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Contract Time Determination in Project Development

July 2011

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Section 100 Contract Time Determination

SECTION 100.00 – CONTRACT TIME DETERMINATION

FHWA GUIDE FOR CONSTRUCTION CONTRACT TIME DETERMINATION PROCEDURES

100.01 Introduction. 23 Code of Federal Regulations 635.121 states that: State Transportation Agencies should have adequate written procedures for the determination of contract time. FHWA provides a Guide for construction time determination in "FHWA GUIDE FOR CONSTRUCTION CONTRACT TIME DETERMINATION PROCEDURES", which is found at

http://www.fhwa.dot.gov/legsregs/directives/techadvs/t508015.htm

There are three general methods to control contract time. These are working days, calendar days, and completion dates. There are, also, various methods to determine contract time or working days necessary to complete a project. While many of the more complex methods offer advantages in project control and monitoring, it appears that they offer only a minimal, if any, improvement in contract time determination. A contract time determination method must allow a designer the ability to estimate a reasonable construction time even though he does not know the particular method or order the job will be constructed by or the type, capacity or quantity of equipment to be used.

If a calendar day or completion date method is selected for a project, a working day calculation must be made. This is to assure that the construction can be completed without significant acceleration or that it does not allow extensive lag time which must be addressed to minimize any effect on the traveling public. Incentive tools may be used to expedite construction and reduce delay and inconvenience to the traveling public caused by construction.

100.02 Procedure. The following procedure to estimate working days incorporates some of the advantages of the Critical Path Method (CPM), Gantt (bar chart), and Precedence methods while retaining a relatively uncomplicated process. A step-by-step approach is used in which the project is analyzed for major critical items. Then each of these items are analyzed for an estimated duration based on quantity, activity, and project type. Finally, this duration's are placed on a modified bar chart, identifying which items could be constructed concurrently, to arrive at a total overall number of working days.

100.03 Forms for Hand Calculations

- Project Working Day Calculation Sheet Appendix A-Worksheet One
- Project Time Adjustment Factors Sheet Appendix A-Worksheet Two
- Contract Time for Completion Sheet Appendix A-Worksheet Three
- Average Productivity Rates Appendix B

100.04 Computerized Method. The procedure outlined below lends itself very well to project scheduling software such as MS Project. The work activities, quantities, and productivity rate can be entered into the standard entry table. A bar chart can be generated directly from this information by MS Project. The activity bars can easily be moved or altered to create a completed schedule. Printouts of the standard activity table and bar chart would replace Worksheet Three.

100.05 Step One. This step involves reviewing the plans, specification and other items to obtain a scope or understanding of the work involved by the person who is estimating the working time. From this investigation and review all necessary work that will be performed to complete the project should be identified. The designer shall prepare the contract time determination and, as a minimum, input should be obtained from the Project Development Engineer and Resident Engineer. On more complicated projects additional people should be included such as the Assistant District Engineer, the Traffic Engineer, Material Engineer and possibly the Bridge Engineer.

Begin Worksheet One “Project Working Day Calculation” by completing the heading information to identify the project. The blank, Type of Time, should note the type of contract time the District desires for this project, either working, days, calendar days, or completion date. (Type may be influenced by environmental constraints.)

100.06 Step Two. Identify all critical or time consuming activities necessary to complete the project. Critical activities are those which cannot be delayed without delay of the project finish date. For the purposes of this analysis, the work should be viewed on the basis of pay item quantities or major work activities by type. General criteria to help identify critical items are:

1. Area of responsibility
2. Craft or crew requirements

3. Equipment requirements & Availability
4. Material requirements
5. Subdivision of work
6. Location of Work
7. Bid or pay items

The list should include all critical bid items, but may include several in one activity. Appendix B contains some of the critical bid items. Activities should be listed in the order in which they would be completed using the second column, titled Work Activities, of Worksheet One. If you are not certain whether the activity is critical, list it anyway because the final time relationship bar chart will determine if it is necessary. All pay items need not be listed. Items such as Traffic Control would seldom be on the critical path. The quantity for each work activity should be listed in the third column. Additional worksheets may be used if necessary.

The Bridge Section will complete a time determination for any structure they design within a project. The worksheets and bar chart will be sent to the District with the C.A. Submittal. The structure should be added as a single line in the Districts Project Time Determination.

