EVALUATION AND DEVELOPMENT

OF

DRAINAGE AND PIPELINE CONSTRUCTION PROCESSES

VOLUME 2

NIGEL BARTRAM

A THESIS SUBMITTED FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

THE UNIVERSITY OF ASTON

OCTOBER 1981

CONTENTS

SECTION 1

PIPELINE ESTIMATING PROGRAMMES

DATA

PROPORTION OF THEORETICAL BUCKET

CAPACITY UTILISED

STRATA * GRADING	PROPORTION OF BUCKET *1 UTILISED
1	0.40
2	0.42
3	0.45
4	0.47
5	0.62
6	0.63
7	0.63
8	0.64
9	0.68
10	0.69

TABLE 1

* Refer to Table 2.11, Volume 1

*1 After, Meadows (1978), and J.C.B. Ltd

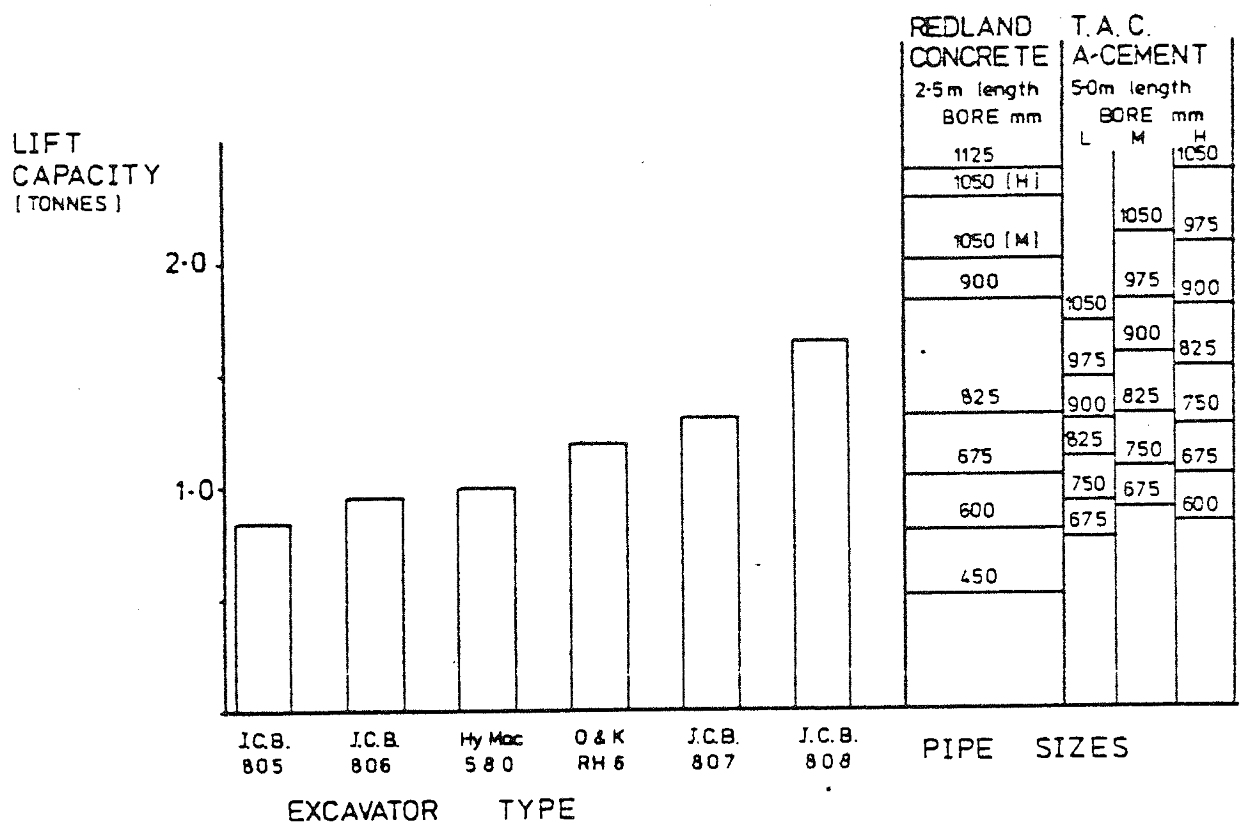


Fig 1. Excavator Lifting Capacities

PIPE OUTSIDE DIAMETERS (M)

NOMINAL BORE (m)	CLAY	CONCRETE	IRON	PLASTIC	ASBESTOS CEMENT	PITCH FIBRE
0.100	0.131		0.118	0.114	0.125	0.122
0.150	0.186	0.203	0.170	0.168	0.180	0.183
0.225	0.272	0.288	0.248	0.245	0.260	0.330
0.300	0.361	0.377	0.326	0.325	0.343	
0.375	0.456	0.459	0.405		0.426	
0.450	0.552	0.543	0.480		0.508	
0.525	0.636	0.626	0.558		0.588	
0.600	0.720	0.709	0.635		0.672	
0.675		0.805	0.711		0.756	
0.750		0.888	0.790		0.837	
0.825		0.937	0.868		0.921	
0.900		1.060	0.945		1.005	
0.975		1.152	1.021		1.073	
1.050		1.238	1.100		1.154	
1.125		1.312	1.178			
1.200		1.411	1.255			
1.275		1.496				
1.350		1.581				
1.425		1.668				
1.500		1.756				
1.575		1.840				
1.650		1.925				

TABLE 2

PIPE WEIGHTS (kg/m)

NOMINAL BORE (m)	CLAY	CONCRETE	IRON	PLASTIC	ASBESTOS CEMENT	PITCH FIBRE
0.100	30.41	30.0	19.63		10.17	4.19
0.150	50.26	60.0	37.36		17.15	8.72
0.225	69.70	80.0	63.99		29.45	17.66
0.300	80.34	110.0	95.63	10.98	51.52	
0.375	123.47	170.0	132.63	13.72	74.00	
0.450	166.60	180.0	174.36	16.46	98.40	
0.525	222.15	250.0	209.05	19.20	148.00	
0.600	277.70	310.0	218.18	21.95	169.20	
0.675		380.0	173.32	24.69	211.20	
0.750		460.0	205.36	27.43	255.40	
0.825		550.0	238.85	31.09	306.60	
0.900		620.0	275.27	34.75	363.00	
0.975		710.0	317.17	36.58	417.60	
1.050		770.0	360.84	38.41	482.00	
1.125		900.0	406.45	41.15		
1.200		960.0	454.72	43.90		
1.275		1125.0		47.56		
1.350		1290.0				
1.425		1420.0				
1.500		1550.0				
1.575		1680.0				
1.650		1810.0				
1.725		2155.0				
1.800		2500.0				
1.875		2675.0				
1.950		2850.0				
2.025		2875.0				
2.100		2900.0				

TABLE 3

LASERS FOR PIPE ALIGNMENT

ELEMENT	STANDARD MINUTE VALUE, PER OCCASION (STD MINS)
Check line & level using laser and Target	1.05

TABLE 4

ERECTION OF TRENCH STRUTS

ELEMENT	STANDARD MINUTE VALUE, PER OCCASION (STD MINS)
Place strut into Trench.	0.17
Adjust strut length	0.44
Fix strut	1.25

TABLE 5

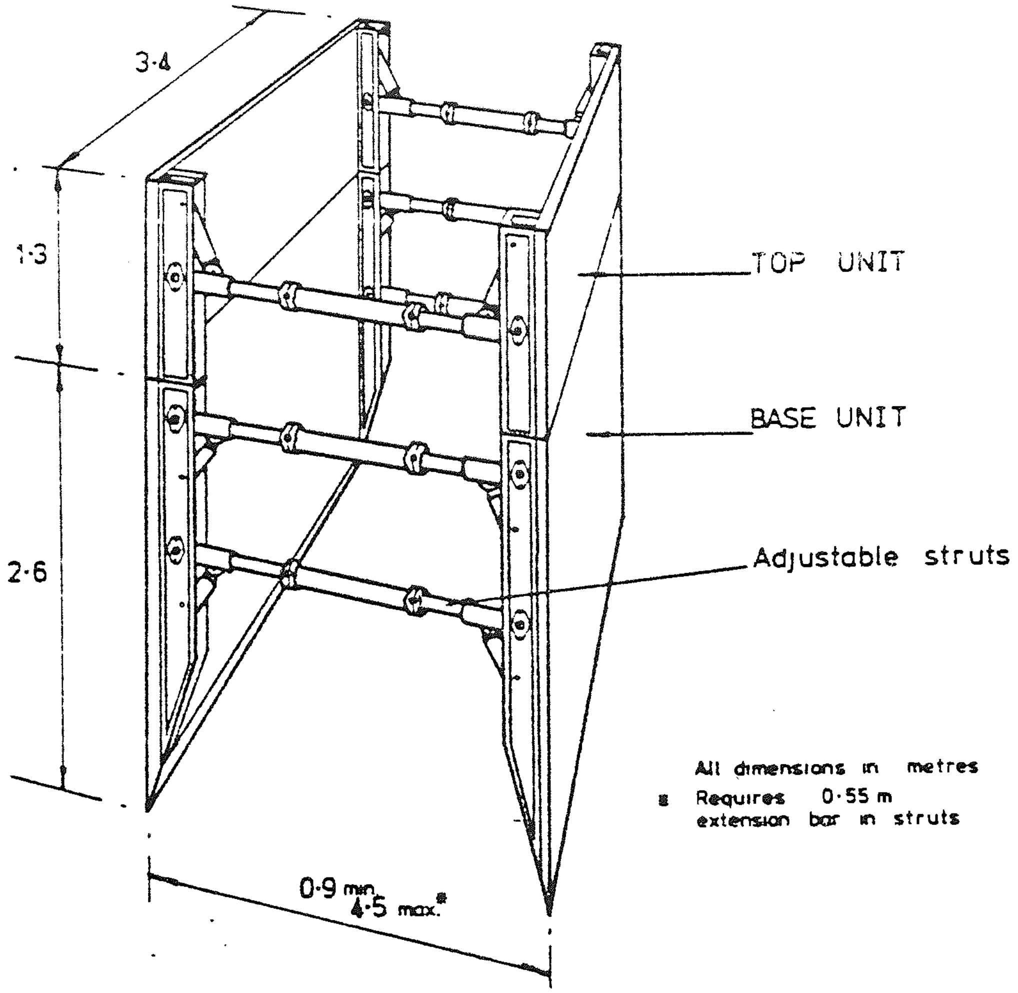


Fig 2.

<u>'Shorco' Trench Lining System</u>

Supplied by:-

Shorco Trench Systems Ltd

Conbex House

Dewsbury Road

Churwell

Leeds LS27 8PR

SHORCO TRENCH LINING SYSTEM

ELEMENT	STANDARD MINUTE VALUE (STD MINS)
Fit slings onto machine	0.63
Remove -ditto-	0.55
Fit slings on Shorco Unit	
Unit in Trench	2.05
Unit not in Trench	1.40
Remove slings form Shorco unit	
Unit in Trench	0.55
Unit not in Trench	1.10
Remove 1.3m section & place aside	1.00
Remove 2.6m section & place aside	
Loose fill ground, 3.5m deep	3.40
Reduce width of unit in Trench	6.50
Place unit in Trench	3.80
JCB 807 travel with box 10m	2.80

TABLE 6

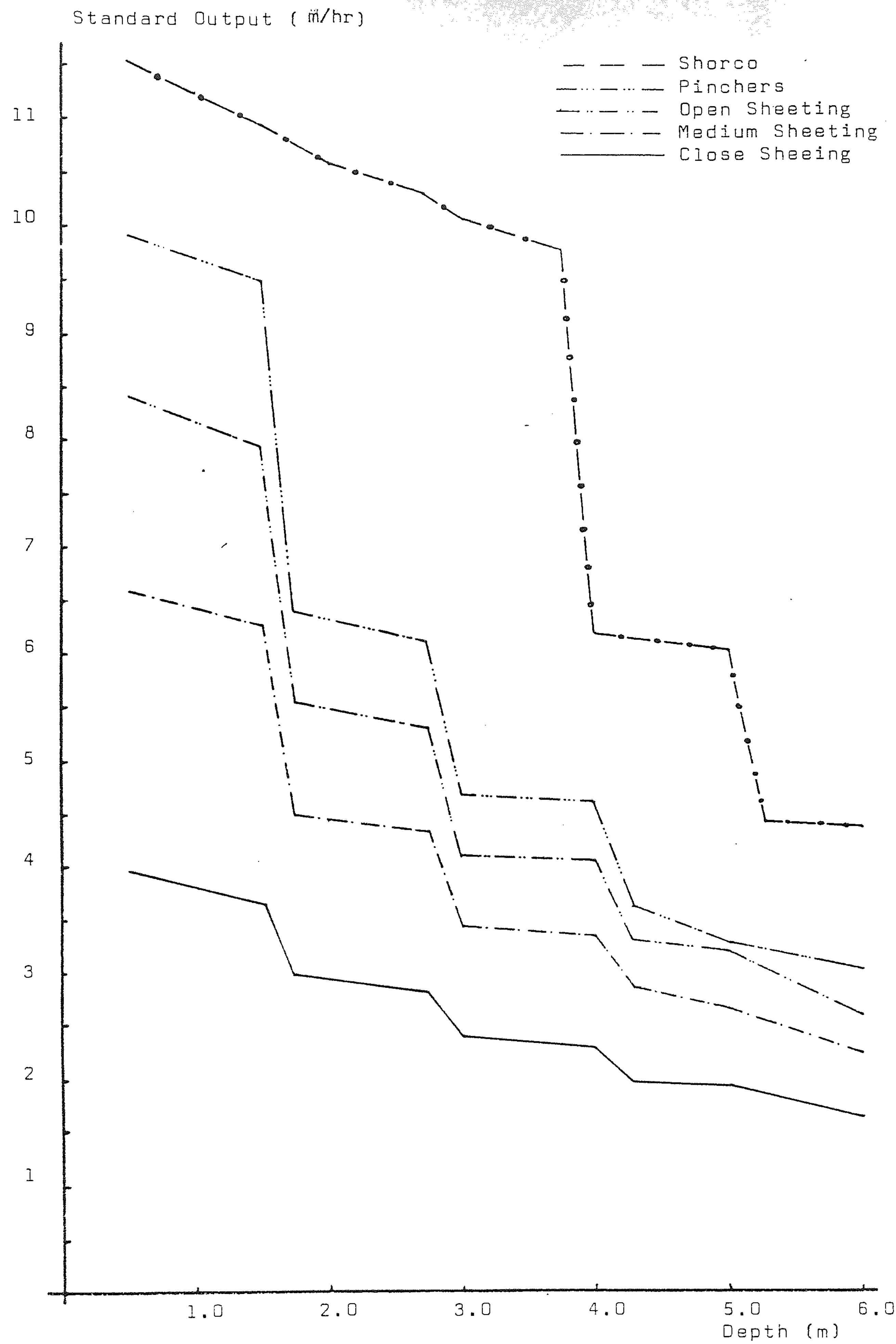


Fig 3. Trench Shoring production Rates

SECTION 2

PIPELINE ESTIMATING PROGRAMMES

USERS MANUAL.

CONTENTS:

CONTENTS:

INDEX:

INDEX:

1.0 INTRODUCTION

The PipeLine Estimating Programmes suite is an on-line interactive computer system for estimating pipeline construction costs. It was developed at the University of Aston by the Author, working for Bryant Construction Limited of Solihull, under a Transport and Road Research Laboratory external research contract.

1.1 ESTIMATING METHOD

PLEP is designed to follow an estimating system shown graphically in fig 1.1. It can handle Bills of Quantities (BoQ) which are in accordance with the Civil Engineering Standard Method of Measurement (CESMM) or other BoQ's following more traditional Methods of Measurement. PLEP can be used as an entity to analyse a particular contract or the individual programmes can be accessed individually. The Analysis of a contract is considered in two stages:

a) Time and Resource analysis of individual operations and

b) Method and Cost Analysis of a complete pipeline construction activity.

1.1.1 TIME ANALYSIS

PLEP stores elemental work measurements data on the operations which comprise pipeline construction. This data is used to synthesise any operation based on dimensions etc., supplied by the User. This information is available from the contract documents and a check list of required data is shown in Table 1.1.

1.1.2 COST ANALYSIS

The cost analysis sub-system is used to assist the User in sorting the results of the time analysis. Further input data is required from the User and a check list is shown in Table 1.2.

