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ENGINEER UNIT DAYS COMPUTER PROGRAM (UNDAY) - USER'S MANUAL.(U)
JUL 79 S J KIM, R NELSON, A M KAO

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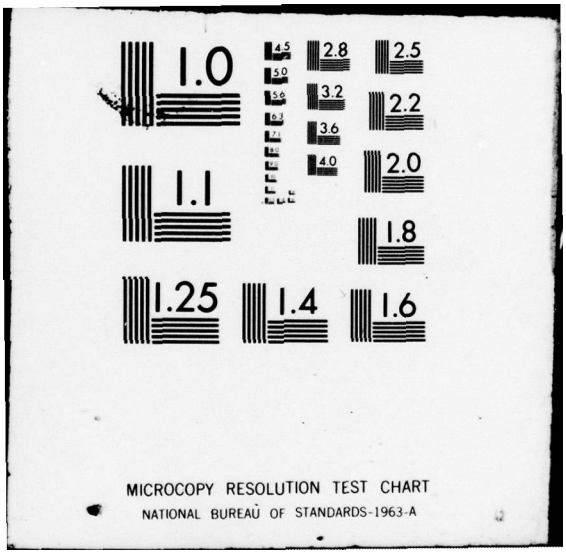
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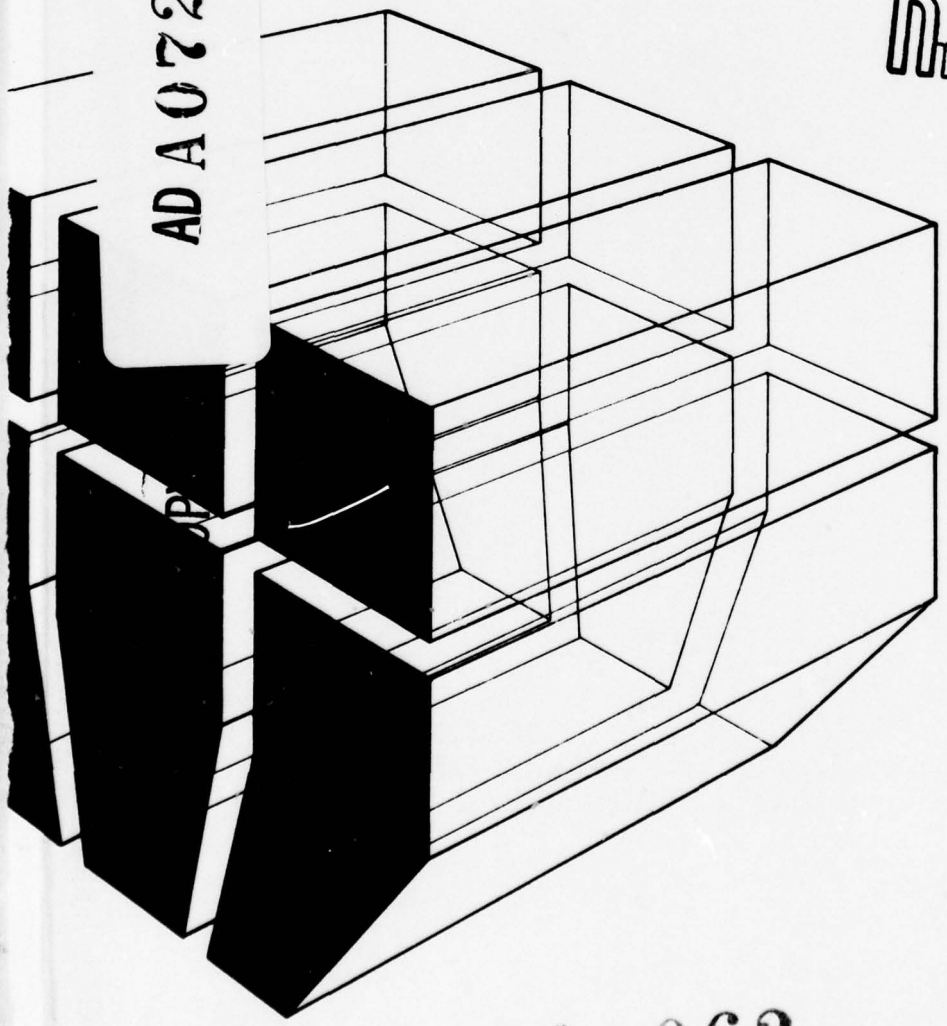
TECHNICAL REPORT M-266
July 1979

LEVEL II

ENGINEER UNIT DAYS COMPUTER PROGRAM (UNDAY)—USER'S MANUAL



by
S. J. Kim
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report describes the Engineer Unit Days Computer Program (UNDAY) and provides the user with information to operate the program. UNDAY was developed to facilitate rapid scheduling of military construction projects using the Army Facilities Components System (AFCS) in the theater of operations. The program selects the engineer construction unit or combination of units that most efficiently meets the resource

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requirements of a given project and calculates the number of work days it requires to complete the facilities.

FOREWORD

This study was conducted for the Directorate of Military Programs, Office of the Chief of Engineers (OCE), under Project 6.37.34A/4A763734DT34, "Development of Engineering Support to the Field Army"; Task 04, "Base Development"; Work Unit 004, "Construction Scheduling of AFCS Facilities."

Mr. G. E. McWhite, DAEN-ZCM, is the OCE Technical Monitor.

The work was performed by the Engineering and Materials Division (EM), U.S. Army Construction Engineering Research Laboratory (CERL), Champaign, IL. Dr. G. R. Williamson is Chief of EM.

COL J. E. Hays is Commander and Director of CERL, and Dr. L. R. Shaffer is Technical Director.

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(UNDAY) - USER'S MANUAL

1 INTRODUCTION

Background

The Army Facilities Components System (AFCS) is a military engineering construction support system for use in a theater of operations (TO). The system was designed in response to the need for an improved construction planning system. Accurate scheduling and coordinated manpower resource activities are vital if construction projects in support of military operations in the TO are to be completed as planned. Late completion hinders the operations of troop units using the facility or installation, while early completion may overload the line of communication and cause inefficient use of manpower and equipment. To avoid these undesirable impacts and to deliver the finished products on time, a valid scheduling procedure is essential at all levels of construction planning.

Several scheduling procedures are available for planning TO construction projects, but they all deal with either theater-level planning or detailed jobsite activity scheduling; none is designed to assist planners concerned with a regional construction program that is part of a Civil Engineering Support Plan. These planners cannot use scheduling procedures developed for other uses because they must address a specific level of schedule detail and must work with limited computational resources in the field. Thus, it is essential to develop an effective tool that will help engineer battalion, group, brigade, or command planners rapidly schedule their construction program using the AFCS.

Purpose

The purpose of this study was to develop the Engineer Unit Days Computer Program (UNDAY) to facilitate scheduling of military construction projects using the AFCS in a TO.

Approach

UNDAY was developed based on the standard critical path method (CPM) of time analysis and scheduling, which was adapted specifically to the requirements of the AFCS in the TO. Chapter 2 gives an overview of the system; Chapter 3 describes the operating procedures, and the appendices contain information on input deck cards and example problems.

System Capability

UNDAY computes the most qualified engineer construction unit(s), down to the platoon level, and the number of work days required to construct AFCS facilities. This concise information can be used as a quick reference guide in the TO for choosing a responsive construction schedule alternative and drawing up to a realistic troop utilization plan. It can also be used by the base development planner in developing an engineer troop deployment plan at the outset of a Civil Engineering Support Plan. The interim calculation results, which include critical path method-based schedules and resource-constrained bar charts, provide for onsite management of construction activities and labor and equipment resources.

Mode of Technology Transfer

The UNDAY program will be transferred in conjunction with TM 5-304, *How to Use the Army Facilities Components System* (Department of the Army [draft]).

2 OVERVIEW

Program Operation

UNDAY is written in FORTRAN-extended, for batch mode operation. System integration tests were conducted on a CDC 6600 computer in a remote batch mode. The program is portable and readily adaptable at any major automatic data processing installation which has FORTRAN-extended compiler capabilities. Inquiries about the availability and use of the program should be addressed to:

U.S. Army Corps of Engineers
Huntsville Division
AFCS Branch
P. O. Box 1600, West Station
Huntsville, AL 35807

Capabilities and Selected Features

UNDAY is applicable to all types of AFCS facilities as well as other TO construction projects that do not exceed the site limitations described below. It is simple and flexible to use.

Input data preparation is simple and does not require extensive data conversion. The required input for normal operation consists of the network diagram, total manhours, and normal crews for construction activities comprising the project. U.S. Army Corps of Engineers, Huntsville Division is incorporating these data into TM 5-302 for AFCS facilities.

The principal output from the program is the result of the unit assignment calculation. The time duration and manpower usage that a specific engineer unit (system chosen or user selected) will require to complete the project are shown. Day-to-day allocation of labor skills to achieve that level of use is also shown. When more than one troop unit is considered for the project, the performances of each are summarized for comparison. The secondary output includes a CPM-based activity time schedule and a manpower allocation bar chart. The time schedule shows the normal project duration, start and finish times, and slack for each activity. The bar chart shows day-to-day resource allocations corresponding to the activity time schedule.

The system has various built-in convenience and flexibility features:

a. Multiple Projects Input. The number of projects in the input deck is not limited. The user may include as many projects as desired, in any order.

b. Labor Skills. The system provides a breakdown of 10 labor skills: (1) unskilled labor (N), (2) electrician (E), (3) structural worker (S), (4) engineer aid (A), (5) utilitiesmen (U), (6) builders-general (B), (7) heavy equipment operator (H), (8) asphalt/concrete equipment operator (P), (9) general construction equipment operator (G), (10) lift/load equipment operator (L). (See Table 1 for detailed definitions of these skills.) These system-defined skills, however, can be easily modified to define fewer new skills. The new set of skills is formed by grouping the set of system-defined skills (see Chapter 3).

c. Engineer TOE Data Base. An independent data array contains construction capabilities of engineer Tables of Organization and Equipment (TOE), expressed in terms of the number of men by skill types in the TOE. Up to 60 TOEs are permitted. The user can easily modify data, or may enter new TOEs to include a modified TOE. If the user specifies a new set of skills, the system automatically adjusts the data to reflect changes in the skill definition.

d. Selection of Candidate TOEs. The user may specify up to five TOEs (or pairs of TOEs) for unit assignment consideration. In the absence of this user input, the system searches through the TOE data base and selects up to five of the most qualified units.

e. Output Control. The system provides the user with extensive control over output--a time-saving feature. All output except the summary of unit assignment calculations can be suppressed.

System Structure

One main program and 10 subroutines comprise the system structure. Figure 1 shows the major functions of the main program, UNDAY, and its relationships with the supporting subroutines. Table 2 describes individual subroutines.

The data processing consists of four steps. First, project-independent information such as the TOE data base and output control information are read in, and associated data arrays are initialized. If specified, user-defined skills are read in and the capability data in the TOE data base is modified accordingly.

Second, project-specific data, such as project number (or seven-digit AFCS number), title, and parameters defining construction activities are read in and checked for error. If no errors are found, CPM calculations are performed and, depending on the user option, a CPM tab sheet and a bar chart schedule may be printed. If fatal errors are present, further processing of this project is bypassed and the next project in the input is read in.

Third, the TOE data base is searched to identify TOEs qualified for construction. Up to five candidates are selected and passed on to the next step. If there is no candidate TOE in the data base, processing of the project terminates with a message to the user and the program begins processing the next project. This step is bypassed when the user furnishes one or more candidates.

Fourth, day-by-day manpower allocation and activity scheduling are computed for each candidate TOE. The optional output consists of bar charts showing the activity time schedule and labor skill allocation, and the TOE's performance evaluation report (optional) indicating project completion time and manpower use efficiency. After calculation is repeated for all candidate TOEs, a summary report which shows performance rankings of the TOEs for that project is printed.

Various complex computations occur during the fourth step. In short, all construction activities that are to continue or start are identified at the beginning of a given day of scheduling. These activities are then prioritized based on an internal classification scheme. Beginning with the first activity in the priority list, all schedule possibilities for each activity (e.g., cancel, normal conduction, or expedited conduction) are identified and recorded along with the rate of resource consumption and impacts on project completion time. After this calculation is performed for all activities under consideration, combinations of schedule possibilities, one from each activity, are evaluated and weighted, and the one most likely to result in the earliest project completion is selected. The selected combination determines allocation of the manpower available for the day. In typical situations, certain activities are cancelled while others are planned for earlier than normal completion. This day-by-day schedule computation terminates when all activities are completed.

Assumptions and Limitations

The following assumptions and limitations apply in using the system:

a. Permissible upper limits are:

(1) 100 activities per project
(2) 10 skill types
(3) 5 skill types per activity
(4) 60 TOEs in the TOE data base.

b. The activity numbering rule, "head node always greater than tail node" or "the event number at the head of the arrow must be larger than the number at the tail" should be observed. "One source and one sink" or "one beginning and one ending" per network should also be observed.

c. A 10-hour work day in the field is assumed. All internal computations are performed in half-day time units, i.e., 5 working hours in the field. The user is responsible for input of net productive hours per 10-hour work day.

d. When the following conditions are detected, bar chart schedules are not printed; however, this does not affect schedule computations:

(1) The project duration exceeds 60 days (or 120 half-day time units).

(2) Summation of the number of concurrent activities per day over the project period exceeds 400 (or 800 if counted on internal time unit basis).

e. During the calculation of the day-by-day schedule, an activity is not interrupted once it is scheduled. Moreover, the activity is carried out as fast as, or faster than any previous work rate.

3 OPERATING PROCEDURE

Problem Definition

The UNDAY program is used primarily to determine the engineer unit(s) most qualified to construct AFCS activities and to indicate how long the unit(s) would require to complete the mission. This application, however, can easily be extended to solving specific problems. For example, the user may (1) specify a particular definition of skill categories rather than using the system-defined standard skills, (2) change the TOE data base or modify it to include any work crews, or (3) input other than AFCS projects. Also, if the normal CPM calculations are the desired output, the user can request the CPM tab sheet and its bar chart schedules with omission of the remaining procedures. Slight variations in input permit these applications.

