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Contract Time Determination Guidelines

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Contract Time Determination Guidelines

Purpose

To provide guidelines for determining contract time on all construction projects.

Policy

Effective January 01, 2008, the Virginia Department of Transportation (VDOT) mandated that all contracts (Construction, Maintenance and Operations Sections) shall have adequate written procedures for the determination of contract time and be in general compliance with FHWA's guide for construction contract time determination procedures (TA 5080.15).

Background

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.

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.

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.

List of Categories on various project types for Determining Contract Time

VDOT has categorized projects into six (6) categories. A schedule submission must be developed at the District level and reviewed at the Central Office prior to inclusion in the PS&E package.

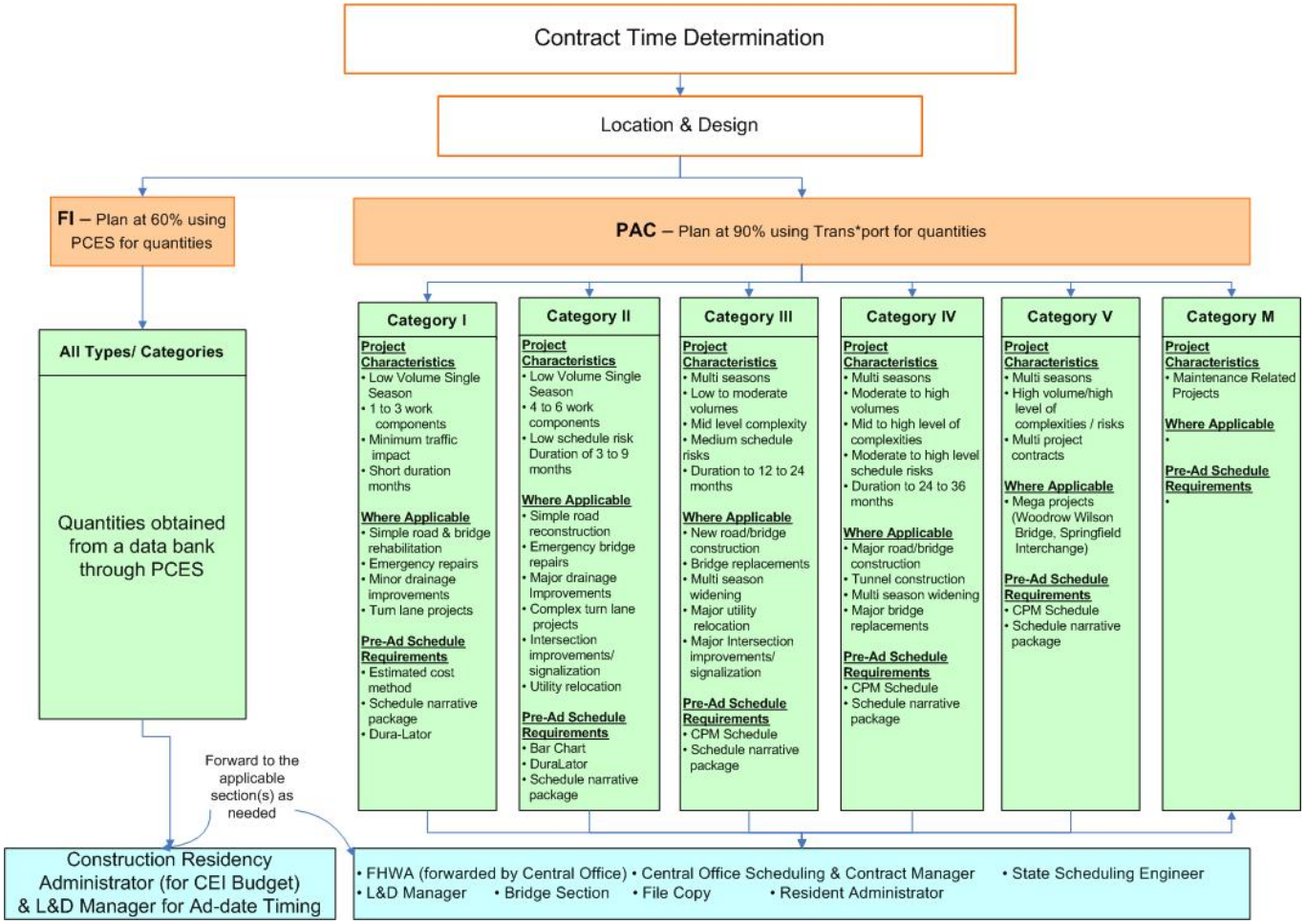


Figure 1. Contract Time Determination Categories

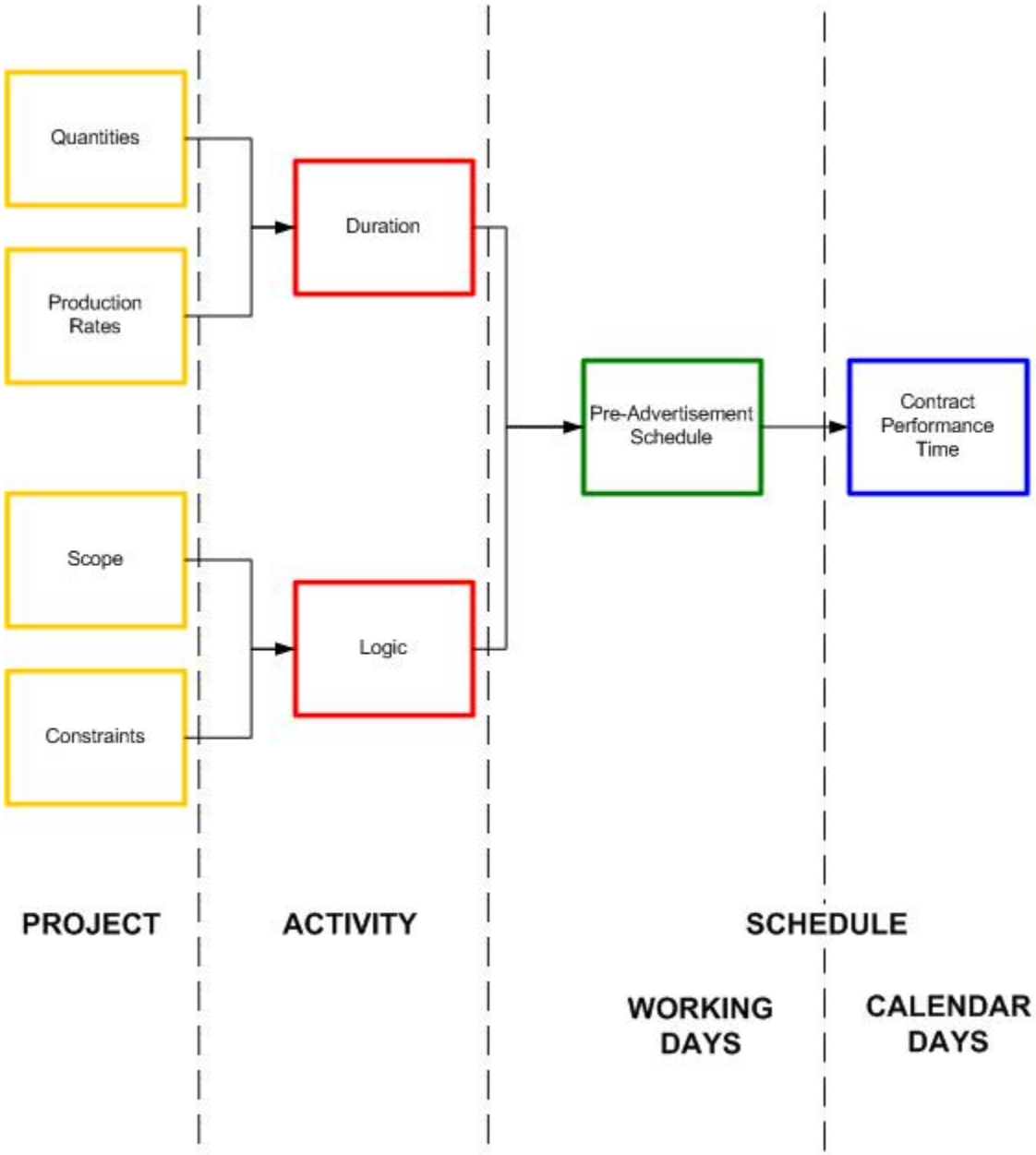


Figure 2. General Contract Time Determination Process flowchart

Steps for Scheduling for Determination of Contract Time

The following steps of scheduling are applicable for all methods used for determining contract time:

1. Define activities
2. Estimate activity duration
3. Define activity relationships
4. Calculate project duration
5. Establish activity time intervals
6. Identify critical activities
7. Publish a working schedule
8. Record assumptions

Elements in Determining Contract Time

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. 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. Experience and judgment are also important elements in the final contract time determination.

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. Consideration shall be taken on 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 VDOT 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, VDOT 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.

For most projects the essential elements in determining contract time include: (1) establishing production rates for all items; (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 or other techniques.

Steps for Establishing Contract Duration

Establishing a project's duration will be accomplished with the following steps for all categories:

- Review the project plans and specifications. Analyze and determine special factors that are controls affecting completion or phasing of the work. If the project has more than one phase, determine what work can be done in each of the phases.
- List the required activities for each phase.
- List each quantity of the unit of work that will be used as a basis for estimating the duration of that activity, e.g. for storm sewers this would be the number of linear feet of pipe, etc.
- On a project with more than one phase use only that quantity associated with that phase. If the list of pay items shows, for instance, 10,000 cubic yards of excavation for a project, that has two phases, that have approximately the same amount on each phase, put 5,000 cubic yards as the unit of work for excavation in Phase 1 and 5,000 cubic yards as the unit of work for excavation in Phase 2. Extreme accuracy is not required. It is only necessary that the parts of activities sum to the whole, but a percent or two of error on any phase will not affect the results.
- Use the production rates to convert the units of work into work days. Do this for each activity in each phase.
- Enter activities to draw the Bar Chart for Estimating Contract Time (Appendix B).
- Conversion from working days to calendar days will be made by use of the Dura-Lator worksheet
- Winter shut down due to seasonal limitations will be addressed if the contract duration requires the work to occur during two or more construction seasons.
- Status of utility report from the Right of Way Division will be checked to determine if any time adjustments are needed before the project is advertised or the Contractor will be able to start work. Also a determination should be made for coordination with utilities for any concurrent utility relocation work required.

Establishing Production Rates

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 have been established in the VDOT’s written procedures based on project size, geographic location, project type (grading, structures, etc.), size, location and complexity for all items of work. This enables VDOT to assign the production rate accordingly (low, moderate, and high).