100.07 Step Three. A production rate should be assigned to each activity and placed in the fourth column, titled Productivity Rate. These may be obtained from the attached average rate tables or estimated based on the project type, local conditions, and construction restrictions. Appendix B contains a set of tables of statewide average productivity rates for significant work activities. The tables are meant as a guide and the values should be adjusted to reflect the actual productivity for the specific type and size of project being analyzed. Activities which do not appear in the following tables should be estimated by discussion with the Resident Engineer or other resources.

100.08 Step Four. Calculate duration for each activity that has been identified. The activity duration shall be expressed in working days. To determine an activity's duration, divide the activity quantity by the selected productivity rate and place this answer in the fifth column, marked Duration Work, expressed as whole days.

100.09 Step Five. Establish the construction logic for the project and identify the relationships between work activities. This step involves identifying, for each activity, the other activities that must be completed before it can begin. All preceding time consuming activities should be noted. These activities can be entered in the sixth column titled Preceding Activities. Sometimes activities can begin before the preceding activity is completely finished. This can be accounted for in the bar graph time line beginning the activity when the appropriate portion of the preceding activity has been accomplished or by splitting the preceding activity into two parts, i.e., production and placement or form, pour, and cure. Can also use a PERT diagram.

100.10 Step Six. At this time it is important to identify factors that may influence job construction. Many other factors may influence or control contract time. They may dictate a beginning, and ending, or a stop work time for certain activities or the entire project. Or they may extend or complicate a portion of the work. These factors may also be calendar dates which the person estimating working days should identify. Following are other factors and consideration which should be reviewed to determine what may alter an activity's duration or the project's completion:

Coordination with utilities	Availability of Materials
High traffic volumes	Local school, business or civic events
Climatic regions	Duration of project
Environmental concerns	Concurrent construction project
Irrigation season	Time of year for letting contract
Sole source contractor workload	Geographic regions/location
Curing time for concrete	Working with traffic
Review time-shop drawings & false work	Urgency of completion
Acquiring permits or licenses	Restrictions on time of operation
Fabrication time	

Worksheet Two "Project Time Adjustment Factors" helps identify this delay time and assign it to the proper work activities. Each of the adjustment listed above are on worksheet two in column one. Other factors that may influence work activities can be listed in the blank lines below. After each adjustment factor list the work activities affected by placing their number in column two. In column three, Additional Days, list the estimated or actual adjustment to the work activity. This time should, also, be placed directly into the activity duration time under column six, other, on Worksheet One.

100.11 Step Seven. Each of the activities listed on Worksheet One should now be listed on Worksheet Three “Contract Time for Completion”. This worksheet will create a bar chart showing critical items and their duration’s to determine the minimum necessary working days to complete this project. Be sure to fill out the second line in the heading of Worksheet Three for Project Type, Anticipated Advertisement Date, and Anticipated Date of Beginning. The typical project type would be a term describing the general work of the project as noted on the Development Program such as:

- Reconstruction/Realignment
- Pavement Rehabilitation /Preservation
- Bridge Replacement
- Minor Widening
- Safety Improvement
- Seal Coat

The “Anticipated Advertisement Date” would be a minimum of 2 months from when the District actually sends the CA Submittal to the Roadway Design Section. The “Anticipated Date of Beginning” would be that time necessary for standard advertisement, approvals, and award. This typically takes three (3) weeks for advertisement and an additional four (4) weeks until the contractor receives “Notice to Proceed”. If the District needs to shorten these times, the Designer should verify with the Roadway Design Engineer that there is available funding, manpower, and resources to accelerate this process.

Columns one and two are for the work activity number and work activity name respectively. Row three, “Working Days, should have a number of working days identified for each period or column to aid in marking the duration bars. There are approximately 22 working days in an average month which could be close enough for a work day calculation.

Columns three, Duration, contains the total duration in working days for each particular work activity which is obtained by adding columns 5 and 6 from Worksheet One. Beginning with the first activity that must be completed, color in the bar next to the work activity to show the number of working days necessary to complete it. Then move to the next activity that must be completed and color in the bar next to this activity, beginning at the point where it's preceding activity (as noted in step six) was completed. Sometimes several activities may begin at the same point or an activity maybe before the preceding activity is complete. This should be shown by beginning the bar accordingly. It is often helpful to write the ending total or date above each bar to ease constructing the chart.