Input Data Preparation

Figure 2 illustrates the deck set-up for input data. The user will have to add to the deck the job control cards required at the computer installation. Detailed descriptions of the data fields, formats, and data contents are given in Appendix A.

TOE Capability Data Base (Cards I and II)

CARD I: One card is required. It defines the number of engineer TOEs in the data base and the numbers and symbols of labor skills (see Chapter 2 for standard symbols).

CARD II: One card is required for each TOE in the data base. Each card gives construction capabilities (the number of men in each skill category), identification number, and descriptive title for the TOE. The order of capability figures should match that of the skill symbols in CARD I. As many as 60 cards are allowed.

Output Control (Card III)

CARD III: One card is required, which applies to all projects in the run. One character, "Y" (for yes) or "N" (for no), controls printing of the TOE data base tab sheet (DBTS), project-specific input data tab sheet (IDTS), resource-unlimited CPM tab sheet (UCTS), resource-unlimited CPM for bar chart (UCBC), and resource-constrained bar chart (RCBC).

Skill Modification (Cards IV and V)

CARD IV: One card is required. It defines new skills from 0 (zero) up to 10; if zero is entered, no change in the skill definition is assumed.

CARD V: This optional card is not required if the standard skill definition is to be used; otherwise, a card is required for each new skill category. Each new skill is defined in terms of the standard skill categorization. For example, a card containing W, 1, B in that order specifies that the new symbol, W, replaces the standard symbol, B, for builder-general; and the card containing V, 5, A, B, E, U, S specifies that the new skill, V, combines five standard skills (i.e., engineer aid, builder general, electricians, utilitiesmen and structure worker), thereby representing a "vertical" skill. Note that the set of new skills defined applies to all projects in the run and should completely cover the standard skills.

Project-Specific Data (Cards VI, VII, VIII, IX)

CARD VI: One card per project is required. It gives project identification number and descriptive title.

CARD VII: One card per project is required. The scale factor (SF) field (required) indicates the net productive hours per day based on a 10-hour work day. The ONUM field (required) indicates the number of user-selected TOEs or pairs of TOEs. If the number is zero or left blank, selection is made by the program. The ODAT field (optional) identifies user-selected TOEs or TOE pairs; up to five selections can be specified. Note that if the ONUM field contains a nonzero positive integer and the ODAT field is blank unit, assignment calculations are suppressed.

CARD VIII: One card per activity is required. Information to be supplied consists of tail and head node numbers, total manhours required, normal crew size (number of men), crew formation (number of men in the crew by skill type), narrative description, and critical duration indicating the least number of days required to complete the activity (default value is a half day). Narrative description and critical duration are optional.

CARD IX: One card is required per project. It indicates the end of input data for that project.

End Card (Card X)

CARD X: One card is required per run. It indicates the end of input data.

Output Reports

Output reports produced by the program are as follows.

a. Construction Troop Unit Data Base (Optional). Shows construction capabilities by standard skill type for all TOEs in the data base (Figure 3).

b. Modified Construction Troop Unit Data Base (Optional). Shows construction capabilities of the TOEs based on new skill categorization specified by the user (Figure 4).

c. Input Data Tab Sheet (Optional). Shows the project-specific data furnished (Figure 5).

d. Resource-Unconstrained CPM Tab Sheet (Optional). Shows normal CPM computation results in tabular form (Figure 6).

e. Resource-Unconstrained CPM Bar Chart (Optional). Shows bar chart schedule assuming no manpower constraints are imposed on the project (Figure 7).

f. Unit Assignment Calculation (Optional). Provides performance evaluation for each candidate TOE considered (Figure 8).

g. Resource Constrained Bar Chart (Optional). Provides manpower allocation bar chart schedule corresponding to the unit assignment calculation report above (Figure 9).

h. Summary of Unit Assignment. Ranks all TOEs considered based on the performance evaluation (Figure 10).

Example Problem

A typical building construction project was selected for demonstrating use of the UNDAY computer program. Appendix B provides example problems for two types of calculations: (1) those with no user modifications, and (2) those with user-supplied skill categories and candidate TOEs.

4 CONCLUSIONS

The Engineer Unit Days Computer program, UNDAY, is designed to serve as a computational tool for a range of construction scheduling and manpower allocation problems involving use of the AFCS in a theater of operations.

The program is simple to use and requires no detailed analyses on the part of users; input data preparation consists of straightforward data conversion and the output is in a readily usable format. The program is flexible to use and adaptable to specific situations.

Table 1

Recommended AFCS Skills

NO	AFCS SKILLS	ABBR	DEFINITION	H,V,G
1.	General Labor	N	Combat Engineer, Pioneer ADM Specialist, Apprentice and Helper	G
2.	Engineer Aid	A	Surveyor, Tapemen, Rodmen Diver, Marine Engineer & Power Boat Operator	V
3.	Builder - General	B	Carpenter & Mason	V
4.	Electrician	E	Electrician	V
5.	Utilitiesmen	U	Plumber & Heat, Cool, Refer Spec	V
6.	Structures Spec	S	Structures Spec, Pipeline Spec, Metal Worker, Welder	V
7.	Heavy Equip Operator	H	Crawler/Wheel Tractor, Scraper, Grader, Loader Op	H
8.	General Const Equip Operator	G	Compressor, Ditching Machine, Power Roller, Water Distributor, Rotary Tiller Op	H
9.	Asphalt/Concrete Equip Operator	P	Asphalt Paver, Production, & Distributor Op Concrete Production & Distributing Equip Op	H
10.	Lifting/Loading Equip Operator	L	Crane, Forklift Op	H

Skills not to be included are: Officer, Non-Commissioned Officer, Administrative Personnel, Maintenance Mechanic, Organic Power Pack/Generator Operator, and other non-productive personnel.

Table 2

UNDAY Subroutine Descriptions

SUBROUTINE NAME	DESCRIPTION
BARCHT	BARCHT plots a bar chart of the project network and a resource use profile. This option is available for unlimited resources and for the limited resources of a given troop unit.
CHOOSE	CHOOSE selects from a data base the unit or combination of units which most efficiently meets the resource requirements of a given project. The number of men in each skill type is required to be at least that number needed for the project.
CMBTRB	CMBTRB allows the formation of new skill types by grouping together basic skills. Unit resources are calculated using the newly created skill types.
DAYCMP	DAYCMP schedules project activities in a way which attempts to maximize the number of men working at any time given the troop resource limitations. On a day-to-day basis activities are scheduled in order of increasing total float until one of the resources is exhausted. Activities can be crashed.
INICPM	INICPM calculates for an activity network the Early Start, Early Finish, Late Start, Late Finish, and Total Float.
NETWRK	NETWRK reads for each activity the total manhours, the crew size and the number of hours worked per day. The activity duration is then calculated. The skills needed for each activity are input. The crew information is organized according to skill type and the manhours required for each skill are calculated for each activity.
NETCHK	NETCHK checks for and lists the following notations errors in an arrow network: (a) Tail is greater than or equal to head (b) Two activities have the same head and tail (c) Activity has no precedent (d) Activity has no successor.
SORT	SORT orders activities in ascending order of the tail. Activities with the same tail are ordered in ascending order of the head.

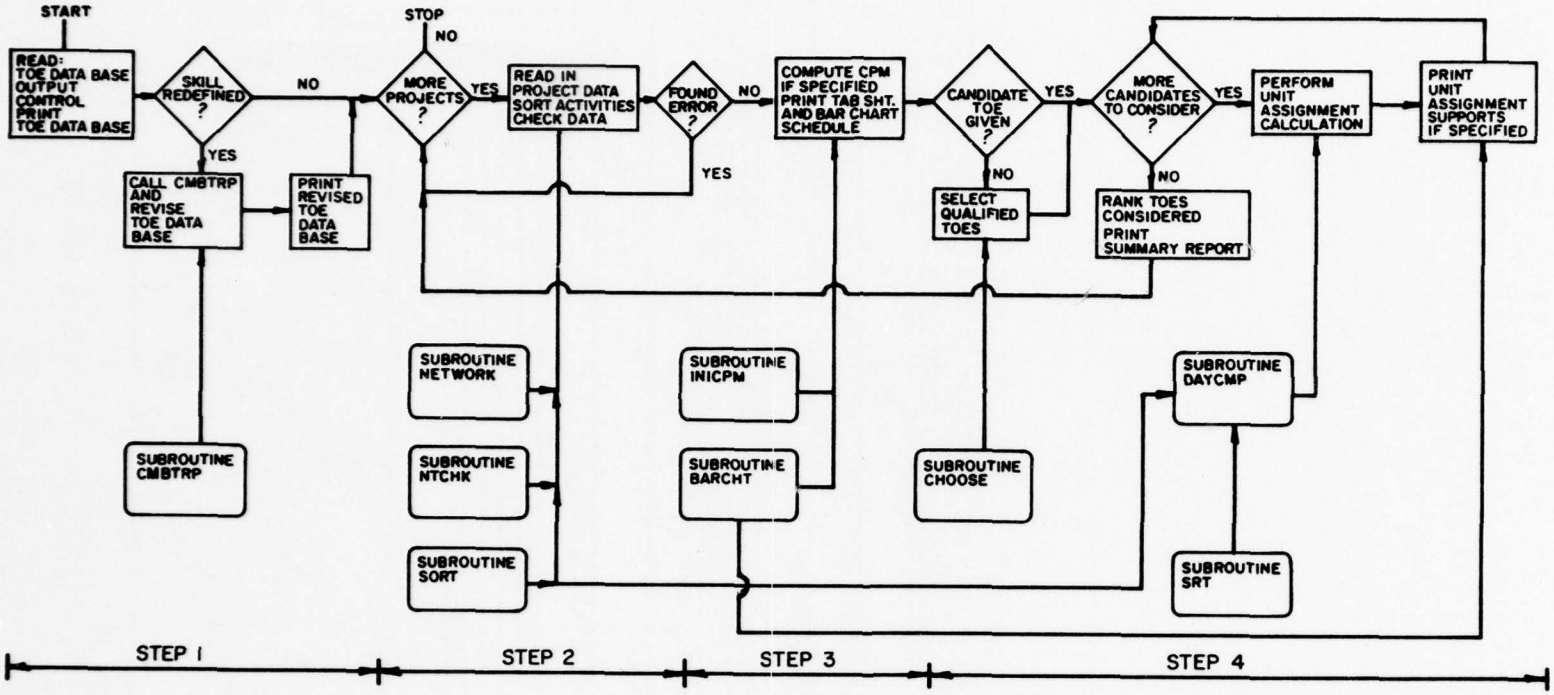


Figure 1. UNDAY program structure.

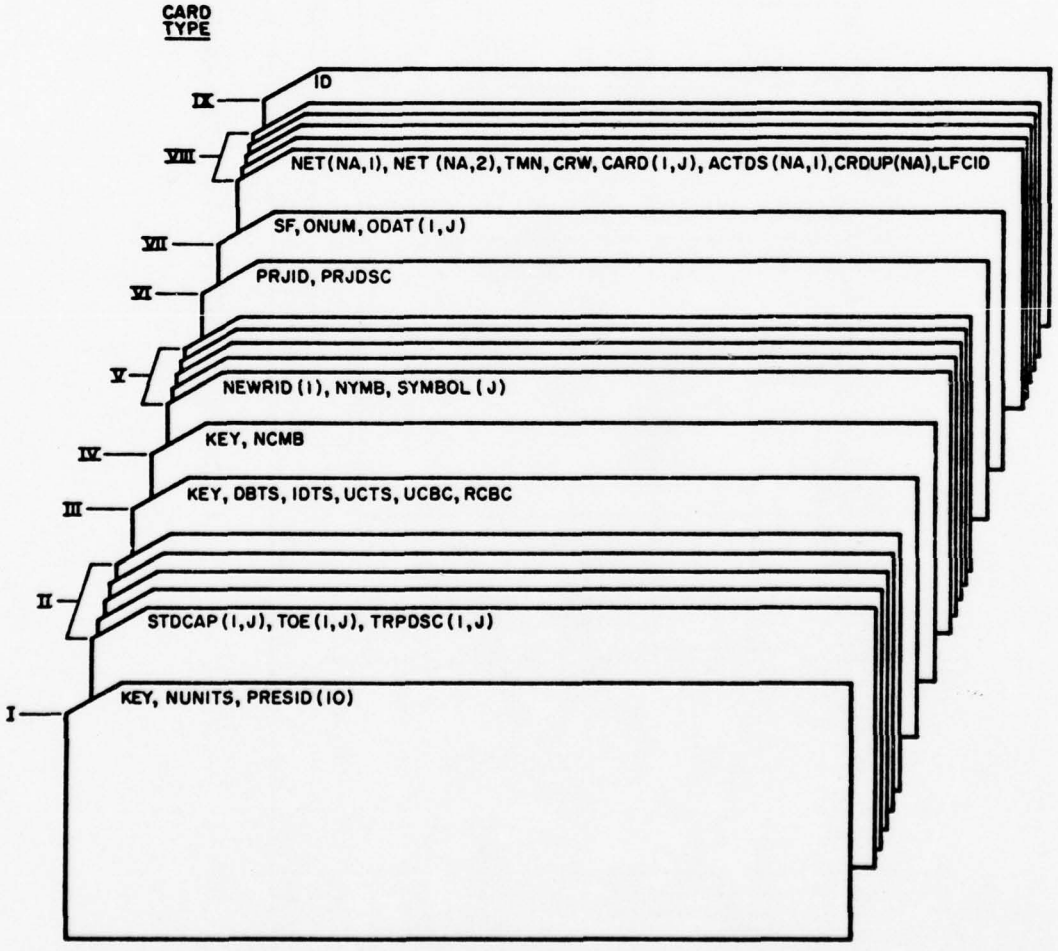


Figure 2. Input deck set-up.

CONSTRUCTION TROOP UNIT DATA BASE

N: UNSKILLED LABOR A: CONSTRUCTION AID B: BUILDERS-GENERAL E: ELECTRICIAN S: STUCTURES WORKERS
U: UTILITIESMEN H: HEAVY EQ. OP. G: GENERAL EQ. OP. P: ASPH/CONC MACH OP. L: LIFT/LOAD EQ. OP.

