

UNITED STATES MARINE CORPS
ENGINEER EQUIPMENT INSTRUCTION COMPANY
MARINE CORPS DETACHMENT
14813 EAST 8TH ST
FORT LEONARD WOOD, MISSOURI 65473

LESSON PLAN

IMPLEMENT PROJECT PLANNING METHOD

EAC-CO1

ENGINEER ASSISTANT CHIEF COURSE

A16EAV1

REVISED 08/01/2014

APPROVED BY _____

DATE _____

INTRODUCTION

(5 Min)

(On CS #1)

1. **GAIN ATTENTION**: Having the ability to perform critical path analysis for project planning and scheduling will enable you to effectively supervise a projects construction sequence through to its completion.

(On CS #2)

2. **OVERVIEW**: The purpose of this lesson is to provide you with the knowledge to plan and supervise surveying and drafting support for construction projects. I will do this by discussing the following areas: job directives, planning phases, planning methods, resource estimating, and project scheduling.

3. **LEARNING OBJECTIVES**

(On CS #3-6)

INSTRUCTORS NOTE

Introduce the learning objectives by having the students read the Learning Objectives in the student outline or presentation.

a. **TERMINAL LEARNING OBJECTIVE**. Provided a project mission, written project specifications, finished design drawings, a completed bill of materials, a scientific calculator, a computer, software applications, a printer, and the references, implement project planning methods detailing all personnel, equipment, and materials necessary to accomplish the mission while establishing a defined duration for each subtask and the overall project/operation and graphically depict the schedule. (1361-SRVY-2005)

b. **ENABLING LEARNING OBJECTIVES**

(1). Given written project specifications, and references, develop an activities list per the MCRP 3-17.7F. (1361-SRVY-2005a)

(2). Given written project specifications, a completed activity list, and references, create a logic diagram per the MCRP 3-17.7F. (1361-SRVY-2005b)

(3). Given written project specifications, a completed activity list, a completed logic diagram, a blank activity

estimate sheets, and references, estimate project activity durations per the MCRP 3-17.7F. (1361-SRVY-2005c)

(4). Given written project specifications, a completed activity list, a completed logic diagram, completed activity estimate sheets, blank activity estimate sheets, and references, create a completed project schedule per the MCRP 3-17.7F. (1361-SRVY-2005d)

(5). Given written project specifications, a completed activity list, completed activity estimate sheets, a computer, with automated software application, and references, create a Gantt chart per the MCRP 3-17.7F. (1361-SRVY-2005e)

(6). Given written project specifications, a completed activity list, completed activity estimate sheets, a computer, with automated software application, and references, create a logic diagram per the MCRP 3-17.7F. (1361-SRVY-2005f)

(7). Given written project specifications, a completed activity list, completed activity estimate sheets, a computer, with automated software application, and references, create a project schedule per the MCRP 3-17.7F. (1361-SRVY-2005g)

(On CS #7)

4. **METHOD/MEDIA**: This lesson will be presented by lecture, demonstration, and practical application. I will be aided by computer slides, and the dry erase board.

(On CS #8)

INSTRUCTORS NOTE

Explain Lesson Critique Forms to students.

5. **EVALUATION**: A two-part closed book written/performance examination, covering the material in this lesson, will be administered at the end of this period of instruction.

INSTRUCTORS NOTE

Refer to the training schedule to give the exact date of the exam.

(On CS #9)

6. **SAFETY/CEASE TRAINING (CT) BRIEF**: In the event of fire, we will consolidate outside where the pavilion is located at and

account for everyone. In the event of a tornado, the passageway on the first deck of Brown Hall will be our consolidation area.

(On CS #10)

TRANSITION: Are there any questions concerning what will be covered in this lesson or how you will be evaluated? Let's start by discussing job directives.

BODY

(15 hrs 20 min)

(On CS #11)

1. **CRITICAL PATH METHOD:** (5 Min) In the early 1960's the Critical Path Method (CPM) was developed as a project planning tool.

a. The Critical Path Method (CPM) is a form of analysis that is used for planning, scheduling, and controlling construction activities for a project from start to finish.

b. The use of the CPM makes it easier to plan, schedule, and manage the sequence of work activities to complete a project on time.

c. The CPM requires a formal, detailed listing of all work related activities that make up the whole project. This requires you to visualize the project from start to finish, so you can estimate the amount of time and the resources required to complete each project activity.

d. The CPM is also known by a few other general phrases. Regardless of which phrase is used, they represent the Critical Path Method.

(1) Construction Management.

(2) Project Planning and Scheduling.

(3) Critical Path Analysis.

2. **PLANNING:** (5 Min) In military construction, the use of the CPM begins with planning. Planning is divided into two distinct stages:

(On CS #12)

a. **Preliminary Planning**: Gives the engineer a quick overall picture of the assigned project and the capacity of the constructing unit to accomplish it. It serves as a guide to the detailed planning which follows. Preliminary planning includes:

- (1) Project site reconnaissance.
- (2) Preliminary material estimates.
- (3) Preliminary equipment estimations.
- (4) Procurement of critical items.

(On CS #13)

b. **Detailed Planning**

(1) Develops an accurate estimate of the work activities, materials, man-hours, and equipment required to construct project from start to finish. A detailed plan includes:

- (a) Review of all drawings and project specifications.
- (b) Detailed estimating of materials, labor and equipment.
- (c) Scheduling work activities.
- (d) Procurement of required materials.

(2) The detailed plan will be submitted in the form of a Gantt Chart, Pert Chart, Activity-on-the Arrow logic diagram, or as an Activity-on-the-Node logic diagram.

(On CS #14)

3. **JOB DIRECTIVES**: (10 Min) The planning process starts with the receipt of a job directive. The job directive (work request) is the authority and tasking of a unit to perform the construction of the project and draw needed materials to complete the project assigned.

a. Job directives vary in both form and content, and may be issued in one of two ways:

- (1) Verbally for simple projects.
- (2) Written for more complex projects.

(On CS #15)

b. The job directive may be in any one of three stages of detail:

(1) It may contain detailed plans and specifications. The more stable the conditions are, the more detailed the directive becomes.

(2) It may simply refer to standard drawings and procedures already published in technical manuals, directives, or automated software programs previously issued from higher headquarters.

(3) It may require the unit to prepare plans and specifications to be approved by the issuing headquarters.

(On CS #16)

c. Regardless of the form the job directive takes, or the amount of detail it provides, the job directive should contain the following information:

(1) Mission. The exact assignment with all necessary and available details.

(2) Location. This may be a definite location, or the directive may require the constructing unit to select a site in a general area.

(3) Time. The starting time and/or required completion dates.

(4) Manpower. Any additional manpower that may be available to the constructing unit.

(5) Equipment. Any additional equipment that may be available to the constructing unit, including any special conditions particular to its use.

(On CS #17)

(6) Materials. Source of and authority for requesting materials, criticality, and lead time for procurement and delivery.

(7) Priorities. A single priority for the entire project or separate priorities for various portions or stages of a project.

(8) Reports. Any reports required by higher headquarters.

(9) Special Instructions. Any additional information concerning the job, including: coordination with the using unit, and unusual problems peculiar to project.

(On CS #18)

TRANSITION: We have covered job directives, planning phases and the history of the CPM.

OPPORTUNITY FOR QUESTIONS:

1. **QUESTIONS FROM THE CLASS:** Do you have any questions?
(Answer students' questions.)

2. **QUESTIONS TO THE CLASS:**

a. QUESTION: In what two forms may job directives be issued?

ANSWER: They may be issued either verbally or in writing.

b. QUESTION: In military construction, the planning process is divided into what two stages?

ANSWER: Preliminary planning and detailed planning.

TRANSITION: So far we have discussed the critical path method, planning phases, and job directives. Next we will discuss the creation of activity lists.

(On CS #19)

4. **ACTIVITY LISTS:** (30 min) An activities (task) list is a complete listing of all the work activities that must be performed from start to finish to complete the project. This is the initial step in the CPM.

a. An activity list can be as brief, or as detailed as need be for the assigned project. The guiding factor which helps you determine how brief or detailed the activities list will be, is the size and complexity of the project.

b. The project must be constructed mentally, and on paper to determine the actual project activities and their relationships to each other. This is the most difficult part of the planning process. You must be able to "think logically" in terms of what activities must be performed, and the order in which the activities must be completed.

c. The first step is to break the project down into each of its actual work activities. This is done by studying site reconnaissance notes, construction plans, project specifications, and "brainstorming" with the Project Officer, Engineer Equipment Chief, and Combat Engineer Chief.

(On CS #20)

d. Let's put this process of "logical thinking" to work using the project scenario of constructing a one lane gravel road that is 1500 feet long, leading to a concrete storage pad that is 32'-0" x 32'-0" in size.

(1) The first step is to make a mental picture of what activities must be performed to construct this project from start to finish, and then create a rough activity list with the help of everyone's input.

ROUGH ACTIVITIES

"Topo" project site	Establish road grades
Lay gravel	Set road alignments
Order gravel	Place concrete forms
Clear roadway	Clear pad site
Prefabricate forms	Create project
Layout pad batter boards	drawings
Pour concrete	Excavate pad footings
Check pad elevation's	Cure concrete
Remove forms	Check Road grades
	Perform "As-built"

(2) Once the rough activities list has been completed, you can begin to put each activity into a logical sequence in which they are to be performed.

(On CS #21)

e. After you have determined the activities to be performed for the project, you must put each task in a logical sequence in which they will actually be constructed. Your finished activity list will be broken down into three separate columns showing the following information:

(1) Activity Number Column: Each and every work activity will be assigned an activity number. It is best to use numeric values in increments of 5 or 10, as this allows you to insert additional tasks later as the need arises. **Never** use the same number twice, as this leads to confusion.

(2) Activity Column: This is a complete listing of all the required tasks, which must be performed to complete the project from start to finish.

(3) "Immediately Preceded By" (IPB) Column: This column is a listing of the activity number(s) for the activities that "**immediately**" proceed the one that is being listed. In other words, what activity(s) must be completed **before** another one can begin? Starting activities will always have the word "**None**" listed here.