As part of this procedure for determining contract completion dates, VDOT has established "Guidelines for Production Rates and Chart for Contract Duration." This document contains a set of production rates for many of the activities that occur in highway/bridge construction projects. Production rates for all possible activities are not included nor are all production rates used in each construction job. The production rates may have to be supplemented with information from other sources and should be adjusted with good engineering judgment and past experience with similar work. See Appendix C.

Other Factors Which Influence Contract Time

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. Inclement weather conditions;
3. Curing time and waiting periods between successive paving courses or between concrete placement operations, as well as specified embankment settlement periods; Emergency conditions.
4. Minimize annoyances in residential areas.
5. Minimize traffic disruption and delay in high traffic areas.
6. Political sensitivity and public awareness.
7. Coordination with adjoining projects to provide usable roadway sections to avoid conflicting operations.
8. Seasonal limitations for certain items when determining both the number of days the contractor will be able to work as well as production rates;
9. Time for reviewing false-work plans, shop drawings, post-tensioning plans, mix designs, etc.
10. Time for fabrication of structural steel and other specialty items;
11. Coordination with utilities;
12. Time to obtain necessary permits;
13. The effect of permitting conditions and/or restrictions;
14. Restrictions for nighttime and weekend operations;
15. Time of the year of the letting as well as duration of the project;
16. Additional time for obtaining specialty items or materials with long-lead requirements;
17. Other pertinent items as determined by VDOT.

In setting contract time it is recommended that calendar days or a completion date be applied to all construction projects. 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.

Adapting Production Rates to a Particular Project

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.

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.

Computation of Contract Time - Developing a Progress Schedule

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.

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.

Techniques to Calculate Contract Time:

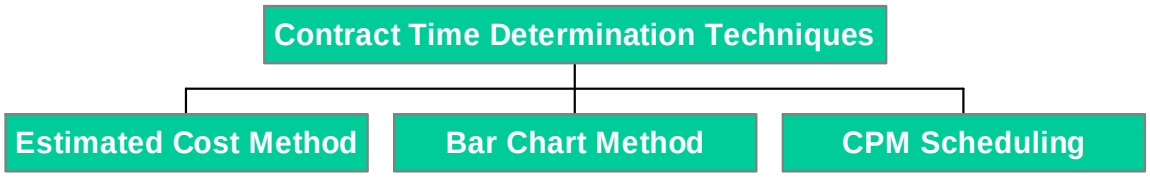


Figure 3: Contract Time Determination Methods

<u>Estimated Cost Method:</u>

The Estimated Cost Method is applicable for projects in which there is primarily one (1) type of work and that work type / component will be performed in a linear fashion. The project should also have a well defined scope of work resulting in minimal risk and uncertainty.

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.

Example of an Estimated Cost Method type for Contract Time Determination

- For example, from historical data and past experience on projects of similar types/conditions, let's estimate that $2 Million of construction work was accomplished in 80 calendar days.
- Current Engineer's estimate shows that the project construction cost to be around $3 Million.
- Calculate ratio using interpolation:

80 days / $2M = x days / $3M, where "x" is the Contract time

$$\frac{80 \text{ days}}{\$2 \text{ M}} = \frac{x \text{ days}}{\$3 \text{ M}}$$

- By cross multiplying the calculation indicates the Contract Time (x) = 120 days
- Add 120 days to Notice to Proceed / Construction Start to get the Contract Completion date.

Bar Chart:

The Bar Chart Method is applicable for use with projects in which there are relatively few work components with easily understood relationships between the components. The project should also have a well defined scope of work. A level of uncertainty unlikely to result in significant changes may be present.

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. A brief description of the procedure used to develop a bar chart to determine contract time is as follows:

1. The first step in developing a bar chart is to break a project down into separate activities or operations necessary for project completion.
2. 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.

3. 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.
4. 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.

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.

Critical Path Method (CPM):

The Critical Path Method is appropriate for projects with several components with complex relationships. These projects exhibit a reasonable potential for significant changes and uncertainty that may result in sequence modifications and / or scope adjustments.

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 Precedent Diagramming Method (PDM) 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.