INDEX	TOE #	UNIT DESCRIPTION	CAPABILITY BY SKILL TYPE (NO OF MEN)										
			N	A	B	E	U	S	H	G	P	L	TOTAL
1	5-35H	ENGR COMBAT BN, CORPS	316	2	6	5	6	1	42	5	1	7	391
2	5-37H	ENGR CBT CO, CORPS	78	0	0	0	0	0	8	1	0	0	87
3	5-37H	PLT-ENGR CBT CO,CBT BN,HVY	25	0	0	0	0	0	2	0	0	0	27
4	5-115H	ENG CBT BN, HVY	69	9	102	54	48	29	53	22	12	14	412
5	5-117H	EQP & MNT CO,CBT BN, HVY	9	0	0	0	0	5	5	7	6	8	40
6	5-118H	ENGR CO, ENGR CBT BN, HVY	20	0	34	18	16	8	16	5	2	2	121
7	5-118H	HOR PLT-ENGR CO,CBT BN,HVY	0	0	0	0	0	0	16	3	0	0	19
8	5-118H	GEN PLT-ENGR CO,CBT BN,HVY	8	0	17	6	6	3	0	1	1	0	42
9	5-195H	ENGR CBT BN, ABN	147	6	8	5	2	7	80	12	6	6	279
10	5-197H	ENGR EQUIP & MNT CO, ABN	3	0	8	5	2	7	8	4	6	6	49
11	5-198H	ENGR CMBT CO, ABN	72	0	0	0	0	0	36	4	0	0	112
12	5-199H	PLT-ENGR CBT CO, ABN	20	0	0	0	0	0	8	1	0	0	29
13	5-54H	ENGR LT EQUIP CO, ABN	0	0	0	0	0	2	72	6	0	7	87
14	5-58H	ENGR CPT SPT EQUIP CO	6	0	0	0	0	3	28	13	7	11	68
15	5-114H	ENGR CONST SPT CO	9	0	0	0	0	2	5	19	16	9	60
16	5-129H	PORT CONSTR CO	25	10	16	4	2	31	5	7	2	14	116
17	5-129H	CON PLT-ENGR PORT CONST CO	7	0	8	2	1	13	0	1	0	4	36
18	5-177H	ENGR PIPELINE CONST SPT CO	30	0	9	0	0	74	4	2	0	8	127
19	5-177H	PL PLT-ENGR PIPLN CONST CO	6	0	3	0	0	24	0	0	0	2	35
20	5-124H	ENGR DUMP TRUCK CO	0	0	0	0	0	0	0	0	0	42	42
21	5-124H	TRK PLT-ENG DUMP TRUCK CO	0	0	0	0	0	0	0	0	0	21	21

Figure 3. Construction troop unit data base.

NEW SKILLS DEFINED

B	1	B
N	1	N
W	8	AEUSHGPL

REVISED TROOP UNIT DATA BASE

INDEX	TOF #	UNIT DESCRIPTION	CAPABILITY BY SKILL TYPE (NO OF MEN)			
			B	N	W	
1	5-35H	ENGR COMBAT BN, CORPS	6	316	69	391
2	5-37H	ENGR CBT CO, CORPS	0	78	9	87
3	5-37H	PLT-ENGR CBT CO,CBT BN,HVY	0	25	2	27
4	5-115H	ENG CBT BN, HVY	102	69	241	412
5	5-117H	EQP & MNT CO,CBT BN, HVY	0	9	31	40
6	5-118H	ENGR CO, ENGR CBT BN, HVY	34	20	67	121
7	5-118H	HOR PLT-ENGR CO,CBT BN,HVY	0	0	19	19
8	5-118H	GEN PLT-ENGR CO,CBT BN,HVY	17	8	17	42
9	5-195H	ENGR CBT BN, ABN	8	147	124	279
10	5-197H	ENGR EQUIP & MNT CO, ABN	8	3	38	49
11	5-198H	ENGR CMBT CO, ABN	0	72	40	112
12	5-198H	PLT-ENGR CBT CO, ABN	0	20	9	29
13	5-54H	ENGR LT EQUIP CO, ABN	0	0	87	87
14	5-58H	ENGR CPT SPT EQUIP CO	0	6	62	68
15	5-114H	ENGR CONST SPT CO	0	9	51	60
16	5-129H	PORT CONSTR CO	16	25	75	116
17	5-129H	CON PLT-ENGR PORT CONST CO	8	7	21	36
18	5-177H	ENGR PIPELINE CONST SPT CO	9	30	88	127
19	5-177H	PL PLT-ENGR PIPLN CONST CO	3	6	26	35
20	5-124H	ENGR DUMP TRUCK CO	0	0	42	42
21	5-124H	TRK PLT-ENG DUMP TRUCK CO	0	0	21	21

Figure 4. Modified construction troop unit data base.

INPUT DATA TAB SHEET

AFCS NUMBER - 341141 DESCRIPTION - WARFHOUSE WITH CONCRETE FOOTINGS

NETWORK PARAMETERS

TAIL	HEAD	TOTAL M-H	CREW SIZE	ACTIVITY DESCRIPTION				CREW FORMATION (NO OF MEN)						CRUSH DUR
1	2	21	3	SITE LAYOUT	B	1	N	2		0	0	0		0
1	5	24	2	FABRICATE FORMS	B	2		0		0	0	0		0
1	6	14	2	FABRICATE ANCHOR STRAPS	W	2		0		0	0	0		0
1	10	48	3	ASSEMBLE COLS. AND GIRDER	B	3		0		0	0	0		0
2	3	60	5	FOOTING EXCAVATION	N	5		0		0	0	0		0
5	6	26	2	ERECT FORMS	B	2		0		0	0	0		0
6	7	20	10	CONCRETE WORK	B	1	N	8	W	1	0	0		0
7	8	0	0	CURE CONCRETE		0		0		0	0	0		3
8	9	6	2	STRIP FORMS	B	2		0		0	0	0		0
9	11	21	3	BACKFILL CONCRETE FOOTING	N	3		0		0	0	0		0
10	12	39	3	PRECUT ROOF FRAME	B	3		0		0	0	0		0
11	14	70	5	INSTALL COLS. AND GIRDERS	B	3	W	2		0	0	0		0
14	15	72	4	INSTALL ROOF FRAME	B	4		0		0	0	0		0
16	17	76	4	INSTALL ROOF DECK	B	4		0		0	0	0		0
17	18	44	4	INSTALL ROOFING	B	4		0		0	0	0		0
18	19	26	2	CLEAN UP	N	2		0		0	0	0		0
3	5	0	0	DUMMY		0		0		0	0	0		0
10	11	0	0	DUMMY		0		0		0	0	0		0
12	14	0	0	DUMMY		0		0		0	0	0		0
15	16	0	0	DUMMY		0		0		0	0	0		0

Figure 5. Input data tab sheet.

PROJECT SUMMARY

AFCS NUMBER - 341141 DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS

196 TOTAL GALF MAN-DAYS REQUIRED FOR PROJECT COMPLETION

RESOURCE REQUIREMENTS BY SKILL TYPES (HALF MAN-DAYS)

B	N	W
128	51	17

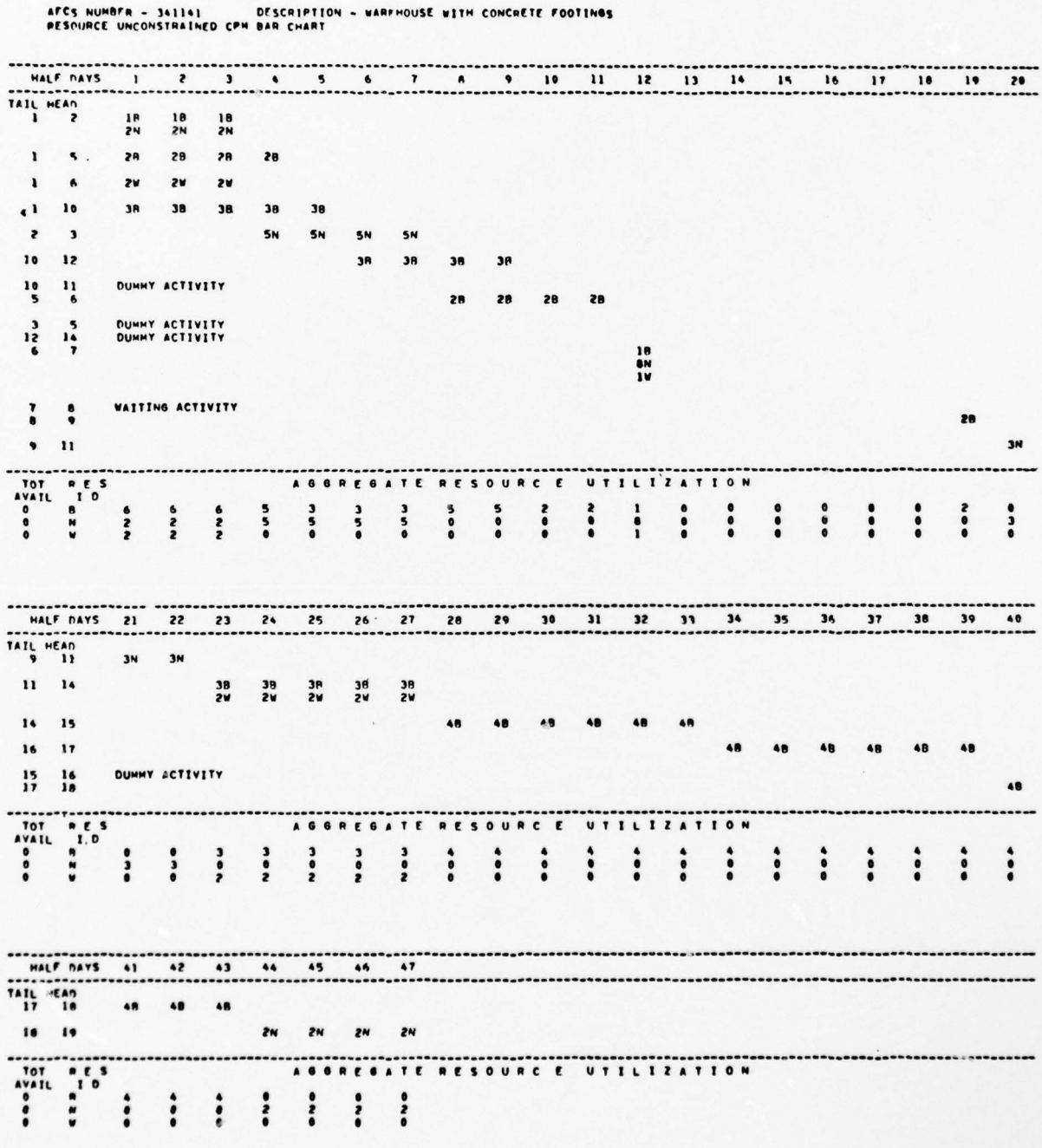
CPM TAB SHEET ASSUMING NO RESOURCE CONSTRAINTS(TIME UNIT = HALF DAY)

TAIL	HEAD	NORMAL DUR	EARLY START	EARLY FINISH	LATE START	LATE FINISH	TOTAL SLACK	NORMAL CREW SIZES B	N	W
1	2	3	0	3	0	3	0	1	2	0
1	5	4	0	4	3	7	3	2	0	0
1	6	3	0	3	8	11	8	0	0	2
1	10	5	0	5	17	22	17	3	0	0
2	3	4	3	7	3	7	0	0	5	0
5	6	4	7	11	7	11	0	2	0	0
6	7	1	11	12	11	12	0	1	8	1
7	8	6	12	18	12	18	0	0	0	0
8	9	1	18	19	18	19	0	2	0	0
9	11	3	19	22	19	22	0	0	3	0
10	12	4	5	9	23	27	18	3	0	0
11	14	5	22	27	22	27	0	3	0	2
14	15	6	27	33	27	33	0	4	0	0
16	17	6	33	39	33	39	0	4	0	0
17	18	4	39	43	39	43	0	4	0	0
18	19	4	43	47	43	47	0	0	2	0
3	5	0	7	7	7	7	0	0	0	0
10	11	0	5	5	22	22	17	0	0	0
12	14	0	9	9	27	27	18	0	0	0
15	16	0	33	33	33	33	0	0	0	0

NORMAL PROJECT DURATION IS : 47 HALF DAYS

OVERRIDE INPUT SPECIFIED

Figure 6. Resource unconstrained CPM tab sheet.



AFCS NUMBER - 341141 DESCRIPTION - WARFHOUSE WITH CONCRETE FOOTINGS
RESOURCE UNCONSTRAINED CPM BAR CHART

HALF DAYS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TAIL HEAD																				
1 2	1R 2N	1B 2N	1B 2N																	
1 5	2B	2B	2B	2B																
1 6	2W	2W	2W																	
1 10	3R	3B	3B	3B	3B															
2 3				5N	5N	5N	5N													
10 12						3R	3R	3B	3R											
10 11	DUMMY ACTIVITY																			
5 6								2B	2B	2B	2B									
3 5	DUMMY ACTIVITY																			
12 14	DUMMY ACTIVITY																			
6 7												1B 8N 1W								
7 8	WAITING ACTIVITY																			
8 9																			2B	
9 11																				3N

TOT AVAIL	RES ID	AGGREGATE RESOURCE UTILIZATION																		
0	B	6	6	6	5	3	3	3	5	5	2	2	1	0	0	0	0	0	2	0
0	N	2	2	2	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	3
0	W	2	2	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

HALF DAYS	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
TAIL HEAD																				
9 11	3N	3N																		
11 14			3B 2W	3B 2W	3R 2W	3B 2W	3B 2W													
14 15								4B	4B	4B	4B	4B	4B							
16 17														4B	4B	4B	4B	4B	4B	
15 16	DUMMY ACTIVITY																			
17 18																				4B

TOT AVAIL	RES ID	AGGREGATE RESOURCE UTILIZATION																		
0	B	0	0	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4
0	N	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	W	0	0	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0

HALF DAYS	41	42	43	44	45	46	47
TAIL HEAD							
17 18	4B	4B	4B				
18 19				2N	2N	2N	2N

TOT AVAIL	RES ID	AGGREGATE RESOURCE UTILIZATION						
0	B	4	4	4	0	0	0	0
0	N	0	0	0	2	2	2	2
0	W	0	0	0	0	0	0	0

Figure 7. Resource unconstrained CPM bar chart.