(On CS #22)

f. Ask yourself the following questions for each work activity of the project to develop the finished activities list:

(1) Which activities start at the beginning of the project? **(Starting Activities)**

(2) Which activities must be finished before another activity can begin? **(Preceding Activities)**

(3) Which activities can either start or finish at the same time as another activity? **(Concurring Activities)**

(4) Which activities cannot begin until another activity is finished? **(Succeeding Activities)**

(5) Which activities may start when a portion of another activity is complete? **(Lagging Activities)**

(On CS #23)

Finished Activities List

<u>Activity Number</u>	<u>Activity</u>	<u>IPB</u>
5	"Topo" project site	None
10	Create project drawings	5
15	Order gravel	None
20	Prefabricate forms	None
25	Clear roadway	10
30	Set road alignments	25
35	Establish road grades	30
40	Check road grades	35
45	Lay gravel	15,40
50	Clear pad site	10
55	Layout pad batter boards	50
60	Excavate pad footings	55
65	Check pad elevation's	60
70	Place concrete forms	20,65
75	Pour concrete	70
80	Cure concrete	75
85	Remove forms	80
90	Perform "As-built"	45,85

g. It is important to remember that an activity list can be as brief or as detailed as necessary. The amount of detail that is required is generally dictated by the size and complexity of the project itself.

INSTRUCTORS NOTE

Conduct a guided discussion to develop a rough and finished activities list for going to formation in the morning. Let the class brainstorm activities but keep the rough list brief and simple.

INTERIM TRANSITION: Do you have any questions before we go into the demonstration.

DEMONSTRATION. (40 Min) Have the students stand up and gather near the dry erase board. Brief the "job directive" of Going to Formation in the Morning.

STUDENT ROLE: Active participation in answering proving questions from the instructor on some of the activities needed to be done prior to being in the morning formation.

INSTRUCTOR(s) ROLE: Using the dry-erase board, write out the brainstormed activities list and guide the students in sequencing in correct order the activities. Write, in logical and in the same format, the activities list; with activity numbering, activity and IPB list from start to finish.

1. **SAFETY BRIEF:** No safety concerns with this class.

2. **SUPERVISION & GUIDANCE:** Ensure all students actively participate in the inputs

DEBRIEF: What you have just seen is a typical creation of an logically sequenced activities list. Correlate this to your engineer missions;

TRANSITION: Do you have any questions on the "guided" demonstration in brainstorming and sequencing activities list for going to formation this morning.

(On CS #16)

OPPORTUNITY FOR QUESTIONS

1. **QUESTIONS FROM THE CLASS:** Do you have any questions concerning activities lists? (Answer students' questions.)

2. **QUESTIONS TO THE CLASS:**

a. **QUESTION:** What is the process called to develop your activities list?

ANSWER: Brainstorming.

b. **QUESTION:** What are the five types of activities that are kept in mind when developing a finished activities list?

ANSWER: Starting, Proceeding, Succeeding, Concurring, and Lagging activities.

(BREAK 10 Min)

TRANSITION: Before the break we covered brainstorming and creating an activities list for a particular project. Let's go ahead and discuss the different graphical diagrams for those activities.

(On CS #27)

5. **PLANNING DIAGRAMS: (40 Min)** The most important feature of the CPM is the planning diagram. The planning diagram graphically shows the projects various work activities. They provide a visual blueprint of the work activities that must be performed during the construction of a project. There are four types of diagrams that can be created.

(On CS #28)

a. Gantt Charts: One method of graphically planning construction projects is through the development of a Gantt Chart, also referred to as a bar chart.

(1) Gantt charts are **time** oriented planning diagrams used primarily for **small** projects, and scheduling inspections.

(2) Work activities on Gantt charts are shown graphically on a calendar time scale.

(3) Each bar represents the start and finish date, with the length of the bar showing the activities duration.

(4) The bars show an activities duration in its entirety, regardless of its dependency on other activities.

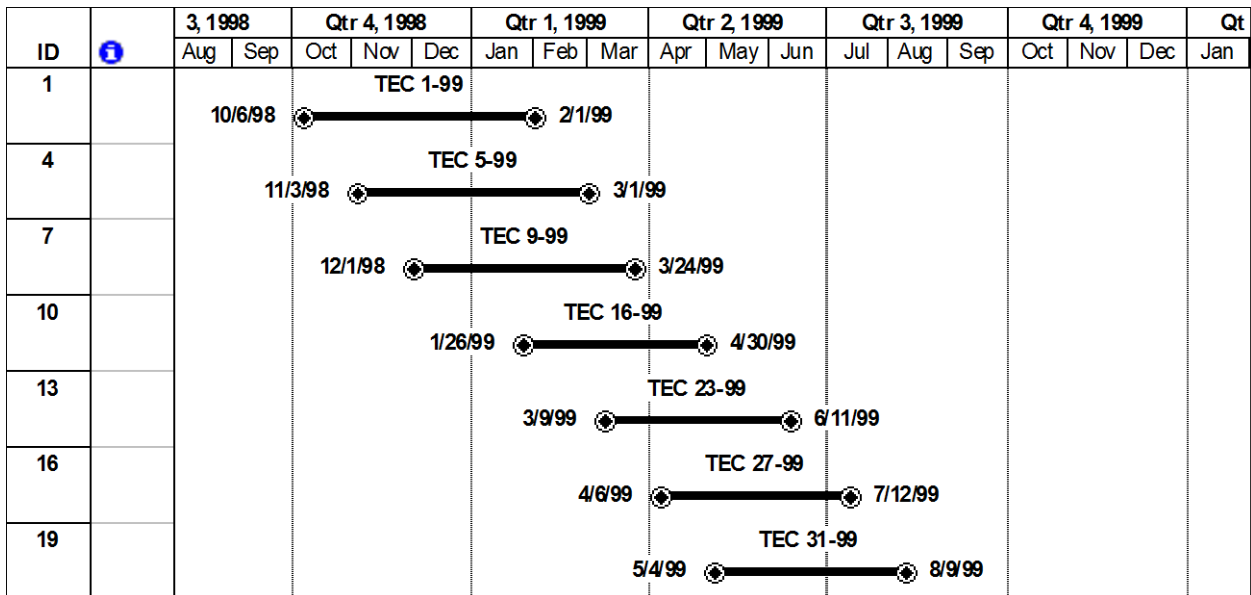
(5) Gantt charts are effortless to construct.

(6) They are brief in format.

(On CS #29)

ID	Task Name	April 7							April 14							April 21							A					
		M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W			
1	Topo project site																											
2	Create project drawings																											
3	Order gravel																											
4	Prefabricate forms																											
5	Clear roadway																											
6	Set road alignments																											
7	Establish road grades																											
8	Check road grades																											
9	Lay gravel																											
10	Clear pad site																											
11	Layout pad batterboards																											

(On CS #30)



(On CS #31)

(7) The major draw-back of Gantt Charts is that you must have a detailed knowledge of the project and the construction techniques used to complete the tasks to interpret the progress of construction work. Other disadvantages of the Gantt Chart are:

- (a) It does not give you the ability to visualize the exact progress of the project.

(b) Anticipate delays or problems soon enough to correct them.

(c) It does not show the detailed sequence of activities of the project.

(d) It does not show which activities are critical to the successful, and timely completion of the project.

(e) It does not show the precise effect of a delay or failure to complete an activity on time.

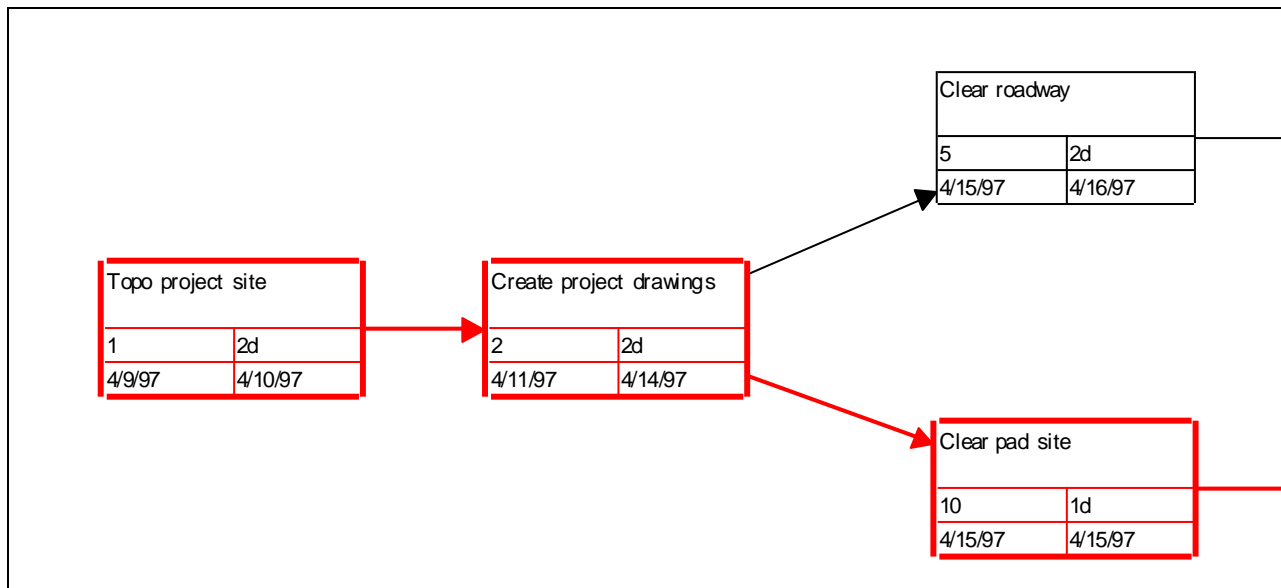
(On CS #32)

b. Pert Chart: The Program Evaluation and Review Technique (PERT) chart addresses probability.

(1) Pert charts are **event** oriented.

(2) This type of diagram is used primarily in research and development projects.