100.12 Step Eight. When all activities are complete the total working day can be determined by taking the total number of days to the end of the last bar. In a group session, the work day estimates shall be discussed with the Project Development Engineer and the Resident Engineer. The final working day estimate (Worksheet One, Two & Three) should be agreed upon, checked and attached to the C.A. submittal.

For calendar day or completion date projects additional information must be added to Worksheet Three. Row one and two can be used to identify a calendar along with the working day calculation. Row One, Year, identifies the year of construction, while each box in Row Two, Month, can identify a month. In this case the specific amount of work days for each month should be identified in Row Three, Working Days." From this you can see if there are enough or too many working days before the completion date or with the number or calendar days allotted.

100.13 Acceleration. In general, the department desires the contractor to complete the project in the shortest time normally necessary. When the working time is restricted such that a contractor must increase his work pace unnaturally or at added cost in defined as acceleration. Acceleration or shortening of the normal time necessary to complete a project can be shown using this process:

A small restriction in the time necessary to complete the project is not consequential, but a significant restriction will result in increased project costs. Mandatory completion dates can, also, cause acceleration by not allowing enough working days to complete the project in the normal manner. Some acceleration may be desirable or necessary and should be accounted for and shown in Worksheet Two. Some common acceleration methods are night work and double shifts. If this is expected of the contractor it should be clearly described in the contract proposal.

100.14 Window of Opportunity. In applying this method the contractor is constrained to actively pursuing the work, which is always in the best interest of the state. On small projects this restriction may be severe enough to eliminate any contractor who is not ready to begin immediately and may drive up the cost of the project. It is not beneficial to extend the number of work days to lend flexibility to attract contractors. However, allowing a window of time between the earliest start date and the mandatory finish date, that is greater than the time necessary, while still limiting the number of working days allowed, can introduce this flexibility.

In other words let's assume that a project needs 12 working days to complete. The specifications allow the contractor to start any time after June 15th but must be completed by August 30th. Once the contractor begins they must complete the work within 12 working days. This allows flexibility in the contract to attract several bidders while still minimizing the delay and impact on the traveling public. Example specifications are available from the Roadway Design Section.

100.15 Summary. A contract time determination using this method is required on all Federal Aid Project and must be included as part of the C.A. Submittal. The Bridge Section will include a time determination for structures with their C.A. submittal to the District. The District should include the bridge working days as a single line in the final time determination and attach the worksheets from the Bridge Section. Monitoring of existing project is recommended to determine if the contract times specified are appropriate. As part of this process, updates and changes to the time determination should be made as necessary.

APPENDIX A WORKSHEETS

ITD 0172 (Rev. 11-05)
itd.idaho.gov

Project Working Day Calculation

Key Number	Project Number	Project Name	Date	Type of Time

Number	Work Activities	Quantity	Productivity Rate	Duration		Preceding Activities
				Work	Other	

ITD 0173 (Rev. 11-05)
itd.idaho.gov

Project Time Adjustment Factors

Key Number	Project Number	Project Name	Date

Adjustment Factors	Work Activities Affected	Additional Days
Coordination With Utilities		
High Traffic Volumes		
Climatic Regions		
Environmental Concerns		
Irrigation Season		
Sole Source Contractor Workload		
Curing Time for Concrete		
Review Time for Shop Drawings and Falsework		
Acquiring Permits or Licenses		
Fabrication Time		
Restrictions on Time of Operation		
Acquiring Specialized Materials		
Local School, Business, or Civic Events		
Other Construction Projects		

CONTRACT TIME FOR COMPLETION

PROJECT NO. ____________________ KEY NO. ________ PROJECT NAME __________________________________ DATE __________

PROJECT TYPE ___________________ Anticipated Advertisement Date ______________ Anticipated Date of Beginning ______________

DATE		YEAR									
		MONTH									
		WORKING DAYS									
#	Work Activities	Duration									

Estimated By: __________________________ Checked By: _______________________________ TOTAL WORKING DAYS: _________