AFCS NUMBER - 341141 DESCRIPTION - WARFHOUSE WITH CONCRETE FOOTINGS

UNIT ASSIGNMENT CALCULATION - NO. 1

TOE NUMBER - 5-118H GEN PLT-ENGR CO,CBT BN,HVY

12 DAYS REQUIRED FOR PROJECT COMPLETION

DURATION COMPRESSION : 48.94 /

19.74% AVERAGE EFFICIENCY OVER ALL RESOURCES

AVERAGE EFFICIENCY BY SKILL TYPE

B	N	W
31.62%	27.60%	4.17%

Figure 8. Unit assignment calculation.

AFCS NUMBER = 341141 DESCRIPTION = WAREHOUSE WITH CONCRETE FOOTINGS

UNIT ASSIGNMENT CALCULATION - NO. 1
TOE NUMBER - S-118H GEN PLT-ENGR CO,CBT BN,HVY

HALF DAYS		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TAIL	HEAD																				
1	2	3R 6N																			
1	10	1R	1B	1R	1B	1B	1B	1R	1B	1B	1B	1B	1B	1B	1B	1B					
1	4	1W	1W	1W	1W	1W	1W														
1	5	2B	2B	2B	2B																
2	3		7N	7N	7N																
5	6					4B	4R														
3	5	DUMMY ACTIVITY																			
6	7							1R 8N 1W													
7	8	WAITING ACTIVITY																			
8	9														2R						
9	11															5N	5N				
10	11	DUMMY ACTIVITY																			
11	14																	8R 5W	8B 5W		
10	12																	6R	6B		
14	15																			12B	12B
12	14	DUMMY ACTIVITY																			

TOT AVAIL	RES ID	AGGREGATE RESOURCE UTILIZATION																			
17	R	6	3	3	3	5	5	2	1	1	1	1	1	1	3	1	0	14	14	12	12
8	N	6	7	7	7	0	0	8	0	0	0	0	0	0	0	5	5	0	0	0	0
17	W	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	5	5	0	0

HALF DAYS		21	22	23	24
TAIL	HEAD				
16	17	12B	12B		
15	16	DUMMY ACTIVITY			
17	18			16B	
18	19				8N

TOT AVAIL	RES ID	AGGREGATE RESOURCE UTILIZATION			
17	R	12	12	16	0
8	N	0	0	0	8
17	W	0	0	0	0

Figure 9. Resource unconstrained bar chart.

AFCS NUMBER - 341141 DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS

SUMMARY OF TROOP UNIT ASSIGNMENT

TOE NUMBER - 5-118H GEN PLT-ENGR CO,CBT BN,HVY

12 DAYS REQUIRED FOR PROJECT COMPLETION

19.74% AVERAGE EFFICIENCY OVER ALL RESOURCES

AVERAGE EFFICIENCY BY SKILL TYPE

B	N	W
31.62%	27.60%	4.17%

Figure 10. Summary of unit assignment.

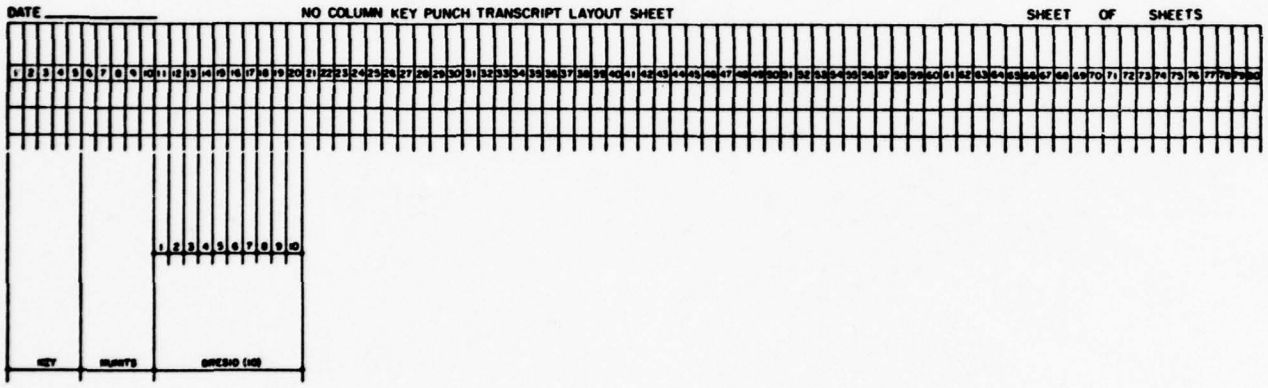
APPENDIX A

DETAILED DESCRIPTION OF INPUT DECK CARDS

CARD TYPE I

Data Element Name	Card Field	No. Characters	Data Type	Limit Values	Data Element Description
KEY	1-5	5	Integer	/	Indicates sequence of input data
NUNITS	6-10	5	Integer	/	No. of construction units (TOEs) in data base
DRESID	(11-20)	(10)	Alphanumeric	/	Names of resources (J)
1	11	1			
2	12	1			
3	13	1			
4	14	1			
5	15	1			
6	16	1			
7	17	1			
8	18	1			
9	19	1			
10	20	1			

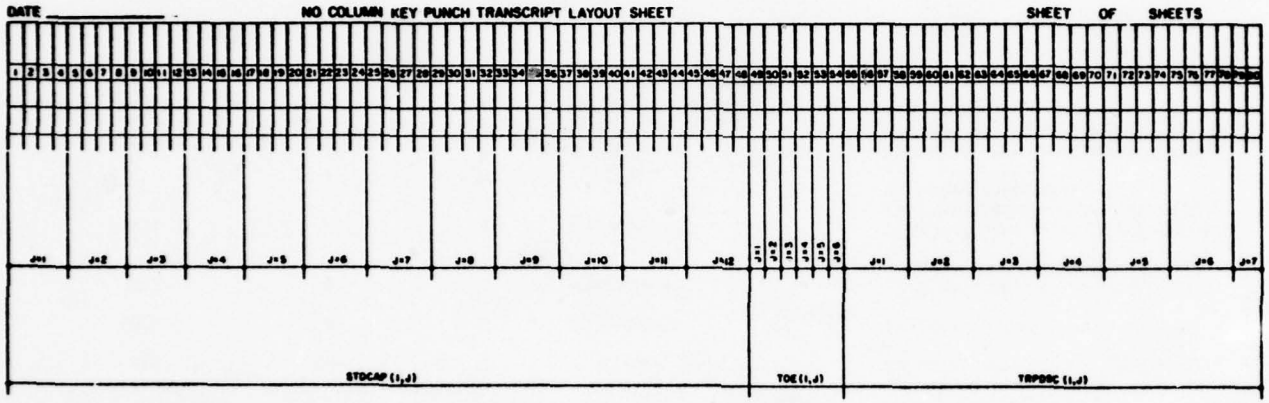
CARD TYPE I



CARD TYPE II

Data Element Name	Card Field	No. Characters	Data Type	Limit Values	Data Element Description
STDCAP(I,J)	(1-40)	(40)	Integer	0-100	No. of men for each resource (J) of a unit (I). The sequence of resources must correspond to that of DRESID
J=1	1-4	4			
J=2	5-8	4			
J=3	9-12	4			
J=4	13-16	4			
J=5	17-20	4			
J=6	21-24	4			
J=7	25-28	4			
J=8	29-32	4			
J=9	33-36	4			
J=10	37-40	4			
TOE (I,J)	(49-54)	(6)	Alphanumeric		TOE number of a unit (I)
J=1	49	1			
J=2	50	1			
J=3	51	1			
J=4	52	1			
J=5	53	1			
J=6	54	1			
TRPDSC (I,J)	(55-80)	(26)	Alphanumeric		Short description of a unit (I)
J=1	55-58	4			
J=2	59-62	4			
J=3	63-66	4			
J=4	67-70	4			
J=5	71-74	4			
J=6	75-78	4			
J=7	79-80	2			

CARD TYPE II

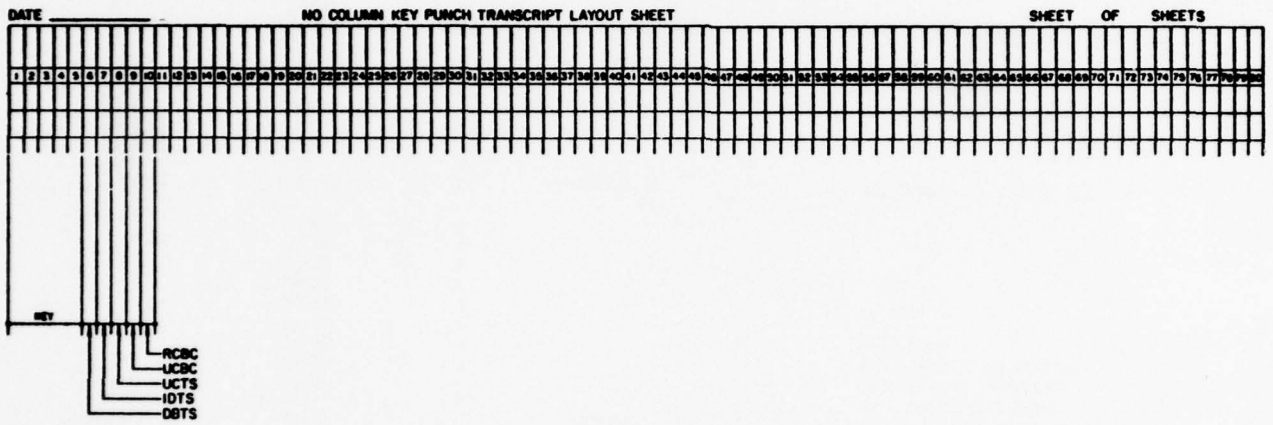


ONE OF THESE CARDS FOR EACH VALUE OF NUNITS

CARD TYPE III

Data Element Name	Card Field	No. Characters	Data Type	Legal Values	Data Element Description
KEY	1-5	5	Integer		Indicates sequence of input data
DBTS	6	1	Alphanumeric		If DTS = Y, data base is output
IDTS	7	1	Alphanumeric		If IDTS=Y, project information is output
UCTS	8	1	Alphanumeric		If UCTS=Y, CPM schedule and resource requirements are output (assuming unlimited resources)
UCBC	9	1	Alphanumeric		If UCBC=Y, bar chart and resource profile are output (assuming unlimited resources)
RCBC	10	1	Alphanumeric		If RCBC=Y, bar chart and resource profile are output (assuming limited resources)

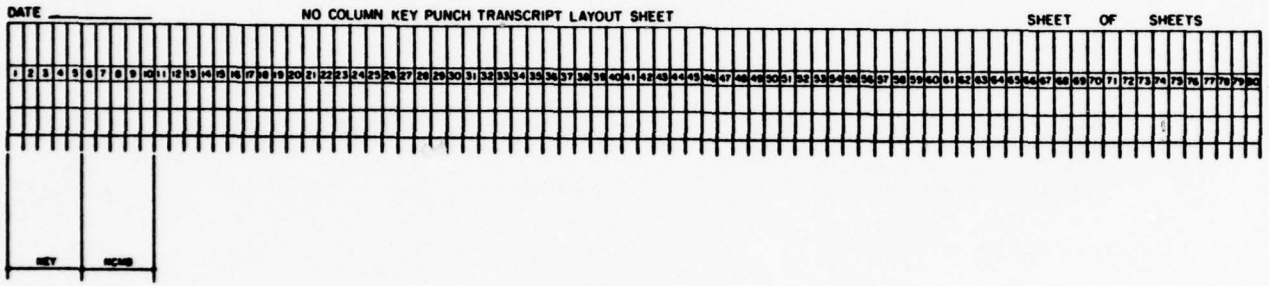
CARD TYPE III



CARD TYPE IV

Data Element Name	Card Field	No. Characters	Data Type	Limit Values	Data Element Description
KEY	1-5	5	Integer		Indicates sequence of input data
NCMB	6-10	5	Integer	0-10	*No. of new skills defined by user*

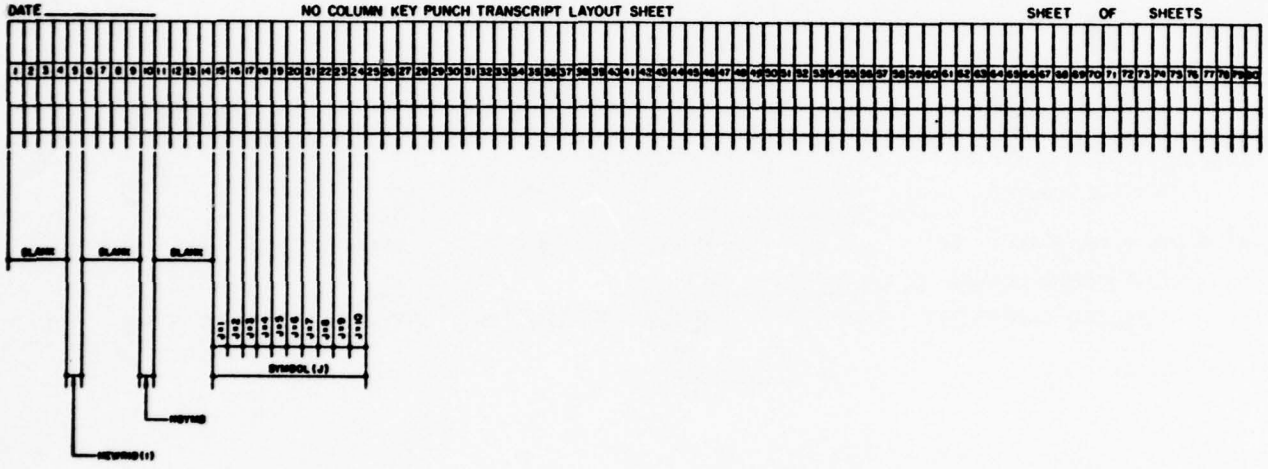
CARD TYPE IV



CARD TYPE V

Data Element Name	Card Field	No. Characters	Data Type	Limit Values	Data Element Description
NEWRID (I)	5	1	Alphanumeric		Name of new skill (I)
NSYMB	10	1	Integer	9	No. of basic skills comprising the new skill named above
SYMBOL (J)	(15-24)	(10)	Alphanumeric		Enumerates the basic skills (J) comprising the new skill named above
J=1	15	1			
J=2	16	1			
J=3	17	1			
J=4	18	1			
J=5	19	1			
J=6	20	1			
J=7	21	1			
J=8	22	1			
J=9	23	1			
J=10	24	1			