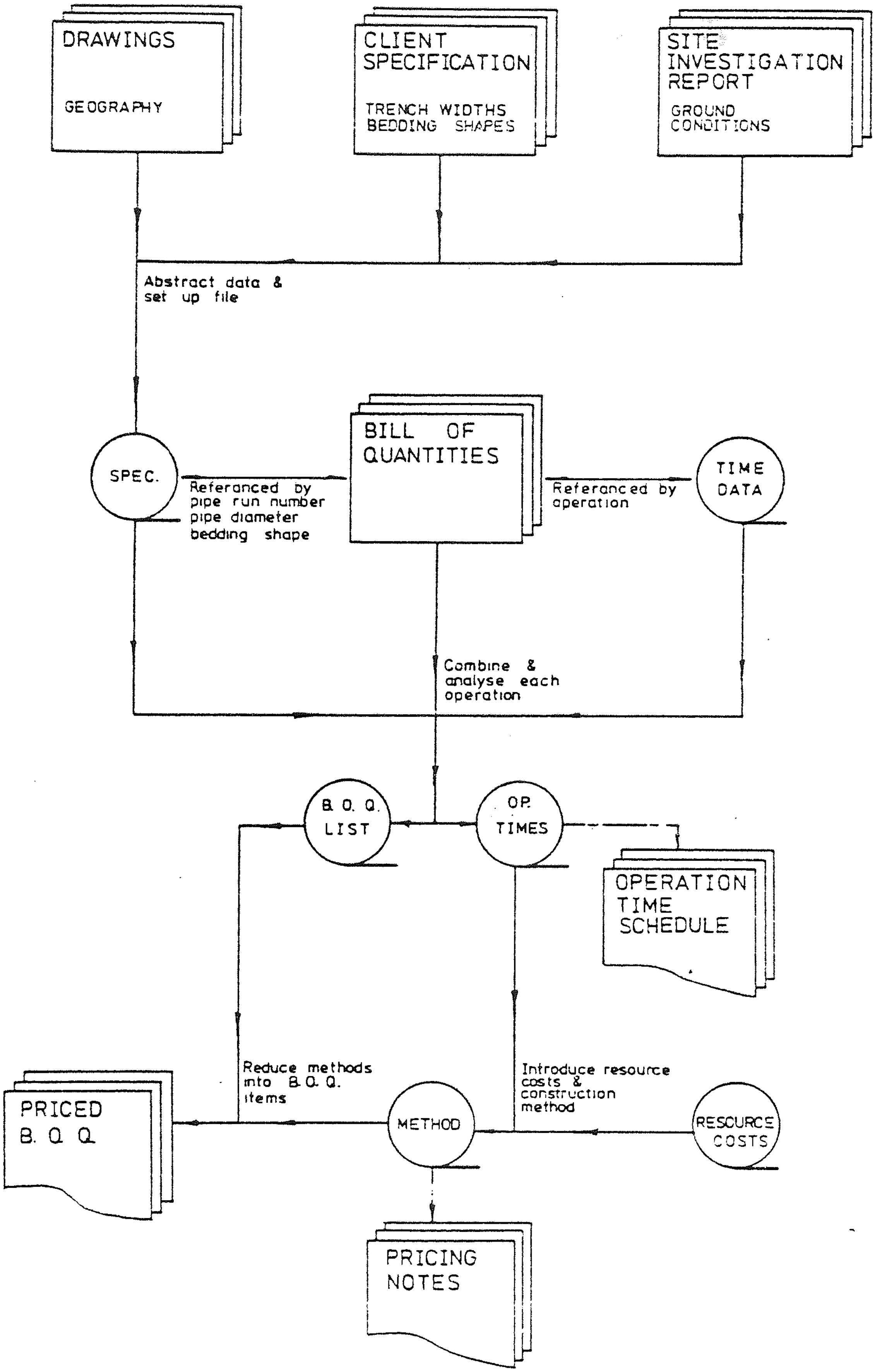


Fig. 1.1. Estimating Method

1.2 USING THE SYSTEM

PLEP comprises of 13 programmes, see fig 1.2. It can be used as a total system or the individual programmes and sub-systems can be accessed separately. It is fully equipped with prompts and explanatory text which are displayed at the User's request. This manual expands on the workings of the system by following through the analysis of a pipeline construction activity.

TABLE 1.1 TIME ANALYSIS DATA CHECKLIST

Most of this data is contained in the contract documents.

1 Contract identification. Estimate reference, see 2.1.1.

2 Specification Input. For each pipe run on the contract you will have to assign a) Run number b) Start point c) End point See fig 3.1.

3 Standard Bedding Shapes, see fig 3.2. Check the factors against the contract specification.

4 Trench widths, see 3.3.2. Check this table against the contract specification.

5 Ground Conditions. Working from the Site Investigation Report decide on the following parameters for each ground type:

a) Strata Grading See Table 3.1

b) Obstruction Grading See Table 3.2

c) Density Kg/m^3) If any are unknown PLEP will
)
d) Cohesion Kn/m^2) select typical values for you.

e) Angle of internal friction.

6 Backfill layer thickness.

TABLE 1.1 TIME ANALYSIS DATA CHECKLIST contd ...

7 For each Bill of Quantities item you will need:

a) Bill number b) Page number c) Item number d) Item quantity e) Operations measured under that item. For CESMM BoQ items this is assigned automatically by PLEP.

8 For each BoQ item you will need:

a) Run number, from 2 above

b) Number of pipes in the trench

c) For each pipe you will need:

i Diameter

ii Material type, see 4.1.1.3 for CESMM BoQ this is assigned for you

iii Depth to invert

iv Trench width, for single trench width PLEP automatically selects from 3.3.2 the width for the pipe diameter

v Pipe length

d) Excavation - Required reach, Unloading height, bucket width, Depth to start of batter, batter angle if required

e) Shoring - Bay length

f) Bedding - Shape Code fig 3.2. Non-standard shape dimensions fig 4.3 pipe outside diameter if this is not included in Appendix A.

g) Pipe laying - Weight of pipe if this is not included in Appendix B.

h) Backfill - Volume, if being used independently of PLEP.

TABLE 1.2 COST ANALYSIS DATA CHECKLIST

1 Run Number

2 If being used independently of PLEP you will need:

a) Vertical Trench volume m3/m

b) Battered Trench volume m3/m

c) Number of pipes

d) For each pipe you will need:

i Pipe material. see 4.1.1.3

ii Diameter

iii Bedding material and volume

iv Cover material and volume

v Backfill vertical trench volume

vi Backfill battered trench volume

3 SUCD (see 8.0) code listing

4 Materials costs for:

a Concrete bedding £/m^3

b Granular bedding £/m^3

c Cost of the pipe(s) £/m

d Showing all in material costs £/hr for:

i Close sheeting see fig 4.1

ii Medium sheeting "

iii Open sheeting "

iv Pinchers "

v Shorco Boxes see fig 4.2

e Production Outputs for:

i Any items of plant which are not covered by PLEP

ii Labour only outputs where no item of plant is required.

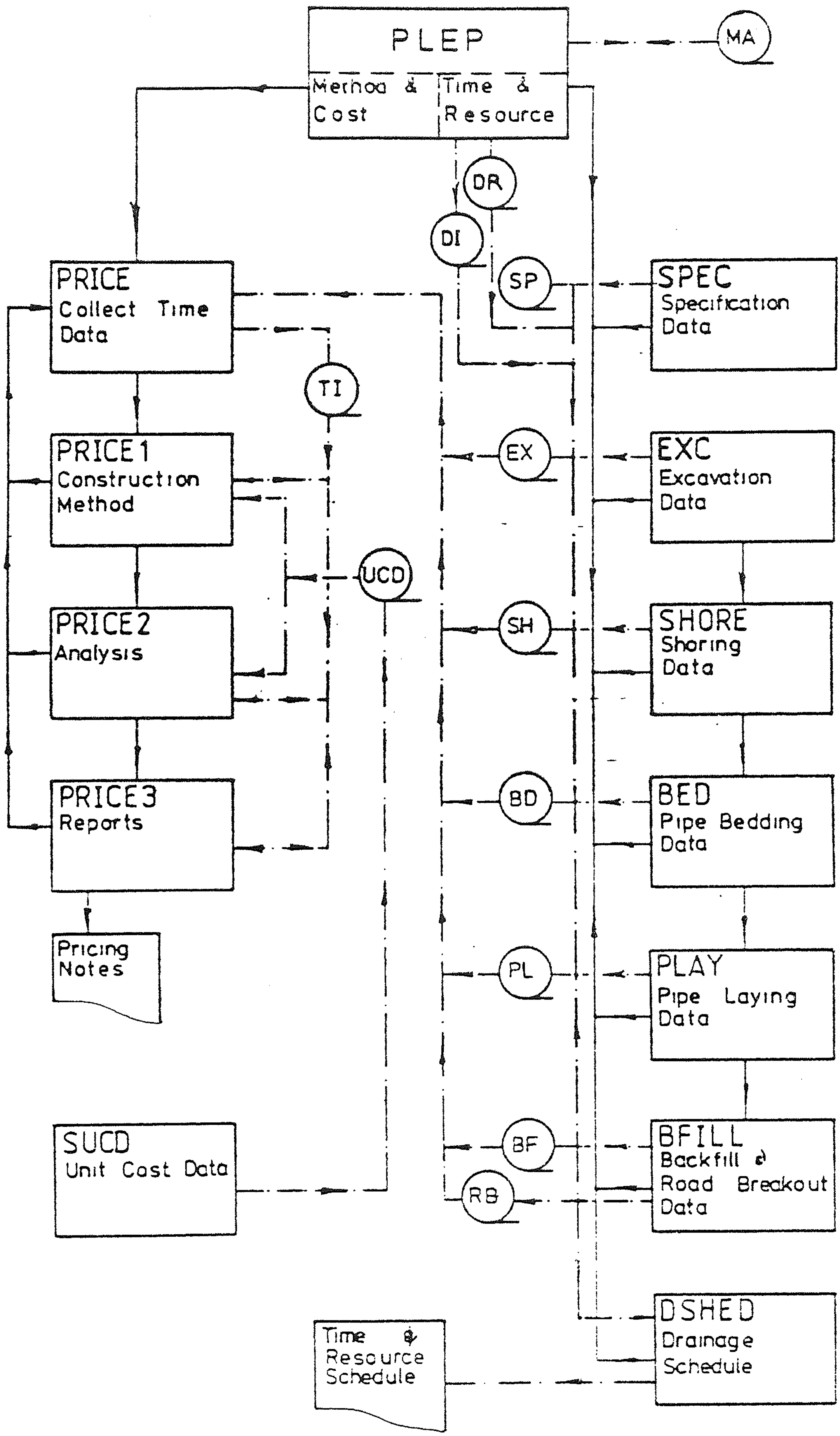


Fig 1.2 Pipeline Estimating Programmes - PLEP

2.0 STARTING UP

'PLEP' can be used by more than one operator to analyse different contracts at one time. Execution can be stopped at certain points and restarted later, thus there are two 'starting up' points:

a) The commencement of the analysis of a project

b) The continuation of the analysis of a project.

2.1 PROJECT COMMENCEMENT

example of project commencement	notes
(1) DRAINAGE STANDARD TIME SYNTHESIS	standard heading
(2) ******** ******** **** *********	
(3) ESTIMATE REFERENCE ? NB/2	see 2.1.1
(4) NEW PROJECT ? YES	PLEP checks that NB/2 is not on file, an error message is printed if NB/2 has already been used and execution skips to line 3.
(5) DESCRIPTION ? AUDNAM DRAINAGE	see 2.1.2
(6) SPECIFICATION INPUT	The specification input programme is automatically called at the commencement of a project see 3.0
(7) ************* *****	

2.1.1 ESTIMATE REFERENCE: A unique four digit alphanumeric code used to identify this project and its data files.

2.1.2 CONTRACT DESCRIPTION: Up to 20 alphanumeric characters used as a heading for the printing of reports etc.

2.2 PROJECT CONTINUATION

example of project continuation	notes
(1) DRAINAGE STANDARD TIME SYSTHESIS	
(2) ******** ******** **** *********	
(3) ESTIMATE REFERENCE ? NB/1	see 2.1.1
(4) NEW PROJECT ? NO	
(5) BILL OF QUANTITIES ANALYSIS	
(6) **** ** ********** ********	
(7) RUN CONTROL (CO/TI/SH/BQ/ST/?) ? TI	see 2.2.1

2.2.1 RUN CONTROL: A two letter code which instructs 'PLEP' to perform the following operations:

CO	-	COST	load and execute the PRICE sub-system see 6.0
TI	-	TIME	load and execute the TIME sub-system see 4.0
SH	-	SCHEDULE	produce a schedule of the time analysis see 5.0
BQ	-	BILL OF QUANTITIES	produce a print of the priced Bill of Quantities see 7.0
ST	-	STOP	cease execution
?	-	QUERY	display a listing of the summary of the run control commands.

3.0 SPECIFICATION INPUT

Upon commencement of a project analysis the specification input programme is called automatically. The input is stored on file and is used for all subsequent analyses of the project.

3.1 INPUT DATA

The programme requires information from three sources:

a) Contract Drawings - The geography of the project see 3.2

b) Client Specification - The bedding dimensions see 3.3.1
The trench widths see 3.3.2
The backfill layer thickness see 3.3.3

3.1 INPUT DATA contd ....

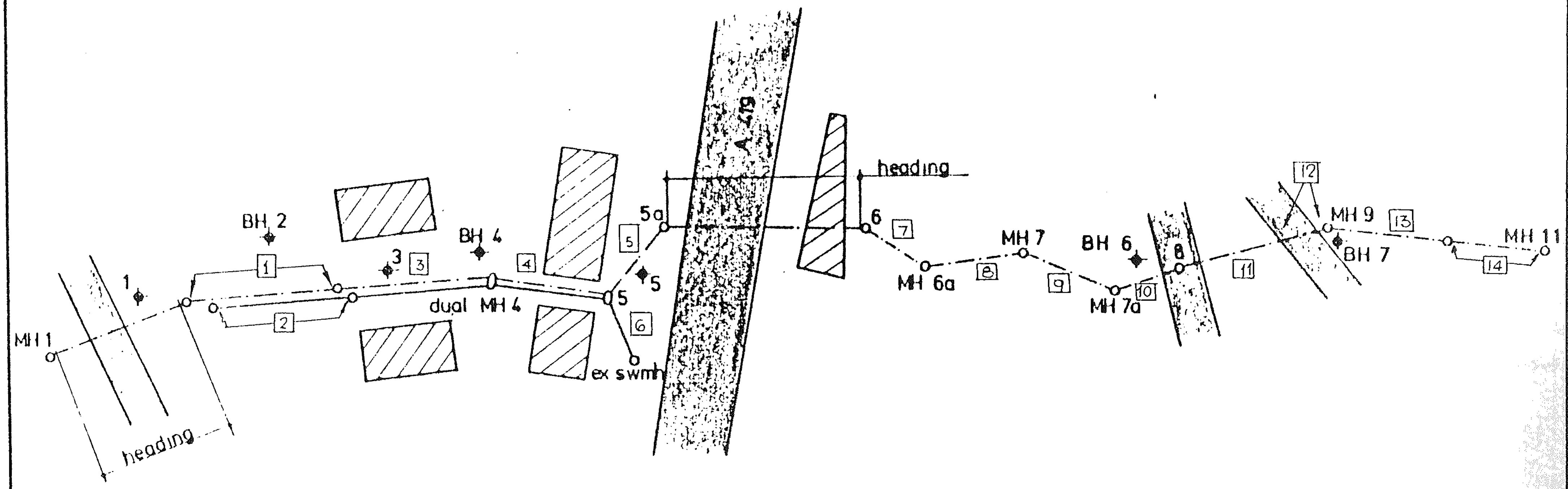
c) Site Investigation Report - The different types of ground on the site see 3.4

3.2 CONTRACT GEOGRAPHY

For an example of pipe run identification see fig 3.1

	example of Contract Geography Input	
(1)	CONTRACT SPECIFICATION	
(2)	******** *************	
(3)	GEOGRAPHY	
(4)	GEOGRAPHY INPUT CONSISTS OF (a) THE START POINT	Standard Notes
(5)	AND (b) THE FINISH POINT OF EACH PIPE RUN.	
(6)	ALLOW UP TO 8 CHARACTERS PER BREAK POINT.	
(7)	TERMINATE INPUT WITH START POINT 'NONE'.	
(8)	RUN NUMBER 1	
(9)	START POINT ? FMH 2	
(10)	FINISH POINT ? FMH 3	
(11)	RUN NUMBER 2	
(12)	START POINT ? SMH 2	
(13)	FINISH POINT ? SMH 3	
	etc.	
(14)	RUN NUMBER 17	
(15)	START POINT ? NONE	

Geography input is terminated



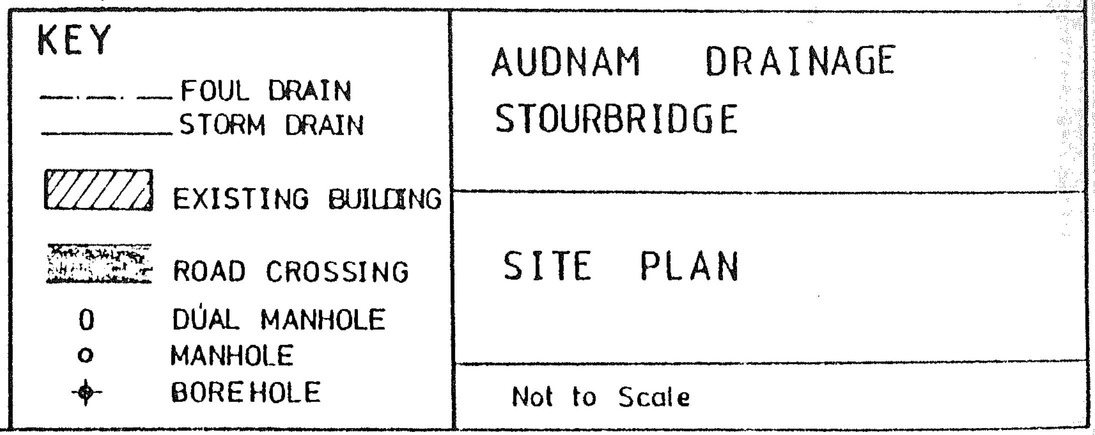


Fig 3.1 Site Plan Showing Pipe run numbers.