Methodology:

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:
    A. It is an accurate technique for determining contract time and verifying that the project can be constructed as designed and with identified construction sequences;
    B. 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
    C. Activities responsible for delays can be identified and corrective measures to keep a project on schedule can be determined.
7. Disadvantages of using the CPM include:
    A. The CPM requires experienced and knowledgeable staff to be used effectively;
    B. They require regular updates to assure that the contractor's operation is accurately represented.

Scheduling Software

VDOT has adopted the use of Primavera e/c software as the scheduling software to maintain a database of all pre-advertisement, active and post construction schedule for Category III and above type schedules.

Work Breakdown Structure (WBS)

A hierarchical framework used to define and organize the project work. Use the following 5-level WBS structure to develop project schedules.

Level	**Title**	**Description**
I	Project	The project
II	Major Phase	This level subdivides the project into the major phases that comprise the project. (e.g., administrative, procurement, construction, etc.)
III	Major Work Item	This level subdivides each of the major phases into major work components or deliverables. (e.g., under the construction phase: bridge 1, bridge 2, roadway, etc.)
IV	Work Package	This level subdivides each of the major work items into work packages or components. (e.g., under bridge 1: abutment, approach, span, etc.)
V	Activity	This level subdivides each of the work packages into specific work activities. (e.g., abutment: excavate for abut, FRP abutment foundation, etc.)