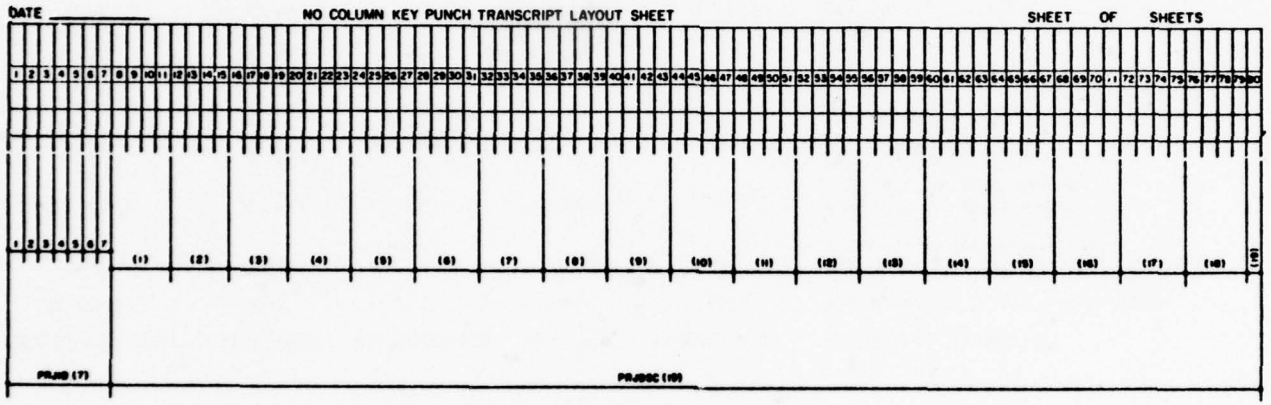
CARD TYPE V



CARD TYPE VI

Data Element Name	Card Field	No. Characters	Data Type	Limit Values	Data Element Description
PRJID	(1-7)	(7)	Alphanumeric		Project identification (AFCS No.)
PRJDSC	(8-80)	(73)	Alphanumeric		Project description

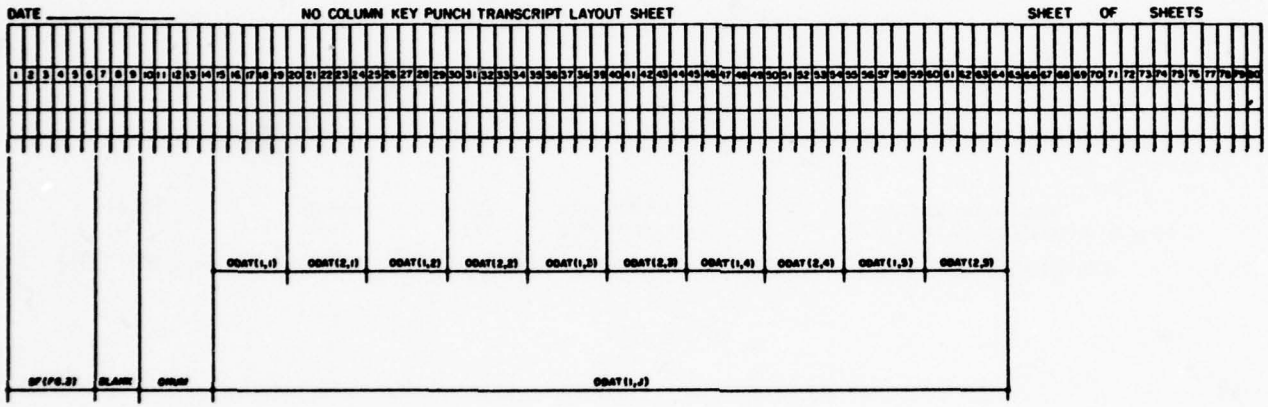
CARD TYPE VI



CARD TYPE VII

Data Element Name	Card Field	No. Characters	Data Type	Limit Values	Data Element Description
SF (F6.3)	1-6	6	Real	0-10	No. of working hrs in a 10-hr day
ONUM	10-14	5	Integer	1-5	No. of units to be scheduled; overrides automatic selection of units
ODAT (I,J)	(17-64)	(30)	Integer		Name of troop units to be used (J); two units may be merged (I=1,2)
(1,1)	17-19	3			
(2,1)	22-24	3			
(1,2)	27-29	3			
(2,2)	32-34	3			
(1,3)	37-39	3			
(2,3)	42-44	3			
(1,4)	47-49	3			
(2,4)	52-54	3			
(1,5)	57-59	3			
(2,5)	62-64	3			

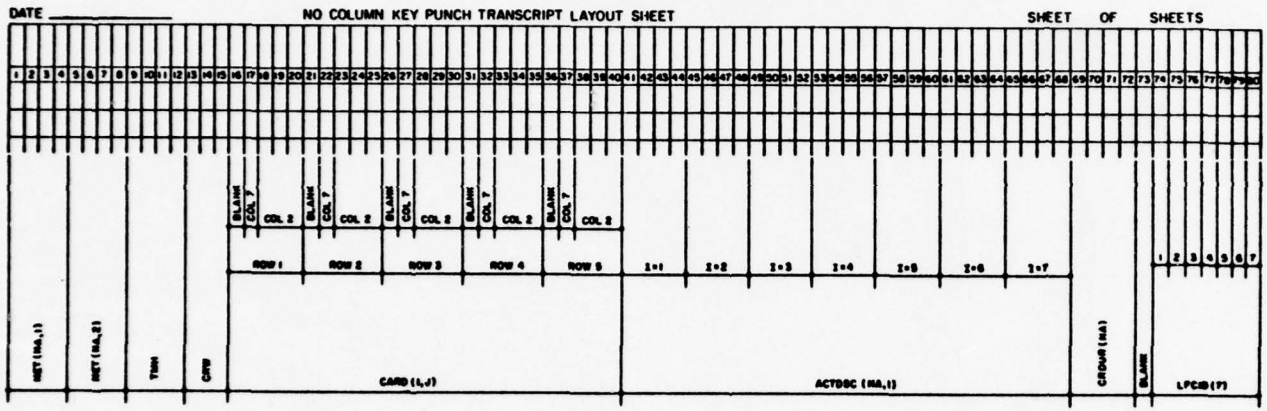
CARD TYPE VII



CARD TYPE VIII

Data Element Name	Card Field	No. Characters	Data Type	Limit Values	Data Element Description
NET (NA,1)	1-4	4	Integer		Tail node of activity (NA)
NET (NA,2)	5-8	4	Integer		Head node of activity (NA)
TMH	9-12	4	Integer		Total no. of manhrs required for activity
CRW	13-15	3	Integer	0-100	Total no. of men used for activity
CARD (I,J)	(17-40)	(20)	J=2-Alphanumeric		
ROW 1			J=2-Integer	0-100	No. of men (J=2) with of a particular named (J=1) skill (I) used in a crew for activity
COL 1	17	1			
COL 2	18-20	3			
ROW 2					
COL 1	22	1			
COL 2	23-25	3			
ROW 3					
COL 1	27	1			
COL 2	28-30	3			
ROW 4					
COL 1	32	1			
COL 2	33-35	3			
ROW 5					
COL 1	37	1			
COL 2	38-40	3			
ACTDSC (NA,I)	(41-68)	(28)	Alphanumeric		Activity (NA) description
I=1	41-44	4			
I=2	45-48	4			
I=3	49-52	4			
I=4	53-56	4			
I=5	57-60	4			
I=6	61-64	4			
I=7	65-68	4			
CRDUR (NA)	69-72	4	Integer		Crash duration of activity (NA)
LFCID	(74-80)	(7)	Alphanumeric		Project ID no. (PRJID) to which activity belongs
1	74	1			
2	75	1			
3	76	1			
4	77	1			
5	78	1			
6	79	1			
7	80	1			

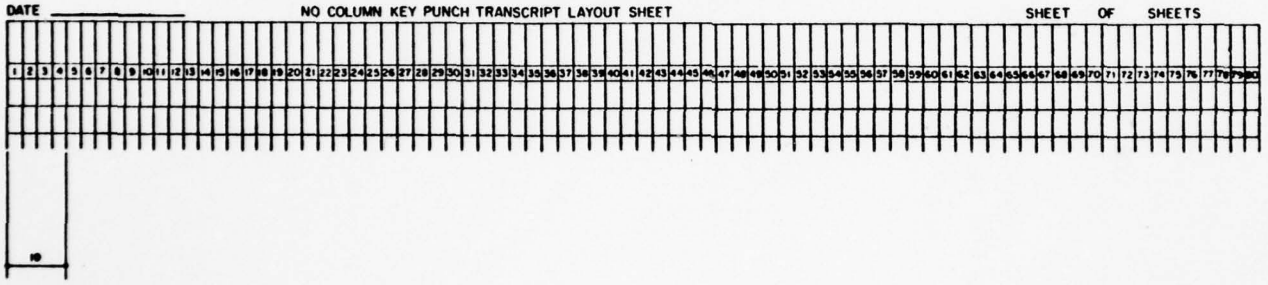
CARD TYPE VIII



CARD TYPE IX

Data Element Name	Card Field	No. Characters	Data Type	Limit Values	Data Element Description
ID	1-4	4	Integer	(-1)-(-9999)	Indicates all activities have been read

CARD TYPE IX & X



APPENDIX B:

EXAMPLE PROBLEMS

Two example problems are presented, one with no user modifications, and one with user-supplied skill categories and candidate TOEs. The same data are used in both problems. The network diagram (Figure B1) illustrates the activities required for the sample problems (heavy lines). The differences in the input decks occur in cards of type IV, V, and VII.

The output for Sample Problem 2 was used to illustrate the output format and is shown in Figures 3 through 10 in the main text.

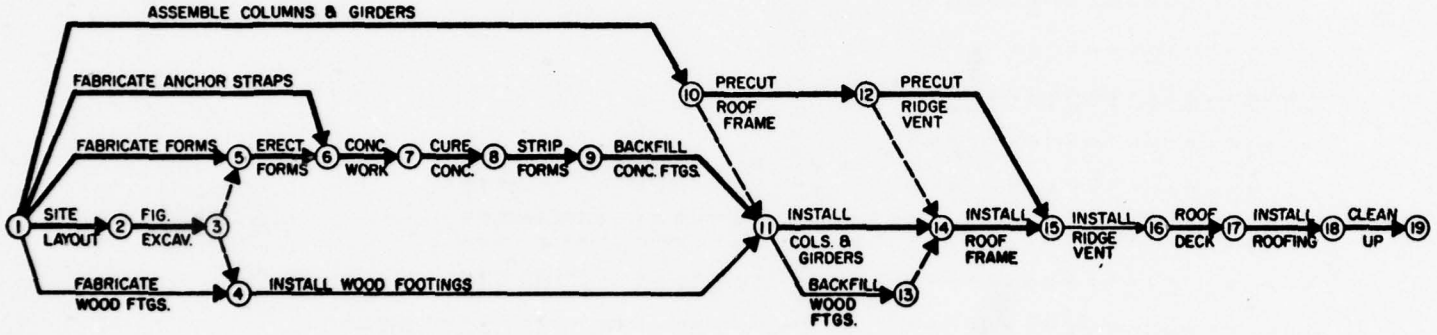


Figure B1. Network diagram.

SAMPLE PROBEM 1. INPUT DECK

```
CARD
TYPE
I  11111   21NAREIISHGPL
     316  2   6   5   6   1  42   5   1   7        5-35HENGR COMBAT BN, CORPS
      78  0   0   0   0   0   8   1   0   0        5-37HENGR CBT CO, CORPS
      25  0   0   0   0   0   2   0   0   0        5-37HPLT-ENGR CBT CO,CHT BN,HVY
      69  9 102  54  48  29  53  22  12  14       5-115HENG CBT BN, HVY
       9  0   0   0   0   5   5   7   6   8       5-117HEQP & MNT CO,CBT BN, HVY
      20  0  34  18  16   8  16   5   2   2       5-118HENGR CO, ENGR CBT BN, HVY
       0  0   0   0   0   0  16   3   0   0       5-118HHQR PLT-ENGR CO,CBT BN,HVY
       8  0  17   6   6   3   0   1   1   0       5-119HGEN PLT-ENGR CO,CBT BN,HVY
     147  6   8   5   2   7  80  12   6   6       5-195HENGR CBT BN, ABN
       3  0   8   5   2   7   8   4   6   6       5-197HENGR EQUIP & MNT CO, ABN
II    72  0   0   0   0   0  36   4   0   0       5-198HENGR CMBT CO, ABN
      20  0   0   0   0   0   8   1   0   0       5-198HPLT-ENGR CBT CO, ABN
       0  0   0   0   0   2  72   6   0   7        5-54HENGR LT EQUIP CO, ABN
       6  0   0   0   0   3  28  13   7  11        5-58HENGR CPT SPT EQUIP CO
       9  0   0   0   0   2   5  19  16   9       5-114HENGR CONST SPT CO
      25 10  16   4   2  31   5   7   2  14       5-129HPORT CONSTR CO
       7  0   8   2   1  13   0   1   0   4       5-129HCON PLT-ENGR PORT CONST CO
      30  0   9   0   0  74   4   2   0   8       5-177HENGR PIPELINE CONST SPT CO
       6  0   3   0   0  24   0   0   0   2       5-177HPL PLT-ENGR PIPLN CONST CO
       0  0   0   0   0   0   0   0   0  42       5-124HENGR DUMP TRUCK CO
       0  0   0   0   0   0   0   0   0  21       5-124HTRK PLT-ENG DUMP TRUCK CO
III  22222YYYYY
IV   33333    3
       B    1   B
V      N    1   N
       W    8   AEUSHGPL
VI   141141  WAREHOUSE WITH CONCRETE FOOTINGS
VII    5.8         1    8
       1   2  21  3 B  1 N  2                    SITE LAYOUT
       1   5  24  2 B  2                        FABRICATE FORMS
       1   6  14  2 W  2                        FABRICATE ANCHOR STRAPS
       1  10  48  3 B  3                        ASSEMBLE COLS. AND GIRDERS
       2   3  60  5 N  5                        FOOTING EXCAVATION
       5   6  26  2 B  2                        ERECT FORMS
       6   7  20 10 B  1 N  8 W  1              CONCRETE WORK
       7   8                                    CURE CONCRETE                    3
       8   9   6  2 B  2                        STRIP FORMS
       9  11  21  3 N  3                        BACKFILL CONCRETE FOOTINGS
VIII  10  12  39  3 B  3                        PRECUT ROOF FRAME
      11  14  70  5 B  3 W  2                   INSTALL COLS. AND GIRDERS
      14  15  72  4 B  4                        INSTALL ROOF FRAME
      16  17  76  4 B  4                        INSTALL ROOF DECK
      17  18  44  4 B  4                        INSTALL ROOFING
      18  19  28  2 N  2                        CLEAN UP
       3   5                                    DUMMY
      10  11                                    DUMMY
      12  14                                    DUMMY
      15  16                                    DUMMY
IX   -5
X    -5
```

SAMPLE PROBLEM 1. OUTPUT

CONSTRUCTION TROOP UNIT DATA BASE

N: UNSKILLED LABOR A: CONSTRUCTION AID B: BUILDERS-GENERAL E: ELECTRICIAN S: STUCTURES WORKERS
U: UTILITIESMEN H: HEAVY EQ. OP. G: GENERAL EQ. OP. P: ASPH/CONC MACH OP. L: LIFT/LOAD EQ. OP.