3.3 CLIENT SPECIFICATION

3.3.1 STANDARD BEDDING SHAPES

'PLEP' stores data for four 'standard'bedding shapes see fig 3.2. The User can amend the factors which define each shape to agree with the contract specification. When the bedding operation is analysed 'PLEP' will automatically calculate the volume of material required for these dimensions. If a 'non-standard' bedding shape is required then the User must input the actual dimensions during the bedding analysis, see 4.4.1.

example of standard pipe support structure input.	notes
(16) PIPE SUPPORT	
(17) BEDDING CLASS 1 CONCRETE ARCH	
(18) STANDARD DIMENSIONS AS FOLLOWS (METRES)	
(19) FOR NOTATION SEE HANDBOOK	
(20) 1. BW = BC * 1.25 - MIN = BC + 0.2	see fig 3.2
(21) 2. Y1 = D * 0.25 - MIN = 0.1	
(22) 3. Y2 = BC * 0.25	
(23) 4. CV = 0.3	
(24) DO YOU WANT THE CONCRETE TO THE TRENCH SIDES? NO	The User can specify full trench width concrete
(25) DO YOU WANT TO CHANGE ANY OF THIS DATA? YES	
(26) ENTER LINE NUMBER, REVISED FIGURE AND M FOR MIN/MAX, OR W FOR	
(27) WORKING DIMENSION ? 1,1.5,W	
(28) ANY MORE CHANGES ? YES	
(29) ENTER REVISION AS BEFORE ?2,0.2,M	
(30) ANY MORE CHANGES ? NO	

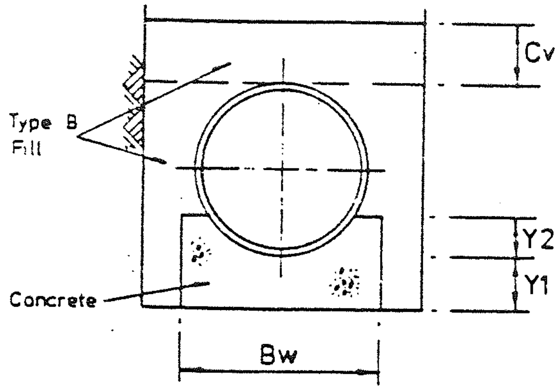
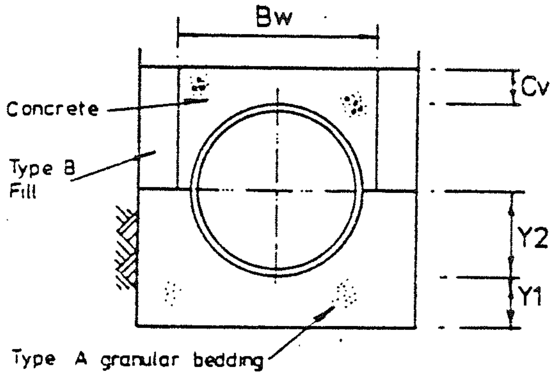
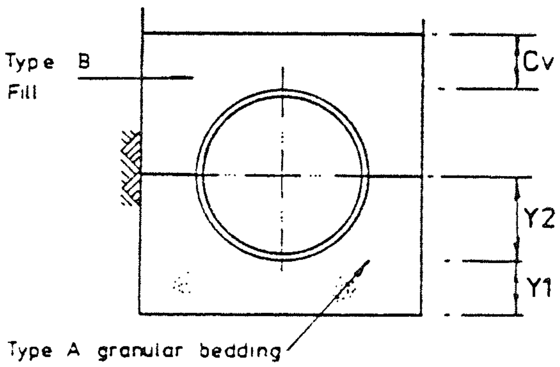
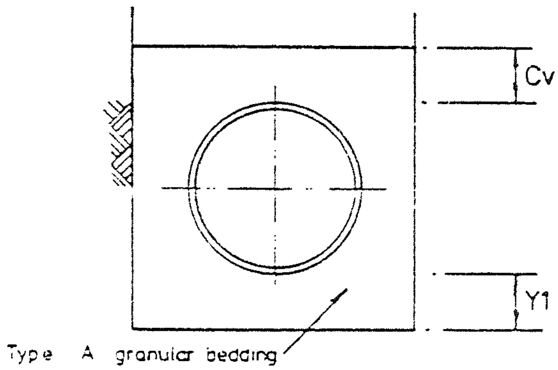
STANDARD SHAPES	DIMENSIONS
CLASS 1 - CONCRETE CRADLE  	NOTE Bc = Pipe Outside Diameter D = Pipe Bore All Dimensions in metres Bw = 1·25 Bc − Bc + 0·2 min. Y1 = 0·25 D − 0·1 min. Y2 = 0·25 Bc Cv = 0·3 min.
CLASS 2 − CONCRETE ARCH  	Bw = 1·25 Bc − Bc + 0·2 min. Y1 = 0·25 D − 0·2 min. MIXED SOILS Y1 = 0·16 D − 0·1 min. UNIFORM SOILS Y2 = 0·5 Bc Cv = 0·25 D − 0·1 min.
CLASS 3 − GRANULAR BED  	Y1 = 0·25 D − 0·2 min MIXED SOILS Y1 = 0·16 D − 0·1 min UNIFORM SOILS Y2 = 0·5 Bc Cv = 0·3
CLASS 4 − GRANULAR SURROUND  	Y1 = 1·0 D - 0·15 max. Cv = 1·0 D - 0·15 max.

Fig. 3.2 Standard Bedding Shapes

(31) DO YOU WANT TO INSPECT THIS DATE AGAIN ? YES	If NO then execution skips to line 37
(32) 1. BW = BC * 1.50 - MIN = BC * 0.2	
(33) 2. Y1 = D * 0.25 - MIN = 0.2	
(34) 3. Y2 = BC * 0.25	
(35) 4. CV = 0.3	
(36) DO YOU WANT TO CHANGE ANY OF THIS DATA ? NO	If YES then execution skips to line 26
(37) EXECUTION STARTS AT LINE (17) FOR THE NEXT SHAPE, AND SO ON, UNTIL ALL 4 HAVE BEEN CHECKED.	

3.3.2 SINGLE TRENCH WIDTHS

'PLEP' stores the 'standard' single pipe trench widths from The Scottish Development Department Specification. These are displayed to the User who can make amendments as required by the contract specification.

Example					Notes
(38)	SINGLE TRENCH WIDTHS				
(39)		DIA	MIN	MAX	'Standard' trench width table
(40)	1.	0.100	0.430	0.630	
(41)	2.	0.150	0.490	0.690	
(42)	3.	0.225	0.580	0.780	
(43)	4.	0.300	0.680	0.880	
(44)	5.	0.375	0.950	1.150	
(45)	6.	0.450	1.030	1.230	
(46)	7.	0.525	1.120	1.320	
(47)	8.	0.600	1.240	1.440	
(48)	9.	0.675	1.330	1.530	
(49)	10.	0.950	1.440	1.640	
(50)	11.	0.825	1.490	1.690	
(51)	12.	0.900	1.920	2.120	
(52)	13.	1.050	2.100	2.300	

(53) 14. 1.200 2.290 2.490	
(54) 15. 1.200 O.D +0.80 O.D +1.00	
(55) DO YOU WANT TO CHANGE ANY OF THIS DATA ? YES	
(56) ENTER LINE NUMBER, REVISED FIGURE AND MIN OR MAX	
(57) ? 2,0.5,MIN	
(58) ANY MORE CHANGES ? NO	If YES execution skips to line (56)
(59) DO YOU WANT TO INSPECT THIS TABLE AGAIN ? NO	If YES execution skips to line (58)

Input continues with Section 3.3.3

3.3.3 GROUND CONDITIONS

For each different type of ground on the site the User must specify the following parameters:

i Strata Grading see table 3.1

ii Obstruction Grading see table 3.2

iii Density Kg/m^3

iv Cohesion Kn/m^2

v Angle of internal friction degrees.

If any of these last three parameters are unknown then enter '99' and PLEP will select typical values from table 3.3. When a ground type has been specified in this way the User must assign each pipe run within that ground type. A maximum of 10 ground types each with a maximum of 10 pipe runs is permitted.

Example of ground specification and pipe run assignation	Notes
(60) GROUND CONDITIONS	
(61) GROUND TYPE 1	Ground type counter
(62) STRATA GRADING ? 9	
(63) OBSTRUCTION GRADING ? 1	

TABLE 3.1 STRATA GRADINGS

Grading	Description *		Casagrande Group Symbol
1	ROCK	Strata and boulders exceeding $0.2m^3$ in size requiring blasting or phuematic tools	
2	MEDIUM ROCK	As 1 but $0.008-0.2m^3$ in size	
3	SOFT ROCK	As 2 but not exceeding $0.008m^3$ in size or possessing bedding planes to allow breakage	
4	WEAK ROCK	As 3 but weak (slate, soft sandstone, shale)	
5	COHESIVE SOIL	Low Plasticity	ML. CL. OL.
6	COHESIVE SOIL	Medium Plasticity	MI. CI. OI.
7	COHESIVE SOIL	High Plasticity	MH. CH. OH.
8	COARSE GRAINED	Sands and gravels	GW. GC. GV
9	COARSE GRAINED	Well graded	GP. GF. SW. SG.
10	COARSE GRAINED	Uniformly graded.	SU. SP. SF.

* Geological Society Engineering Group Working Party (1977)

* British Standard Code of Practice CP 2001 (1957).

TABLE 3.2 OBSTRUCTION GRADINGS *

Grading	Description
1	Metalled road surfaces or similar obstructions on top of frequently occurring services.
2	Frequently occurring major services and house connections.
3	a) Infrequent major services and frequent house connections, or ... b) Infrequent major and minor services, or ... c) Infrequent minor services, and or, tree roots etc.
4	Minor obstructions only e.g. tree roots, small quantities of hardcore.
5	No obstruction other than those which are an integral part of the strata.

* Bramwell (1974)

(64) DENSITY (Kg/m^3) ? 99

Enter '99' if unknown

(65) COHESION (Kn/m^2) ? 0

"

(66) PHI (DEGREES) ? 99

"

(67) INPUT THE NUMBERS OF THE PIPE RUNS
WHICH ARE IN THIS GROUND TYPE.

(68) ENTER EACH ONE ON A SEPARATE LINE.
TERMINATE WITH '0'.

(69) ? 1

(70) ? 2

(71) ? 0

An error message is displayed if a pipe run has already been assigned to a different ground type.

(72) ANY MORE GROUND TYPES ? NO

If YES then execution skips to line (61) and increases the counter by 1.

(73) SUMMARY OF GROUND DATA

(74)	GROUND	STRATA	OBSTRUCTION	DENSITY	COHESION	PHI
(75)		1	2	3	4	5
(76)	1	9	1	99.0	0.0	99.0
(77)	2	9	4	99.0	0.0	99.0
(78)	3	9	3	99.0	0.0	99.0

etc ...

(79) DO YOU WANT TO AMEND ANY OF THIS DATA ? YES

(80) ENTER GROUND TYPE 'I' COLUMN NUMBER 'J' AND

(81) REVISED FIGURE 'X'

(82) I.J.X ? 3,2,2

(83) ANY MORE REVISIONS ? NO

(84) DO YOU WANT TO INSPECT THIS DATA AGAIN ? NO

If YES execution skips to line 74.

(85)	RUN NO.	GROUND TYPE
(86)	1	1
(87)	2	1
(88)	3	2
(89)	4	2
(90)	5	3

etc ...

An error message occurs if a pipe run has not been assigned to a Ground type.

(91)	DO YOU WANT TO AMEND ANY OF THIS DATA ? <u>YES</u>	
(92)	ENTER RUN NUMBER 'I' AND GROUND TYPE 'J'	
(93)	I.J. ? <u>5 , 4</u>	Error message if the ground type has not been defined.
(94)	ANY MORE REVISIONS ? <u>NO</u>	If <u>YES</u> execution skips to line 92.
(95)	DO YOU WANT A PRINT OF THIS DATA ? <u>YES</u>	A printing of the specification data is produced, see Fig.3.4

Specification input is completed at line 95 and execution of PLEP continues at line 5 section 2.2

CONTRACT SPECIFICATION
****

ESTIMATE REFERENCE NB/2
CONTRACT AUDNAM DRAINAGE - STOURBRIDGE

GEOGRAPHY
****

RUN NUMBER	START	FINISH	GROUND
1	FMH 2	FMH 3	1
2	SMH 2	SMH 3	1
3	SMH 3	DMH 4	2
4	DMH 4	JUNCTION	2
5	JUNCTION	FMH 5	3
6	JUNCTION	SMH 5B	3
7	SMH 5B	MH 5A	3
8	SMH 5	SMH 5C	3
9	SMH 6	SMH 6A	3
10	SMH 6A	SMH 7	4
11	SMH 7	SMH 7A	3
12	SMH 7A	SMH 8	3
13	SMH 8	ROAD	3
14	ROAD	SMH 9	1
15	SMH 9	SMH 10	4
16	SMH 10	SMH 11	4

GROUND CONDITIONS
****

GROUND TYPE	STRATA	OBSTRUCTION	DENSITY [KG/M3]	COHESION [KN/M2]	PHI DEGREES
1	9.0	1	99.0	0.0	99.0
2	9.0	4	99.0	0.0	99.0
3	9.0	3	99.0	0.0	99.0
4	8.0	4	99.0	0.0	99.0

TRENCH WIDTHS
****

DIAMETER	MINIMUM	MAXIMUM
.1	.43	.63
.15	.49	.69
.225	.58	.78
.3	.68	1.2
.375	.95	1.15
.45	1.03	1.23
.525	1.12	1.32
.6	1	1.2
.675	1.33	1.53
.75	1.4	1.6
.825	1.49	1.69
.9	1.92	2.12
1.05	2.1	2.32
1.2	2.29	2.7
> 1.2	O.D + .8	O.D. + 1

BACKFILL LAYER THICKNESS = .25

BEDDING COEFFICIENTS
****

BEDDING CLASS 1, CONCRETE CRADLE
BW = BC * 1.25 - MINUMUM = BC+ .2
Y1 = D * .25 - MINIMUM = .1 MIXED SOILS
Y1 = D * .25 - MINIMUM = .1 UNIFORM SOILS
Y2 = BC * .25 - MINIMUM = .1
CV = 0

Fig.3.4 TYPICAL CONTRACT SPECIFICATION

BEDDING CLASS 2, CONCRETE ARCH
BW = BC * 1.25 - MINUMUM = BC+ .2
Y1 = BC * .25 - MINIMUM = .2 MIXED SOILS
Y1 = BC * .1667 - MINIMUM = .1 UNIFORM SOILS
Y2 = BC * .5
CV = D * .25 - MIN / MAX = .1

BEDDING CLASS 3, GRANULAR BED
Y1 = BC * .25 - MINIMUM = .2 MIXED SOILS
Y1 = BC * .16667 - MINIMUM = .1 UNIFORM SOILS
Y2 = BC * .5
CV = 0

BEDDING CLASS 4, GRANULAR BED & SURROUND
Y1 = D * 1 - MINIMUM = .15 MIXED SOILS
Y1 = D * 1 - MINIMUM = .15 UNIFORM SOILS
Y2 = BC * .5
CV = D * 1 - MIN / MAX = .15

TABLE 3.3 TYPICAL GROUND PARAMETERS
(after Tomlinson 1971)

Strata Grading	Cohesion (Kn/m^2)	Angle of Internal Friction (Degrees)	Density (Kg/m^3)
5	50.0	7	2200
6	20.0	5	2000
7	7.5	3	1800
8	0.0	30	1800
9	0.0	40	2000
10	0.0	30	1800

4.0 TIME ANALYSIS SUB-SYSTEM

4.1 The time analysis sub-system is called following the entry of the 'TI' run control. This sub-system produces the standard time and resource requirements of each pipeline construction operation. In addition, each operation can be analysed independently of the PLEP by executing a particular analysis programme.

