	East
Ditch Excavation			
Range	C.Y.	125-1000	200-1000
Normal	C.Y.	400	500
Concrete Inlet	Ea.	4	4
Cement Conc. Gutter	L.F.	250-400	250-400
Asphalt Conc. Gutter	L.F.	600-1000	600-1000
Hand-Placed Rip Rap	C.Y.	30-50	30-50
Rip Rap			
Range	Ton	70-500	70-500
Normal	Ton	300	300
Quarry Spalls			
Range	Ton	100-600	100-600
Normal	Ton	400	400
End Section W/Bars	Ea.	3	3
Flared End Section	Ea.	7-20	7-20
Underdrain Pipe			
Range	L.F.	100-500	100-500
Normal	L.F.	200	200
Drain Pipe			
Range	L.F.	100-400	100-400
Normal	L.F.	200	200
Culvert Pipe 12”-36”			
Range	L.F.	50-300	100-300
Normal	L.F.	100	150
Culvert Pipe 42”-72”	L.F.	20-100	50-100
Stru. Plate Pipe	L.F.	50-100	50-100
Stru. Plate Pipe Arch	L.F.	50-100	50-100
Steel Underpass	L.F.	50-100	50-100

Drainage Items

1. End sections are usually incidental to pipe runs.
2. Pipe production rates can vary due to depth of structure excavation.

STORM SEWERS			
Item	**Units**	**Daily Production Rate (based on 8-hour day)**	
		West	**East**
Catch Basin Type 1	Ea.	5	5
Catch Basin Type 2 48”-54”	Ea.	2	2
Catch Basin Type 2 72”-96”	Ea.	1	1
Catch Basin Type 3	Ea.	2	2
Testing Storm Sewer Pipe			
Range	L.F.	500-2500	500-2500
Normal	L.F.	1000	1000
Storm Sewer Pipe 12”-36”			
Range	L.F.	300-1500	500-2000
Normal	L.F.	800	1500
Storm Sewer Pipe 42”-72”	L.F.	50-200	50-200

Storm Sewer Items

1. Pipe production rates can vary due to depth of structure excavation.
2. Testing production rates are dependent on pipe sizes (large diameter pipe requires more time than small diameter pipe).

SANITARY SEWER			
Item	**Units**	**Daily Production Rate (based on 8-hour day)**	
		West	**East**
Testing Sewer Pipe			
Range	L.F.	500-2500	500-2500
Normal	L.F.	1000	1000
Sewer Pipe 6”-48”	L.F.	200-400	200-400

Sanitary Sewer Items

1. Pipe production rates can vary due to depth of trench excavation.
2. Conflicts with existing utilities can cause reduced production rates.
3. Testing production rates are dependent on pipe sizes (large diameter pipe requires more time than small diameter pipe).

WATER LINES			
Item	**Units**	**Daily Production Rate (based on 8-hour day)**	
		West	**East**
Installing Valves	Ea.	3	3
Hydrant Assembly	Ea.	2	2
Resetting Existing Hydrant	Ea.	2	2
Service Connection	Ea.	3.5	3.5
Water Main			
Range	L.F.	100-800	100-800
Normal	L.F.	300	300

Water Line Items

1. Water main production rates can vary due to depth of excavation.
2. Time must be allowed for cleaning and testing.
3. Conflicts with existing utilities can cause reduced production rates.

STRUCTURE
See the *Bridge Design Manual* for construction time rates.

SURFACING			
Item	**Units**	**Daily Production Rate (based on 8-hour day)**	
		West	**East**
Ballast	Ton	1000-3000	1000-3000
Gravel Base	Ton	1000-3000	1000-3000
Crushed Surf. Base Course	Ton	1000-3000	1000-3000
Crushed Surf. Top Course	Ton	500-2000	500-2000

Surfacing Items

1. Shoulder work can reduce production rates.
2. Irregular areas can reduce production rates.

BITUMINOUS SURFACE TREATMENT			
Item	**Units**	**Daily Production Rate (based on 8-hour day)**	
		West	**East**
Processing and Finishing			
Range	Mile	0.25-2	0.25-2
Normal	Mile	0.75	0.75
New Construction			
Range	Mile	1-7	1-7
Normal	Mile	5	5
Seal Coats			
Range	Mile	3-10	3-10
Normal	Mile	8	8

CEMENT CONCRETE PAVEMENT			
Item	**Units**	**Daily Production Rate (based on 8-hour day)**	
		West	**East**
Cement Conc. Pavement	C.Y.	1200	1200
Bridge Approach Slab	S.Y.	25	25

Cement Concrete Pavement Items

1. Concrete paving rates are based on a single drum batch plant. A single drum batch plant produces 10 CY per minute, with 90% efficiency.
2. Concrete paving “Rule of Thumb” is 1 mile of 24-foot-wide pavement per day (slip form).
3. Unfinished concrete pavement usually has irregular areas that require more forming and handwork.
4. Allow time for forming, if required, and curing.
5. Cement Conc. Approaches are usually incidental to sidewalk work.