(On CS #33)



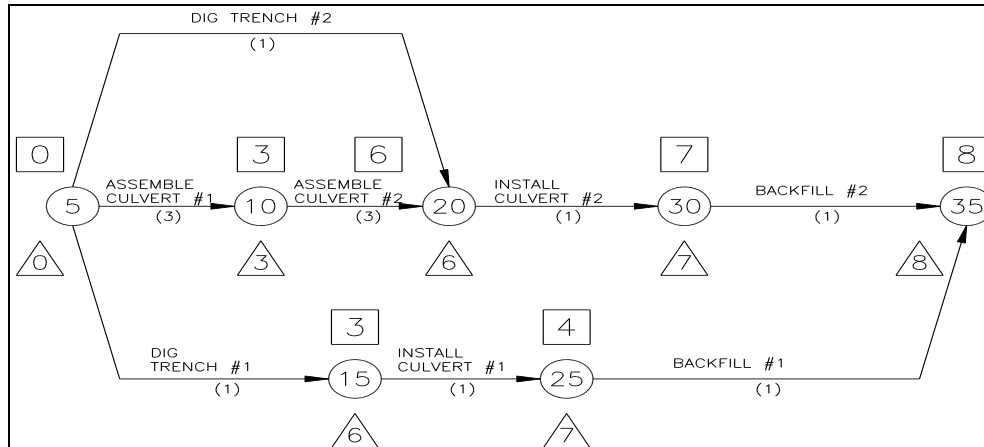
(On CS #34)

c. Activity-On-The-Arrow (AOA): This format is more complex in its creation and is "**activity**" oriented.

(1) Has a tendency to lead to confusion when trying to interpret it.

(2) This format is the least desirable due to these factors.

(On CS #35)



(On CS #36)

d. Activity-On-The-Node (AON): The use of this type of format will eliminate confusion, and allows you to adjust to many of the problems that might arise during the construction phase of the project. It is "activity" oriented.

(1) The AON format is the primary planning diagram that is used for project planning for military construction.

(2) It is especially useful for planning **large** construction projects.

(On CS #37)

(3) This diagramming method is used effectively for the Critical Path Method in planning the following areas:

- (a) Construction.
- (b) Maintenance.
- (c) Project Design.
- (d) Military Combat Tasks.

(e) Logistics.

(On CS #38)

(4) The AON format overcomes the disadvantages of using the Gantt Chart by showing an accurate, timely, and easily understood picture of the project. Other advantages of using this type of diagram are:

(a) Reduces the risk of overlooking essential construction tasks.

(b) Provides a blueprint for long-range planning of the project.

(c) Shows the interrelationship between work activities.

(d) Focuses attention on critical work activities.

(e) Allows you to make timely decisions to correct problems if complications should arise.

(f) Allows you to manage manpower, material, and equipment resources more effectively.

(On CS #39)

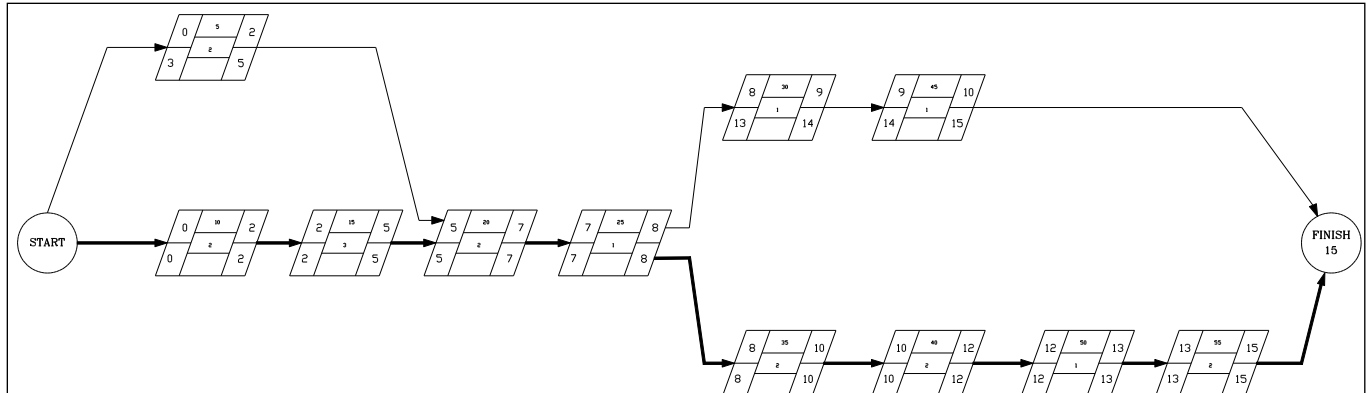
(5) Though the AON is a powerful tool for Officers and Staff NCO's to use for project planning purposes, it does have its disadvantages.

(a) The AON format does not solve engineering problems that may be encountered.

(b) It does not make planning decisions for you.

(c) It does not provide anything substantial to the actual construction of the project itself.

(On CS #40)



TRANSITION: Do you have any questions on planning diagrams.

(On CS #16)

OPPORTUNITY FOR QUESTIONS

1. **QUESTIONS FROM THE CLASS:** Do you have any questions concerning planning diagrams? (Answer students' questions.)

2. **QUESTIONS TO THE CLASS:**

a. QUESTION:

ANSWER:

b. QUESTION:

ANSWER:

TRANSITION: Are there any more questions before we move on.

(On CS #41)

6. **ACTIVITY-ON-THE-NODE DIAGRAM ELEMENTS:** (30 Min) Before creating your planning diagram, you must have an understanding of what each element of the diagram represents. We will concentrate our emphasis on the Activity-on-the-Node diagram format. There are four basic elements of an AON diagram:

(On CS #42)

a. **Activity Nodes:** An activity node is a simple rectangle or parallelogram that represents each activity from the finished activities list. Each node is connected by precedence arrows,

and contains certain information to enable you to manage that work activities completion:

EARLY START	ACTIVITY NUMBER	EARLY FINISH
	DURATION	
LATE START	RESOURCES	LATE FINISH

(1) Activity Number: A number that identifies a specific work activity. These numbers are **never** duplicated, as it will lead to confusion. These numbers are taken from the finished activities list activity number column.

(2) Duration: A number, which is represented in hours, days, weeks, or months. This number is the calculated amount of time that is required to complete that activity, and is extracted from production estimate sheets, activity estimate sheets, or from published equipment and man-hour tables.

(3) Resources: Shows the required resource(s) needed to complete that activity (manpower, materials, and/or equipment). This is normally left blank when there is more than one required resource for the activity.

(4) Early Start (ES): A number, which is represented in hours, days, weeks, or months. This is the earliest time that an activity can logically start without affecting succeeding activities. This number represents the end of a working hour, day, week, or month.

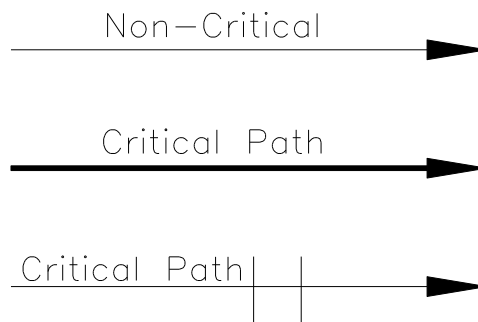
(5) Early Finish (EF): A number, which is represented in hours, days, weeks, or months. This is the earliest time that an activity can logically finish without affecting succeeding activities. This number represents the end of a working hour, day, week, or month.

(6) Late Start: A number, which is represented in hours, days, weeks, or months. This is the latest time that an activity can start without delaying the **entire project**. This number represents the end of a working hour, day, week, or month.

(7) Late Finish: A number, which is represented in hours, days, weeks, or months. This is the latest time that an activity can finish without delaying the **entire project**. This number represents the end of a working hour, day, week, or month.

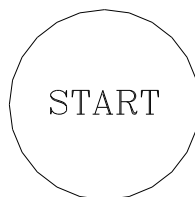
(On CS #43)

b. Precedence Arrows: Also referred to as "logic" arrows, show the order sequence, and the interrelationship between work activities. They are drawn to show how each every activity is connected, and help to identify the "critical path" of the project. These logic arrows are never drawn backwards, but can cross each other.



(On CS #44)

c. Start Node: This type of node is shown as a circle, and has no duration time associated with it. All starting activities are tied in to this node at the beginning of the diagram with precedence arrows.



d. Finish Node: This type of node is shown as a circle, and has the total project duration time associated with it. All finishing activities are tied in to this node at the end of the diagram with precedence arrows.



TRANSITION: We have discussed planning diagrams and AON elements. Are there any questions?

(On CS #45)

OPPORTUNITY FOR QUESTIONS

1. **QUESTIONS FROM THE CLASS:** Answer student's questions.

2. **QUESTIONS TO THE CLASS:**

a. QUESTION: What type of planning diagram is "event" oriented?

ANSWER: Pert chart.

b. QUESTION: What type of planning diagram is "time" oriented?

ANSWER: Gantt chart.

c. QUESTION: What type of planning diagram is "activity" oriented?

ANSWER: AOA and AON diagrams.

TRANSITION: Now, let's continue and discuss how to create an AON logic diagram.

(On CS #46)

7. **ACTIVITY-ON-THE-NODE DIAGRAM CREATION: (20 min)** After you have the necessary activity relationships identified in the finished activities list, you must now apply them to the creation of a planning diagram, also referred to as a "logic" diagram. This is done, by working left to right on a piece of blank scratch paper.

a. Start off with drawing the Start Node; this is the "Jumping Off" point for all starting activities, and the rest of your diagram.

(On CS #47)

b. The activity nodes are now drawn in their proper logical sequence using the activities listed in the IPB column of the finished activities list. Use the following logic rules to create the AON logic diagram:

(1) What activity(s) start at the beginning of the project? **(Starting)** These activity nodes will always have "None" listed in the IPB column.