4.1.1 BoQ ITEM IDENTIFICATION

During system use the first input required from the User is to identify the BoQ item under consideration, assign the operations measured under that item and to input the basic dimensions.

Example of BoQ item identification	Notes
(1) BILL OF QUANTITIES ANALYSIS	Corresponds with line 7 Section 2.2
(2) **** ** ********** ********	
(3) RUN CONTROL (CO/TI/SH/BQ/ST/?) ? TI	See 2.2.1

(4)	(ITEM COUNT 1)	Items are counted automatically Basic BoQ item identified
(5)	BILL NUMBER ? 3	
(6)	PAGE NUMBER ? 26	
(7)	ITEM NUMBER ? 326	
(8)	ITEM QUANTITY ? 100	
(9)	UNITS (M/M2/M3) ? M	
(10)	RUN NUMBER ? 1	The run number, see 3.3.3 to which this item relates is specified
(11)	RUN NUMBER 1 GROUND TYPE 1	Ground information retrieved and displayed to ensure no errors.
(12)	STRATA GRADING 9 CONSTRUCTION GRADING 1	
(13)	CORRECT ? YES	If an error has occurred the User can specify the strata and obstruction grading.
(14)	OPERATION COVERAGE (? FOR CODE LIST) ? EX,SH,PB,PL,BF	See section 4.1.1.1
(15)	NUMBER OF PIPES IN TRENCH ? 1	Dimensions input see 4.1.1.2
(16)	PIPE 1 DEPTH TO INVERT ? 5.75	
(17)	PIPE 1 DIAMETER ? 0.60	
(18)	PIPE 1 MATERIAL (0 FOR CODE LIST ?) ? 3	See 4.1.1.3
(19)	MAX TRENCH WIDTH 1.2 M	From table of standard trench widths see 3.3.2

Execution continues with the operation analysis of the first operation in the code list.

For dual pipe trenches, dimensions are specified by the User. See 4.1.1.4 during the operation analysis.

4.1.1.1 OPERATION COVERAGE

It is necessary that the system knows which operations are measured under each BoQ item. For BoQ's produced in accordance with the CESMM this is done automatically by PLEP following the item prefix letter I, J, etc. For BoQ's produced in accordance with other methods of measurement the User must specify the included operations, two digit codes are input as per line 14, section 4.1.1. and are as follows:

EX - Excavation

SH - Shoring

PB - Pipe Bedding

PL - Pipe Laying

BF - Backfill

RB - Road Breakout

4.1.1.2 DIMENSIONS INPUT

During the analysis of a complete pipeline construction activity PLEP requires 15 input variables. To ensure a minimum of input a dimensions file is set up for each item, this file is checked on the analysis of each operation and if any required dimension is missing the User is prompted for input. For CESMM BoQ items some input is defined by the item number, e.g. the pipe material type in line 18, section 4.1.1.

4.1.1.3 PIPE MATERIAL CODE LIST

If the User inputs '0' in line 18, section 4.4.1 the following list of pipe material code numbers is displayed in accordance with the CESMM.

CODE	DESCRIPTION
1	CLAY
2	PRESTRESSED CONCRETE
3	OTHER CONCRETE
4	CAST OR SPUN IRON
5	STEEL
6	PLASTICS
7	ASBESTOS CEMENT
8	PITCH FIBRE

The pipe material type is used in the analysis of pipe laying, to determine the type of jointing, and in the bedding analysis to determine the pipe outside diameter from stored values.

4.1.1.4 DUAL PIPE TRENCH DIMENSIONS

During the analysis of any operation the dimensions for dual pipe trenches are supplied by the User. These are stored on file and are used subsequently without prompting the User.

Example of Dual Pipe Trench dimensions input		Notes
(1) HOW MANY PIPES IN THE TRENCH	? 2	
(2) DATA FOR PIPE NUMBER	1	
(3) DEPTH TO INVERT	? 4.0	
(4) DIAMETER	? 0.6	
(5) TRENCH WIDTH	? 1.2	
(6) PIPE MATERIAL CODE	? 3	See 4.1.1.3
(7) BEDDING SHAPE CODE	? 1	See 4.4.1, and 4.4.2
(8) PIPE LENGTH	? 2.4	
(9) DATA FOR PIPE NUMBER 2 (Repeats from line (3)).		

4.2 EXCAVATION ANALYSIS

This analysis can be performed independently of the PLEP system by executing the programme 'EXC'.

Example of Excavation Rate Analysis		Notes
(1) EXCAVATION		
(2) **********		
(3) LOADING HEIGHT	? 2.5	
(4) REQUIRED REACH	? 3.0	
(5) ESTIMATE OF BUCKET WIDTH	? 0.6	
(6) MACHINE SELECTION		
(7) ******* *********		
(8) DO YOU WANT THE MACHINE LIST	? YES	If NO execution skips to line 21

(9) MACHINES CONSIDERED:

	CODE	MACHINE
(10)	CODE	MACHINE
(11)	1	JCB 3
(12)	2	JCB 3C
(13)	3	JCB 3D
(14)	4	JCB 805
(15)	5	JCB 806
(16)	6	JCB 807
(17)	7	HY-MAC 580
(18)	8	O & K RH6
(19)	9	JCB 808

(20) DO YOU WANT TO REMOVE ANY MACHINES FROM THIS LIST ? NO

(21) THE FOLLOWING MACHINES WILL DIG THE REQUIRED DEPTH OF 5.75M

(The capable machines are displayed)

(22) THE FOLLOWING MACHINES SATISFY THE UNLOADING REQUIREMENTS

(The capable machines are displayed)

(23) EXCAVATION RATES

(24) ********** *****

(25) VERTICALLY SIDED TRENCH

(26) MACHINE CODE STANDARD OUTPUT

(27) VO N3/HR

(28) 4 11.28

(29) DO YOU WANT TO AMEND THIS OUTPUT ? NO

(Lines 28 and 29 are repeated until all the machines have been displayed).

(30) DO YOU WANT TO CONSIDER A BATTERED TRENCH ? YES

(31) BATTERED TRENCH VOLUME CALCULATIONS

(32) ENTER DEPTH TO START OF BATTER ? 4.0

(33) ENTER BATTER ANGLE ? 45

Notes

A facility is available to remove unwanted machines

PLEP checked required digging depth against stored maxima for each machine. See table 4.1

PLEP checks the unloading dimensions against stored maxima for each machine see table 4.1

The User has the option of revising each output rate at his discretion.

If NO then execution skips to line 35.

TABLE 4.1 EXCAVATOR PHYSICAL DATA

MACHINE TYPE		DIGGING DEPTH (mm)			HORIZONTAL REACH (mm)			LOADING HEIGHT (mm)		
		Normal	Short Arm	Long Arm	Normal	Short Arm	Long Arm	Normal	Short Arm	Long Arm
1	JCB 3	3721			5309			3416		
2	JCB 3C	4120			5490			3350		
3	JCB 3D	4690			6170			4240		
4	JCB 805		5020	5810		8380	9020		5530	5740
5	JCB 806B		5200	5810		8570	9090		5500	5720
6	JCB 807B		5200	6360		8570	9750		5500	6110
7	JCB 808		5760	6800		9170	10180		5730	6180
8	HY-MAC 580		4420	6430		7470	9070		5360	3050
9	RH6		5100	6700		8250	9900		4000	4000

(34) BATTERED TRENCH VOLUME = 22.90 M3/ML

(The excavation rates are recalculated and displayed as lines 26-29)

(35) SUMMARY OF CALCULATIONS

(36) VERTICAL TRENCH = 6.90 M3/ML

(37)	M/C	STD OUTPUT	REV OUTPUT	DURATION
(38)		M3/HR	M3/HR	HR/ML
(39)	4	11.28	11.28	0.61
(40)	5	11.90	11.90	0.58

etc ...

(41) BATTERED TRENCH = 22.90 M3/ML

(42)	M/C	STD OUTPUT	REV OUTPUT	DURATION
(43)		M3/HR	M3/HR	HR/ML
(44)	4	12.15	12.15	1.88
(45)	5	13.00	13.00	1.76

etc ...

(Excavation analysis is completed, and execution continues with the next operation measured under this BoQ item, or if all operations have been analysed execution returns to run control line 7, section 2.1.)

Notes

In non system use the User has the option of generating a print of the calculations, and repeating the analysis for different conditions

4.3 SHORING ANALYSIS

This analysis can be performed independently of the PLEP System by executing the programme 'SHORE'

Example of shoring analysis

(1) SHORING

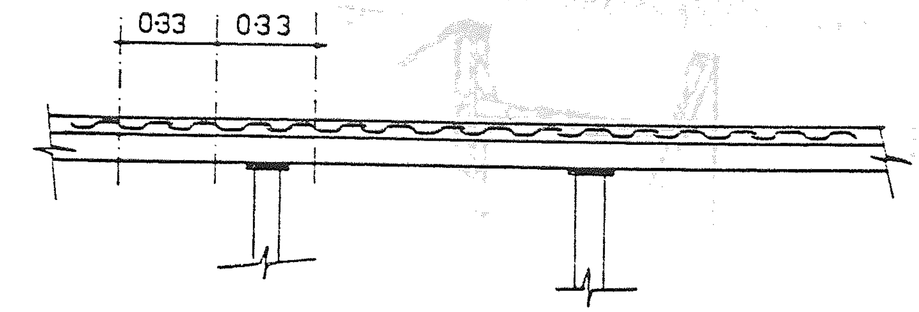
(2) *******

(3) SUPPORTED DEPTH ? 5.75

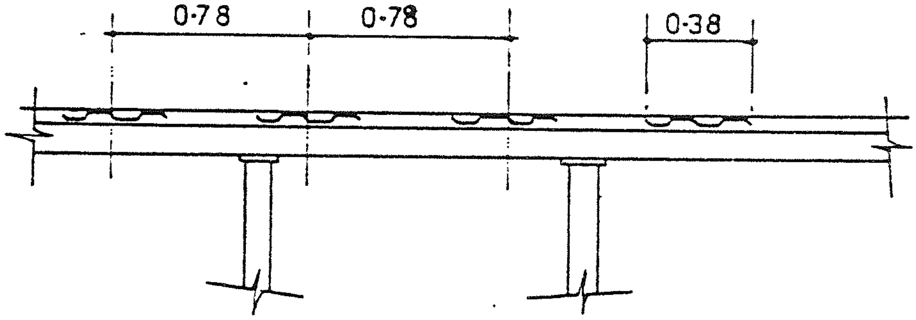
(4) TRENCH WIDTH ? 1.20

The programme checks the dimension file and if these dimensions are known then execution skips to line 5.

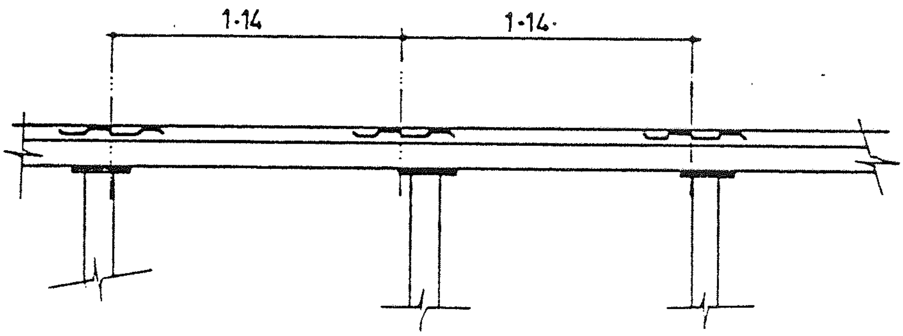
	Notes
(5) THE FOLLOWING SHORING TYPES ARE CONSIDERED	
(6) (1) CLOSE SHEETING (Sheets at 0.33m ctrs)	See fig 4.1 for examples of shoring types
(7) (2) MEDIUM SHEETING(Sheets at 0.76m ctrs)	
(8) (3) OPEN SHEETING (Sheets at 1.1m ctrs)	
(9) (4) PINCHERS (Sheets at 1.5m ctrs)	
(10) (5) 'SHORCO' LINING SYSTEM	See fig 4.2
(11) ENTER THE NUMBERS OF ANY TYPES YOU DO	The User specifies by code number any unsuitable types. These are omitted from the subsequent analysis.
(12) NOT WANT TO CONSIDER. ALL ON ONE LINE	
(13) SEPARATED BY COMMAS?	
(14) DESIGN BAY LENGTH ? 2.5	
(15) MATERIALS REQUIREMENTS	The programme calculates the number of sheets struts and walers required according to the critera described in tables
(16) SHEETS -CLOSE = 30	
(17) -MEDIUM = 14	
(18) -OPEN = 10	
(19) -PINCH = 8	
(20) WALERS -SIZE = .10 x .3 x 10No.	
(21) STRUTS -CLOSE = 20	
(22) -MEDIUM = 20	
(23) -OPEN = 20	
(24) -PINCHERS = 20	
(25) SHORCO BOXES	
(26) 3 BOXES ARE REQUIRED 1No. 2.6 x 3.4 and (27) 2No. 1.3 x 3.4	Number of boxes depends on depth of trench
(28) METHODS	
(29) (1) USING A PRE-DUG PILOT TRENCH OR	
(30) (2) EXCAVATE INSIDE BOX	
(31) WHICH METHOD DO YOU WANT TO CONSIDER ?	User specifies which method is appropriate
(32) STANDARD OUTPUTS	