APPENDIX B AVERAGE PRODUCTIVITY RATES

AVERAGE PRODUCTIVITY RATES

DECEMBER 2005

Work Activity	Type	Productivity Rate
MOBILIZATION	Small (Seal coat or small projects	2 days minimum
	Medium (Less than $2 million)	5 days
	Large (Greater than $2 million	8 days
EARTHWORK Excavation	Small (Shoulder Work)	1500 CY /Day
	Medium (Reconstruction)	4000 CY/Day
	Large (Scraper Work	6000 CY/Day
Borrow	Truck	5000 CY/Day
	Scraper	8000 CY/Day
Rock	Blasting	2000 CY/Day
AGGREGATE PRODUCTION		
Base		
Plantmix		
Cover Coat		
AGGREGATE PLACEMENT		
Base	8” lift the 14G grader and large single drum roller	2000 Tons/Day
Plantmix	Leveling Course	2000 Tons/Day
	Base Course	2400 Tons/Day
	Wearing Course	2000 Tons/Day
Cover Coat		8 Lane Miles/Day
CONCRETE PAVING PLACEMENT	Standard Width	8,300 SY/Day
	Non-Standard Width	2,000 SY/Day
REPAIR		3,500 SY/Day
	Joint Sealing	10,000 SY/Day
MISCELLANEOUS Curb & Gutter		2,000 Feet/Day
Sidewalk		2,500 Feet/Day

Fencing	Woven Wire/ Barbwire	4,000 Feet/Day
	Chain Link	2,000 Feet/Day
Guardrail	Precast concrete	1,200 Feet/Day
	Cast in Place	1,500 Feet/Day
	Steel	750 Feet/Day
Pipe Culvert	24” or less	300 Feet/Day
	30” or more	150 Feet/Day

Work Activity		Type	Productivity Rate
BRIDGE	**SUBSTRUCTURE**		
	General	Structure Excavation	1 Day/Footing
		Compacting Backfill	1 Day/Footing
		Drive Piles	150 Feet/Day
		Construct Cofferdams	25 Feet/Day *Measured along perimeter of cofferdam*
		Place Seal Concrete	1 Day/Footing
		Cure Seal Concrete	5 Day/Footing
		Dewatering Cofferdam	1 Day/Footing
		Shoring	320 SF/Day
	Footing	Form Footings	150 SF/Day
		Place Footing Reinforcement	2500 #/Day
		Place Footing Concrete	400 CY/Day ≤ footing/day
		Cure Concrete	3 Days
		Strip Footing Forms	1 Footing/Day
	Columns	Form Columns	300 SF/Day
		Place Column Reinforcement	5000 #/Day
		Place Column Concrete	32 FT/Day/Column
		Cure Column Concrete	3 Days
		Strip Column Concrete	2 columns/Day
	Piers	Form Pier	600 SF/Day
		Place Pier Reinforcement	3000 #/Day
		Place Pier Concrete	400 CY Day
		Cure Pier Concrete	3 Days
		Strip Pier Forms	1 Day/pier
	Abutments	Form Abutment	600 SF/Day
		Place Abutment Reinforcement	2500 Lbs/Day

	Place Abutment Concrete	400 CY/Day
	Cure Abutment Concrete	3 Days
	Strip Abutment Forms	2 Days/abutment

Work Activity	Type	Productivity Rate
Wing Walls	Form Wing Wall	250 SF/Day
	Place Wing Wall Reinforcement	2500 #/Day
	Place Wing Wall Concrete	400 CY/Day
	Cure Wing Wall Concrete	3 Days
	Strip Wind Wall Forms	1 Day/ Wing Wall
Bent Caps	Form Bent Cap Wall	250 SF/Day
	Place Bent Cap Reinforcement	5000 #/Day
	Place Bent Cap Concrete	400 CY/Day
	Cure Bent Cap Concrete	3 Days
	Strip Bent Cap Forms	1 Day/Cap
BRIDGE SUPERSTRUCTURE		
Prestress Girders	Shop Drawings	15 Days
	Form Diaphragms	320 SF/Day
	Place Diaphragms Reinforcement	2500 #/Day
	Place Diaphragms Concrete	200 CY/Day
	Fabrication[1]	200 Feet/Day
	Erection	4 Girders/Day
	Cure Girders	28 Days
Steel Girders	Shop Drawings	21 Days
	Fabrication	10 Tons/Day
	Erection	4 Pieces/Day
Cast-in Place		
Post-Tension	Falsework Shop Drawings	15 Days
	Falsework Erection	10 Days/Span
	Place Reinforcement	3500 #/Day
	Place Bottom Slab Concrete	400 CY/Day
	Form Webs	1300 SF/Day
	Place Web Concrete	400 CY/Day
	Cure bottom Slab & Web	7 Days
	Form Deck Slab	1300 SF/Day