(2) What activity(s) must be finished before the start of another? **(Preceding)**

(3) What activity(s) may either start or finish at the same time as another? **(Concurring)**

(4) What activity(s) cannot begin until another is finished? **(Succeeding)**

(5) Which activities may start when a portion of another activity is complete? **(Lagging)**

c. The activity nodes are now linked together with precedence arrows. When activity nodes are linked together with precedence arrows, the diagram will show how all activities are interrelated, and what their dependence is on the other activities. All finishing activities for the project must end at the Finish Node.

d. If there are any mistakes in your logic, you will catch them here during the creation of the logic diagram.

INTERIM TRANSITION: We have discussed AON creation, do you have questions? Let's go ahead and conduct a demonstration before moving on.

(On CS #48)

INSTRUCTORS NOTE

Conduct a guided demonstration to develop an AON logic diagram using the finished activities list that was created for going to formation in the morning.

DEMONSTRATION. (50 Min) Have the students stand up and gather near the dry erase board. With the completed logical sequencing

of the Activities List and its related IPB of the previous "going to formation" still on the board, create an Activity on the Node" (AON) planning diagram next to it.

STUDENT ROLE: Active participation in answering proving questions from the instructor in the creation of a correct AON diagram

INSTRUCTOR(s) ROLE: Using the dry-erase board, write and graphically create an AON diagram and guide the students in inputting correct order and representation of the activities in AON format.

1. **SAFETY BRIEF:** No safety concerns with this class.

2. **SUPERVISION & GUIDANCE:** Ensure all students actively participate in the inputs

DEBRIEF: What you have just seen is a typical creation of an AON and logically sequencing an activities list. Correlate this to your engineer missions.

INTERIM TRANSITION: You have just seen the Activities on the Node (AON) diagram creation. Do you have any questions before the practical application.

(On CS #49)

INSTRUCTORS NOTE:

Conduct logic diagram practical exercise. Hand out practical exercise sheets.

PRACTICAL APPLICATION: (1.0 Hrs) This PA is designed to test your knowledge on all of the items covered so far. This PA should take about 1 hour to complete. Any practical problems that you do not finish will be completed as homework and turned in before class resumes the following day.

PRACTICE: Complete logic diagrams for all problems on page 1 of the PA worksheet package.

PROVIDE-HELP: Walk around the classroom and assist all students.

SAFETY BRIEF: No safety concerns with this class.

SUPERVISION & GUIDANCE: Be sure to follow the step by step directions covered in your student outline and from the demonstration presented earlier.

DEBRIEF: After the PA, ask the students if there are any questions.

(On CS #50)

TRANSITION: Do you have any questions concerning the procedures to create an AON diagram?

OPPORTUNITY FOR QUESTIONS

1. **QUESTIONS FROM THE CLASS:** Answer student's questions.

2. **QUESTIONS TO THE CLASS:**

a. **QUESTION:** What logic rules are used to create a logic diagram?

ANSWER: Starting, Proceeding, Succeeding, Concurring, and Lagging activities.

b. **QUESTION:** What must all finishing nodes tie into?

ANSWER: Finish node.

INTERIM TRANSITION: If you have no questions let's take a break and then we will move forward to the resources and durations associated with those activities within your diagrams.

(On CS #51)

(BREAK 10 Min)

(On CS #52)

8. **RESOURCE ESTIMATES: (40 Min)** One of the most important steps in planning a project is estimating activity durations. Carelessly made estimates may lead to failure to meet completion dates. They may cause uneconomical use of personnel, materials, time, and equipment and they may seriously jeopardize a tactical or strategic situation. Preliminary estimates yield approximate data for planning purposes. The next step in the planning

process is to estimate the required resources for each and every activity within the project.

a. Estimated resources are materials, personnel and equipment quantities, and man-hours and equipment hours. These are all of the resources that are required to complete each respective activity within the project. There are two types of estimates:

(On CS #53)

(1) Material Estimates. Determine the materials required for a given work item. Study the plans and specifications in detail to ensure that all necessary materials are included.

(a) Work items. Determine the work items. These should agree with the CPM activities list, except where a more detailed breakdown is required for accuracy and completeness.

(b) Materials. Determine the materials required for a given work item. Study the plans and specifications in detail to ensure that all necessary materials are included.

(c) Quantities. Calculate the quantity of each item of material needed in the

(d) Waste factors. Apply a waste factor, if appropriate, to each of the materials required. The waste factor should reflect conditions at the work site, intended use of the material, and skill level of the troops working with the material. Include spillage, breakage, cutting waste, and spoilage in the waste factor. Investigate any unusually high waste factor to determine if any action can be taken to reduce it.

(e) Total material requirement. Combine the originally calculated quantity and the allowance for waste to give the total material required.

(f) Bill of materials. Draw up a consolidated BOM by combining like materials from all the work items to obtain a grand total for each type of material needed. This BOM should contain all the materials necessary to complete the job. The BOM is submitted through the appropriate supply channels for procurement.

(On CS #54)

(2) Equipment/Manpower Estimates.

(a) Work items. List the work items to be estimated. In most cases, these will be the work items used in the material estimate, although additional activities which require workers or equipment without expending materials may be added.

(b) Available resources and methods. Consider available resources and methods of construction, to decide how to accomplish the work component. Describe the method of construction, including sketches (as required), to provide guidance for the supervisor. If the method of construction is different from the method the work rate is based upon, adjust the actual work rate for this difference.

(c) Material usage. From the material estimate, determine the quantity of material that will be handled. This material estimate usually includes a waste factor. However, since the purpose here is to apply a work rate to the quantity of material handled, accuracy in determining how much of the material will be used at the specified work rate is important. For example, if the work rate for setting forms is given in terms of linear feet of formwork per unit of time and if extra form material has been ordered as waste, the extra form material should be omitted from this calculation. The amount of forms to be set is determined by the configuration of the concrete structure rather than by the quantity of material ordered. Even if the waste allowance is used, it most likely will be used to replace broken, rotten, or lost wood and thus not add to the linear feet of formwork actually set.

(d) Work rate. Select a work rate appropriate for the work item being estimated. An accurate work rate is the heart of a good estimate.

(e) Labor. Calculate the standard effort required to accomplish the work item. If the work rate has been given in the usual form of man-hours (the amount of effort produced by one person working for one hour) or man-days per unit of quantity, multiply the quantity from Step 3 by the work rate to get the total man-hours or man-days for the task. When a work rate is presented in any other form, the planner should first convert to effort per unit of quantity.

$$\underline{1} \text{ Quantity} \times \text{Work Rate} = \text{Standard Effort}$$

(f) Efficiency factor. Decide whether the unit or organization can operate at the work rate given. If the work rate used in the estimate has been taken from a standard source, expect variations in local conditions. To compensate for this, apply an efficiency factor. This factor is a measure of the effectiveness of the troops in their situation compared to the standard conditions used in the estimating reference source. It is most commonly given as a percentage.

(g) Total labor hours. Divide the standard effort computed in Step 5 by the work-force efficiency to find "troop effort." Thus, if the standard effort originally calculated was 60 man-hours and the unit operates at 80 percent efficiency, the unit will have to expend 75 man-hours to complete the task.

$$\frac{1}{\text{Efficiency}} \text{ Standard Effort} = \text{Troop Effort}$$

(h) Project duration. Divide the total effort by the crew size to obtain the duration. The crew must be capable of operating at the efficiency used in the estimate. If not, the efficiency factor must be readjusted, changing the troop effort and affecting the duration.

$$\frac{1}{\text{Crew Size}} \text{ Troop Effort} = \text{Duration}$$

(On CS #55)

b. Duration's are calculated based on the amount of material that must be handled, or the amount of effort that must be put in using manpower. It is the estimated amount of time that it will take to complete an activity from start to finish. Duration's are represented in hours, days, weeks, or months. There are a few guidelines that will aid you during the calculation of activity duration's.

(1) Increasing a crew size or the numbers of equipment will reduce the duration time of an activity.

(2) Decreasing the crew size or the numbers of equipment will increase the duration time of an activity.

(3) Increasing the length of the workday will reduce the duration time of an activity.

(4) Decreasing the length of the workday will increase the duration time of an activity.

(5) Working on the weekend will reduce the duration time of the project as a whole.

c. After the resources and duration's for each activity have been determined, annotate them on the finished activities list for a quick reference, and label each activities duration on the logic diagram you created previously.

(On CS #56)

TRANSITION: Do you have any questions concerning Resource Estimates in relation to an activity (task) list?

OPPORTUNITY FOR QUESTIONS

1. **QUESTIONS FROM THE CLASS:** Answer student's questions.

2. **QUESTIONS TO THE CLASS:**

a. QUESTION: What are the two types of estimates?

ANSWER: Material and Equipment/manpower estimates.

b. QUESTION: What effect does increasing equipment quantities have on the duration of an activity?

ANSWER: It reduces its duration time.

TRANSITION: If you have no further questions let's move on to Early/late Event Times.

(On CS #57)

9. **EARLY/LATE EVENT TIMES: (50 Min)** After all duration's have been computed, you are now able to calculate all of the early and late event times for each activity on the logic diagram.

a. Each early and late event time serves a specific purpose. A description of each type of event time is as follows:

(1) Early Start: The earliest time that activity can logically start without delaying follow-on activities.

(2) Early Finish: The earliest time that activity can finish without delaying follow-on activities. (**Early Start + Duration**)

(3) Late Finish: The latest time an activity can finish without delaying the entire project.