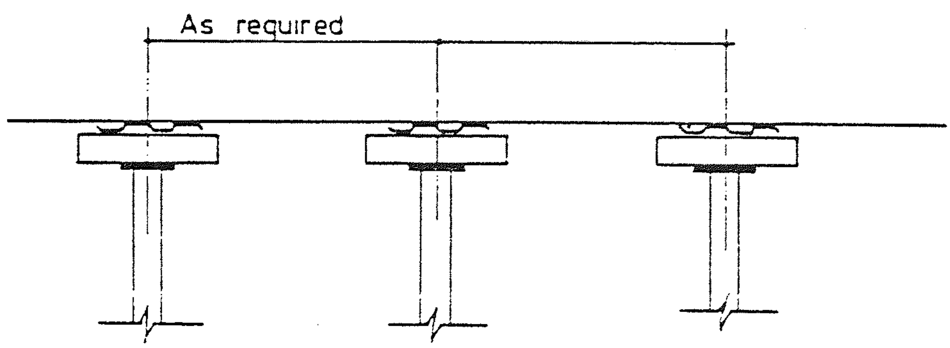
(a) CLOSE SHEETING



(b) MEDIUM SHEETING



(c) OPEN SHEETING



(d) PINCHERS

Fig 4.1 TRENCH SUPPORT TYPES

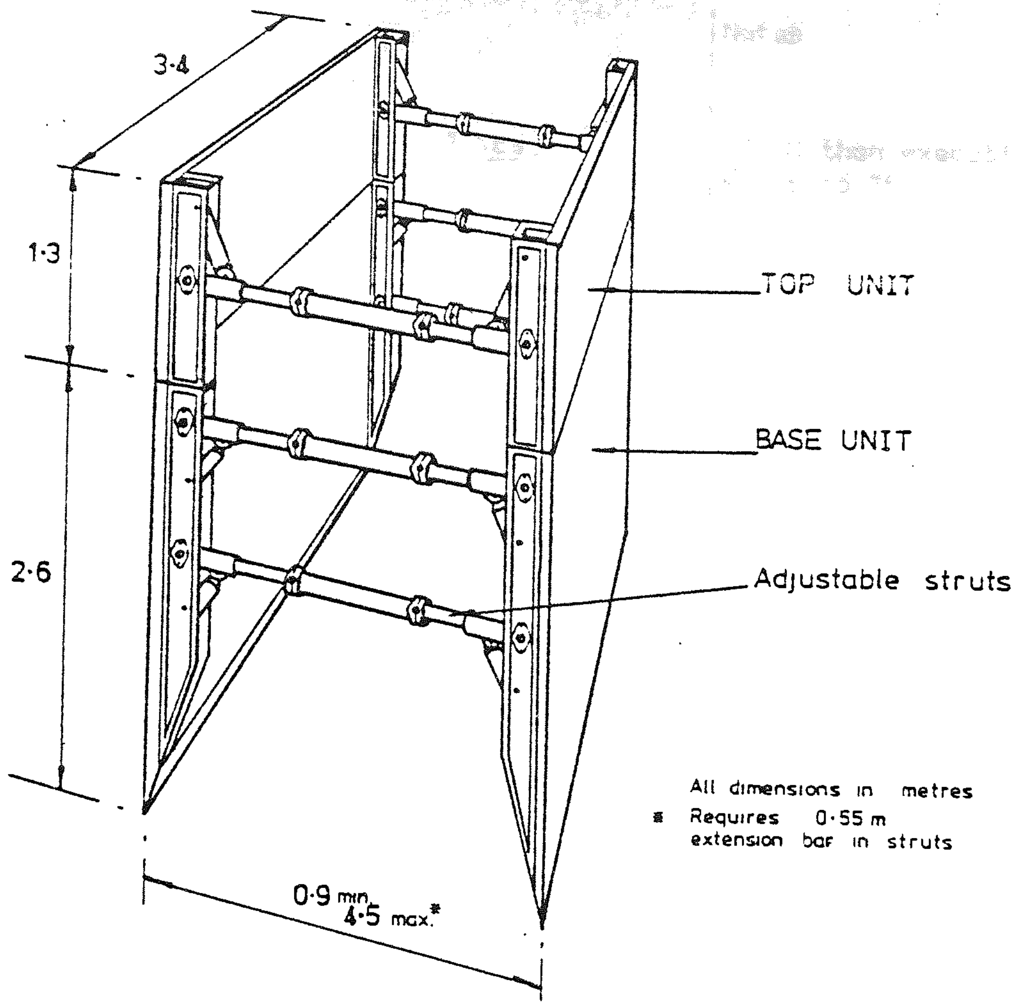


Fig. 4.2 'Shorco' Boxes Trench Support System

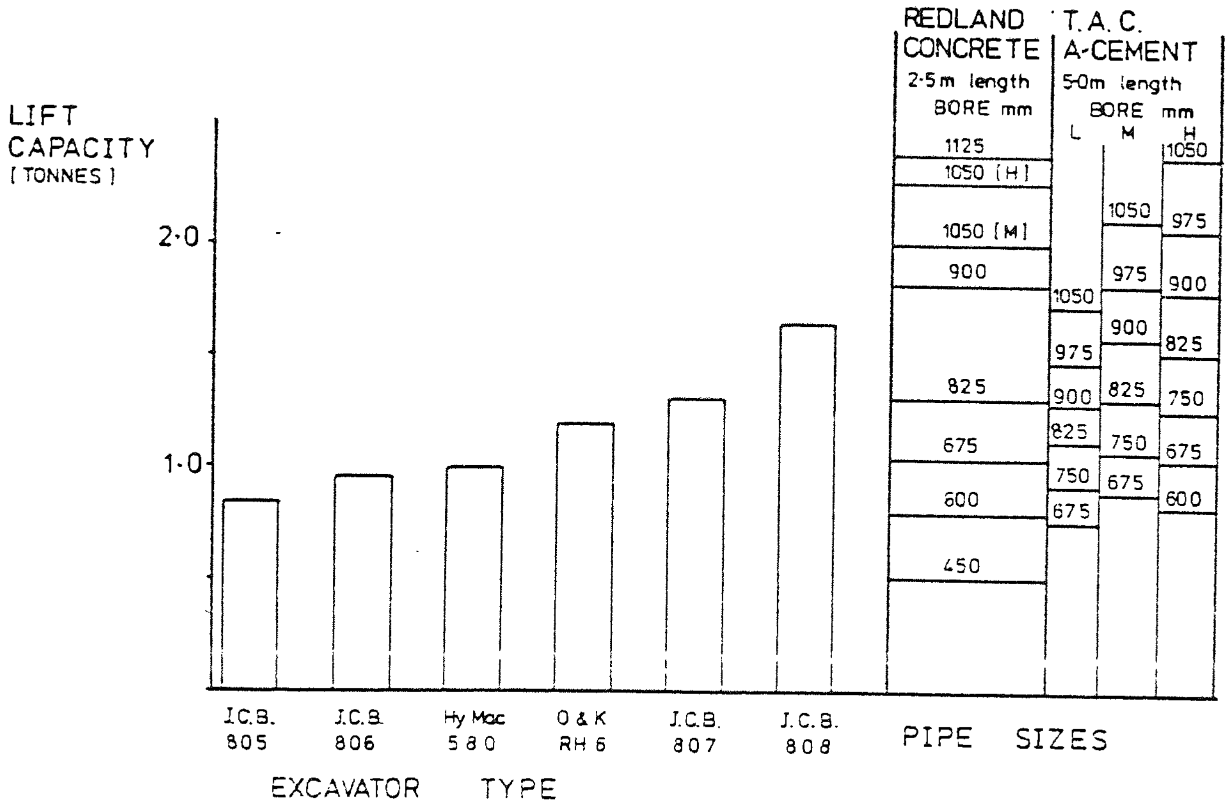


Fig. 4.4 Excavator lifting capacities.

		Notes
(33)	CLOSE SHEETING = 1.0 ML/hr	
(34)	DO YOU WANT TO REVISE THIS OUTPUT ? YES	If NO then execution skips to 36
(35)	ENTER REVISED OUTPUT ? 1.6	
(36)	MEDIUM SHEETING = 2.27 ML/hr	
(37)	DO YOU WANT TO REVISE THIS OUTPUT ? NO	
(38)	OPEN SHEETING = 2.69 ML/hr	
(39)	DO YOU WANT TO REVISE THIS OUTPUT ? NO	
(40)	PINCHERS = 3.05 ML/hr	
(41)	DO YOU WANT TO REVISE THIS OUTPUT ? NO	
(42)	SHORCO BOXES = 4.58 ML/hr	
(43)	DO YOU WANT TO REVISE THIS OUTPUT ? NO	
	(Shoring analysis is completed, and execution continues with the next operation measured under this BoQ item, or if all the operations have been analysed execution returns to run control, line 7 section 2.2)	
	(In non-system use the User has the option of generating a print of the calculations and repeating the analysis for different conditions)	

4.4 PIPE SUPPORT STRUCTURE ANALYSIS

This analysis can be performed independently of the PLEP system by executing the programme 'BED'.

	Example of pipe support structure analysis	
(1)	PIPE BEDDING	
	(Dimensions: PLEP checks the file and prompts for any unknown dimensions)	See 4.1.1.4
(2)	SHAPE CODE	
(3)	(0 FOR CODE LIST) ? 3	See 4.4.1, 3.3.1
(4)	PIPE MATERIAL CODE	
(5)	(0 FOR CODE LIST) ? 2	See 4.1.1.3
(6)	ANALYSIS OF PIPE NUMBER 1	

Notes

(7) PIPE OUTSIDE DIAMETER 0.710M

(8) WHICH GROUND CONDITION (U.M.N) ? U

Applies to standard shapes only. U - Uniform soils M - Mixed soils N - Not applicable

(10) SUMMARY OF BEDDING DIMENSIONS AND VOLUMES

(11) VOLUMES - BEDDING .408 M3/ML, COVER .59 M3/ML

(12) TOTAL DISPLACED VOLUME - 1.392 M3/ML

(13) BEDDING OUTPUTS AND DURATIONS

(15) PIPE NUMBER 1

(16) BEDDING MATERIAL GRANULAR

(17) VOLUME .408 M3/ML

(18) OUTPUT 2.08 M3/HR

(19) DO YOU WANT TO CHANGE THIS OUTPUT ? YES

If NO then line 21

(20) ENTER PREFERRED OUTPUT M3/HR ? 2.10

(21) COVER MATERIAL SELECTED FILL

(22) VOLUME .59 M3/ML

(23) OUTPUT 1.93 M3/HR

(24) DO YOU WANT TO CHANGE THIS OUTPUT ? NO

(25) TOTAL DURATION = .490 Hours/M

(Analysis is completed and analysis continues with the next operation measured under this BoQ item, or if all operations have been analysed execution returns to Run Control line 7, section 2.1)

In non-system use the User has the option of printing the results and repeating the analysis.

4.4.1 NON "STANDARD" BEDDING SHAPES

The dimensions for 'standard' bedding shapes are calculated from the factors input in the specification routines, see 3.3.1. The code list is as follows:

1 CONCRETE CRADLE

2 CONCRETE ARCH

3 GRANULAR BED

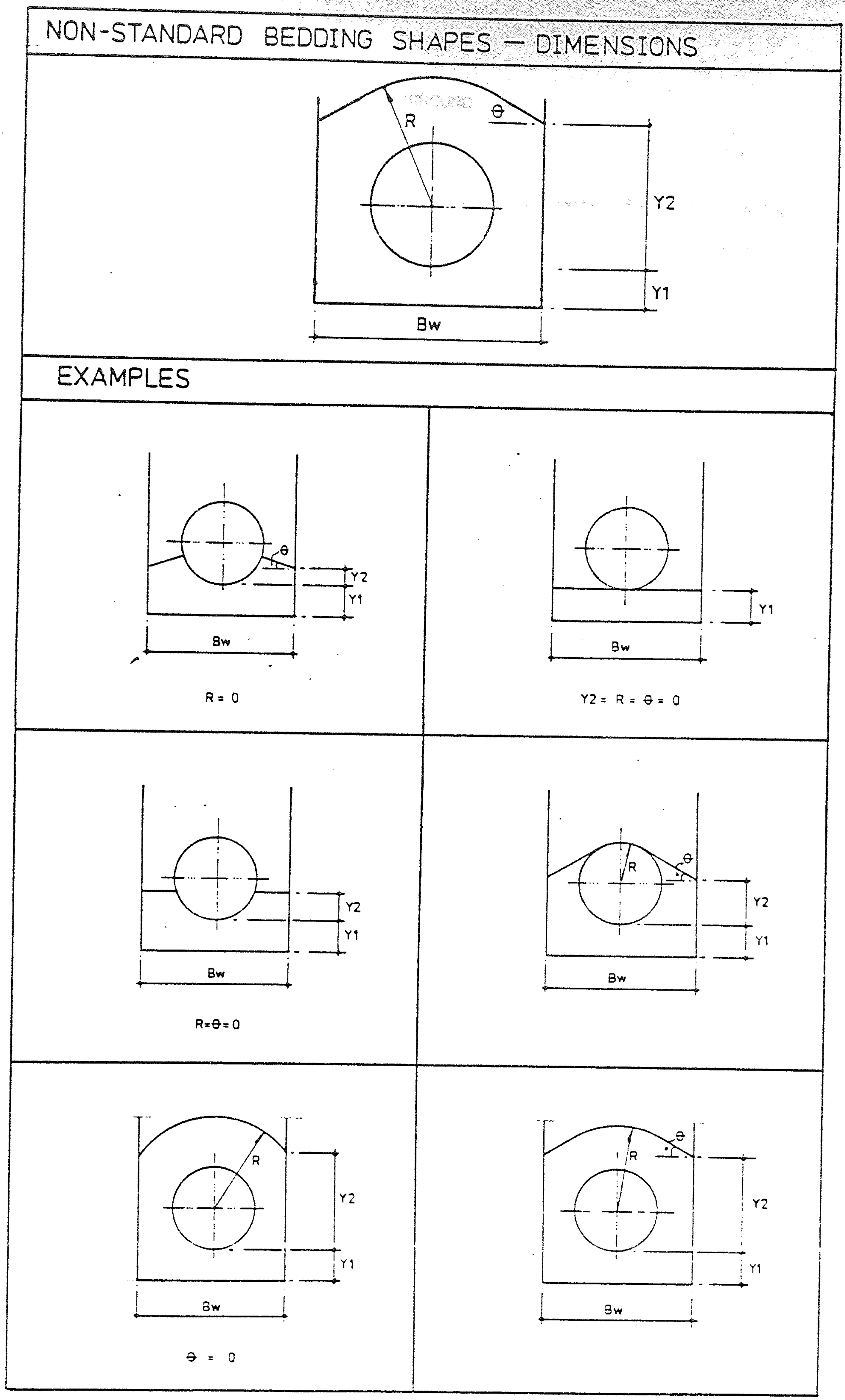


Fig. 4.3 Non-Standard Bedding Shapes.45.

4 GRANULAR BED AND SURROUND

5 SPECIAL

For a code 5 bedding structure the User is prompted for the working dimensions. Fig 4.3 shows six typical shapes and the dimensions required to define each shape. PLEP stores data on the outside diameters of seven pipe types, see Appendix A, and this figure for the particular pipe is used in calculating the bedding material volumes.

4.5 PIPE LAYING OPERATION ANALYSIS

The programme can be performed independently of the PLEP system by executing the programme 'PLAY'

Example of pipe laying operation analysis	Notes
(1) PIPELAYING	
(2) **********	
(Dimensions: PLEP checks the file and prompts the User for any unknown dimensions)	See 4.1.1.4
(3) LASER SETTING OUT ? YES	
(4) TOTAL PIPE WEIGHT = 0.80 tonnes	See 4.5.1
(5) THIS PIPE CAN BE LIFTED BY ANY M/C	See 4.5.2
(6) PIPELAYING DATA	
(7) ********** ****	
(8) PIPE MEN M/C STANDARD OUTPUT	
(9) 1 3 any 4.10	
(10) DO YOU WANT TO AMEND ANY OF THIS DATA ? YES	If NO then execution skips to line 25
(11) DO YOU WANT ANY HELP ? YES	
(12) REVISIONS TO PIPE LAYING DATA - REQUIRED INPUT:-	
(13) 1st LINE = PIPE NUMBER	
(14) 2nd LINE = CODE GS - GANG SIZE, MC - MACHINE OP - OUTPUT	

	Notes
(15) 3rd LINE = REVISED FIGURE	
(16) EG TO CHANGE PLANT TO JCB 806	
(17) ? 1	
(18) ? MC	
(19) ? 6	See 4.5.2
(20) ENTER REVISION	
(21) ? 1	
(22) ? GS	
(23) ? 2	
(24) ANY MORE REVISIONS ? NO	If YES execution skips to line 11
(25) DATA SUMMARY	
(26) PIPE MEN M/C OUTPUT DURATION	
(21) 1 2 any 4.10 0.24	
(Analysis of pipelaying is complete. Execution continues with the next operation measured under this BoQ item, or if all the operations are analysed then execution returns to Run Control line 7, section 2.2)	If in non-system use the User has the option of printing the result and repeating the analysis.

4.5.1 PIPE WEIGHTS

PLEP stores data on pipe weights, see Appendix B, for seven of the pipe materials shown in section 4.1.1.3. The exception is steel pipes, where the weight is governed by the thickness of the pipe wall. From this data and the length of the pipe the total weight is calculated.

4.5.2 PIPELAYING MACHINES

The maximum lifting capacities are shown in fig 4.4. PLEP selects the smallest machine capable of lifting the pipe. The User can amend this choice of plant using the following codes, (line 19, sect 4.5).

CODE	MACHINE
1	JCB 805
2	JCB 806
3	HY-MAC 580
4	O & K RH6
5	JCB 807
6	JCB 808
7	CRANE
8	ANY MACHINE i.e. PIPE IS UNDER 1 TONNE
9	SPECIAL

The User has the option of specifying his own plant.