	Place Deck Slab Concrete	400 CY/Day
	Deck Cure	10 Days
	Post-Tensioning Shop Drawings	15 Days
	Post-Tensioning	6 Tendons/Day
	Grouting	6 Tendons/Day
	Remove Falsework	3 Day/Span
Work Activity	**Type**	**Productivity Rate**
Decks	Deck Forms	1300 SF/Day
	Place Deck Reinforcement	10,000 #/Day
	Place Deck Concrete[2]	400 CY/Day
	Cure Deck Concrete	10 Days
	Strip Deck Forms	3 Days/Span
General	Concert Parapet	80 Feet/Day
	Hydro Demolition (1½" Depth of Deck)	3500 SF/Day
	Place Concrete Deck Overlay	75 CY/Day
	Cure Concrete Deck Overlay	4 Days
	Install Metal Railing	200 Feet/Day

[1] The time for fabrication should only be used for small projects when erection of girders is expected within 45 days from the beginning of the project.

[2] The amount of concrete in a deck pour is usually governed by the deck placing sequence shown on the plans

APPENDIX C Example

Example

Worksheet One- Project Working Day Calculation

Worksheet Two- Project Time Adjustment Factors

Worksheet Three- Contract Time for Completion

EXAMPLE

This is an example of a contract time determination on a primary arterial using a working days contract time. The following pages contain copies of the roadway summary, Worksheet One, Worksheet Two, and Worksheet Three. Some of the times were listed out on Worksheet One and then combined into one activity for Worksheet Three. This is possible for activities which are alike and will be completed sequentially like removal items, earthwork, etc. For a Working Day calculation only a number which easily allows the bar chart to be constructed needs to be placed in each column across from the title Working Days. There is an average of 22 working days in a month which would give an approximation of the number of months to complete the project.

The Bridge activity is assumed to have come from a Bridge Section time determination which should be attached. In an actual contract time determination, several of the items of this project could be completed concurrently or at least part of some activities at the same time which would reduce the time necessary.

WORK SHEET ONE

EXAMPLE

PROJECT WORKING DAY CALCULATION

PROJECT NO. IM-9311(038)45 KEY NO. 9999 DATE 10/01/05

PROJECT NAME Example TYPE OF TIME Working Days

NO.	Work Activities	Quantity	Productivity Rate	Duration		Preceding Activities
				Work	Other	
2	Mobilization	High		8		
3	Irrigation 24" or less	12,800	300 Ft/Day	42		2
	Irrigation 30" or more	220 Ft	150 FT/Day	2		2
4	Concrete Ditch	13,165 Ft	400 Ft/Day	33	2	2
5	Bridge	See Bridge	Worksheet	63	10	2
6	Excavation	196,000 CY	6,000 CY/Day	33		3
	Borrow	249,000 CY	8,000 CY/Day	32		3
	Bit Removal	18,145 CY	4,000 CY/Day	5		3
7	Stripping Material	75,000 CY	8,000 CY/Day	10		3
8	Drainage 24" or less	11,845 Ft	300 Ft/Day	40		3
	Drainage 30" or more	2,150 Ft	150 Ft/Day	15		3
9	¾" Aggregate Production	78,000 Tons	2,400 T/Day	33		3,7
	Plant Mix Aggregate	62,500 Tons	2,000 T/Day	31		3,7
	Cover Coat	2,200 Tons	800 Tons/Day	3		3,7
10	¾" Aggregate Placement	78,000 Tons	2,000 T/Day	40		6

	(w/Sub Grade Geotextile)					
11	Bituminous Paving	65,000 Tons	2,000 T/Day	33		10
12	Surface Treatment	2,2000 Tons	800 Tons/Day	3	2	11
13	Seeding	43 Acre	10 A/Day	5		11
14	Clean-up	1	5/Day/Project	5		11

WORK SHEET TWO

EXAMPLE

PROJECT TIME ADJUSTMENT FACTORS

PROJECT NO. IM-9311(038) KEY NO. 9999

PROJECT NAME. EXAMPLE DATE 10/01/05

Adjustment Factors	Work Activities Affected	Additional Days
Coordination with utilities		
High traffic volumes		
Climatic regions	4,12	2, 2
Environmental Concerns		
Irrigation season		
Sole source contractor workload		
Curing time for concrete		
Review time for shop drawings & falsework	5	10
Acquiring permits or License		
Fabrication time		
Restriction on time of operation		
Acquiring specialized materials		
Local school, business, or civic events		
Other construction projects		