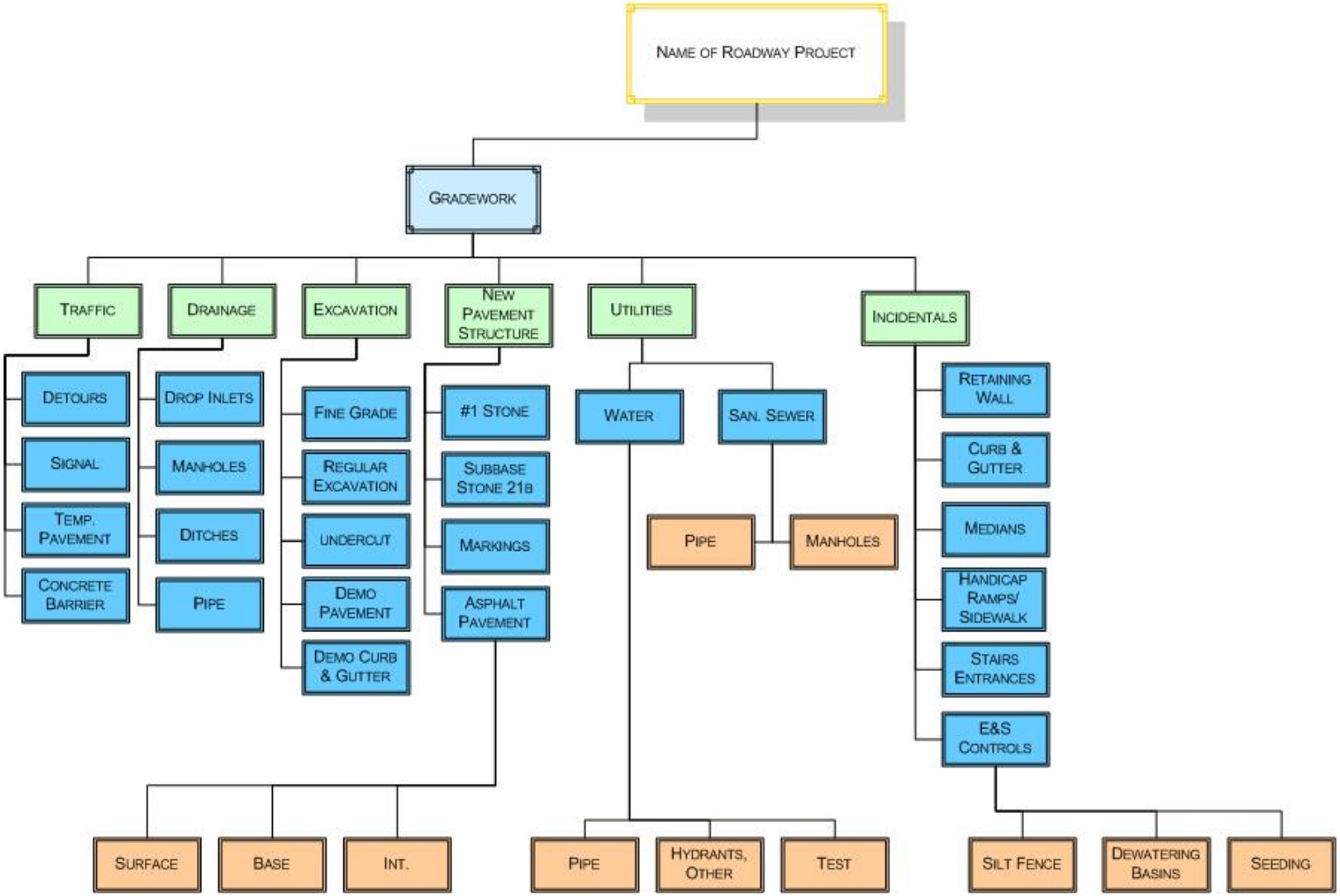


Figure 4: Typical WBS for Roadway Construction

Figure C – Typical Roadway WBS

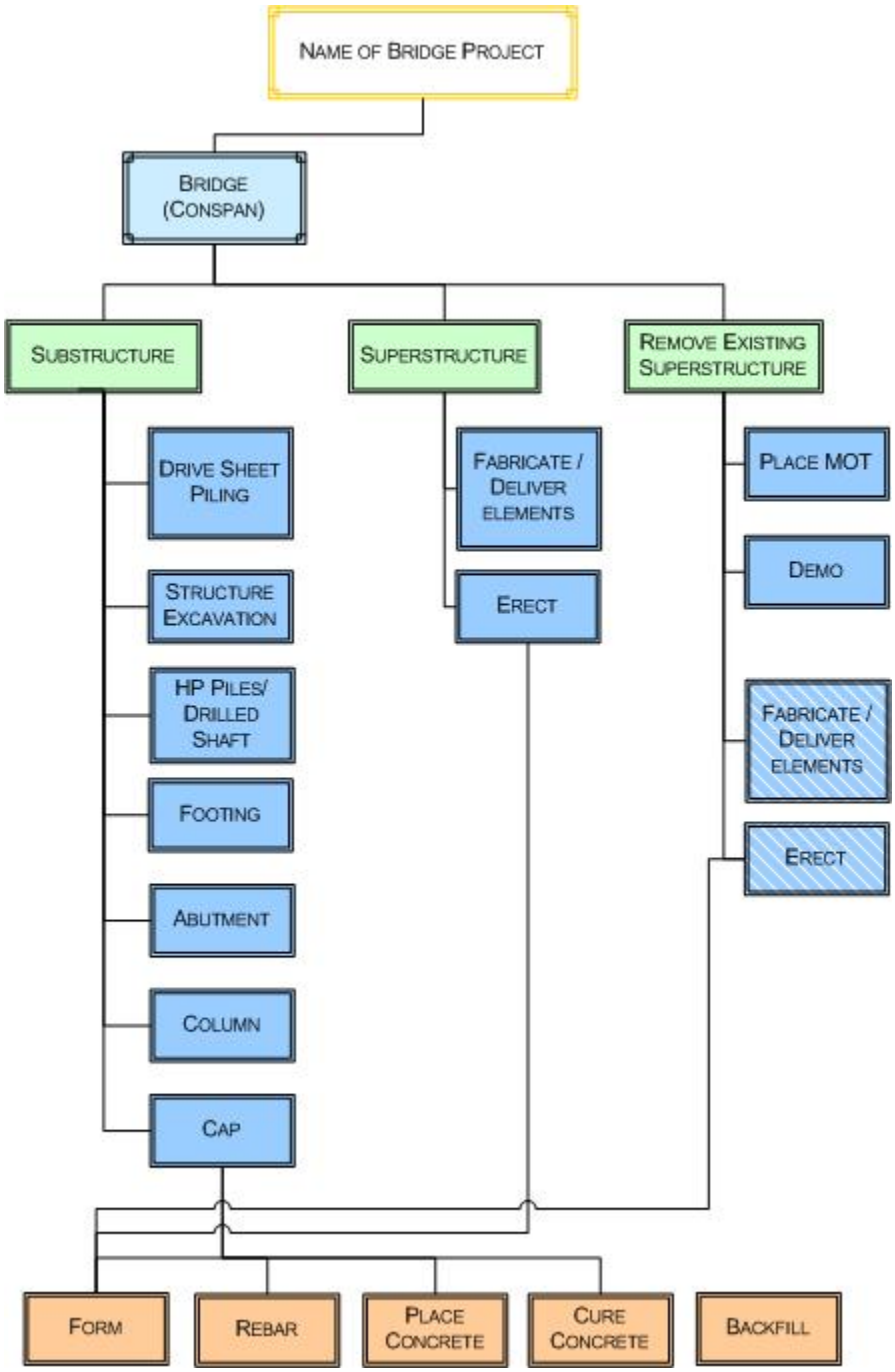


Figure 5: Typical WBS for Bridge Construction

Activity Codes:

All pre-advertisement schedules shall be categorized and the activities coded as listed below:

RESP: Responsibility
Prime Contractor
Sub-Contractor
Fabricator
Utility Companies
Other Government Agencies

AREA: Area of Construction
Direction (NB / SB, etc.) with station limits for grading work
Bridge numbers
Box Culverts
Storm Water Management Ponds
Electrical

CLAS: Class of Work

Bridge items

SHEE	Sheeting
BDST	Clearing site, bridge
COCU	Concrete culverts
PILE	Piles
WALL	Noise Barrier
BRST	Temporary Shielding
COFF	Cofferdams
REIN	Reinforcing Steel
TEST	Temporary Structure
DECK	Deck Repair
CONS	Structural Concrete
DIVE	Underwater Inspection
STEL	Structural Steel
PREC	Precast/Prestressed Beams
OSIG	Overhead/Cantilever signs
BEXC	Bridge Excavation
BMIC	Bridge Miscellaneous (Fence, railing, joints, guiderail, etc.)

Road Items

CLER	Clearing site items
DRAN	Drainage items
EART	Earthwork items
PAVE	Asphalt Pavement items
LAND	Landscape items
UTIL	Utility items
MISC	Miscellaneous items
ELEC	Electrical and Signal items
CURB	Curb items
MAIN	Maintenance of traffic items
LTSD	Traffic stripes, signs and delineators
AGGR	Aggregates (Subbase, DGABC, etc.)
ITSW	ITS Work
CONC	Concrete Pavement
DEMO	Demolition
ENVR	Environmental
MILL	Milling
SLAB	Approach and Transition Slabs
RCSC	Removal of Concrete Base and Roadway
RDST	Removal of curb
WALK	Sidewalks and Driveways
THLS	Temporary Lighting
FENC	Fence
BRAL	Beam Guide Rail

Calendar Types:

Calendars shall be assigned to each activity according to one of the following conditions as stated below:

Global 7-Day Calendar (7 days/week, 24 hours/day). This calendar has no allowances for holidays or weekends. This calendar is used for administrative items such as the advertisement and award periods, shop drawing submittals, Department reviews and concrete curing.

Standard 5-Day Calendar (5 days/week, 8 hours/day) is the default calendar and is used to represent a standard five (5) day workweek (Monday through Friday) with time off for the following holidays: New Year's Day, Memorial Day, 4th of July, Labor Day, Thanksgiving, and Christmas as defined in the 2002 VDOT Road and Bridge Specifications. Normal weather conditions considered unfavorable were included in this calendar as non-work days. Unfavorable weather days were forecast based on NOAA historical data for the last five (5) years with a 0.10" threshold.

Winter Calendar restricts number of workdays for intermediate and surface asphalt, as well as cement treated aggregate between December 24th and March 15th due to specified temperature limitations identified in the 2002 Road and Bridge Specifications. In addition, most asphalt plants shut down during a portion of this period. The scheduler has used his judgment in the determination of other temperature sensitive activities such as base asphalt, as these tend to be a function of a particular projects' importance to the regional transportation network.

Environmental Calendar is necessary to account for in stream restrictions due to permitting restrictions between February 15th and June 30th of each year. This includes restricting activities that can

disturb water born habitats, (pile driving, cofferdams, dredging, excavation), during certain seasonal periods.

Landscaping Calendar restricts landscaping activities specifically for plants between April 1st and September 30th of each year.

Other Calendars are generally applicable to special circumstances where the work hours may be 10 or 12 shifts and the work week may last for 4 or 6 days per week. These types of calendars are appropriate for emergency contracts.

Best Practices

In developing a schedule, the following best practices shall be adapted:

- Clearly defined activities.
- Good logic.
- Negative lags will not be permitted.
- Do not use a Finish to Start relationship with a lag. An activity must be added to represent the lag time.
- A project shall have one beginning and one end. All activities shall have a predecessor and successor except the project's start and finish milestones. No "Open Ends" will be permitted.
- Durations of work activities shall not exceed the update cycle (30 calendar days). Longer durations are okay provided there is a quantitative means for measuring progress.
- If an activity has a Start-to-Start relationship - it shall be closed with a Finish-to-Finish or Finish-to-Start relationship. (No open ends)
- All intermediate milestones (Interim Completion Dates) required for the project shall be shown in proper logical sequence and input as either the "Start-no-Earlier-Than" or "Finish-no-Later-Than" date. Use of Mandatory Finish and Mandatory Starts while scheduling through Primavera e/c software is not advisable.

Schedule Narrative

All Contract Time Determination shall include a Schedule Narrative Package as referenced in Appendix D.

Appendix A – Scheduling Terms

Activity. A discrete, identifiable task or event that takes time, has a definable start and stop date, furthers the work's progress, and can be used to plan, schedule, and monitor a project.

Activity, Controlling. The first incomplete activity on the critical path. *(Also referred to as the controlling operation.)*

Activity, Critical. Any activity on the critical path.

Activity ID. A unique, alphanumeric, identification code assigned to an activity. *(It is recommended that owners and contractors in a particular industry or region adopt a standard activity numbering system to facilitate the integration of schedules across projects. This system could be tied to the standard specification formats adopted by certain industries, such as the format used by the Construction Specification Institute, the AASHTO Guide Specification, or other similar model or guide specification systems. It could also be tied to a standard work breakdown structure for work typical to the industry. The standard activity numbering system should be set forth in a Scheduling Manual that has been ratified by owners, contractors, subcontractors, and suppliers and then referenced as the standard for activity numbering in the scheduling specification.)*

Activity Network Diagram. *(Also called a pure-logic diagram.)* A graphic representation of a CPM schedule that shows the relationships among activities.