(4) Late Start: The latest time an activity can start without delaying the entire project. (**Late Finish - Duration**)

(On CS #58)

ACTIVITIES LIST WITH DURATION'S

<u>Activity Number</u>	<u>Activity</u>	<u>IPB</u>	<u>Duration</u>
5	"Topo" project site	None	2 days
10	Create project drawings	5	2 days
15	Order gravel	None	6 days
20	Prefabricate forms	None	1 day
25	Clear roadway	10	2 days
30	Set road alignments	25	1 day
35	Establish road grades	30	1 day
40	Check road grades	35	2 days
45	Lay gravel	15,40	2 days
50	Clear pad site	10	1 day
55	Layout pad batterboards	50	1 day
60	Excavate pad footings	55	2 days
65	Check pad elevation's	60	1 day
70	Place concrete forms	20,65	1 day
75	Pour concrete	70	1 day
80	Cure concrete	75	6 days
85	Remove forms	80	1 day
90	Perform "As-built"	45,85	2 days

b. Begin computing early start times by placing a zero (0) in the upper-left corner of the activity nodes that are **starting** activities. Starting activities will always have "None" in the IPB column, and an early start time of **zero**.

c. Compute the early finish time for each of the starting activities, and annotate the time in the upper-right corner of the node. (**Early Start + Duration**)

d. The early finish that you just computed, now becomes the early start for the next activity(s), and is annotated in the upper left-hand corner of that next activity(s). If two or more proceeding activities close on a single activity, use the

greater early finish time for the next activity nodes early start.

e. Repeat the process for the rest of the activity nodes in the logic diagram. This process is referred to as the "**Forward Pass**".

f. After you have computed the early finish for the last activity node, this becomes the **total duration** for the project, and is annotated on the finish node. If more than 1 activity closes on the finish node at the same time, you must use the **largest** early finish value as the total duration.

g. Now you must compute the late finish and late start times for each activity. This process is referred to as the "**Backward Pass**".

h. Annotate the **total duration** as the late finish for each of the activity nodes that closed on the finish node. These times are placed in the lower-right hand corner of the activity node.

i. Next, compute the late start times for each respective activity node, and annotate the time in the lower-left corner of the activity node.

(Late Finish - Duration)

j. The late start that you just computed, now becomes the late finish for the next activity. If two or more proceeding activities close on a single activity use the **smaller** late start time for that next activity nodes late finish.

k. Repeat this process for the rest of the activity nodes until you are at the beginning of the CPM diagram again.

l. After you have computed the late start for the last activity nodes, this completes the backward pass.

(On CS #59)

m. Now by simple observation, you can identify the **Critical Activities** and the projects **Critical Path**. Use the following guidelines to determine which activities are critical.

(1) The early start time for a particular activity is the same as the late start time.

(2) The early finish time for a particular activity is the same as the late finish time.

n. When critical activities are linked together, they form the critical path of the project. The logic arrows linking critical activities can be made with a thicker line width, highlighted in color, or shown with two vertical lines drawn on the logic arrow identifying it as part of the critical path. This critical path must also begin at the start node and end on the finish node.

o. There will **always** be at least one or more critical paths. All critical paths must be continuous. Any critical path that does not start at the start node and end at the finish node indicates a logic mistake, or a simple mistake that was made during the calculation of the forward or backward pass.

(1) Note: If a critical activity is delayed by any amount of time, the entire project completion will be delayed by that same amount of time.

INTERIM TRANSITION: Now that we have covered Forward and Backward Passes of activity durations, are there any questions before we go through the demonstration?

(On CS #60)

INSTRUCTORS NOTE

Introduce and conduct a guided demonstration to calculate the early and late event times for the project discussed earlier. Draw a prototype logic diagram on the dry erase board to aid in this demonstration.

DEMONSTRATION. (90 Min) Ensure the student can see the dry erase board. With the activities list with duration times discussed earlier, fill in the blocks of the AON diagram.

STUDENT ROLE: Active participation in answering some of the basic mathematical computation in determining concepts presented earlier.

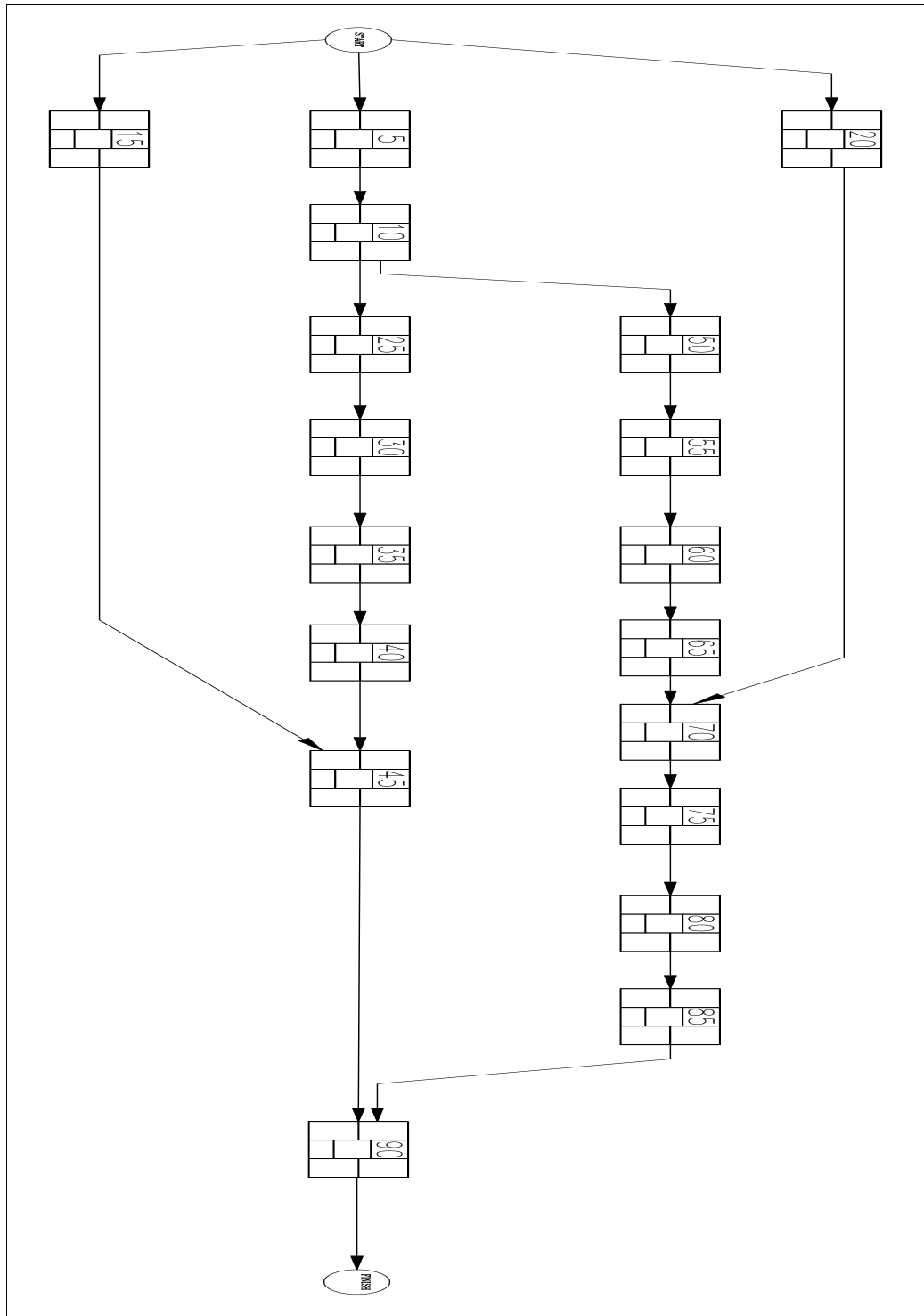
INSTRUCTOR(s) ROLE: Using the dry-erase board, write and graphically create an AON diagram per activities list discussed earlier. Guide the students in inputting correct duration times and explain further the concepts of: forward/backward pass, early/late starts, critical path/activities

1. **SAFETY BRIEF:** No safety concerns with this class.

2. **SUPERVISION & GUIDANCE:** Ensure all students actively participate in the inputs.

DEBRIEF: What you have just seen are the duration inputs in a particular project AON diagram. You have also seen the identification of critical activities and paths. Correlate this to your engineer missions;

EARLY/LATE EVENT TIMES DEMONSTRATION



INTERIM TRANSITION: You have just seen a demonstration of Forward and Backward passes input in an AON diagram. Do you have any questions before the practical application?

(On CS #61)

INSTRUCTORS NOTE:

Conduct logic Forward Pass / Backward Pass practical exercises.
Hand out practical exercise sheets.

PRACTICAL APPLICATION: (1.0 Hrs) This PA is designed to test your knowledge on all of the items covered so far. This PA should take about 1 hour to complete. Any practical problems that you do not finish will be completed as homework and turned in before class resumes the following day.

PRACTICE: Complete the forward and backward pass on each logic diagram for all problems on pages 2 and 3 of the PA worksheet package.

PROVIDE-HELP: Walk around the classroom and assist all students.

SAFETY BRIEF: No safety concerns with this class.

SUPERVISION & GUIDANCE: Be sure to follow the step by step directions covered in your student outline and from the demonstration presented earlier.

DEBRIEF: After the PA, ask the students if there are any questions.

(On CS #62)

TRANSITION: You have just spent the last 1 hour conducting practical applications.

OPPORTUNITY FOR QUESTIONS

1. **QUESTIONS FROM THE CLASS:** Do you have any questions concerning the material we have discussed? (Answer students' questions.)

2. **QUESTIONS TO THE CLASS**

a. QUESTION: What are some of the types of resources that must be estimated for an activity?

ANSWER: Material, personnel and equipment quantities, and man-hours and equipment hours.

b. QUESTION: What is the term that is used to calculate the early event times for a project?

ANSWER: Forward pass.

c. QUESTION: What is the term that is used to calculate the late event times for a project?

ANSWER: Backward pass.

TRANSITION: If there are no further questions, let's take a 10 minute break and then we will move on to the discussion of the Early Start Schedule.