By entering a Code '9' the User can specify any type of plant required.

4.6 BACKFILL ANALYSIS

This analysis is performed independently of the PLEP System by executing the programme 'BFILL'.

Example of Backfill Analysis	Notes
(1) BACKFILL	
(2) ********	
(3) LAYER THICKNESS 0.25 M.	Obtained from the specification input See 4.6.1.
(4) VOLUME OF BACKFILL = 5.508 M3/M	
(5) GANG LAB PLANT OUTPUT DURATION	
(6) (M3/HR) (HR/M)	
(7) 1 2 6.25 .88	
(8) 2 2 DUMPER 19.05 .29	
(9) 3 2 JCB 32 25.00 .22	
(10) 4 2 DROTT'75 40.00 .14	
(11) A PEGSON RAMMER IS REQUIRED IN ALL THE ABOVE GANGS	
(12) DO YOU WANT TO AMEND ANY OF THIS DATA ?YES	
(13) ENTER THE GANG NUMBER ?2	
(14) PREFERRED GANG SIZE ?3	

(15) DO YOU WANT TO CHANGE THE PLANT ?NO

(16) REVISED OUTPUT (M3/M) ? 20.0

(17) ANY MORE REVISIONS ? NO

(18) DO YOU WANT TO REVIEW THIS DATA ? NO

(Analysis is complete. Execution continues with the next operation measured under this item, or returns to Run Control line 7, section 2.2)

The User has the option of specifying his own plant.

If YES then execution skips to line 5.
In non-system use the User has the option of printing the results and repeating the analysis.

4.6.1 BACKFILL VOLUME

The volume of backfill is calculated from the total excavated volume, 4.2, and the total displaced volume 4.4.

4.7 ROAD BREAKOUT ANALYSIS

This analysis can be performed independently of the PLEP system by executing the programme BFILL and selecting the road breakout routines in response to a prompt.

Example of Road Breakout Analysis	Notes
(1) ROAD BREAKOUT	
(2) **** ********	
(3) BREAKOUT MATERIAL (C/F/?) ? F	C = CONCRETE F = FLEXIBLE ? produces display
(4) BREAKOUT WIDTH (M) ? 1.2	
(5) DEPTH OF ROAD (M) ? .15	
(6) FLEXIBLE ROAD CONSTRUCTION	
(7) ******** **** ************	
(8) BREAKOUT VOLUME = 0.18 M3/M	
(9) GANG LABOUR PLANT OUTPUT DURATION	
(10) (M3/HR) (HR/M)	
(11) 1 2 COMPRESSOR 0.80 0.23	

(12) 2 1 IPH 1.74 0.10

(13) DO YOU WANT TO AMEND ANY OF THIS DATA ?YES — If NO execution skips to line 19

(14) ENTER THE GANG NUMBER ? 1

(15) PREFERRED GANG SIZE ? 3

(16) DO YOU WANT TO CHANGE THE PLANT ? NO

(17) ENTER PREFERRED OUTPUT (M3/HR) ? 1.2

(18) ANY MORE REVISIONS ? NO — If YES then execution skips to line 9

(Analysis is complete and execution returns to Run Control line 7 Section 2.2) — If in non-system use the User has the option of printing the results and repeating the analysis.

5.0 TIME AND RESOURCE SCHEDULE

This routine is executed following the Run Control character 'SH'. It is entirely automatic and requires no information from the User. The function of this routine is to generate a schedule of all the time and resource analyses performed on this project up to date. An example of this schedule is shown in fig. 5.1.

6.0 COST SUB-SYSTEM

This sub-system is executed following the Run Control 'CO', line 7 Section 2.2. It can be used independently of PLEP system by executing the programme 'PRICE'.

The objective of this sub-system is to assist the User to determine the optimum resource configeration and construction method using the operation time data. Having determined this the relevant costs are calculated for each BoQ item. An obvious requirement is therefore the unit costs of both materials and resources, resource costs are stored on file via the programme SUCD, the User must therefore check that the current data on file is in agreement with the figures for the particular

......

BILL ITEM TIME ANALYSIS

DATE 11/3/80

ESTIMATE REFERENCE NB/3
CONTRACT BURTON-ON-TRENT IN TOWN DRAINAGE

[ITEM COUNT]	1
BILL NUMBER	1
PAGE NUMBER	1
ITEM NUMBER	1
RUN NUMBER	1 = MH 19 - MH 20

EXCAVATION	VOLUMES [M3/M]	RESOURCE	STD OUTPUT [M3/HR]	REV OUTPUT [M3/HR]	DURATION [HR/M]
STRATA 9	VERTICAL 5.6	JCB 3D	14.25	14.25	0.39
OBSTRUCTION 1		JCB 805	24.63	24.63	0.23
DEPTH 2.25		JCB 806	26.00	26.00	0.22
WIDTH 2.5		JCB 807	27.37	27.37	0.21
		HY-MAC 580	30.81	30.81	0.18
		O & K RH6	30.41	30.41	0.18
		JCB 808	38.01	38.01	0.15

SHORING	TYPE	MATERIALS	RESOURCES	STD OUTPUT M/HR	REV OUTPUT M/HR	DURATION HR/M
DEPTH 2.25	CLOSE	SHEETS 30 NO WALERS 0.10 * 0.15 - 4 NO STRUTS 8 NO	3 MEN	2.88	2.88	0.35
	MEDIUM	SHEETS 14 NO WALERS 0.10 * 0.15 - 4 NO STRUTS 8 NO	3 MEN	4.41	4.41	0.23
	OPEN	SHEETS 10 NO WALERS 0.10 * 0.15 - 4 NO STRUTS 8 NO	3 MEN	5.43	5.43	0.18
	PINCHERS	SHEETS 8 NO WALERS 0.08 * 0.08 - 16 NO STRUTS 8 NO	3 MEN	6.24	6.24	0.16
	SHORCO	1 NO 2.6 * 3.4	3 MEN JCB 807	10.53	10.53	0.09

BEDDING	PIPE NO	VOLUMES [M3/M]		DISPLACED [M3/M]	RESOURCES	STD OUTPUT [M3/HR]	REV OUTPUT [M3/HR]	DURATION [HR/M]
SHAPE 5	1	CONCRETE	0.85	1.90	1 GNGR 2 LAB	7.33	7.33	0.12
	1	GRANULAR	0.00			0.00	0.00	
SHAPE 5	2	CONCRETE	0.55	0.65	1 GNGR 2 LAB	3.33	3.33	0.16
	2	GRANULAR	0.00			0.00	0.00	
				0.00				0.28

PIPELAYING	DEPTH [M]	DIA [M]	MATERIAL	RESOURCES	STD OUTPUT [M/HR]	REV OUTPUT [M/HR]	DURATION [HR/M]
1	2.25	1.050	A/CEMENT	3 LAB + O&K RH6	5.52	5.52	0.18
2	2.25	0.300	CLAY	3 LAB + ANY M/C	8.69	8.69	0.12

BACKFILL LAYERS = 0.30 M	VOLUME [M3/M]	RESOURCES	STD OUTPUT [M3/HR]	REV OUTPUT [M3/HR]	DURATION
VERTICAL	3.50	2 LAB	5.59	5.59	0.63
		2 LAB + DUMPER	16.00	16.00	0.27
		2 LAB + JCB #3C	20.00	20.00	0.18
		2 LAB + DROTT	28.57	28.57	[illegible]

Fig. 5.1 TYPICAL TIME AND RESOURCE SCHEDULE

contract under consideration. Material costs are input during the running of PLEP.

6.1 INPUT DATA

6.1.1 TIME AND RESOURCE DATA

In system use PLEP will retrieve from file the time and resource data from the time analysis, for a particular pipe run specified by the User. For non-system use PLEP will prompt the User from the data required.

Example of non-system data input, illustrating the data retrieved during system use.		Notes
(1) PIPELINE PRICING		
(2) ******** *******		
(3) ENTER THE FOLLOWING INFORMATION FOR THIS PIPE RUN:		
(4) RUN NUMBER	? 1	
(5) VERTICAL TRENCH VOLUME M3/M	? 6.90	
(6) BATTERED TRENCH VOLUME M3/M	?22.9	
(7) NUMBER OF PIPES	? 1	
(8) PIPE 1		
(9) DIAMETER (m)	? 0.60	
(10) MATERIAL (0 for Code List)	? 2	See Section 4.1.1.3
(11) BEDDING		
(12) PIPE 1		
(13) BED MATERIAL (0 for Code List)	? 3	See Section 6.1.1.1
(14) VOLUME (M3/M)	? .408	
(15) COVER MATERIAL (0 for Code List)	? 3	
(16) VOLUME (M3/M)	? .59	
(17) BACKFILL		
(18) VERTICAL TRENCH BACKFILL (M3/M)	? 5.508	

	Notes
(19) BATTERED TRENCH BACKFILL (M3/M) ? 21.508	
(This concludes the input of the physical dimensions of the pipe run. This information would be abstracted from file and displayed to the User in system use.)	

6.1.1.1 PIPE BEDDING MATERIALS

In the pipe sub-system the pipe support structure materials codes are as follows:

1	CONCRETE
2	GRANULAR
3	SELECTED FILL
4	NONE REQUIRED

These codes are assigned automatically if in system use, from the time analysis. They are only required if 'PRICE' is in non-system use.

6.1.2 RESOURCE ASSIGNING

To ensure that the correct plant and labour costs are abstracted from the SUCD file, the User must enter the SUCD codes for the typical items of plant as follows:

Example of Resource Assigning			Notes
(1)	ENTER THE SUCD CODES FOR THE FOLLOWING PLANT ITEMS:		
(2)	JCB 3	? E1	The unit costs of these items of plant are retrieved from the SUCD file. An error message is printed if an entered code is not in the UCD file.
(3)	JCB 3C	? E2	
(4)	JCB 3D	? E3	
(5)	JCB 805	? E4	
(6)	JCB 806	? E5	
(7)	JCB 807	? E6	
(8)	HY-MAC 580	? E7	

		Notes
(9) O & R	? E8	
(10) JCB 808	? E9	
(11) ENTER THE CODE OF A CRANE FOR PIPELAYING AND SHORING IF REQUIRED		
(12) CRANE CODE	? C 1	
(13) ENTER CODE OF DROTT	? D 2	

6.1.3 MATERIALS COSTS

The units costs of basic materials are supplied by the User in the following way.

Example of Materials Cost input			Notes
(1) ENTER THE FOLLOWING MATERIALS COSTS:			
(2) CONCRETE BEDDING	£/M3	? 22.00	
(3) GRANULAR BEDDING	£/M3	? 9.04	
(4) PIPE PRICES (£/M)			
(5) 0.600 DIAMETER CONCRETE		? 31.15	Any other pipes are also listed
(6) SHORING MATERIALS ALL IN COST		£/HR	
(7) CLOSE SHEETING		? 10.00	
(8) MEDIUM SHEETING		? 8.00	
(9) OPEN SHEETING		? 6.00	
(10) PINCHERS		? 4.00	
(11) SHORCO BOXES		? 12.00	

6.2 METHOD DEFINITION

Having assigned the resources and input the materials costs the User then needs to define the first trial method of construction.

6.2.1 OPERATIONS OPTIONS

Two of the construction operations can be performed in various ways, excavation can be either a battered or vertical trench and there ....

are various standards of shoring.

Example of Operations Option Input:	Notes
(1) METHOD OF CONSTRUCTION	
(2) ****** ** ************	
(3) ENTER THE FOLLOWING INFORMATION TO DEFINE THE FIRST TRIAL METHOD	
(4) TRENCH X-SECTION (V/B) ? V	V = Vertical B = Battered
(5) SHORING METHOD (£/M/O/P/S/N/?) ? P	C = Close sheeting M = Medium sheeting O = Open sheeting P = Pinchers S = Shorco Boxes N = No shoring ? displays this list

6.2.2 RESOURCE DEFINITION

The User must know define which resources are required for each operation:

6.2.2.1 Example of PLANT definition		Notes
(1) ENTER THE CODE FOR THE ITEM OF PLANT FOR EACH OF THE FOLLOWING OPERATIONS. IF NONE THEN ENTER 'NO'.		PLEP checks the production output data for each operation. If no output is known for the particular item of plant the User is prompted to supply the information.
(2) EXCAVATION	? E5	
(3) SHORING	? E5	
(4) BEDDING	? D2	
(5) PIPE LAYING	? E5	
(6) BACKFILL	? D2	

(If for any operation no plant is required, PLEP will prompt the User for a labour only output for that operation.)

6.2.2.2 Example of LABOUR definition	
(1) ENTER THE LABOUR REQUIREMENTS FOR EACH OPERATION. IF NONE ARE REQUIRED ENTER 'NO'.	The SUCO labour codes are input by the User.
(2) EXCAVATION	

		Notes
(3)	LABOUR CODE ? L1	
(4)	NUMBER REQUIRED ? 1	A maximum of two labour types per operation is allowed.
(5)	LABOUR CODE ? NO	
(6)	SHORING	
(7)	LABOUR CODE ? L1	
(8)	NUMBER REQUIRED ? 2	
	etc ...	

6.2.2.3	Example of NON-MEASURABLE PLANT definition	Notes
(1)	ENTER THE CODE OF ANY NON-MEASURABLE PLANT EG. PUMPS WHICH YOU WANT TO ALLOW AGAINST THIS METHOD. IF NONE ARE REQUIRED ENTER 'NO'.	A maximum of 5 non-measurable plant items is allowed
(2)	PLANT CODE ? P4	
(3)	PLANT CODE ? NO	

6.2.3 COMBINED OPERATIONS

The final task of method definition is to input the combined operations. These are the operations which can be performed simultaneously. PLEP supplied full explanatory notes for this input as follows:

	Example of Combined Operations input	Notes
(1)	COMBINED OPERATIONS	
(2)	******** **********	
(3)	DO YOU WANT AN EXAMPLE OF COMBINED OPERATIONS INPUT ? YES	If NO then execution skips to line 15
(4)	THE METHOD IS DEFINED BY SPECIFYING THE COMBINED OPERATIONS. THESE ARE THE OPERATIONS WHICH ARE PERFORMED CONSECUTIVELY. OPERATION CODES ARE EX SH PB PL BF. THIS INPUT IS PROMPTED BY AN ASTERISK. TERMINATE THE INPUT WITH 'NO'.	

	Notes
(5) EXAMPLE BAR CHART	
(6) EXCAVATION ! ****	
(7) SHORING ! ******	
(8) BEDDING ! *****	
(9) PIPE LAYING ! ********	
(10) BACKFILL ! ****	
(11) THE INPUT FOR THIS WOULD BE:	
(12) * EX, SH, PB	
(13) * PL, BF	
(14) * NO	
(15) * <u>EX, SH</u>	Example of Users Input
(16) * <u>PB</u>	
(17) * <u>PL, BF</u>	
(18) * <u>NO</u>	

(PLEP checks that all operations have been input, if not an error message results and input starts again at line 3.)

6.3 ANALYSIS

The analysis of this trial method is performed automatically and results are displayed to the User during analysis.

Example of Method Analysis				Notes
(1)	ANALYSING METHOD NUMBER 1			
(2)	EXCAVATION	OUTPUT DURATION	= 11.28 M3/HR = .61 MINS/M	
(3)	SHORING	OUTPUT DURATION	= 3.05 M3/HR = .33 MINS/M	
(4)	BEDDING			
(5)	PIPE 1 BED MATERIAL	OUTPUT DURATION	= 2.08 M3/HR = 11.7 MINS/M	

Notes

```
(6)  PIPE 1 COVER MATERIAL
                          OUTPUT      =   1.93 M3/HR
                          DURATION    =  18.3  MINS/M

(7)  TOTAL PIPELAYING DURATION        =  30.04 MINS/M

(8)  PIPELAYING

(9)  PIPE 1               OUTPUT      =   4.10 M/HR
                          DURATION    =  14.4  MINS/M

(10) PIPELAYING DURATION              =  14.4  MINS/M

(11) BACKFILL             OUTPUT      =  40.0  M3/HR
                          DURATION    =   6.6  MINS/M

(12) TOTAL DURATION                   =  56.0  MINS/M

(13) BAR CHART

(14) OPERATION          !  TIME     MINS/M

(15)                    ! 0     20     40     60     80     100

(16) --------------------------------------------------

(17) EXCAVATE           ! *********

(18) SHORT              !         ******

(19) BEDDING            ! *********

(20) PIPE LAY           ! *****

(21) BACKFILL           !     ****

(22) --------------------------------------------------

(23) LABOUR REQUIREMENTS BY OPERATION

(24) EXCAVATION         L1 * 1No.

(25) SHORING            L1 * 2No.

     etc ...

(26) FROM THE COMBINED OPERATIONS THIS REDUCES TO
     A GANG SIZE AS FOLLOWS:

(27) L1 * 1 No.  @  3.00 £/HR

     etc ...

(28) TOTAL LABOUR COST               = 10.95 £/HR
                                     = 10.22 £/M
```

Displays the labour input See 6.2.2.2.