INDEX	TOE #	UNIT DESCRIPTION	CAPABILITY BY SKILL TYPE (NO OF MEN)										
			N	A	B	E	U	S	H	G	P	L	TOTAL
1	5-35H	ENGR COMBAT BN, CORPS	316	2	6	5	6	1	42	5	1	7	391
2	5-37H	ENGR CBT CO, CORPS	78	0	0	0	0	0	8	1	0	0	87
3	5-37H	PLT-ENGR CBT CO,CBT BN,HVY	25	0	0	0	0	0	2	0	0	0	27
4	5-115H	ENG CBT BN, HVY	69	9	102	54	48	29	53	22	12	14	412
5	5-117H	EQP & MNT CO,CBT BN, HVY	9	0	0	0	0	5	5	7	6	8	40
6	5-11AH	ENGR CO, ENGR CBT BN, HVY	20	0	34	18	16	8	16	5	2	2	121
7	5-11AH	MOR PLT-ENGR CO,CBT BN,HVY	0	0	0	0	0	0	16	3	0	0	19
8	5-11AH	GEN PLT-ENGR CO,CBT BN,HVY	8	0	17	6	6	3	0	1	1	0	42
9	5-195H	ENGR CBT BN, ABN	147	6	8	5	2	7	80	12	6	6	279
10	5-197H	ENGR EQUIP & MNT CO, ABN	3	0	8	5	2	7	8	4	6	6	49
11	5-19AH	ENGR CMBT CO, ABN	72	0	0	0	0	0	36	4	0	0	112
12	5-19AH	PLT-ENGR CBT CO, ABN	20	0	0	0	0	0	8	1	0	0	29
13	5-54H	ENGR LT EQUIP CO, ABN	0	0	0	0	0	2	72	6	0	7	87
14	5-58H	ENGR CPT SPT EQUIP CO	6	0	0	0	0	3	28	13	7	11	68
15	5-114H	ENGR CONST SPT CO	9	0	0	0	0	2	5	19	16	9	60
16	5-129H	PORT CONSTR CO	25	10	16	4	2	31	5	7	2	14	116
17	5-129H	CON PLT-ENGR PORT CONST CO	7	0	8	2	1	13	0	1	0	4	36
18	5-177H	ENGR PIPELINE CONST SPT CO	30	0	9	0	0	74	4	2	0	8	127
19	5-177H	PL PLT-ENGR PIPLN CONST CO	6	0	3	0	0	24	0	0	0	2	35
20	5-124H	ENGR DUMP TRUCK CO	0	0	0	0	0	0	0	0	0	42	42
21	5-124H	TRK PLT-ENG DUMP TRUCK CO	0	0	0	0	0	0	0	0	0	21	21

INPUT DATA TAB SHEET

AFCS NUMBER - 341141 DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS

NETWORK PARAMETERS

TAIL	HEAD	TOTAL M-H	CREW SIZE	ACTIVITY DESCRIPTION				CREW FORMATION (NO OF MEN)					CRUSH DUR
1	2	21	3	SITE LAYOUT	B	1	N	2		0	0	0	0
1	5	24	2	FABRICATE FORMS	B	2		0		0	0	0	0
1	6	14	2	FABRICATE ANCHOR STRAPS	S	2		0		0	0	0	0
1	10	48	3	ASSEMBLE COLS. AND GIRDER	B	3		0		0	0	0	0
2	3	60	5	FOOTING EXCAVATION	N	5		0		0	0	0	0
5	6	26	2	ERECT FORMS	B	2		0		0	0	0	0
6	7	20	10	CONCRETE WORK	B	1	N	8	P	1	0	0	0
7	8	0	0	CURE CONCRETE		0		0		0	0	0	3
8	9	6	2	STRIP FORMS	B	2		0		0	0	0	0
9	11	21	3	BACKFILL CONCRETE FOOTING	N	3		0		0	0	0	0
10	12	39	3	PRECUT ROOF FRAME	B	3		0		0	0	0	0
11	14	70	5	INSTALL COLS. AND GIRDERS	B	3	S	2		0	0	0	0
14	15	72	4	INSTALL ROOF FRAME	B	4		0		0	0	0	0
16	17	76	4	INSTALL ROOF DECK	B	4		0		0	0	0	0
17	18	44	4	INSTALL ROOFING	B	4		0		0	0	0	0
18	19	24	2	CLEAN UP	N	2		0		0	0	0	0
3	5	0	0	DUMMY		0		0		0	0	0	0
10	11	0	0	DUMMY		0		0		0	0	0	0
12	14	0	0	DUMMY		0		0		0	0	0	0
15	16	0	0	DUMMY		0		0		0	0	0	0

PROJECT SUMMARY

AFCS NUMBER - 341141 DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS

196 TOTAL GALF MAN-DAYS REQUIRED FOR PROJECT COMPLETION

RESOURCE REQUIREMENTS BY SKILL TYPES (HALF MAN-DAYS)

B	N	S	P	A	E	U	H	G	L
12A	51	16	1	0	0	0	0	0	0

CPM TAB SHEET ASSUMING NO RESOURCE CONSTRAINTS(TIME UNIT = HALF DAY)

TAIL	HEAD	NORMAL DUR	EARLY START	EARLY FINISH	LATE START	LATE FINISH	TOTAL SLACK	NORMAL CREW SIZES B	N	S	P	A	F	U	H	G	L
1	2	3	0	3	0	3	0	1	2	0	0	0	0	0	0	0	0
1	5	4	0	4	3	7	3	2	0	0	0	0	0	0	0	0	0
1	6	3	0	3	8	11	8	0	0	2	0	0	0	0	0	0	0
1	10	5	0	5	17	22	17	3	0	0	0	0	0	0	0	0	0
2	3	4	3	7	3	7	0	0	5	0	0	0	0	0	0	0	0
5	6	4	7	11	7	11	0	2	0	0	0	0	0	0	0	0	0
6	7	1	11	12	11	12	0	1	8	0	1	0	0	0	0	0	0
7	8	6	12	18	12	18	0	0	0	0	0	0	0	0	0	0	0
8	9	1	18	19	18	19	0	2	0	0	0	0	0	0	0	0	0
9	11	3	19	22	19	22	0	0	3	0	0	0	0	0	0	0	0
10	12	4	5	9	23	27	18	3	0	0	0	0	0	0	0	0	0
11	14	5	22	27	22	27	0	3	0	2	0	0	0	0	0	0	0
14	15	6	27	33	27	33	0	4	0	0	0	0	0	0	0	0	0
16	17	6	33	39	33	39	0	4	0	0	0	0	0	0	0	0	0
17	18	4	39	43	39	43	0	4	0	0	0	0	0	0	0	0	0
18	19	4	43	47	43	47	0	0	2	0	0	0	0	0	0	0	0
3	5	0	7	7	7	7	0	0	0	0	0	0	0	0	0	0	0
10	11	0	5	5	22	22	17	0	0	0	0	0	0	0	0	0	0
12	14	0	9	9	27	27	18	0	0	0	0	0	0	0	0	0	0
15	16	0	33	33	33	33	0	0	0	0	0	0	0	0	0	0	0

NORMAL PROJECT DURATION IS : 47 HALF DAYS

AFCS NUMBER - 341141 DESCRIPTION - WARFHOUSE WITH CONCRETE FOOTINGS
RESOURCE UNCONSTRAINED CPM BAR CHART

HALF DAYS		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TAIL	HEAD																				
1	2	1A 2N	1B 2N	1A 2N																	
1	5	2A	2B	2B	2B																
1	6	2S	2S	2S																	
1	10	3A	3B	3B	3B	3A															
2	3				5N	5N	5N	5N													
10	12						3B	3A	3A	3B											
10	11	DUMMY ACTIVITY																			
5	6								2B	2B	2B	2B									
3	5	DUMMY ACTIVITY																			
12	14	DUMMY ACTIVITY																			
6	7												1A 8N 1P								
7	8	WAITING ACTIVITY																			
8	9																			2A	
9	11																				3N

TOT AVAIL	RES ID	AGGREGATE RESOURCE UTILIZATION																			
0	A	6	6	6	5	3	3	3	5	5	2	2	1	0	0	0	0	0	0	2	0
0	N	2	2	2	5	5	5	5	0	0	0	0	8	0	0	0	0	0	0	0	3
0	S	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	P	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0

HALF DAYS	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
TAIL HEAD																				
9 11	3N	3N																		
11 14			3B	3B	3B	3B	3B													
			2S	2S	2S	2S	2S													
14 15								4B	4B	4B	4B	4B	4B							
16 17														4B	4B	4B	4B	4B	4B	
15 16	DUMMY ACTIVITY																			
17 18																				4B

TOT AVAIL	RES ID	AGGREGATE RESOURCE UTILIZATION																			
0	B	0	0	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4
0	N	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	S	0	0	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
0	P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

HALF DAYS	41	42	43	44	45	46	47
TAIL HEAD							
17 18	4B	4B	4B				
18 19				2N	2N	2N	2N

TOT AVAIL	RES ID	AGGREGATE RESOURCE UTILIZATION						
0	B	4	4	4	0	0	0	0
0	N	0	0	0	2	2	2	2
0	S	0	0	0	0	0	0	0
0	P	0	0	0	0	0	0	0

AFCS NUMBER - 341141 DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS

UNIT ASSIGNMENT CALCULATION - NO. 1

TOE NUMBER - 5-118H GEN PLT-ENGR CO,CBT BN,HVY

13 DAYS REQUIRED FOR PROJECT COMPLETION

DURATION COMPRESSION : 44.68 %

26.66% AVERAGE EFFICIENCY OVER ALL RESOURCES

AVERAGE EFFICIENCY BY SKILL TYPE

B	N	S	P	A	E	U	H	G	L
29.19%	25.48%	23.08%	3.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

AFCS NUMBER - 341141 DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS

UNIT ASSIGNMENT CALCULATION - NO. 1
TOE NUMBER - 5-11AH GEN PLT-ENGR CO,CBT BN,HVY

HALF DAYS		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TAIL	HEAD																				
1	2	3R 6N																			
1	10	1R	1R	1R	1R	1R	1R	1R	1R	1R	1R	1R	1R	1R	1R	1R					
1	6	1S	1S	1S	1S	1S	1S														
1	5	2R	2R	2R	2R																
2	3		7N	7N	7N																
5	6					4R	4R														
3	5	DUMMY ACTIVITY																			
6	7							1R 8N 1P													
7	8	WAITING ACTIVITY																			
8	9														2R						
9	11															5N	5M				
10	11	DUMMY ACTIVITY																			
11	14																	4R 3S	4R 3S	4R 3S	4R 3S
10	12																	3R	3R	3R	3R

TOT AVAIL	P F S I D	AGGREGATE RESOURCE UTILIZATION																			
17	R	6	3	3	3	5	5	2	1	1	1	1	1	1	3	1	0	7	7	7	7
8	M	6	7	7	7	0	0	8	0	0	0	0	0	0	0	5	5	0	0	0	0
3	S	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	3	3	3	3
1	P	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

HALF DAYS		21	22	23	24	25	26
TAIL	HEAD						
14	15	12R	12B				
12	14	DUMMY ACTIVITY					
16	17			12B	12B		
15	16	DUMMY ACTIVITY					
17	18					16B	
18	19						8N

TOT AVAIL	P F S I D	AGGREGATE RESOURCE UTILIZATION					
17	R	12	12	12	12	16	0
8	M	0	0	0	0	0	8
3	S	0	0	0	0	0	0
1	P	0	0	0	0	0	0

AFCS NUMBER - 341141 DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS

UNIT ASSIGNMENT CALCULATION - NO. 2

TOE NUMBER - 5-197H ENGR EQUIP & MNT CO. ARN
TOE NUMBER - 5-37H PLT-ENGR CRT CO.CBT BN.HVY

13 DAYS REQUIRED FOR PROJECT COMPLETION

DURATION COMPRESSION : 46.81 %

16.16% AVERAGE EFFICIENCY OVER ALL RESOURCES

AVERAGE EFFICIENCY BY SKILL TYPE

B	N	S	P	A	F	U	H	G	L
65.00%	7.29%	9.14%	.67%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

AFCS NUMBER - 341141 DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS

UNIT ASSIGNMENT CALCULATION - NO. 2
TOE NUMBER - 5-197H ENGR EQUIP & MNT CO, ARN
TOE NUMBER - 5-37H PLT-ENGR CAT CO,CAT BN,HVY