(On CS #63)

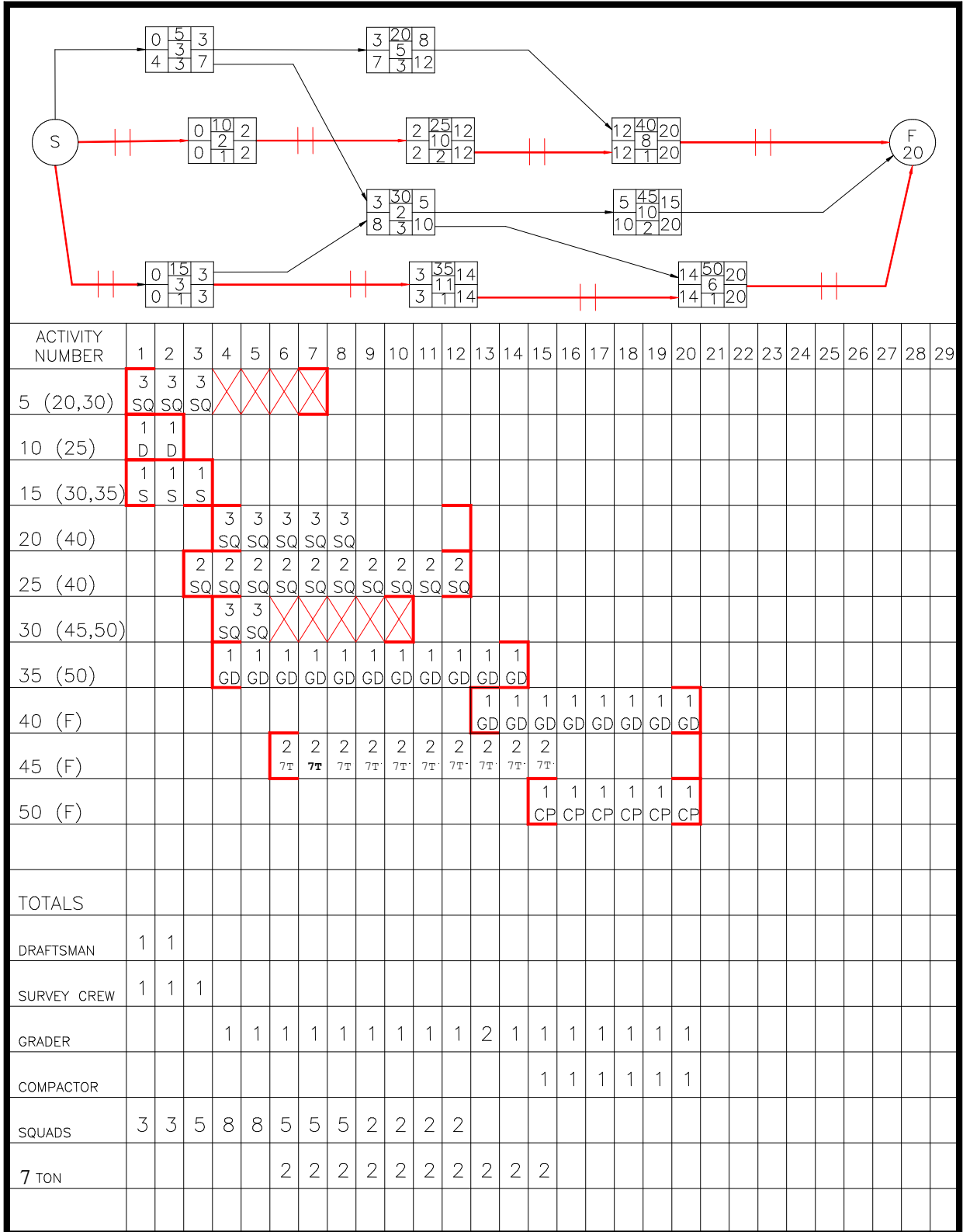
(BREAK 10 Min)

TRANSITION: Before the break we discussed activity resource estimates and duration. Let's us move on to the Early Start Schedule.

(On CS #64)

10. **EARLY START SCHEDULE: (50 Min)** An early start schedule, when joined with the logic diagram, graphically shows all of the planning information that is needed to manage the construction of a project. The early start schedule in itself, enables you to schedule and track all required activity resources for each and every day of the project from start to finish. This schedule is instrumental in anticipating and adjusting for any possible delays.

(On CS #65)



ACTIVITY NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
5 (20,30)	3 SQ	3 SQ	3 SQ	X	X	X	X																						
10 (25)	1 D	1 D																											
15 (30,35)	1 S	1 S	1 S																										
20 (40)				3 SQ	3 SQ	3 SQ	3 SQ	3 SQ																					
25 (40)				2 SQ	2 SQ	2 SQ	2 SQ	2 SQ	2 SQ	2 SQ	2 SQ	2 SQ	2 SQ																
30 (45,50)				3 SQ	3 SQ	X	X	X	X	X																			
35 (50)				1 GD	1 GD	1 GD	1 GD	1 GD	1 GD	1 GD	1 GD	1 GD	1 GD	1 GD	1 GD														
40 (F)														1 GD	1 GD	1 GD	1 GD	1 GD	1 GD	1 GD	1 GD	1 GD							
45 (F)						2 7T	2 7T	2 7T	2 7T	2 7T	2 7T	2 7T	2 7T	2 7T	2 7T														
50 (F)																					1 CP	1 CP	1 CP	1 CP	1 CP	1 CP			
TOTALS																													
DRAFTSMAN	1	1																											
SURVEY CREW	1	1	1																										
GRADER				1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1								
COMPACTOR																1	1	1	1	1	1								
SQUADS	3	3	5	8	8	5	5	5	2	2	2	2																	
7 TON						2	2	2	2	2	2	2	2	2	2														

(On CS #66)

a. **Float:** Any activity that is not on the Critical Path is a non-critical activity, and will contain float time. Float is any extra time that is available to complete an activity beyond its actual duration without effecting the entire project duration. An example would be having six (6) days available to do four (4) days of work to complete an activity.

(1) Total Float (TF): The entire amount of time that an activity can be delayed without delaying the projects estimated completion time. It is computed by the following formula: **TF = LS - ES** or **TF = LF - EF**. Both equations will give the same answer.

(2) Interfering Float (IF): The time that is available to delay an activity without delaying the entire projects completion time, but delaying an activity into interfering float will delay the start of one or more non-critical activities later. If more than one activity follows the one being computed for, always use the **smallest** ES time using the formula: **IF = LF - (ES of following activity)**.

(3) Free Float (FF): Time that is available to delay an activity without delaying the start of any other activity, or the projects completion time. Free float is determined by: **FF = TF - IF**.

(On CS #67)

b. All non-critical activities will have total float, but they can have all interfering float, free float, or a combination of the two.

c. Critical activities on the Critical Path will have **no float time**.

d. This early start schedule will show when all activities are to start and finish on schedule, and list the resources and the numbers that are required for each day of work.

(1) The first step is to list all activity numbers in numerical order. After each activity number, write in parentheses the activity number(s) for the activity(s) that are connected to it with a logic arrow.

(2) The next step is to draw time brackets to represent the early start time and late finish time. The number of blank boxes in between these brackets is equal to the activities duration.

(a) Note: Early start times for starting activities will always be day 1. All other early start times will begin on the morning of the following day. This is because the early start times you calculated represent the end of that work day, and a follow on activity, logically, will not start until the morning of the next working day.

(3) Once the time brackets have been drawn in, you must schedule the required resources to complete that respective activity. This information is extracted from each activity estimate sheet.

(a) Starting at the start bracket, place the number of each kind of resource inside each box from left to right. Do not exceed the activities duration when labeling its resources.

(On CS #68)

(b) Along with the resource quantity, an abbreviation identifying the type of resource is also included. Some of the standardized abbreviations are as follows:

1 Squads = SQ

2 7-ton MTRV truck = 7T

3 Tram = TR

4 Scraper = SC

5 Dozer = DZ

6 Grader = GD

7 Backhoe Loader = BL

8 Excavator = EX

9 Survey Crew = EA

10 Compactor = CP

11 Draftsman = EA

12 Dump Truck = DT

(On CS #69)

(4) The blank boxes that remain represent the amount of float time that is available for **non-critical activities**. This float will be interfering float, free float, or a combination of the two. Remember, **critical activities** have no float.

(a) Calculate the interfering float for that activity.

(b) Calculate the free float for that activity.

(c) Starting at the ending bracket, and working right to left, write an "X" in each box for the number of days of **interfering float** time the activity may have. Interfering float is always shown first.

(d) Free float is then shown by leaving the boxes **blank**. If an activity has no interfering float, all of the remaining boxes will be left blank. All finishing activities have nothing but free float.

(5) The final step is total all the resources for each day of the project and list them at the bottom of the schedule.

e. After you have finished with all of your scheduling, the early start schedule is complete. You now have the all the information you need to manage and control the progress of the construction project.

INTERIM TRANSITION: Are there any questions before we start our demonstration? Answer any questions students may have.

(Off CS #70)

INSTRUCTORS NOTE

Introduce and conduct a guided demonstration to create an early start schedule using the example found in the student outline. Plot a 36" x 24" copy of this schedule to aid in this demonstration.