Notes

(29) MATERIALS

(30) SHORING MATERIALS = 4.0 £/HR = 3.73 £/M

(31) BEDDING MATERIALS

(32) GRANULAR BEDDING .408 M3 @ 9.04 = 3.68 £/M

(33) TOTAL = 3.68 £/M

(34) PIPES

(35) .60 DIA @ 31.15 £/M

(36) PIPE TOTAL COST = 31.15 £/M

(37) TOTAL MATERIALS COST = 38.58 £/M

(38) MEASURED PLANT

(39) PLANT REQUIRED

(40) EXCAVATION E5

(41) SHORING E5

etc ...

displays measured plant requirement see 6.2.2.1.

(42) TOTAL MEASURED PLANT REQUIREMENTS AS FOLLOWS:

(43) 2 No. E5 @ 12.01 £/HR = 24.02 £/HR

(44) 1 No. D2 @ 11.91 £/HR = 11.91 £/HR
(45) TOTAL MEASURED PLANT = 35.93 £/HR
(46) NON MEASURED PLANT

(47) 1 No. P4 @ .84 £/HR

(48) TOTAL NON MEASURED PLANT = .84 £/HR

(49) TOTAL PLANT COST = 36.77 £/HR

(50) = 34.31 £/M

(51) SUMMARY

(52) *******

(53) METHOD NUMBER 1

(54) DURATION = 56.0 MINS/M

(55) = 33.6 HOURS TOTAL

		Notes
(56) COSTS		
(57) LABOUR	= 10.22 £/M	
(58) MATERIALS	= 38.58 £/M	
(59) PLANT	= 34.31 £/M	
(60) TOTAL COST	= 107.18 £/M	
(61)	= 10718.00 £TOTAL	

(Analysis is now complete, execution continues with Control Command, Section 6.4.)

6.4 CONTROL COMMANDS

At the completion of a method analysis the User has 5 options which are exercised using the Control Command:

Example:			Notes
(1)	CONTROL COMMAND (A/C/R/S/P?) ? ?		
(2)	A - ACCEPT	I.E. YOU ARE SATISFIED WITH A PARTICULAR ANALYSIS AND WANT THAT METHOD ADOPTING	See 6.4.1.
(3)	C - CHANGE	I.E. YOU WANT TO MAKE SOME CHANGES TO THE LAST METHOD FOR RE-ANALYSIS	See 6.4.2.
(4)	R - REVIEW	TAKE A DETAILED LOOK AT AN ALREADY ANALYSED METHOD	See 6.4.3.
(5)	S - SUMMARY	TABULATE THE COST FIGURES FOR ALL THE METHODS ANALYSED UP TO NOW	See 6.4.4.
(6)	P - PRINT	GENERATE A PRINT OF A METHOD	See 6.4.5.
(7)	CONTROL COMMAND (A/C/R/S/P/?) ?		

6.4.1. CONTROL COMMAND ACCEPT

When the User is satisfied that a particular method meets his needs that method is accepted by the Control Command 'A'. PLEP will print the pricing note, see fig. 6.1, for that method number for the specified pipe run. It will then go on to apportion the total costs in BoQ rates for each BoQ item which measures operations in this pipe run. This is done by assigning each direct operation cost, labour materials and plant to the item which measures that operation. The non-measured plant costs are divided between all items as a proportion of the cost of each operation to the total cost. Further PLEP will prompt the User for any other pipe runs which are to be priced using this method. The output figures and volumes etc., of each additional pipe run are abstracted from the time data files.

Examples of Accept Control Command	Notes
(1) CONTROL COMMAND (A/C/R/S/P/?) ? A	
(2) ENTER THE NUMBER OF THE METHOD TO BE ACCEPTED ? 1	
(3) DO YOU WANT TO USE THIS METHOD FOR OTHER PIPE RUNS ? YES	
(4) ENTER THE NUMBERS OF THE OTHER RUNS WHICH ARE TO BE PRICED USING THIS METHOD. ONE PER LINE TERMINATE WITH '0'.	
(5) ? 2	
(6) ? 0	
(PLEP then repeats the analysis from line 1, section 6.1.3. and prompts the User for any unknowns for the pricing of the subsequent pipe runs. This is done automatically.)	

6.4.2. CONTROL COMMAND CHANGE

If the User is not satisfied with a particular method he can modify the various parts following the control command 'C'. The User is prompted for the particular changes he wishes to make in the following way.

Example of Change Control Command	Notes
(1) CONTROL COMMAND (A/C/R/S/P/?) ? C	
(2) METHOD NUMBER 2	

		Notes
(3)	TO DEFINE THIS METHOD ANY DIFFERENCES FROM METHOD NUMBER 1 MUST BE SPECIFIED IF NO CHANGES ARE MADE THE CONDITIONS IN METHOD NUMBER 1 ARE ASSUMED TO APPLY.	
(4)	DO YOU WANT TO CHANGE THE OPERATIONS OPTIONS ? <u>NO</u>	If <u>YES</u> Section 6.2.1 is executed, and continues here.
(5)	DO YOU WANT TO CHANGE THE PLANT ? <u>NO</u>	If <u>YES</u> Section 6.2.2.1 is executed.
(6)	DO YOU WANT TO CHANGE THE LABOUR ? <u>NO</u>	If <u>YES</u> Section 6.2.2.2 is executed.
(7)	DO YOU WANT TO CHANGE THE NON-MEASURED PLANT ? <u>NO</u>	If <u>YES</u> Section 6.2.2.3 is executed.
(8)	DO YOU WANT TO CHANGE THE MATERIALS ? <u>NO</u>	If <u>YES</u> Section 6.1.3 is executed.
(9)	DO YOU WANT TO CHANGE THE COMBINED OPERATIONS ? <u>NO</u>	If <u>YES</u> Section 6.2.3 is executed

(The analysis of the new method is executed as Section 6.3.)

6.4.3 CONTROL COMMAND REVIEW

If during the analysis of a pipe run the User wants to reappraise an already analysed method, this is achieved by the Control Command 'R'. The User is prompted for the method number required and then section 6.3 is re-executed with the information relating to that method number.

6.4.4. CONTROL COMMAND SUMMARY

A Summary of the results of all the method analyses performed is displayed following the Control Command 'S'. These summaries take the form of lines 53 to 61, of Section 6.3.

6.4.5 CONTROL COMMAND PRINT

The User can generate a print of a particular method analysis by using the Control Command 'P'. An example of these pricing notes is shown in fig. 6.1.

```
                              PRICING NOTES
                              *************

        RUN NUMBER(S)   2       METHOD NUMBER  1        RUN LENGTH  310  M

-------------------------------------------------------------------------------------------
!  operation   !   option     !  volumes      !  output     !    time   -->    mins/m            !
!              !              !  m3/m         !  per hour   !0       10        20       30      40 !
-------------------------------------------------------------------------------------------
! excavate     ! vertical     !   3.94016     !   21.8077   ! *********                          !
! shore        ! shorco       !               !  11.8621    !         *****                      !
! BEDDING      !              ! 0.0  0.4  0.2!0.0  9.0 25.0 !             ***                    !
! pipelay      !              !               ! 50.74  0.00 !                  *                 !
! backfill     !              !   2.7235      !    25       !                   ******           !
-------------------------------------------------------------------------------------------

-------------------------------------------------------------------------------------------
! RESOURCES   !         LABOUR           !            MATERIALS                 !      PLANT         !
-------------------------------------------------------------------------------------------
! excavation  ! 1 no L1                  !                                      !   JCB 806          !
! shoring     ! 2 no L2                  !              10   $/hr               !   JCB 806          !
! bedding     ! 2 no L2                  ! 0.44 m3 GRAV @  9.00                 !   JCB 806          !
! pipelay     ! 2 no L2                  ! 0.525 ACEMNT @ 50.00                 !   JCB 806          !
! backfill    ! 1 no L2                  !                                      !   JCB 806          !
-------------------------------------------------------------------------------------------
! totals      ! 1 no ganger     @ 3.00 !    bedding + pipes =  53.9358    $/m    ! 1 no JCB 806  @ 12.01 !
!             ! 2 no labourer   @ 2.65 !                                         !                       !
-------------------------------------------------------------------------------------------

-------------------------------------------------------------------------------------------
!  NON - MEASURED PLANT    !  2 IN.  UNIV @  0.78                                            !
-------------------------------------------------------------------------------------------

-------------------------------------------------------------------------------------------
!    DURATION            !      MINS/M          !    PREDICTED S.P.I.       !   ANTICIPATED DURATION   !
-------------------------------------------------------------------------------------------
!                        !      27.0349         !     75                    !    36.0466               !
-------------------------------------------------------------------------------------------

-------------------------------------------------------------------------------------------
!    COSTS $/m      !     LABOUR        !    MATERIALS     !     PLANT       !      TOTAL          !
-------------------------------------------------------------------------------------------
!   standard time   !    3.73983        !    58.4417       !     5.76294     !    67.9444          !
!   s.p.i. addition !     1.24661       !                  !     1.92078     !    3.16759          !
!    totals         !    4.98644        !    58.4417       !     7.68392     !    71.112           !
-------------------------------------------------------------------------------------------
```

Fig 6.1 Typical Pricing Notes

7.0 BILL OF QUANTITIES

Run Control BoQ will produce a print of the priced Bill of Quantities items. This must be used only after the successful cost analysis of a method.

8.0 STANDARD UNIT COST DATA

The standard unit cost data file SUCO is used to set up and periodically revise the unit data file UCO. This data is used by the sub-system in the analysis of a method for a particular pipe run. This programme is completely free standing and cannot be called from the PLEP system.

Example of SUCO Input	Notes
(1) LABOUR AND PLANT RATES	
(2) ****** *** ***** *****	
(3) THESE RATES WERE LAST AMENDED ON 17;1;81	
(4) CLASS 1; CODE LETTER; E-EXCAVATORS	
(5) CODE DESCRIPTION RATE FUEL	
(6) £/hr £/hr	
(8) E1 JCB 3C	Programme displays the stored data in this class of plant.
(9) E2 JCB 805	
(10) E3 JCB 806	
(11) DO YOU WANT TO AMEND ANY OF THESE RATES ? YES	If User responds NO the execution skips to line 15
(12) PLANT CODE ? E1	An error message is printed if the code is not already in the list.
(13) RATE, FUEL ? 6.5, 0.78	
(14) ANY MORE REVISIONS ? NO	If YES execution skips to line 12.
(15) DO YOU WANT TO ADD ANY MORE PLANT TO THIS LIST ? YES	If NO execution skips to line 20.

	Notes
(16) ENTER PLANT CODE ? E4	An error message is printed if this code does not start with the class code letter, or has already been used
(17) DESCRIPTION ? HY-MAC 580	
(18) RATE, FUEL ? 11.00, 1.01	
(19) ANY MORE ADDITIONS ? NO	If YES execution skips to line 18
(20) DO YOU WANT TO REVIEW THIS DATA ? NO	If YES execution skips to line 5 Execution then recommences at line 4 for the next class of plant, until all the stored data has been displayed and amended as required
(21) DO YOU WANT TO ADD ANY MORE PLANT CLASSES TO THIS LIST ? YES	If NO execution skips to line 24
(22) NEW CLASSIFICATION CODE LETTER ? P	Error message if code has already been used
(23) DESCRIPTION ? PUMPS	Execution skips to line 16
(24) ANY MORE PLANT CLASSES ? NO	If YES then execution skips to line 22
(25) LABOUR	
(26) ******	
(27) L1 LABOURERS 2.65 £/hr	Displays all the stored labour rates
(28) L2 CARPENTERS 3.00 £/hr	
----"----	
(29) DO YOU WANT TO AMEND ANY OF THIS DATA ? YES	If NO then execution skips to line 33
(30) LABOUR CODE ? L1	Error message if code is not in the list
(31) ALL IN RATE £/hr ? 2.75	
(32) ANY MORE REVISIONS ? NO	If YES execution skips to line 30

	Notes
(33) DO YOU WANT TO ADD ANY MORE LABOUR TYPES ? YES	If NO execution skips to line 38
(34) LABOUR CODE ? L3	Error message if code already in list
(35) DESCRIPTION ? GANGER	
(36) ALL IN RATE £/hr ? 3.15	
(37) ANY MORE ADDITIONAL LABOUR RATES ? NO	If YES execution skips to line 34
(38)	Programme prints on the line printer all the stored labour and plant data. See fig 8.1 and execution ceases.

LABOUR AND PLANT RATES
****

THESE RATES WERE LAST AMENDED ON 11/ 1/80

CLASS	TYPE	RATE [#/HR]	FUEL [#/HR]	TOTAL [#/HR]
E - EXCAVATORS	E1 - JCB 3	6.50	0.78	7.28
	E2 - JCB 3C	7.63	0.99	8.62
	E3 - JCB 3D	8.06	1.09	9.15
	E4 - JCB 805	9.87	1.32	11.19
	E5 - HY-MAC 590	10.36	1.65	12.01
	E6 - JCB 806	10.36	1.65	12.01
	E7 - JCB 807	11.68	1.70	13.38
	E8 - JCB 808	13.00	1.75	14.75
	E9 - O&K RH6	11.70	1.70	13.40
C - CRANES	C1 - 19 RB	4.50	0.68	5.18
	C2 - 22 RB	10.25	1.35	11.60
	C3 - PENNINE	9.20	1.30	10.50
	C4 - 7T MOBILE	8.99	0.50	9.49
	C5 - 12T MOBILE	10.08	0.50	10.58
D - DOZERS/LOADERS	D1 - B100	7.63	0.99	8.62
	D2 - CAT 951	9.27	2.64	11.91
	D3 - CAT 955	10.63	3.46	14.09
	D4 - CAT D4	9.54	1.65	11.19
	D5 - CAT D6	16.90	2.97	19.87
	D6 - CAT D8	18.58	5.24	23.82
R - ROLLERS	R1 - BOMAG 35	0.78	0.16	0.94
	R2 - BOMAG 65	0.96	0.16	1.12
	R3 - BOMAG 75	1.09	0.23	1.32
	R4 - BOMAG 90	1.23	0.32	1.55
	R5 - BOMAG 200	6.26	1.30	7.56
	R6 - 8 - 10 TON	1.91	0.71	2.62
	R7 - 54T	1.04	0.16	1.20
	R8 - 72T	2.18	0.33	2.51
	R9 - PLATE COMPACTOR	0.60	0.27	0.87
T - TRACTORS/TRAILERS	T1 - TRACTOR	1.30	0.65	1.95
	T2 - TRAILER 2 WHEEL	0.26	0.00	0.26
	T3 - TRAILER 4 WHEEL	0.44	0.00	0.44
	T4 - TRAILER TIPPING	0.98	0.00	0.98
P - PUMPS	P1 - 2 IN. UNIVAC	0.69	0.09	0.78
	P2 - 3 IN UNIVAC	0.82	0.16	0.98
	P3 - 4 IN UNIVAC	1.05	0.32	1.37
	P4 - 6 IN UNIVAC	1.92	0.65	2.57

Fig 8.1 TYPICAL UNIT COST DATA PRINT OUT

REFERENCES

BRAMWELL D.M. (1974) Computer Aided Systems in Civil Engineering using drainage as the prime data base. PhD Thesis, the University of Aston, Civil Engineering Department.

BRITISH STANDARD CODE OF PRACTICE CP 2001 (1951). Site Investigations. London (British Standards Institution).

GEOLOGICAL SOCIETY ENGINEERING GROUP WORKING PARTY. (1977). The description of rock masses for engineering purposes. Q.J. Engng. Geology, 1977, 10(4), 355-388.

SCOTTISH DEVELOPMENT DEPARTMENT (1979) Standard Specification for water and sewerage schemes. Second Edition. Edinburgh (HMSO).

TOMLINSON M.J. (1975). Foundation Design and Construction. Pitman Publishing Limited. London.