Bar Chart. *(Also called a Gantt chart)* A graphic representation of a schedule without relationships. A timescale appears along the horizontal axis.

Calendar Day. A day on the calendar; beginning and ending at midnight.

Completion Date, Contract. The original date specified in the contract for completion of the project or a revised date resulting from authorized time extensions. The contract may also specify completion dates for interim milestones, phases, or other portions of the project.

Completion Date, Scheduled. The completion date projected or forecasted by the schedule. The schedule may also project or forecast interim completion dates for milestones, phases, or other portions of the project.

Constraints. A restriction imposed on the start or finish dates of an activity that modifies or overrides the activity's logic relationships.

Critical Path. The Longest Path.

Critical Path Method (CPM) – A network analysis technique used to predict duration by analyzing which sequence of activities (which path) has the least amount of scheduling flexibility (the least amount of float). Early dates are calculated by means of a forward pass using a specified start date. Late dates are calculated by means of a backward pass starting from a specified completion date (usually the forward pass's calculated project early finish date).

Data Date. The first day in the Initial or Baseline Schedule and the first day for performance of the work remaining in the Monthly Schedule Update or Revised Schedule. *(May also be defined as the date from which a schedule is calculated.)*

Duration, Original. The estimated time, expressed in workdays, needed to perform an activity.

Duration, Remaining. The estimated time, expressed in workdays, needed to complete an activity.

Float, Free. The amount of time an activity can be delayed and not delay its successor(s).

Float, Total. The amount of time an activity can be delayed and not delay the project completion date.

Holidays. Holidays observed are:

1st day in January (New Year's Day)
3rd Monday in January (Martin Luther King, Jr. Day)
3rd Monday in February (Presidents' Day)
Last Monday in May (Memorial Day)
4th day in July (Independence Day)
1st Monday in September (Labor Day)
11th day in November (Veterans Day)
4th Thursday in November (Thanksgiving Day)
25th day in December (Christmas Day)

For holidays that fall on a Saturday, both the Saturday and the preceding Friday are considered to be holidays. For holidays that fall on a Sunday, both the Sunday and the following Monday are considered to be holidays.

Longest Path. The sequence of activities that establishes the scheduled completion date.

Milestone. An activity, with no duration, that is typically used to represent the beginning or end of the project or its interim stages.

Narrative Report. A descriptive report submitted with each schedule. The required contents of this report are set forth in this specification.

Open End. The condition that exists when an activity has either no predecessor or no successor, or when an activity's only predecessor relationship is a finish-to-finish relationship or only successor relationship is a start-to-start relationship.

Predecessor. An activity that is defined by schedule logic to precede another activity. A predecessor may control the start or finish date of its successor.

Relationship. The interdependence among activities. Relationships link an activity to its predecessors and successors. *(A schedule's relationships are sometimes referred to as the logic of the schedule. Examples of relationships are: finish-to-start, start-to-start, and finish-to-finish.)*

Schedule. Activities organized by relationships to depict the plan for execution of a project.

Schedule, Baseline. The accepted schedule showing the original plan to complete the entire project. *(Sometimes known as the as-planned schedule.)*

Successor. An activity that is defined by schedule logic to succeed another activity. The start or finish date of a successor may be controlled by its predecessor.

Relationships Between Activities:

a. Finish to Start - The successor activity can begin only when the current activity completes
b. Finish to Finish – The finish of the successor activity depends on the finish of the current activity
c. Start to Start – The start of the successor activity depends on the start of the current activity

d. Start to Finish – The successor activity cannot finish until the current activity starts

Work Breakdown Structure (WBS) - A deliverable-oriented grouping of project elements, which organizes and defines the total scope of the project. Each descending level represents an increasingly detailed definition of a project component.

Working Schedule – A schedule utilized for duration of a project for creation of the baseline schedule and updates.

Work Package - A deliverable at the lowest level of the work breakdown structure. A work package contains activities.

Appendix B – Bar Chart Worksheet Instructions

The following instructions contain the recommended steps for using the bar chart worksheet. The production rate sheet should be used for selecting base production rates.

1.) In the Description column, enter the work activities.
   a. Class Example – Initial traffic control, Demolish existing structure, Demolish pavement, Abutment A Reconstruction, Abutment B Reconstruction, Pier 1 Reconstruction, Pier 2 Reconstruction, Riprap slope protection, Place structural steel, Form & Pour Deck, Cure Deck, Parapet, Grade and Paving
   b. The following are given durations: Demolish Existing Structure – 21 days, Grade and Paving - 15 days, Piers 1 & 2 Reconstruction – 8 days each
2.) In the ID No. column, enter the numbers 1-13.
3.) In the contract quantity column, enter the quantities from the proposal.
   a. Note: If the user selects the number of days to complete an activity, for example, 8 days for abutment construction, he or she should enter 8 days in the contract quantity column and 1 day as the base production rate.
4.) In the units columns, before and after the base production rate column, list the appropriate units for the work activity.
5.) In the base production rate column, enter the base production rates using the reference sheet as guidance.
6.) Click the second sheet in excel to access the adjusted production rate calculator. Select the appropriate selection of factors specific to your project. Except for special circumstances, no more than 2 factors should be selected since several factors have similar effects on production.
7.) In the preceding activity column, under ID, assign logic to your work activities, thinking in terms of crews. For the class example, we will most likely have one bridge crew working in a linear manner from start to completion. Some of the grade and paving work is likely to be subcontracted and could be formed concurrently to some extent. For projects under 2 million, it will be most common to have 1 or 2 crews working concurrently with additional subcontractor activity possible.
8.) In the preceding activity column, under percent complete, enter the percent a preceding activity must complete before the successor activity can start.
9.) Using the Hide feature in excel, hide the lines not used for you schedule.
10.) Review bar chart to check logic to make sure it makes sense, and to double check for concurrent activities.
11.) Review the total working days and apply the figure to the weather conversion calendar (Dura-Lator) to establish a fixed date.

Appendix C – EBK (Experience Based Knowledge)

VDOT VirginiaTech Partnership for Project Scheduling

Take a Tour

1 Introduction
2 Background
FHWA Guidelines Overview
FHWA Essential Elements
Establishing Production Rates
VT-VDOT Partnership
3 Performance Time Data (PTD's)
Overview
Matrix
Parameters
4 Experience Based Knowledge Database (EBK)
Developing EBK Production Data
What is EBK?
Why Assemble EBK?
What is Source of the EBK Data?
What is the EBK Format?
5 User's Guide
6 FAQ
7 Contact Information

1 Introduction

For projects of minimal complexity, the sum of the work for major activities as determined by dividing the contract quantity by the production rate is the estimated construction duration.