DEMONSTRATION. (90 Min) Ensure the student can see the large format printout of the Early Start Schedule. With the materials and concepts discussed earlier, fill in the blocks of the Early Start Schedule

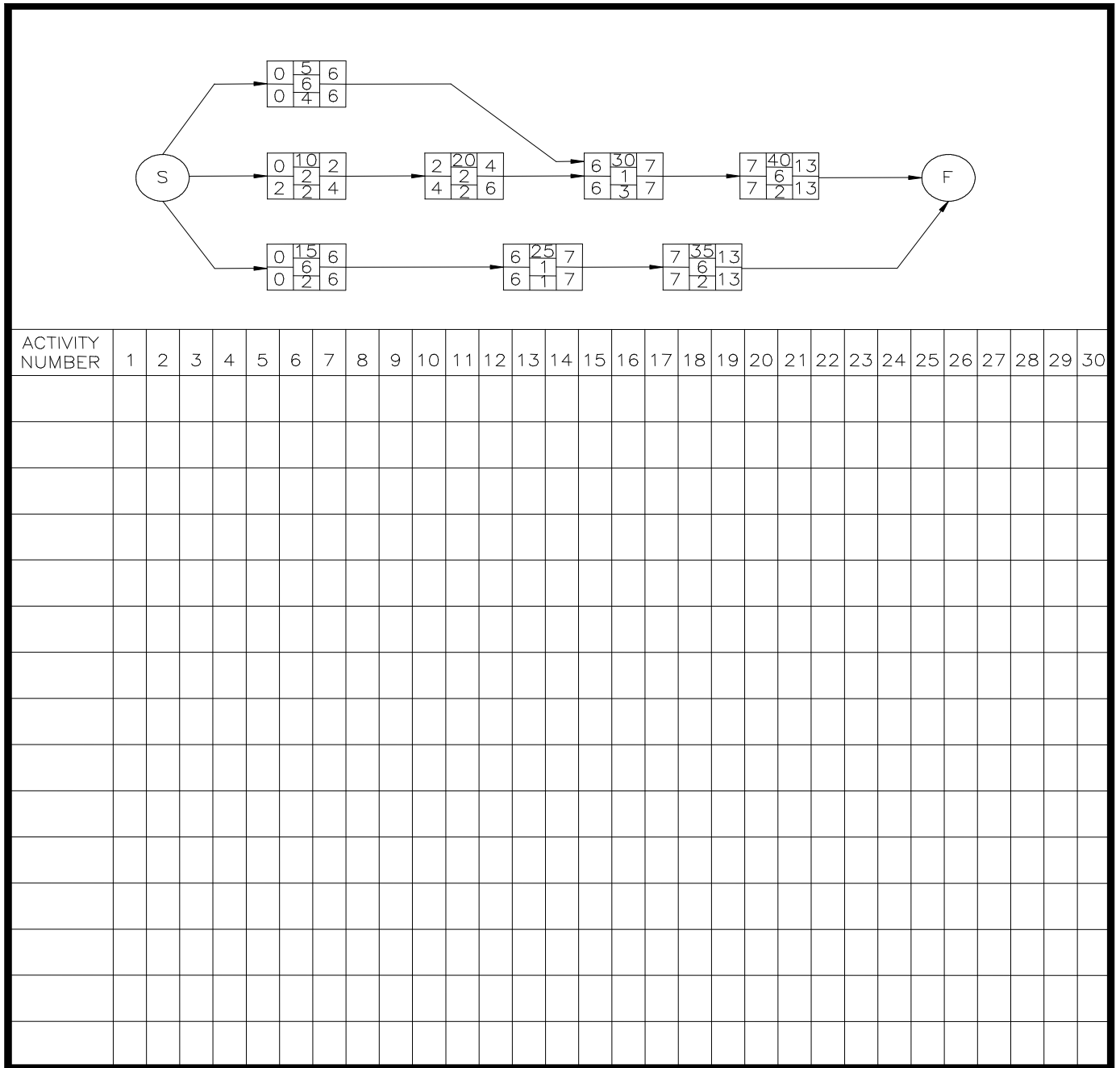
STUDENT ROLE: Active participation in answering numbers, letters, graphics inputted in the Early Start Schedule.

INSTRUCTOR(s) ROLE: Using the printout, write and graphically input data on the Early Start Schedule per material discussed earlier. Guide the students in critical analysis of the materials learned in the input/identification of: Critical Activities, Free Floats, Interfering Float,

1. **SAFETY BRIEF:** No safety concerns with this class.
2. **SUPERVISION & GUIDANCE:** Ensure all students actively participate in the inputs.

DEBRIEF: What you have just seen are the duration inputs in a particular project AON diagram. You have also seen the identification of critical activities and paths. Correlate this to your engineer missions;

(On CS #71)



INTERIM TRANSITION: So far we have discussed and seen a demonstration on the Early Start Schedules. Take a 10 minute break and after that you will begin your practical application.

(On CS #72)

(BREAK 10 Min)

(Off CS #73)

INSTRUCTORS NOTE

Introduce Early Start Schedule practical application. Hand out practical exercise sheets.

PRACTICAL APPLICATION: (1.0 Hrs) This PA is designed to test your knowledge on all of the items covered so far. This PA should take about 1 hour to complete. Any practical problems that you do not finish will be completed as homework and turned in before class resumes the following day.

PRACTICE: Complete an early start schedule for each logic diagram on pages 4 thru 14 of the PA worksheet package.

PROVIDE-HELP: Walk around the classroom and assist all students.

SAFETY BRIEF: No safety concerns with this class.

SUPERVISION & GUIDANCE: Be sure to follow the step by step directions covered in your student outline and from the demonstration presented earlier.

DEBRIEF: After the PA, ask the students if there are any questions.

(On CS #74)

TRANSITION: What are your questions?

OPPORTUNITY FOR QUESTIONS

1. **QUESTIONS FROM THE CLASS:** Do you have any questions concerning the material we have discussed? Answer students' questions.

2. **QUESTIONS TO THE CLASS**

a. QUESTION: What is float?

ANSWER: Float is any extra time that is available to complete an activity beyond its actual duration without effecting the entire project duration.

b. QUESTION: What is interfering float?

ANSWER: The time that is available to delay an activity without delaying the entire projects completion time, but delaying an activity into interfering float will delay the start of one or more non-critical activities later.

c. **QUESTION:** What is free float?

ANSWER: Time that is available to delay an activity without delaying the start of any other activity, or the projects' completion time.

(On CS #75)

(BREAK 10 Min)

TRANSITION: You have now learned how to complete an Early Start Schedule. As you know, we all want a clean product for briefings. We can now transfer all our information to the Microsoft Office Project.

(On CS #76)

11. **MICROSOFT PROJECT: (50 Min)** This program is an automated software application that will aid you in the process of planning and scheduling construction work. It does not make the actual decisions for you, but aid you in reducing the amount of time that normally is required to create CPM diagrams and schedules.

a. Prior to using this program effectively, you must make some initial planning decisions:

(1) What are the work activities.

(2) What are the required resources and their quantities for each activity to be performed.

(3) What are each activities duration times.

(4) When will the project construction actually begin or finish.

b. After you have made these determinations, all you have to do is input the information into the software program to create all of the necessary planning schedules and diagrams.

(On CS #77-78)

c. **Date, Time, and Duration Settings**: Prior to inputting the planning information you have determined, you must establish some initial settings for the project you are creating.

(1) Using the mouse, move the selection arrow to the **TOOLS** menu and press the left mouse button. A cascading sub-menu will appear with various options.

(2) Using the selection arrow, select **OPTIONS**.

(a) In the **Options** dialogue box pick the **VIEW** tab. We will establish the format we want all activity starting and ending dates to be shown in. Select the **DATE FORMAT** scroll arrow, and change the format of the date to read **1/31/94**.

(b) Now select the **CALENDAR** tab. We will not make any changes here, but if you needed to, you could establish important settings such as:

- 1) What day of the week all work begins on.
- 2) When does the fiscal year begin.
- 3) What time of the day will all work begin and end.
- 4) How many hours in the day will work be performed.
- 5) How many hours per week will work be done.

(c) Now select the **SCHEDULE** tab. We will be setting the time unit format for activity duration's as **DAYS**, and for work duration's as **HOURS**.

1) Note: Leave the **SLACK** time at **zero (0)**. By doing so will let the program calculate all **float** times for each activity.

(d) Select the **OK** button at the right of the dialogue box to complete this set of selections.

(3) The next settings that you must establish are working and non-working days and times.

(a) Select the **TOOLS** menu.

(b) Next select **CHANGE WORKING TIME.**

1) The Change Working Time dialogue box will appear. From here you establish what dates are working days during the project, and which days are non-working. We will start by inputting holidays as non-working days.

2) Picking the scroll bar to the left of the currently displayed month will backup on month at a time. Scroll back to **JANUARY** of this year.

3) To establish days as non-working, simple pick the day with the mouse selection arrow and then pick the **NON-WORKING** dates button to the left. This will shade out that date and identify it as a non-working day.

Note: Weekends are automatically considered non-working.

4) To identify days as working days, simply follow the same procedure for selecting the date, and then pick the **WORKING** dates button.

a) Use the following information to input as non-working days:

Month	Date	Holiday
January	1	New Years Day
January	19	Martin Luther King Jr.
February	16	Birthday
May	25	George Washington Birthday
July	4	Memorial Day
September	7	Independence Day
October	12	Labor Day
November	11	Columbus Day
November	26	Veterans Day
December	25	Thanksgiving Day
		Christmas Day

(c) Working times for the whole month, are changed by simply changing the default times to the times you anticipate starting and ending work each day.

(d) Select the **OK** button to complete this group of settings for your project.

(On CS #79)

d. **Resource Settings**: Now we will input all of our available resources that we will be using during the construction of this project. The quantities of resources can be input using one of two methods:

(1) Input the unit's actual T/O and T/E manpower and equipment resources that can be drawn from as a whole for the completion of the project.

(2) Input the personnel and equipment resources that that can be drawn from at the Company, Platoon, and/or Section level.

(3) To input your resources information, pick the **VIEW** menu.

(a) From this cascading menu pick **RESOURCE SHEET**.

(b) A blank resource sheet will now be shown. To input your project resource information, simply pick the blank space under the respective column heading and input the necessary resource information.

1) **RESOURCE NAME**: Input the name of the resources that are required. Use the standard resource names discussed earlier in this lesson.

2) **INITIALS**: Input initials to identify the resource. Use the standard resource abbreviations discussed earlier in this lesson.

3) **MAXIMUM UNITS**: Input the total quantities that are available for each resource. (Unit, Company, Platoon, or Section level)

(c) Input the following resource requirements for the demonstration.

Resource	Initials	O/H Quantity
Survey Crew	S	2
Draftsman	D	3
Squads	SQ	9
Graders	GD	5
Compactors	CP	3

Dozer's	DZ	22
Scrapers	SC	3
Excavators	EX	3
7 Tons	7T	5

(d) After you have input all of the required resource information for your project, select the **VIEW** menu again, and pick **GANTT CHART** to return to your original screen display.

(On CS #80-81)

e. **Inputting Activity Information:** You are now ready to start inputting your project activity information. There are a couple of different methods of doing this, but we will concentrate on the basic procedures for inputting information.

(1) Move the vertical display divider all the way to the right, so the entire activity sheet can be seen. This is done by picking the divider, and then dragging and dropping it to the far right of the screen.