HALF DAYS		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TAIL	HEAD																				
1	10	1R	1R	2R	2R	2R	2R	2R	2R	2R											
1	4	1S	1S	4S																	
1	5	2R	6R																		
1	2	3R 6N																			
2	3		20N																		
3	5	DUMMY ACTIVITY																			
5	6				4R	4R															
6	7						1R 8N 1P														
7	8	WAITING ACTIVITY																			
10	11	DUMMY ACTIVITY																			
10	12											6R	6R								
8	9													2R							
12	14	DUMMY ACTIVITY																			
9	11														9N						
11	14															8R 5S	8R 5S				
14	15																	8R	8R	8R	
16	17																				8R
15	16	DUMMY ACTIVITY																			

TOT AVAIL	RES ID	AGGREGATE RESOURCE UTILIZATION																			
8	R	6	7	2	6	6	3	2	2	2	0	6	6	2	0	8	8	8	8	8	8
28	N	6	20	0	0	0	8	0	0	0	0	0	0	0	9	0	0	0	0	0	0
7	S	1	1	4	0	0	0	0	0	0	0	0	0	0	0	5	5	0	0	0	0
6	P	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

HALF DAYS	21	22	23	24	25
TAIL HEAD					
16 17	BR	BB			
17 1A			BB	BB	
1A 19					BN

TOT AVAIL	P F S I D	AGGREGATE RESOURCE UTILIZATION				
8	R	8	A	8	8	0
2A	N	0	0	0	0	A
7	S	0	0	0	0	0
6	P	0	0	0	0	0

AFCS NUMBER - 341141 DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS

UNIT ASSIGNMENT CALCULATION - NO. 3

TOE NUMBER - 5-117H EQP & MNT CO.CRT BN. HVY
TOE NUMBER - 5-129H CON PLT-ENGR PORT CONST CO

14 DAYS REQUIRED FOR PROJECT COMPLETION

DURATION COMPRESSION : 42.55 %

15.28% AVERAGE EFFICIENCY OVER ALL RESOURCES

AVERAGE EFFICIENCY BY SKILL TYPE

B	N	S	P	A	F	U	H	G	L
59.72%	11.81%	3.50%	.62%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

AFCS NUMBER - 341141 DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS

UNIT ASSIGNMENT CALCULATION - NO. 3
TOE NUMBER - 5-117H EQP & MNT CO,CAT BN, HVY
TOE NUMBER - 5-129H CON PLT-ENGR PORT CONST CO

HALF DAYS		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TAIL	HEAD																				
1	10	1R	1R	1R	1R	1R	1R	1R	1R	1R	1R	1R	1R	1R	2R						
1	4	1S	1S	1S	2S	2S															
1	5	2R	3R	3R																	
1	2	3R 6N																			
2	3		10N	10N																	
5	6				4R	4R															
3	5	DUMMY ACTIVITY																			
4	7						1R 8N 1P														
7	8	WAITING ACTIVITY																			
8	9													2R							
9	11														9N						
10	12															6R	6R				
10	11	DUMMY ACTIVITY																			
11	14																	8R 5S	8B 5S		
12	14	DUMMY ACTIVITY																			
14	15																			8R	8B

TOT AVAIL	P F S I D	AGGREGATE RESOURCE UTILIZATION																			
8	R	6	4	4	5	5	2	1	1	1	1	1	1	3	2	6	6	8	8	8	8
16	N	6	10	10	0	0	8	0	0	0	0	0	0	0	9	0	0	0	0	0	0
18	S	1	1	1	2	2	0	0	0	0	0	0	0	0	0	0	0	5	5	0	0
6	P	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

HALF DAYS	21	22	23	24	25	26	27
TAIL HEAD							
14 15	AA						
16 17		BB	BB	BB			
15 1A	DUMMY ACTIVITY						
17 1A					BB	BB	
18 19							BN

TOT AVAIL	RES ID	AGGREGATE RESOURCE UTILIZATION						
8	A	8	8	8	8	8	8	0
16	N	0	0	0	0	0	0	8
18	S	0	0	0	0	0	0	0
6	P	0	0	0	0	0	0	0

AFCS NUMBER - 341141 DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS

UNIT ASSIGNMENT CALCULATION - NO. 4

TOF NUMBER - 5-124H ENGR DUMP TRUCK CO
TOF NUMBER - 5-118H GEN PLT-ENGR CO.CRT BN.HVY

13 DAYS REQUIRED FOR PROJECT COMPLETION

DURATION COMPRESSION : 44.68 %

26.66% AVERAGE EFFICIENCY OVER ALL RESOURCES

AVERAGE EFFICIENCY BY SKILL TYPE

B	N	S	P	A	F	U	H	G	L
29.19%	25.48%	23.08%	3.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

AFCS NUMBER - 341141 DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS

UNIT ASSIGNMENT CALCULATION - NO. 4
TOF NUMBER - 5-124M ENGR DUMP TRUCK CO
TOF NUMBER - 5-118M GEN PLT-ENGR CO.CBT BN.HVY

HALF DAYS		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TAIL	HEAD																				
1	2	3R 6N																			
1	10	1R	1B	1B	1B	1R	1R	1B	1B	1R	1B	1B	1B	1R	1B	1R					
1	6	1S	1S	1S	1S	1S	1S														
1	5	2R	2B	2B	2B																
2	3		7N	7N	7N																
5	6					4R	4B														
3	5	DUMMY ACTIVITY																			
6	7							1R 8N 1P													
7	8	WAITING ACTIVITY																			
8	9														2R						
9	11															5N	5N				
10	11	DUMMY ACTIVITY																			
11	14																	4R 3S	4B 3S	4R 3S	4R 3S
10	12																	3R	3B	3B	3R

TOT AVAIL	RES ID	AGGREGATE RESOURCE UTILIZATION																			
17	R	6	3	3	3	5	5	2	1	1	1	1	1	1	3	1	0	7	7	7	7
8	N	6	7	7	7	0	0	8	0	0	0	0	0	0	0	5	5	0	0	0	0
3	S	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	3	3	3	3
1	P	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

HALF DAYS	21	22	23	24	25	26
TAIL HEAD						
14 15	12A	12B				
12 14	DUMMY ACTIVITY					
16 17			12A	12B		
15 14	DUMMY ACTIVITY					
17 18					16A	
18 19						AN

TOT AVAIL	P E S I D	AGGREGATE RESOURCE UTILIZATION					
17	A	12	12	12	12	16	0
A	N	0	0	0	0	0	A
3	S	0	0	0	0	0	0
1	P	0	0	0	0	0	0

AFCS NUMBER - 341141 DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS

UNIT ASSIGNMENT CALCULATION - NO. 5

TOE NUMBER - 5-114H ENGR CONST SPT CO
TOE NUMBER - 5-129H CON PLT-ENGR PORT CONST CO

14 DAYS REQUIRED FOR PROJECT COMPLETION

DURATION COMPRESSION : 42.55 %

13.33% AVERAGE EFFICIENCY OVER ALL RESOURCES

AVERAGE EFFICIENCY BY SKILL TYPE

B	N	S	P	A	F	U	H	G	L
59.72%	11.81%	4.20%	.23%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

AFCS NUMBER - 341141 DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS

UNIT ASSIGNMENT CALCULATION - NO. 5
TOE NUMBER - 5-114H ENGR CONST SPT CO
TOE NUMBER - 5-129H CON PLT-ENGR PORT CONST CO

HALF DAYS		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TAIL	HEAD																				
1	10	1R	1R	1R	1R	1R	1R	1R	1R	1R	1R	1R	1R	1R	2R						
1	6	1S	1S	1S	2S	2S															
1	5	2R	3R	3R																	
1	2	3R 6N																			
2	3		10N	10N																	
5	6				4R	4R															
3	5	DUMMY ACTIVITY																			
6	7						1R 8N 1P														
7	8	WAITING ACTIVITY																			
8	9													2R							
9	11														9N						
10	12															6R	6R				
10	11	DUMMY ACTIVITY																			
11	14																	8R 5S	8R 5S		
12	14	DUMMY ACTIVITY																			
14	15																			8R	8R

TOT AVAIL	RES ID	AGGREGATE RESOURCE UTILIZATION																			
8	R	6	4	4	5	5	2	1	1	1	1	1	1	3	2	6	6	R	8	8	8
16	N	6	10	10	0	0	8	0	0	0	0	0	0	0	9	0	0	0	0	0	0
15	S	1	1	1	2	2	0	0	0	0	0	0	0	0	0	0	0	5	5	0	0
16	P	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

HALF DAYS	21	22	23	24	25	26	27
TAIL HEAD							
14 15	AA						
14 17		BB	AB	BB			
15 14	DUMMY ACTIVITY						
17 18					BB	BB	
18 19							BN

TOT AVAIL	P F S I D	AGGREGATE RESOURCE UTILIZATION						
8	A	8	8	8	8	8	8	0
16	N	0	0	0	0	0	0	8
15	S	0	0	0	0	0	0	0
16	P	0	0	0	0	0	0	0

AFCS NUMBER - 341141 DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS

SUMMARY OF TROOP UNIT ASSIGNMENT

TOE NUMBER - 5-118H GEN PLT-ENGR CO.CBT BN.HVY

13 DAYS REQUIRED FOR PROJECT COMPLETION

26.66% AVERAGE EFFICIENCY OVER ALL RESOURCES

AVERAGE EFFICIENCY BY SKILL TYPE									
B	N	S	P	A	E	U	M	G	L
29.19%	25.48%	23.08%	3.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

TOE NUMBER - 5-124H ENGR DUMP TRUCK CO
TOE NUMBER - 5-118H GEN PLT-ENGR CO.CBT BN.HVY

13 DAYS REQUIRED FOR PROJECT COMPLETION

26.66% AVERAGE EFFICIENCY OVER ALL RESOURCES

AVERAGE EFFICIENCY BY SKILL TYPE									
B	N	S	P	A	E	U	M	G	L
29.19%	25.48%	23.08%	3.85%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

TOE NUMBER - 5-197H ENGR EQUIP & MNT CO. ABN
TOE NUMBER - 5-37H PLT-ENGR CAT CO.CBT BN.HVY

13 DAYS REQUIRED FOR PROJECT COMPLETION

16.16% AVERAGE EFFICIENCY OVER ALL RESOURCES

AVERAGE EFFICIENCY BY SKILL TYPE									
B	N	S	P	A	E	U	M	G	L
65.00%	7.29%	9.14%	.67%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

TOE NUMBER - 5-117H EQP & MNT CO.CBT BN. HVY
TOE NUMBER - 5-129H CON PLT-ENGR PORT CONST CO

14 DAYS REQUIRED FOR PROJECT COMPLETION

15.28% AVERAGE EFFICIENCY OVER ALL RESOURCES

AVERAGE EFFICIENCY BY SKILL TYPE									
B	N	S	P	A	E	U	M	G	L
59.72%	11.81%	3.50%	.62%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

TOE NUMBER - 5-114H ENGR CONST SPT CO
TOE NUMBER - 5-129H CON PLT-ENGR PORT CONST CO

14 DAYS REQUIRED FOR PROJECT COMPLETION

13.33% AVERAGE EFFICIENCY OVER ALL RESOURCES

AVERAGE EFFICIENCY BY SKILL TYPE									
B	N	S	P	A	E	U	M	G	L
59.72%	11.81%	4.20%	.23%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

SAMPLE PROBLEM 2. INPUT DECK

```
CARD
TYPE
 I  1
    11111   21NABEUSMGPL
      316    2    6    5    6    1   42    5    1    7        5-35MENGR COMBAT BN, CORPS
       78    0    0    0    0    0    8    1    0    0        5-37MENGR CBT CO, CORPS
       25    0    0    0    0    0    2    0    0    0        5-37MPLT-ENGR CBT CO,CBT BN,MVY
       69    9  102   54   48   29   53   22   12   14      5-115MENG CBT BN, MVY
        9    0    0    0    0    5    5    7    6    8      5-117MEQP & MNT CO,CBT BN, MVY
       20    0   34   18   16    8   16    5    2    2      5-118MENGR CO, ENGR CBT BN, MVY
        0    0    0    0    0    0   16    3    0    0      5-118MHOR PLT-ENGR CO,CBT BN,MVY
        8    0   17    6    6    3    0    1    1    0      5-118MGEN PLT-ENGR CO,CBT BN,MVY
      147    6    8    5    2    7   80   12    6    6      5-195MENGR CBT BN, ABN
 II     3    0    8    5    2    7    8    4    6    6      5-197MENGR EQUIP & MNT CO, ABN
       72    0    0    0    0    0   36    4    0    0      5-198MENGR CMBT CO, ABN
       20    0    0    0    0    0    8    1    0    0      5-198MPLT-ENGR CBT CO, ABN
        0    0    0    0    0    2   72    6    0    7       5-54MENGR LT EQUIP CO, ABN
        6    0    0    0    0    3   28   13    7   11       5-58MENGR CPT SPT EQUIP CO
        9    0    0    0    0    2    5   19   16    9      5-114MENGR CONST SPT CO
       25   10   16    4    2   31    5    7    2   14      5-129MPORT CONSTR CO
        7    0    8    2    1   13    0    1    0    4      5-129MCON PLT-ENGR PORT CONST CO
       30    0    9    0    0   74    4    2    0    8      5-177MENGR PIPELINE CONST SPT CO
        6    0    3    0    0   24    0    0    0    2      5-177MPL PLT-ENGR PIPLN CONST CO
        0    0    0    0    0    0    0    0    0   42      5-124MENGR DUMP TRUCK CO
        0    0    0    0    0    0    0    0    0   21      5-124MTRK PLT-ENG DUMP TRUCK CO
III  22222YYYYY
 IV  3333    0
  V  3414141 WAREHOUSE WITH CONCRETE FOOTINGS
VII  6.8         0
        1    2   21   3 B   1 N  2              SITE LAYOUT
        1    5   24   2 B   2                   FABRICATE FORMS
        1    6   14   2 S   2                   FABRICATE ANCHOR STRAPS
        1   10   48   3 B   3                   ASSEMBLE COLS. AND GIRDERS
        2    3   60   5 N   5                   FOOTING EXCAVATION
        5    6   24   2 B   2                   ERECT FORMS
        6    7   20  10 B   1 N  8 P  1         CONCRETE WORK
        7    8                                  CURE CONCRETE                    3
        8    9    6   2 B   2                   STRIP FORMS
VIII    9   11   21   3 N   3                   BACKFILL CONCRETE FOOTINGS
       10   12   39   3 B   3                   PRECUT ROOF FRAME
       11   14   70   5 B   3 S  2              INSTALL COLS. AND GIRDERS
       14   15   72   4 B   4                   INSTALL ROOF FRAME
       16   17   76   4 B   4                   INSTALL ROOF DECK
       17   18   44   4 B   4                   INSTALL ROOFING
       18   19   26   2 N   2                   CLEAN UP
        3    5                                  DUMMY
       10   11                                  DUMMY
       12   14                                  DUMMY
       15   16                                  DUMMY
 IX  -9
  X  -5
  #              END OF INFORMATION
```

SAMPLE PROBLEM 2. OUTPUT

CONSTRUCTION TROOP UNIT DATA BASE

N: UNSKILLED LABOR A: CONSTRUCTION AID B: BUILDERS-GENERAL E: ELECTRICIAN S: STUCTURES WORKERS
U: UTILITIESMEN H: HEAVY EQ. OP. G: GENERAL EQ. OP. P: ASPH/CONC MACH OP. L: LIFT/LOAD EQ. OP.