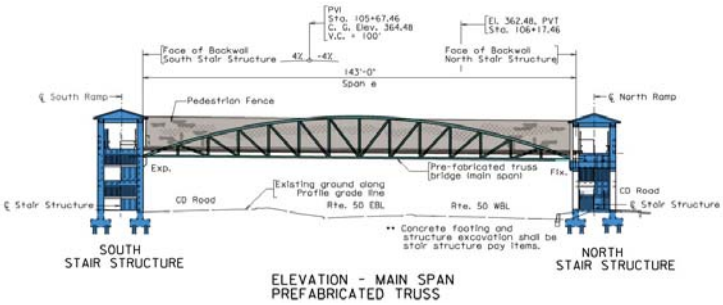
Activity Description	Unit	Quantity	Calculated Duration
Mobilization	Days	1	2
Grading	LS	1	3
Aggregate Sub-base #21B	Tons	164	2
Std. Comb. Curb & Gutter CG-6	LF	60	2
Rad. Comb. Curb & Gutter CG-7	LF	13	2
CG-12 Detectable Warning Surface	SY	7	1
Hydraulic Cement Conc. Sidewalk (4")	SY	345	2
Siltation Control Excavation	CY	49	1
		Total Working Days	**15**

Pre-Bid Conceptual Schedule for Contract Time Determination

Project #
0050-029-138, C501
Rte 50 Pedestrian Bridge
PPMS # 56866/56780

December 4, 2007

Pedestrian Bridge over Route 50



Virginia Department of Transportation

NOVA District • Project Controls

Pre-Bid Conceptual Schedule for Contract Time Determination

Project #
0050-029-138, C501
Rte 50 Pedestrian Bridge
Fairfax
PPMS # 56866/56780

December 4, 2007

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Conceptual Schedule for

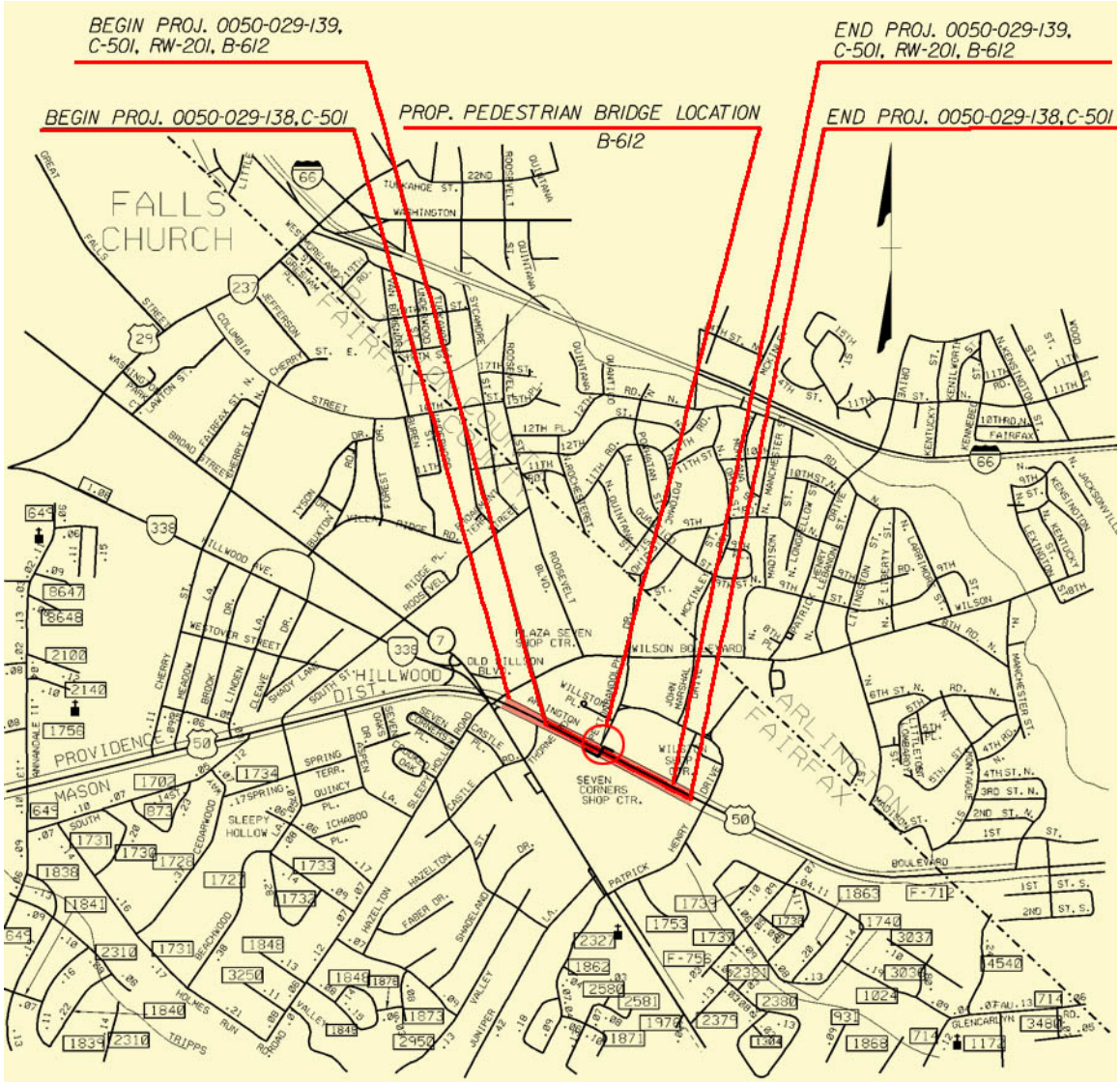
Contract Time Determination……..1

Production Rates……2

CPM Graphics……..3

Overview

The objective of this project is to provide pedestrians with a facility to cross Arlington Boulevard and to prevent pedestrians from crossing the road at undesignated, mid-block areas. The main features of the project are the pedestrian bridge which will be a steel truss bridge with ADA-compliant ramps, and the vinyl-coated chain link fencing. The bridge links the northern side of Route 50 with the southern side at the shopping center and the areas where the future transit center will be located. Since this project is strictly initiated to protect pedestrian traffic, a chain link fence will be placed on both sides of the roadway between the service roads and Route 50. The chain link fence will be augmented with landscaping in certain locations on the project, both to discourage scaling the fence and to make it more aesthetically pleasing. An additional fence will be added on the main span of the bridge to provide additional safety for the traveling public and for pedestrians. The bridge and ramps will be lit with pedestrian-scale lighting.



A conceptual critical path method (CPM) schedule was developed for this project using plans provided by the NOVA Location & Design section. The plans reviewed were dated October 2006.

The NOVA Project Controls Team was requested to develop a conceptual schedule in September 2006. As part of the development of the Conceptual CPM Schedule, a Schedule Narrative was authored. This Schedule Narrative outlines the information used to develop the schedule, explain the basis of the construction logic employed, assumptions made, production rates, sensitivity factors, calculated durations, calendar considerations and other items.

Conceptual Schedule Narrative:

I. Methodology

Scheduling Guidelines

- The Conceptual Schedule was developed using NOVA's Interim Pre-construction CPM Scheduling guidelines for the Purpose of Contract Time Determinations, April 2005.
- Productivity Rates were as provided by the VDOT-VT Partnership for Scheduling, spring 2005. These interim productivity rates with project specific adjustment factors (sensitivity factors) were developed by the Scheduling Partnership from average rates published in five (5) nearby states, (KY, TN, NJ, WV, GA).
- Correction factors of the base production rate were used to calculate activity duration using an Excel Spreadsheet program developed by the VDOT-VT Partnership for Scheduling.
- Primavera (P3) software was used to assist in the analysis.