(2) Starting on the first row, type in the name of first activity from your finished activity list.

(3) Press the **LEFT ARROW KEY** on your keyboard to move to the next column, and type in this activity's **DURATION**.

(4) Press the **LEFT ARROW KEY** on your keyboard to move to the next column, and type in this activities **STARTING DATE**.

(5) Press the **LEFT ARROW KEY** twice on your keyboard, to move to the next column, and type in this activity's **PREDECESSORS**. Remember, all starting activities have no predecessors.

(6) Leave the **RESOURCE** information blank for now, as we will come back to it after all of the rest of the activity information has been input. This will reduce substantial typing on your part.

(7) Repeat these steps for each activity remaining on your activity list. Skip past the **STARTING DATES**, these will automatically be calculated by the program after you have input the current activities proceeding activities.

(8) The final step is to input each activities required resources. Scroll back up to the first activity line, and pick its task name.

(9) Pick the **INSERT** menu, and then pick **RESOURCE ASSIGNMENT**. The resource assignment dialogue box will appear with all of the available resources that you input during the setup of this project.

(a) From your finished activities list, identify what type of resource and its quantity that is needed to complete this activity. In the Resource Assignments box, pick the **UNITS** space next to the resource you are going to assign.

(b) Type in the required activity resource quantity using the keyboard.

(c) Repeat this process for each and every activity. When you are finished with all activities, press the **CLOSE** button.

(10) Use the finish activities list shown below to input your project activity information.

ACTIVITIES LIST				
Activity #	Activity	IPB	Duration	Resources
1	"Topo" project site	None	2 days	(1) Survey Crew
2	Create project drawings	1	2 days	(1) Draftsman
3	Order gravel	None	6 days	None
4	Prefabricate forms	None	1 day	(2) Squads
5	Clear and grub roadway	2	2 days	(2) Dozer's
6	Set road alignments	5	1 day	(1) Survey Crew
7	Establish road grades	6	3 days	(1) Grader, (1) Scrapper, (1) Compactor
8	Check road grades	7	1 day	(1) Survey Crew
9	Lay gravel	3,7	2 days	(1) Grader, (2) 7 Tons, (1) Compactor
10	Clear and grub pad site	2	1 day	(1) Dozer, (1) Grader

11	Layout batterboards	10	1 day	(1) Survey Crew
12	Excavate pad footings	11	2 days	(1) Excavator, (2) Squads
13	Check pad elevation's	12	1 day	(1) Survey Crew
14	Place concrete forms	4,13	1 day	(3) Squads
15	Pour concrete	14	1 day	(2) Squads
16	Cure concrete	15	6 days	(1) Squad
17	Remove forms	16	1 day	(2) Squads
18	Perform "As-built"	9,17	2 days	(1) Survey Crew

(On CS #82-83)

f. **Editing Planning Diagrams**: As you input your activity information, the program will automatically create your planning diagrams. There are two types of planning diagrams that are created for use, a Gantt Chart and a Pert Chart. You can edit these diagrams to suit your particular needs.

(1) We will edit the Gantt Chart first. Move the vertical display divider all the way to the left, so the entire Gantt Chart can be seen. This is done by picking the divider and then dragging and dropping it to the far left of the screen.

(2) Pick the **FORMAT** menu, and then select the **BAR STYLES** option.

(a) Under the **NAME** column, pick **PROGRESS** and then pick the **CUT ROW** button. This will delete this row from the set, as it is not needed for our chart. This will also reduce the amount of clutter that will be shown in your printed copies. Repeat this process for the remaining items, but do not delete **TASK**.

(b) We are going to show various pieces of information that will be displayed with the bar on our Gantt Chart. To set this information display format pick the **TASK** name, and then pick the **TEXT** tab.

(c) We will want the starting date for each activity to be displayed to the left of each bar. To do this pick the information block, to the right of the **LEFT** entry label. Now select the down scroll arrow located to the right of the entry display line, and scroll down and select the word **START**. This

will format the display to show all activities starting dates to the left of the Gantt Chart bar. Using the same procedures for each display entry, make the following selections to format the rest of the display information on your Gantt Chart bars.

<u>Location</u>	<u>Selection</u>	<u>Displayed Information</u>
Right	Finish	Activities ending date
Top	Name	Activity name
Bottom	Resource Names	Required resources and quantities
Inside	Duration	Activity duration's

(d) After you have made your selections, pick the **OK** button to accept these settings. This process can also be accomplished during the initial setup of the project settings.

(e) To print this Gantt Chart, drag the vertical display divider to the location that you want, and simply select the **PRINT PREVIEW** button from the screen toolbar.

(3) Now let's edit the Pert Chart that has been created. Pick the **VIEW** menu, and then select **PERT CHART**.

(4) The original Pert Chart that has been created is not in any logical sequence of flow. You must drag and drop each activity node so the precedence arrows logically connect each node and present a clear picture of the project.

(5) Using the rules of logic that were discussed previously in this lesson, simply pick the activity boxes, and then drag them into a location that allows the precedence arrows to connect each of them properly. Begin arranging the starting activities first, and work through the rest of the diagram to the finishing activities.

(a) Note: A Pert Chart does not have a start node or a finish node.

(6) Once you have your Pert Chart organized, you can print a copy of it by using the same procedures that were discussed for printing the Gantt Chart.

(On CS #84)

g. **Project Reports**: This program provides you with the capabilities to print off several different types of project reports to supplement the planning diagrams. We will discuss a few of the more important ones to develop a complete project planning package.

(1) From the menu bar, pick **VIEW**.

(2) Select **RESOURCE USAGE**. The Resource Usage report is shown. This report is similar to the Early Start schedules you created earlier in this lesson. This report lists all the resources that are required for the project, their total work duration's (including float), and the days that the resources are required.

(3) From the menu bar, pick **VIEW**.

(4) Select **RESOURCE GRAPH**. The Resource Graph report is shown. This report lists the allocations and work duration's for all the resources that are required for the project. It will also show if there are any resource conflicts due to an over allocation of actual on-hand quantities.

(5) From the menu bar, pick **VIEW**.

(a) Select **REPORTS**. This will display the Reports display dialogue box which you will gain access to all the reports you may need pertaining to the entire project, and/or reports dealing with activities and resources in general.

(b) Select **OVERVIEW**. This set of report options deals specifically with the project as a whole.

1) Select **TOP-LEVEL TASKS**. This report will list all activity information for the entire project.

2) Select **CRITICAL TASKS**. This report will list all critical activity information for the entire project.

3) Select **WORKING DAYS**. This report will list all working and non-working day information for the entire project.

(c) Select **CURRENT ACTIVITIES**. This set of report options deals specifically with the project activities.

1) Select **UNSTARTED TASKS**. This report will list all unstarted activities as of the current date of the project.

(d) Select **ASSIGNMENTS**. This set of report options deals specifically with resources for the project.

1) Select **WHO DOES WHAT**. This report will list each project resource individually, and all the activities they are assigned to for the entire project.

2) Select **WHO DOES WHAT WHEN**. This report will list all the resource information for the entire project in a more detailed version of an Early Start schedule.

(6) All of these reports can be printed after they are reviewed to include them with the planning diagrams. This will provide you with all of the planning information to manage the construction of a project from start to finish.

INTERIM TRANSITION: Do you have any questions before we begin our guided demonstration? Answer any questions the students may have.

(On CS #85)

INSTRUCTORS NOTE

Introduce and conduct a guided demonstration on Microsoft Office Project software. Inform the students that only basic operations will be demonstrated.

DEMONSTRATION. (60 Min) Ensure the student can see the presentation screen of the Microsoft Office Project start-up and settings input.

STUDENT ROLE: Pay attention to the following demonstration on Microsoft Office Project software.

INSTRUCTOR(s) ROLE: Demonstrate the following Microsoft Office Project inputs: Date, time, duration settings; Resource Settings; GANTT Chart view; PERT Chart view; Report production/printout.

1. **SAFETY BRIEF:** No safety concerns with this class.

2. **SUPERVISION & GUIDANCE:** Ensure all students actively participate in the inputs.

DEBRIEF: What you have just seen are some of the basic inputs in starting and creating a particular Microsoft Office Project file.

INTERIM TRANSITION: For the last 45 minutes seen a demonstration on Microsoft Office Project software. Let's continue and begin your practical application.

(On CS #86)

INSTRUCTOR NOTE

Introduce the following practical application

PRACTICAL APPLICATION: (30 Min) This PA is designed to test your knowledge of the Microsoft Project software program. This PA should take about 30 minutes to complete.

PRACTICE: Complete the problems on pages 15 thru 18 of the PA worksheet package.

PROVIDE-HELP: Walk around the classroom and assist all students.

SAFETY BRIEF: No safety concerns with this class.

SUPERVISION & GUIDANCE: Be sure to follow the step by step directions covered in your student outline and from the demonstration presented earlier.

DEBRIEF: After the PA, ask the students if there are any questions.

(On CS #87)

TRANSITION: Are there any questions on the practical exercises you have completed? Answer any questions the students may have.

OPPORTUNITY FOR QUESTIONS

1. **QUESTIONS FROM THE CLASS:** Do you have any questions concerning the material we have discussed? Answer students' questions.

2. **QUESTIONS TO THE CLASS**

a. QUESTION: How does Microsoft Office Project calculate float times?

ANSWER: By inputting ZERO (0) in the Slack Time upon setting up the Microsoft Office Project file.

b. QUESTION: Does a PERT Chart have a Start and Finish Node?

ANSWER: No.

(On CS #88)

SUMMARY

(5 Min)

During this lesson you have learned how to plan a project by creating an activities list, estimate activity resources, create a CPM logic diagram, and generate an early start schedule. The use of the Critical Path Method as a planning tool for construction projects is very beneficial, and should never be disregarded. Take a 10 minute break. The next lesson will begin at _____.

(BREAK-10min)

REFERENCES

Project Management	MCRP 3-17.7F
Seabee Planner's and Estimator's Handbook	NAVFAC P-405
Microsoft Project Reference Manual	