INDEX	TOE #	UNIT DESCRIPTION	CAPABILITY BY SKILL TYPE (NO OF MEN)										
			N	A	B	E	U	S	H	G	P	L	TOTAL
1	5-35H	ENGR COMBAT BN, CORPS	316	2	6	5	6	1	42	5	1	7	391
2	5-37H	ENGR CBT CO, CORPS	78	0	0	0	0	0	8	1	0	0	87
3	5-37H	PLT-ENGR CBT CO.CBT BN.HVY	25	0	0	0	0	0	2	0	0	0	27
4	5-115H	ENG CBT BN, HVY	69	9	102	54	48	29	53	22	12	14	412
5	5-117H	EQP & MNT CO.CBT BN, HVY	9	0	0	0	0	5	5	7	6	8	40
6	5-118H	ENGR CO, ENGR CBT BN, HVY	20	0	34	18	16	8	16	5	2	2	121
7	5-118H	HOR PLT-ENGR CO.CBT BN.HVY	0	0	0	0	0	0	14	3	0	0	19
8	5-118H	GEN PLT-ENGR CO.CBT BN.HVY	8	0	17	6	6	3	0	1	1	0	42
9	5-195H	ENGR CBT BN, ABN	147	6	8	5	2	7	80	12	6	6	279
10	5-197H	ENGR EQUIP & MNT CO. ABN	3	0	8	5	2	7	8	4	6	6	49
11	5-198H	ENGR CMBT CO, ABN	72	0	0	0	0	0	36	4	0	0	112
12	5-198H	PLT-ENGR CBT CO. ABN	20	0	0	0	0	0	8	1	0	0	29
13	5-54H	ENGR LT EQUIP CO. ABN	0	0	0	0	0	2	72	6	0	7	87
14	5-58H	ENGR CPT SPT EQUIP CO	6	0	0	0	0	3	28	13	7	11	68
15	5-114H	ENGR CONST SPT CO	9	0	0	0	0	2	5	19	16	9	60
16	5-129H	PORT CONSTR CO	25	10	16	4	2	31	5	7	2	14	116
17	5-129H	CON PLT-ENGR PORT CONST CO	7	0	8	2	1	13	0	1	0	4	36
18	5-177H	ENGR PIPELINE CONST SPT CO	30	0	9	0	0	74	4	2	0	8	127
19	5-177H	PL PLT-ENGR PIPLN CONST CO	6	0	3	0	0	24	0	0	0	2	35
20	5-124H	ENGR DUMP TRUCK CO	0	0	0	0	0	0	0	0	0	42	42
21	5-124H	TRK PLT-ENG DUMP TRUCK CO	0	0	0	0	0	0	0	0	0	21	21

NEW SKILLS DEFINED

B	1	B
N	1	N
W	8	AEUSHGPL

REVISED TROOP UNIT DATA BASE

INDEX	TOE #	UNIT DESCRIPTION	CAPABILITY BY SKILL TYPE (NO OF MEN)			
			B	N	W	
1	5-35H	ENGR COMBAT BN, CORPS	6	316	69	391
2	5-37H	ENGR CBT CO, CORPS	0	78	9	87
3	5-37H	PLT-ENGR CBT CO,CBT BN,HVY	0	25	2	27
4	5-115H	ENG CBT BN, HVY	102	69	241	412
5	5-117H	EQP & MNT CO,CBT BN, HVY	0	9	31	40
6	5-118H	ENGR CO, ENGR CBT BN, HVY	34	20	67	121
7	5-118H	HOR PLT-ENGR CO,CBT BN,HVY	0	0	19	19
8	5-118H	GEN PLT-ENGR CO,CBT BN,HVY	17	8	17	42
9	5-195H	ENGR CBT BN, ABN	8	147	124	279
10	5-197H	ENGR EQUIP & MNT CO, ABN	8	3	38	49
11	5-198H	ENGR CMBT CO, ABN	0	72	40	112
12	5-198H	PLT-ENGR CBT CO, ABN	0	20	9	29
13	5-54H	ENGR LT EQUIP CO, ABN	0	0	87	87
14	5-58H	ENGR CPT SPT EQUIP CO	0	6	62	68
15	5-114H	ENGR CONST SPT CO	0	9	51	60
16	5-129H	PORT CONSTR CO	16	25	75	116
17	5-129H	CON PLT-ENGR PORT CONST CO	8	7	21	36
18	5-177H	ENGR PIPELINE CONST SPT CO	9	30	88	127
19	5-177H	PL PLT-ENGR PIPLN CONST CO	3	6	26	35
20	5-124H	ENGR DUMP TRUCK CO	0	0	42	42
21	5-124H	TRK PLT-ENG DUMP TRUCK CO	0	0	21	21

INPUT DATA TAB SHEET

AFCS NUMBER - 341141 DESCRIPTION - WARFHOUSE WITH CONCRETE FOOTINGS

NETWORK PARAMETERS

TAIL	HEAD	TOTAL M-H	CREW SIZE	ACTIVITY DESCRIPTION				CREW FORMATION (NO OF MEN)					CRUSH DUR
1	2	21	3	SITE LAYOUT	B	1	N	2		0	0	0	0
1	5	24	2	FABRICATE FORMS	B	2		0		0	0	0	0
1	6	14	2	FABRICATE ANCHOR STRAPS	W	2		0		0	0	0	0
1	10	48	3	ASSEMBLE COLS. AND GIRDER	B	3		0		0	0	0	0
2	3	60	5	FOOTING EXCAVATION	N	5		0		0	0	0	0
5	6	26	2	ERECT FORMS	B	2		0		0	0	0	0
6	7	20	10	CONCRETE WORK	B	1	N	8	W	1	0	0	0
7	8	0	0	CURE CONCRETE		0		0		0	0	0	3
8	9	6	2	STRIP FORMS	B	2		0		0	0	0	0
9	11	21	3	BACKFILL CONCRETE FOOTING	N	3		0		0	0	0	0
10	12	39	3	PRECUT ROOF FRAME	B	3		0		0	0	0	0
11	14	70	5	INSTALL COLS. AND GIRDERS	B	3	W	2		0	0	0	0
14	15	72	4	INSTALL ROOF FRAME	B	4		0		0	0	0	0
16	17	76	4	INSTALL ROOF DECK	B	4		0		0	0	0	0
17	18	44	4	INSTALL ROOFING	B	4		0		0	0	0	0
18	19	26	2	CLEAN UP	N	2		0		0	0	0	0
3	5	0	0	DUMMY		0		0		0	0	0	0
10	11	0	0	DUMMY		0		0		0	0	0	0
12	14	0	0	DUMMY		0		0		0	0	0	0
15	16	0	0	DUMMY		0		0		0	0	0	0

PROJECT SUMMARY

AFCS NUMBER - 341141 DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS

196 TOTAL GALF MAN-DAYS REQUIRED FOR PROJECT COMPLETION

RESOURCE REQUIREMENTS BY SKILL TYPES (HALF MAN-DAYS)

B	N	W
128	51	17

CPM TAB SHEET ASSUMING NO RESOURCE CONSTRAINTS(TIME UNIT = HALF DAY)

TAIL	HEAD	NORMAL DUR	EARLY START	EARLY FINISH	LATE START	LATE FINISH	TOTAL SLACK	NORMAL CREW SIZES B	N	W
1	2	3	0	3	0	3	0	1	2	0
1	5	4	0	4	3	7	3	2	0	0
1	6	3	0	3	8	11	8	0	0	2
1	10	5	0	5	17	22	17	3	0	0
2	3	4	3	7	3	7	0	0	5	0
5	6	4	7	11	7	11	0	2	0	0
6	7	1	11	12	11	12	0	1	8	1
7	8	6	12	18	12	18	0	0	0	0
8	9	1	18	19	18	19	0	2	0	0
9	11	3	19	22	19	22	0	0	3	0
10	12	4	5	9	23	27	18	3	0	0
11	14	5	22	27	22	27	0	3	0	2
14	15	6	27	33	27	33	0	4	0	0
16	17	6	33	39	33	39	0	4	0	0
17	18	4	39	43	39	43	0	4	0	0
18	19	4	43	47	43	47	0	0	2	0
3	5	0	7	7	7	7	0	0	0	0
10	11	0	5	5	22	22	17	0	0	0
12	14	0	9	9	27	27	18	0	0	0
15	16	0	33	33	33	33	0	0	0	0

NORMAL PROJECT DURATION IS : 47 HALF DAYS

OVERRIDE INPUT SPECIFIED

AFCS NUMBER - 341141 . DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS
RESOURCE UNCONSTRAINED CPM BAR CHART

HALF DAYS		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TAIL	HEAD																				
1	2	1R 2N	1B 2N	1B 2N																	
1	5	2B	2B	2B	2B																
1	6	2W	2W	2W																	
1	10	3R	3B	3B	3B	3B															
2	3				5N	5N	5N	5N													
10	12						3R	3B	3B	3R											
10	11	DUMMY ACTIVITY																			
5	6								2B	2B	2B	2B									
3	5	DUMMY ACTIVITY																			
12	14	DUMMY ACTIVITY																			
6	7												1B 8N 1W								
7	8	WAITING ACTIVITY																			
8	9																			2B	
9	11																				3N

TOT AVAIL	RES ID	AGGREGATE RESOURCE UTILIZATION																			
0	B	6	6	6	5	3	3	3	5	5	2	2	1	0	0	0	0	0	0	2	0
0	N	2	2	2	5	5	5	5	0	0	0	0	8	0	0	0	0	0	0	0	3
0	W	2	2	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0

HALF DAYS		21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
TAIL	HEAD																				
9	11	3N	3N																		
11	14			3B 2W	3B 2W	3R 2W	3B 2W	3B 2W													
14	15								4B	4B	4B	4B	4B	4R							
16	17														4B	4B	4B	4B	4B	4B	
15	16	DUMMY ACTIVITY																			
17	18																				4B

TOT AVAIL	RES ID	AGGREGATE RESOURCE UTILIZATION																			
0	B	0	0	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4
0	N	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	W	0	0	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0

HALF DAYS		41	42	43	44	45	46	47
TAIL	HEAD							
17	18	4R	4B	4B				
18	19				2N	2N	2N	2N

TOT AVAIL	RES ID	AGGREGATE RESOURCE UTILIZATION						
0	B	4	4	4	0	0	0	0
0	N	0	0	0	2	2	2	2
0	W	0	0	0	0	0	0	0

AFCS NUMBER - 341141 DESCRIPTION - WARFHOUSE WITH CONCRETE FOOTINGS

UNIT ASSIGNMENT CALCULATION - NO. 1

TOE NUMBER - 5-118H GEN PLT-ENGR CO,CBT BN,HVY

12 DAYS REQUIRED FOR PROJECT COMPLETION

DURATION COMPRESSION : 48.94 /

19.74% AVERAGE EFFICIENCY OVER ALL RESOURCES

AVERAGE EFFICIENCY BY SKILL TYPE

B	N	W
31.62%	27.60%	4.17%

AFCS NUMBER - 341141 DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS

UNIT ASSIGNMENT CALCULATION - NO. 1
TOE NUMBER - 5-118M GEN PLT-ENGR CO,CBT BN,HVY

HALF DAYS		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TAIL	HEAD																				
1	2	3R 6N																			
1	10	1R	1B	1R	1B	1B	1B	1R	1B	1B	1B	1B	1B	1B	1B	1B					
1	6	1W	1W	1W	1W	1W	1W														
1	5	2B	2B	2B	2B																
2	3		7N	7N	7N																
5	6					4B	4R														
3	5	DUMMY ACTIVITY																			
6	7							1R 8N 1W													
7	8	WAITING ACTIVITY																			
8	9														2R						
9	11															5N	5N				
10	11	DUMMY ACTIVITY																			
11	14																	8R 5W	8B 5W		
10	12																	6R	6B		
14	15																			12B	12B
12	14	DUMMY ACTIVITY																			

TOT AVAIL	RES ID	AGGREGATE RESOURCE UTILIZATION																			
17	R	6	3	3	3	5	5	2	1	1	1	1	1	1	3	1	0	14	14	12	12
8	N	4	7	7	7	0	0	8	0	0	0	0	0	0	0	5	5	0	0	0	0
17	W	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	5	5	0	0

HALF DAYS		21	22	23	24
TAIL	HEAD				
16	17	12R	12B		
15	16	DUMMY ACTIVITY			
17	18			16B	
18	19				8N

TOT AVAIL	RES ID	AGGREGATE RESOURCE UTILIZATION			
17	R	12	12	16	0
8	N	0	0	0	8
17	W	0	0	0	0

AFCS NUMBER - 341141 DESCRIPTION - WAREHOUSE WITH CONCRETE FOOTINGS

SUMMARY OF TROOP UNIT ASSIGNMENT

TOE NUMBER - 5-118H GEN PLT-ENGR CO,CBT BN,HVY

12 DAYS REQUIRED FOR PROJECT COMPLETION

19.74% AVERAGE EFFICIENCY OVER ALL RESOURCES

AVERAGE EFFICIENCY BY SKILL TYPE

B	N	W
31.62%	27.60%	4.17%

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