Example of duration calculations for total project planned activities

Description	Contract Quantity	Units	Base Production Rate	Units	Working Day Duration
Phase I					
Mobilization	5	days	1	days	**5**
Submittals for Water Line	22	days	1	days	**22**
Submittals for Structural and Bridge	22	days	1	days	**22**
Review time for FCWA	22	days	1	days	**22**
Review time for VDOT Structural and Bridge	22	days	1	days	**22**
Install MOT and set up Detour	5	days	5	days	**2**
Install 60" RCP (280.0 LF)	280	lf	48	lf	**22**
Remove 60" RCP install Temp. Drainage	40	lf	100	lf	**2**
Install Str 5-6, 5-7, 5-11, 5-13, 5-9, 5-10, 5-14	7	days	2	days	**7**
Install pipe between Str 5-11 to 5-13	126	lf	144	lf	**2**
Install pipe between 5-9, 5-10 and 5-14	45	lf	144	lf	**1**
Demo existing Asphalt, CG & Retaining Wall	700	cy	1,500	cy	**2**

II. References:

The Conceptual CPM Schedule was developed based on the following information available at the time of preparation:

- Pre-advertisement Roadway Plans, as provided in October 2006.
- Quantities were estimated from Plans date October 2006.

III. Calendars

Calendars were assigned to each activity according to one of the following conditions as stated below.

2 – Global 7-Day Calendar (7 days/week, 24 hours/day). This calendar has no allowances for holidays or weekends. This calendar is used for administrative items such as the advertisement and award periods, shop drawing submittals, Department reviews.

3 – Standard 5-Day Calendar (5 days/week, 8 hours/day) is the default calendar and is used to represent a standard five (5) day workweek (Monday through Friday) with time off for the following holidays: New Year's Day, Memorial Day, 4th of July, Labor Day, Thanksgiving, and Christmas as defined in the 2002 Road and Bridge Specifications. Normal weather conditions considered unfavorable were included in this calendar as non work days. Unfavorable weather days were forecast based on NOAA historical data for the last five (5) years with a 0.10" threshold. For additional information, see NOVA's *Interim Preconstruction CPM Scheduling Guidelines for the Purpose of Contract Time Determination – April 2005.*

4 – Winter Calendar restricts number of workdays for intermediate and surface asphalt, as well as cement treated aggregate between December 24th and March 15th due to specified temperature limitations identified in the 2002 Road and Bridge Specifications. In addition, most asphalt plants shut down during a portion of this period. The scheduler has used their judgment in the determination of other temperature sensitive activities such as base asphalt, as these tend to be a function of a particular projects' importance to the regional transportation network. In addition, the placement of some concrete activities for pavement structure was restricted during this time period.

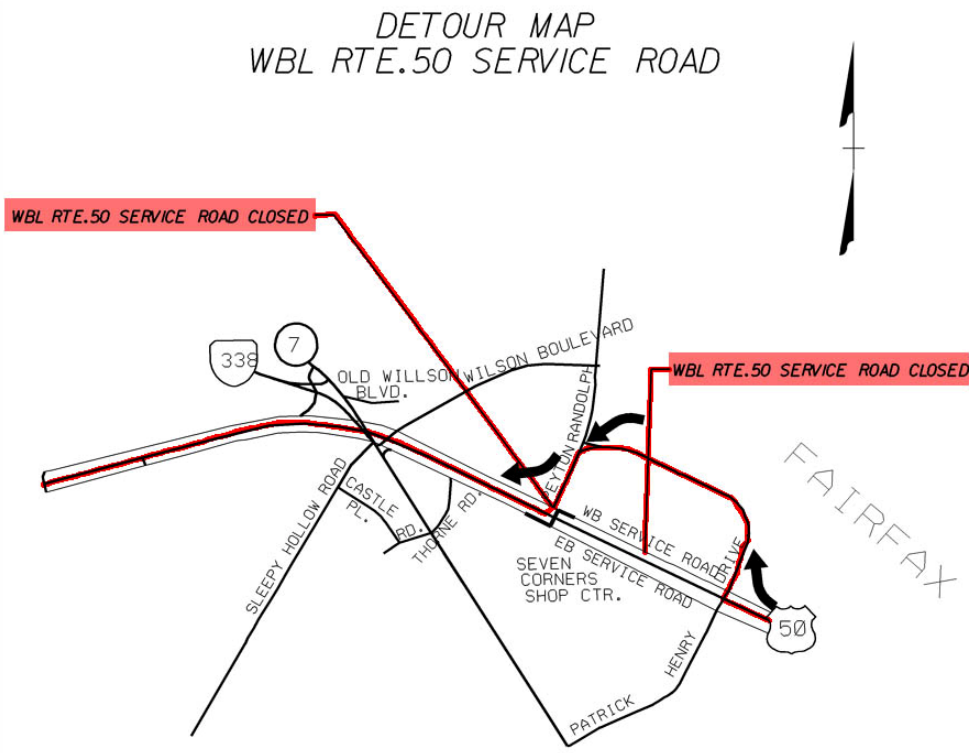
5 - Planting Calendar restricts the placement of landscaping items between April 1st and September 30th. This constraint is typically identified in project specific Special Provisions or on the Landscaping Summary Sheet of the project plans.

IV. Resources and Approach:

The project was broken into four (4) Phases:

Phase I:

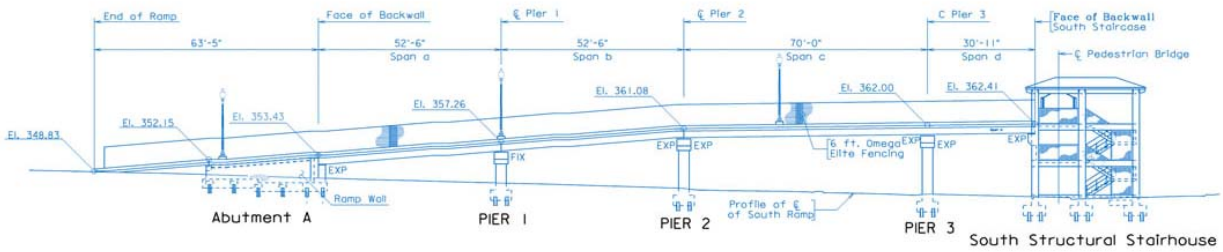
Close one lane along Westbound Route 50 and the slip ramp on the service road using concrete barrier. Install and complete the new sixty (60”) inch storm drainage pipe prior to removing the existing sixty (60”) inch. Remove existing curb and gutter, sidewalk and retaining wall.



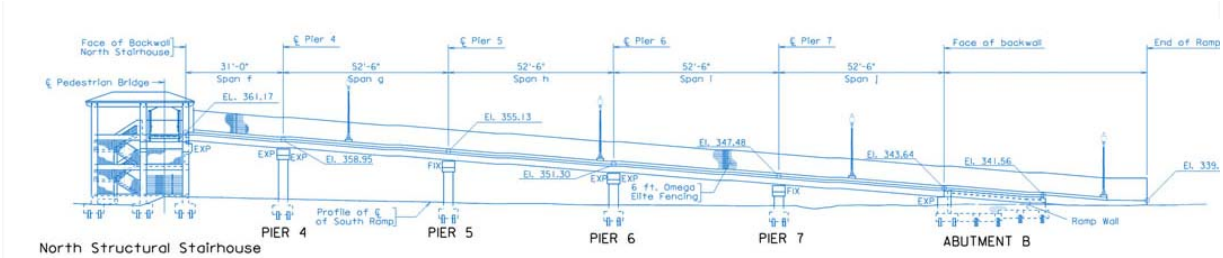
Detour for Phase I and II

Phase II:

Continue to close one (1) lane along westbound Route 50 and the service road prior to any utility work. Install proposed water and sewer lines with a temporary pump around station to handle the sanitary sewer flow. Once the existing utilities are relocated then construction of the bridge and stairwell can begin. Construct the median barrier, sidewalks and all curb and gutter and pavement.