HOT MIX ASPHALT			
Item	**Units**	**Daily Production Rate (based on 8-hour day)**	
		West	**East**
Preparation of Untreated Roadway	Mile	0.5-2	0.5-2
Planing Bituminous Pavement			
Range	S.Y.	7000-13000	7000-13000
Normal	S.Y.	9000	9000
Hot Mix Asphalt for Prelevel			
Range	Ton	500-1500	500-2000
Normal	Ton	700	1500
HMA for Pavement	Ton	1200-2200	1500-3000

Asphalt Concrete Pavement Items

1. Time may be required for road approaches.
2. Night work will affect paving production.
3. Requirements to plane/pave back in the same day will affect project time.

IRRIGATION AND WATER DISTRIBUTION

Irrigation and Water Distribution Items

1. Lump Sum…Contacts.

EROSION CONTROL AND PLANTING			
Item	**Units**	**Daily Production Rate (based on 8-hour day)**	
		West	**East**
Seed Fert. and Mulching			
Range	Ac.	4-10	5-20
Normal	Ac.	5	8
Preparation for Planting			
Range	S.Y.	2000-5000	2000-5000
Normal	S.Y.	3000	3000
Sod Installation	S.Y.	800-2750	800-2750
Seeded Lawn Installation			
Range	S.Y.	2000-18000	2000-18000
Normal	S.Y.	2400	2400
Mulching, With Binding Agent	C.Y.	360	360

TRAFFIC			
Item	**Units**	**Daily Production Rate (based on 8-hour day)**	
		West	**East**
Cement Conc. Curb	L.F.	1500	3000
Beam Guardrail			
Range	L.F.	450-1850	450-1850
Normal	L.F.	750	750
Beam Guardrail Anchor	Ea.	5	5
Raising Existing Beam Guardrail	L.F.	1500	1500
Precast Conc. Barrier	L.F.	1000-2000	1000-2000
Cast-In-Place Barrier	L.F.	100-800	100-800
Temp. Conc. Barrier	L.F.	1000-2000	1000-2000
Removing & Resetting Conc. Barrier	L.F.	600-1200	1000-2000
Flexible Guideposts	Ea.	80-160	80-160
Paint Line	L.F.	14,000-100,000	14,000-200,000
Plastic Line (using push cart)	L.F.	400	400
Plastic Line (using truck)	L.F.	2000-40,000	2000-40,000
Raised Pavement Marker	Hund.	8	8
Asphalt Rumble Strips	L.F.	20,000	20,000

Traffic Items

1. Allow time for forming and curing of concrete work.
2. Pavement-marking production rates will decrease in channelization, intersection, and interchange areas.
3. For projects with large quantities of Plastic line, a truck may be more efficient means of production. Assumptions: Paint trucks can run at 5-10 mph during the striping operation. A crew can paint at least 5000 L.F./hour, and spent the rest of the 8-hour shift doing manual painting of arrows etc.

SIGNAL / ILLUMINATION	
Four-Pole Signal Intersection	10-20 days
Illumination System Includes the following work: • Excavation • Concrete • Cure time • Plumbing • Conduit • Wiring	5 days per pole
Signal/Illumination Items 1. For material procurement, use four (4) months minimum. 2. These would be noncharged workdays in most cases. 3. Revising/modifying existing system may warrant additional time. 4. Salvaging existing equipment may warrant additional time. 5. On projects where the electrical work is a small part of the overall work, it is doubtful that this work would be critical.	

SIGNING	
Sign Installation • Cantilever Sign Structure • Sign Bridge • Overhead Structure • Wood Posts • Metal Posts (concrete base)	 2 days 5 days 2 days 15/day 4/day
Fabrication • Signs • Cantilever Sign Structure • Sign Bridge Structure	 500 ft^2/day 120 days 120 days
Signing Items 1. Structure fabrication time includes approval of shop plans. 2. Fabrication of multiple structures would take less time.	

OTHER ITEMS			
Item	**Units**	**Daily Production Rate (based on 8-hour day)**	
		West	**East**
Monument Case and Cover	Ea.	8	8
Conc. Slope Protection	S.Y.	100	100
Chain Link Fence	L.F.	250-700	250-700
Wire Fence			
Range	L.F.	500-2000	500-2000
Normal	L.F.	1000	1000
Glare Screen			
Range	L.F.	100-1000	300-1900
Normal	L.F.	350	1100
Gabion Cribbing			
Range	C.Y.	20-110	20-110
Normal	C.Y.	40	40
Adjust Drain Structure	Ea.	4-11	4-11
Adjust Manhole	Ea.	4	4
Manhole Under 12 Ft.	Ea.	1.5	1.5
Manhole Over 12 Ft.	Ea.	1	1
Adjust Catch Basin	Ea.	4-12	4-12
Adjust Valve Box	Ea.	4-10	4-10

Other Items

1. Fencing production rates will vary with terrain, groundwater, and alignment.