CONTRACT TIME FOR COMPLETION

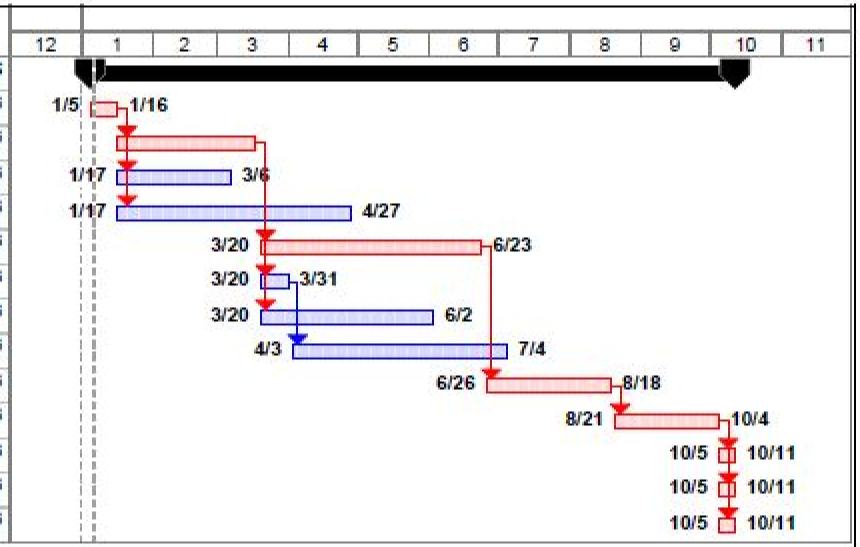
PROJECT NO. _______________ KEY NO. ________ PROJECT NAME _________________________________ DATE ________

PROJECT TYPE _____________ Anticipated Advertisement Date ______________ Anticipated Date of Beginning ______________

DATE		YEAR										
		MONTH										
		WORKING DAYS	22	22	22	22	22	22	22	22	22	22
#	Work Activities	Duration										
2	MOBILIZATION	8										
3	IRRIGATION	44										
4	CONCRETE DITCH	35										
5	BRIDGE	73										
6	EARTHWORK	70										
7	STRIPPING MATLS	10										
8	DRAINAGE	55										
9	AGGREGATE PRODUCTION	67										
10	AGGREGATE PLACEMENT	40										
11	BITUMINOUS PAVING	33										
12	SURFACE TREATMENT	5										
13	SEEDING	5										
14	CLEAN-UP	5										

Estimated By: __________________________ Checked By: _____________________________ TOTAL WORKING DAYS: __200____

ID		Task Name	Duration	Start	Finish
1		**TIME DETERMIATION**	**200 days**	**Thu 1/5/06**	**Wed 10/11/06**
2		MOBILIZATION	8 days	Thu 1/5/06	Mon 1/16/06
3		IRRIGATION	44 days	Tue 1/17/06	Fri 3/17/06
4		CONCRETE DITCH	35 days	Tue 1/17/06	Mon 3/6/06
5		BRIDGE	73 days	Tue 1/17/06	Thu 4/27/06
6		EARTHWORK	70 days	Mon 3/20/06	Fri 6/23/06
7		STRIPPING MTLS	10 days	Mon 3/20/06	Fri 3/31/06
8		DRAINAGE	55 days	Mon 3/20/06	Fri 6/2/06
9		AGGREGATE PRODUCTION	67 days	Mon 4/3/06	Tue 7/4/06
10		AGGREGATE PLACEMENT	40 days	Mon 6/26/06	Fri 8/18/06
11		BITUMINOUS PAVING	33 days	Mon 8/21/06	Wed 10/4/06
12		SURFACE TREATMENT	5 days	Thu 10/5/06	Wed 10/11/06
13		SEEDING	5 days	Thu 10/5/06	Wed 10/11/06
14		CLEAN-UP	5 days	Thu 10/5/06	Wed 10/11/06



Project: EXAMPLE
Date: Fri 1/6/06

Task
Critical Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Critical Task
Rolled Up Milestone
Rolled Up Progress
Split
External Tasks
Project Summary
Group By Summary