ELEVATION - SOUTH RAMP



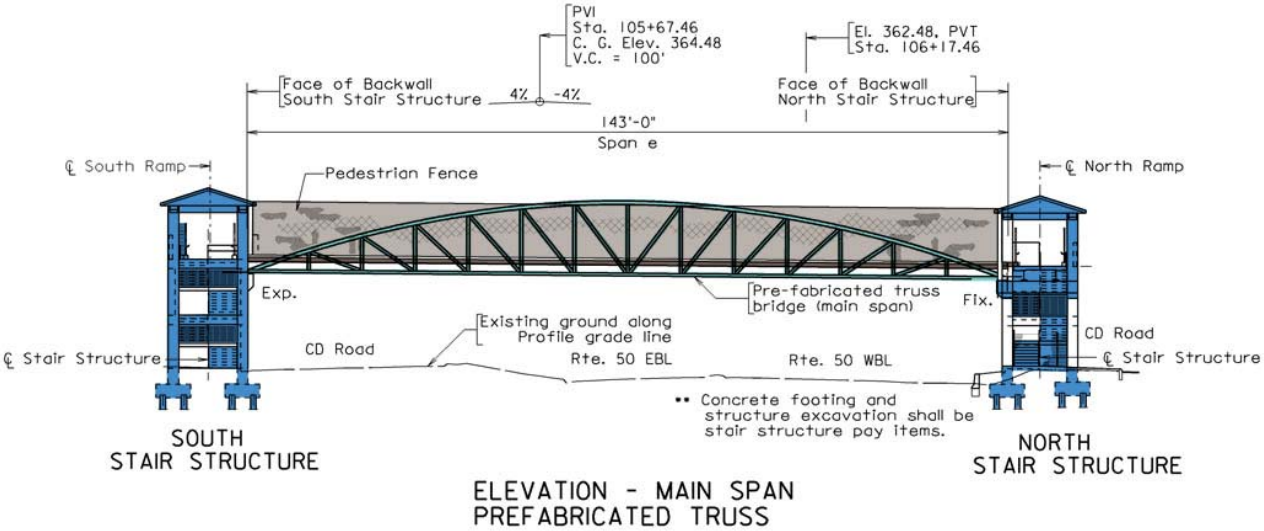
ELEVATION - NORTH RAMP

Phase III:

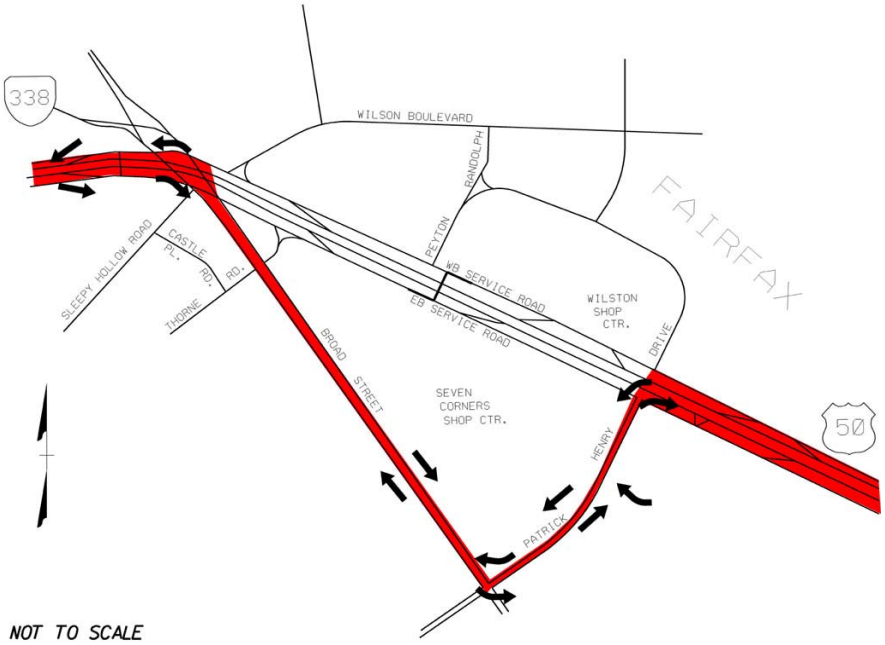
Close one (1) lane along eastbound service road and begin with pavement demolition. Install drainage and remove existing drainage structures. Demo existing curb and gutter, asphalt prior to construction of the bridge and stairwells. Construct all proposed curb, gutter, sidewalk and asphalt.

Phase IV:

Place the Pre-Fabricated portion of the Bridge and complete all remaining bridge work, like the pedestrian fence, etc.



ELEVATION - MAIN SPAN
PREFABRICATED TRUSS



Detour for Phase IV

Sub-contractors were anticipated for fence, curb and gutter, paving and pavement marking related activities.

V. Assumptions

The following assumptions were used in the schedule development:

- All storm drainage, water and sanitary sewer line work shall be completed prior to starting bridge work on the approach ramps.
- All Roadway closure with detour stated in the plans are permitted in conjunction with local Governments and NOVA Traffic Engineering.
- Allow a 30 day review time for NOVA's Structures and Bridge (as per contract).
- Allow a 45 day review time for Fairfax County Water Authority (FCWA) water and sewer line items.
- There are no utility conflicts except as noted in the plans or any issues with the MOT.
- Project is expected to be advertised on June 12, 2007 with N.T.P. issued no later than 60 days from the bid opening.
- Normal workday includes an 8-hour shift, Monday through Friday excluding major holidays.
- All permits will be obtained prior to N.T.P.
- The Contractor is responsible for procuring a staging area for stockpiling material and assembling beams.
- Route 50 can only be completely closed from 09:00 PM Saturday night to 05:00 AM Sunday during erection of the pre-fabricated pedestrian bridge trusses over Route 50.
- Contractor will adequately plan his/her work according to the sequence of construction provided in the contract documents and prosecute the work in a continuous fashion.
- It was also assumed that all work associated with the water and sewer line (i.e. connections, testing, engaging and disengaging of the old and new water line) can occur at any time and does not require advanced notification to FCWA other than the standard 48 hours notification prior to any tie-ins or testing.

VI. Findings

The Conceptual Contract time for the work as identified in the latest plan submission, October 2006 reveals some 264 calendar days or some nine (9) months is warranted for construction duration. This was determined using an assumed NTP of September 22, 2007. Consideration was given to the contract time assigned for construction assuming construction would commence immediately following the NTP. As this project for the most part consists of bridge work, weather considerations are not the drivers for successful contract completion, yet certainly will impact the project should the commencement be later in the construction season as opposed to late spring / early summer at the beginning of the construction season.

Based on the information available and assumptions as stated above, the Project Controls team recommends a Substantial Completion date of May 14, 2008 and a fixed end date of June 12, 2008. The intent of the Substantial Completion is to require the Contractor to complete all contract work by May 14, 2008 with the exception of the work directly related to punch list items, minor amounts of incidental

construction outside the limits of the roadway, seeding/ over seeding to ensure establishment of permanent vegetative cover in accordance with Department of Conservation and Recreation (DCR) E&S minimum standards MS-3. In addition, the period between the substantial completion and the contract completion allows for the Contractor to remove all temporary erosion and sedimentation control measures after final site stabilization in accordance with DCR minimum standards MS-18. The above recommendations are subsequent to consultation with Fairfax Construction and with their concurrence.