APPENDIX A

PIPE WEIGHTS (kg/m)

NOMINAL BORE (m)	CLAY	CONCRETE	IRON	PLASTIC	ASBESTOS CEMENT	PITCH FIBRE
0.100	30.41	30.0	19.63		10.17	4.19
0.150	50.26	60.0	37.36		17.15	8.72
0.225	69.70	80.0	63.99		29.45	17.66
0.300	80.34	110.0	95.63	10.98	51.52	
0.375	123.47	170.0	132.63	13.72	74.00	
0.450	166.60	180.0	174.36	16.46	98.40	
0.525	222.15	250.0	209.05	19.20	148.00	
0.600	277.70	310.0	218.18	21.95	169.20	
0.675		380.0	173.32	24.69	211.20	
0.750		460.0	205.36	27.43	255.40	
0.825		550.0	238.85	31.09	306.60	
0.900		620.0	275.27	34.75	363.00	
0.975		710.0	317.17	36.58	417.60	
1.050		770.0	360.84	38.41	482.00	
1.125		900.0	406.45	41.15		
1.200		960.0	454.72	43.90		
1.275		1125.0		47.56		
1.350		1290.0				
1.425		1420.0				
1.500		1550.0				
1.575		1680.0				
1.650		1810.0				
1.725		2155.0				
1.800		2500.0				
1.875		2675.0				
1.950		2850.0				
2.025		2875.0				
2.100		2900.0				

APPENDIX B

PIPE OUTSIDE DIAMETERS (M)

NOMINAL BORE (m)	CLAY	CONCRETE	IRON	PLASTIC	ASBESTOS CEMENT	PITCH FIBRE
0.100	0.131		0.118	0.114	0.125	0.122
0.150	0.186	0.203	0.170	0.168	0.160	0.183
0.225	0.272	0.288	0.248	0.245	0.260	0.330
0.300	0.361	0.377	0.326	0.325	0.343	
0.375	0.456	0.459	0.405		0.426	
0.450	0.552	0.543	0.480		0.508	
0.525	0.636	0.626	0.558		0.588	
0.600	0.720	0.709	0.635		0.672	
0.675		0.805	0.711		0.756	
0.750		0.888	0.790		0.837	
0.825		0.937	0.868		0.921	
0.900		1.060	0.945		1.005	
0.975		1.152	1.021		1.073	
1.050		1.238	1.100		1.154	
1.125		1.312	1.178			
1.200		1.411	1.255			
1.275		1.496				
1.350		1.581				
1.425		1.668				
1.500		1.756				
1.575		1.840				
1.650		1.925				

SECTION 3

PIPELINE ESTIMATING SYSTEM - PROGRAMME LISTINGS

3.1 - Structure of PLEP data files.

3.1.1. Files Used.

The names of the files used by the PLEP system are stored in the string F$. In each programme the relevant file name from F$ is assigned to an input/output channel number. The names of the files and the positions of each file name in F$ are shown in Table 1.1. In addition to these files the standard file "MASTER" is used to store the data which identifies each current PLEP project.

Table 3.1 - PLEP data Files.

No.	Data	Name.	Position in F$
1.	Specification.	SPn	F$(1,3)
2.	PLEP control.	DRn	F$(4,6)
3.	Dimensions.	DIn	F$(7,9)
4.	Excavation.	EXn	F$(10,12)
5.	Shoring.	SHn	F$(13,15)
6.	Pipe bedding.	PBn	F$(16,18)
7.	Pipe laying.	PLn	F$(19,21)
8.	Backfill	BFn	F$(22,24)
9.	Road breakout.	RBn	F$(25,27)

3.1.2. MASTER File.

This file stores the estimate reference and description of each current PLEP project. The generation number 'n' of the files shown in Table 1.1 is the location within MASTER of the description of the particular project which is being analysed.

Structure of MASTER file.

Record No.	Variable.	Description.
1	N	The number of current projects.
2	E$(10),E1$(60)	Estimate reference E$ and description E1$ of the first project in list.

Note record = 2 repeats for each current project.

3.1.3 Specification File - SPn.

File Length = 10 records.

This file stores the data which forms the Project specification.

Structure of Specification File.

Record No.	Variable.	Description.
1.	N1,B1	The number of pipe runs - N1.
		Backfile layer thickness (m) - B1.
2.	S$(240)	The start points of the first 30 pipe runs.
3.	S1$(160)	The start points of the second 20 pipe runs.
		i.e. runs 31 to 50.
4.	F$(240)	Finish points - as record 2.
5.	F1$(160)	Finish points - as record 3.
6.	C(15,3)	Single trench widths - C(I,J)
		j=1 - pipe diameter (m)
		j=2 - min trench width (m)
		j=3 - max trench width (m)
7.	B(4,10)	Standard bedding shape coefficients (see below)
8 and 9.	G(20,5)	Ground data for maximum of 20 different
		types - G(i.j)
		j=1 - Strata grading.
		j-2 - Obstruction grading.
		j-3 - Cohesion (KN/m2
		J-4 - Density (Kg/m3)
		j-5 - Angle of internal friction (deg)
10	S(50)	Ground type for each run number i.e. for
		run number 'n' the ground type is equal to
		S(n).

3.1.4. PLEP control file - DRn.

File length =

This file stores the Bill item descriptions and also the information regarding the operations included in each item.

Structure of File.

Record No.	Variable.	Description.
1.	N	The number of items in store and the number of current item during analysis.
2.	B$(10),P$(10), I$(10),	Bill number, page number and item number of the 1st item analysed.
3.	C(10)	Control array for 1st item analysed (see below)

Record numbers 2 and 3 repeart for each item.

Control Array C(10)

Initially this array is coded to show which operations are included in the particular item, as follows.

c(1) - Excavation	1 = included, 0 = excluded
C(2) - Shoring.	ditto
C(3) - Pipe bedding.	ditto
C(4) - Pipe laying.	ditto
C(5) - Backfill.	ditto
C(6) - Road breakout.	ditto

After the analysis of a particular operation this array stores the record number in the particular data file where the results are stored.

e.g. C(1) gives record number in Excavation file of the data for this item.

3.1.5 Dimensions File - DIn

File length =

This file stores, for each B of Q item, the input dimensions etc as follows :

Record No.	Variable.	Description.
1	D(2.7). M(20)	The basic dimensions - D, and various code numbers etc in M.

Record numbers 1 repeats for each B of Q item.

Dimensions Array.

	1	2	3	4	5	6	7
1	loading height	diameter pipe 1	depth pipe 1	trench width.	pipe length	bucket width	RdB/out width.
2	loading reach	diameter pipe 2	depth. pipe 2	trench width 2	pipe length		RdB/out depth.

Code Array M(20)

1	=	Number of pipes in trench.	
2	=	Run number.	
3	=	Strata grading.	
4	=	Obstruction grading.	
5	=	1st pipe bedding material code	(as CESMM)
6	=	2nd pipe bedding material code	(as CESMM)
7	=	1st pipe material code	(as CESMM)
8	=	2nd pipe material code	(as CESMM)
9	=	Road breakout material code.	1 = conc. 2 = flexible.
10	=	1st pipe diameter code.	(as CESMM)
11	=	2nd pipe diameter code.	(as CESMM)
12	=	Ground type.	
13	=	1st pipe bedding shape.	
14	=	2nd pipe bedding shape.	
15	=	1st pipe depth code	(as CESMM)
16	=	2nd pipe depth code	(as CESMM)
17	=	Item quantity	
18	=	Quantity units 1 = m. 2 = m2.	3= m3
19	=	Not used.	
20	=	Not used.	

3.1.6. Excavation File - Exn.

File length =

Storage of excavation Data as follows:

Record No.	Variable.	Description.
1	N	The number of excavation items currentlyin store.
2	V(2),E(9,7)	Trench volumes - V(1)=straight sided V(2)=battered Excavation data - E as below

Record 2 repeats for each set of excavation results.

Excavation data - Array E(i,J)

I=1 to 9 - Excavator types.

J=1 coded,1 = excavator included 0 = excluded.

j=2 standard output (m3/hr) - Vertically sided trench.

j=3 revised output (m3/hr) "

j=4 standard duration (hr/m) "

j=5 standard output (m3/hr)-battered trench.

j=6 revised output (m3/hr) "

j=7 standard duration (hr/m) "

3.1.7. Shoring Data File - SHn

File length =

Record No.	Variable.	Description.
1	N	Number of shoring items on file.
2	S(5,4),R(5.5)L	R= shoring material requirements.
		S= shoring time data.
		L=Bay length.

Record 2, repeats for each set of shoring data.

Time data array - S(i.j)

i = 1 close sheeting.
i = 2 Medium sheeting.
i = 3 Open sheeting.
i = 4 Pinchers.
i = 5 Shorco 'Escon' boxes.

j = 1 Code - 1 = included 0 = excluded.
j = 2 Standard output. (mlin/hr)
j = 5 Revised output (mlin/hr)
j = 4 Standard duration(hr /m)

Materials requirements array - R(i.j).

i = 1 to 5 as above.

j = 1 Number of trench sheets
j = 2 Waling width.
j = 3 Waling depth
j = 4 Number of walings
j = 5 Number of struts.

Applies to traditoral shoring types only.

R(5,1) = Number of shorco boxes required.

3.1.8. Pipe bedding file - PBn

File length =

Storage of pipe bedding data for each B of Q item as follows :

Record No.	Variable.	Description.
1	N	The number of items of bedding data in store.
2	R(20)	Bedding data array - see below

Record 2 repeats for each bedding data set.

Pipe bedding data array - R(20)

1 =	pipe 1	Volume of bed material (m3/m)
2 =	pipe 2	Volume of bed material (m3/m)
3 =	pipe 1	Volume of cover material (m3/m)
4 =	pipe 2	Volume of cover material (m3/m)
5 =	pipe 1	standard output for bed material (m3/hr)
6 =	pipe 2	ditto
7 =	pipe 1	Standard output for cover material (m3/hr)
8 =	pipe 2	ditto
9 =	pipe 1	Revised output bed material (m3/hr)
10 =	pipe 2	ditto
11 =	pipe 1	Revised output cover material (m3/hr)
12 =	pipe 2	ditto
13 =	pipe 1	Displaced volume. (m3/m)
14 =	pipe 2	ditto
15 =	pipe 1	Std. duration (hr/m)
16 =	pipe 2	ditto
17 =	Total displaced volume.	
18 =	Total duration.	
19 =	Gang size.	
20 =	Machine code number (as used in excavation programme).	

3.1.9. Pipelaying Data File - PLn.

File length =

Record No.	Variable.	Description.
1	N	Number of items of pipelayiing data in store.
2	G(6.2) C$(60)	See below.

Record 2 repeats for each pipelaying data set.

Pipelaying data array G(I.J.)

J = Pipe number.

I = 1 gang size.

I = 2 machine code number of standard pipelaying machines if this equals 9 then ' non ' standard m/c has been specified.

I = 3 Standard output (mlin/hr)

I = 4 Revised output (mlin/hr)

I = 5 Standard duration.(hr/m)

I = 6 If non standard machine this contains the position in string C$ of the users supplied machine description.

3.1.10. Backfill Data File. BFn

This file stores the backfill data for four different gang sizes.

Record No.	Variable.	Description.
1	N	Number of backfill data items in store.
2	A(2),B(4,8),S$(100)	See below.

Record number 2 repeats for each backfill data set.

Backfill volumes array A(2).

A(1) = straight sided trench backfill volume (m3/m)
A(2) = battered trench backfill volume (m3/m)

Backfill time and resource array B(i.j)

I = 1 to 4 are the gang code numbers.

J = 1 Gang size.
J = 2 Plant code number. If non standard machine then this value = 9
J = 3 Standard output (m3/hr)
J = 4 Revised output (m3/hr)
J = 5 Standard duration straight sided trench (hr /m)
J = 6 Standard duration battered trench (hr/m)
J = 7 If non standard machine then this value is the position in S$ of the users supplied machine description.

3.1.11. Road Breakout Data File - RBn

File length =

This file stores road breakout data for two different gang sizes.

Record No.	Variable	Description.
1	N	Number of backfill items in store.
2	R2,R3,B(2.6) X$(20)	R2 = breakout volume (m3/m) R3 = 1 if concrete road,2 if flexible road. B Breakout time and resource data - see below.

Record 2 repeats for each road breakout data set.

Breakout time and resource array B(I.J).

I = gang number

J = 1 - gang size.

J = 2 - plant code, if non standard plant item then this value = 9

J = 3 - standard output (m3/hr)

J = 4 - Revised output (m3/hr)

J = 5 - standard duration. (hr/m)

J = 6 - If non standard machine then this value is the position in X$ of the users supplied machine description.

PLEP

```
10   COM N1,F$[30]
15   REM            DRAINAGE DATA - MASTER SEGMENT
20   REM            N. Bartram          APRIL '79
30   FILES master,*,*,*,*,*,*,*,*,*
40   DIM R$[3],E$[10],E1$[10],E0$[60],B$[10],I$[10],P$[10]
50   DIM C$[20],X[6],Y[6],A$[2]
60   DIM D[2,7],M[20],G[20,5],S[50]
100   PRINT TAB(20);"DRAINAGE STANDARD TIME SYNTHESIS"
105   PRINT TAB(20);"********************************"
110   PRINT
112   READ #1,1;N1
115   PRINT TAB(10);"ESTIMATE REFERENCE";TAB(40);
120   INPUT E$
121   E$=UPS$(E$)
130   PRINT TAB(10);"NEW PROJECT";TAB(40);
140   INPUT R$
141   R$=UPS$(R$)
150   IF R$="YES" THEN 180
160   IF R$="NO" THEN 200
170   GOTO 130
180   GOSUB 1000
190   CHAIN "spec"
200   GOSUB 1650
260   PRINT TAB(20);"BILL OF QUANTITY ANALYSIS"
270   PRINT TAB(20);"*************************"
280   ASSIGN F$[4,6],2,V1
282   ASSIGN F$[7,9],3,V1
285   READ #2,1;N1
286   MAT M=ZER
288   MAT D=ZER
289   GOSUB 5000
290   N1=N1+1
300   PRINT #2,1;N1
310   PRINT TAB(5);"[ Item Number ";N1;"]"
320   PRINT TAB(10);"BILL NUMBER";TAB(30);
330   INPUT B$
340   PRINT TAB(10);"PAGE NUMBER";TAB(30);
350   INPUT P$
360   PRINT TAB(10);"ITEM NUMBER";TAB(30);
370   INPUT I$
372   GOSUB 6000
375   PRINT TAB(10);"RUN NUMBER";TAB(25);
377   INPUT M[2]
378   GOSUB 4350
380   GOSUB 1800
390   GOSUB 2000
400   IF C[10]=0 THEN 420
410   GOSUB 2100
420   X=X+1
430   MAT  PRINT #2,X;C
440   IF C[1]=0 THEN 460
445   GOSUB 2200
```

```
450  CHAIN "exc"
460  IF C[2]=0 THEN 480
470  CHAIN "shore"
480  IF C[3]=0 THEN 490
485  CHAIN "bed"
490  IF C[4]=0 THEN 500
495  CHAIN "play"
500  IF C[5]=0 THEN 510
505  CHAIN "bfill"
510  IF C[6]=0 THEN 520
515  CHAIN "bfill"
520  GOTO 289
530  PRINT TAB(5);"** SORRY NO MORE OPERATIONS AVAILABLE **"
590  GOTO 285
1000  REM                    NEW PROJECT
1010  FOR J=2 TO N1+1
1020  READ #1,J;E1$,E0$
1030  IF E$=E1$ THEN 1060
1040  NEXT J
1050  GOTO 1080
1060  PRINT TAB(5);"** ERROR - ";E$;" WAS ASSIGNED TO ";E0$;"**
1070  GOTO 115
1080  PRINT TAB(10);"DESCRIPTION";TAB(30);
1090  INPUT E0$
1100  N1=N1+1
1105  PRINT #1,1;N1
1110  PRINT #1,N1+1;E$,E0$
1120  GOSUB 1200
1130  GOSUB 1450
1135  ASSIGN F$[4,6],2,V1
1136  X=0
1137  PRINT #2,1;X
1140  ASSIGN F$[7,9],3,V1
1145  ASSIGN F$[10,12],4,V1
1147  PRINT #4,1;X
1150  ASSIGN F$[13,15],5,V1
1155  ASSIGN F$[16,18],6,V1
1160  ASSIGN F$[19,21],7,V1
1165  ASSIGN F$[22,24],8,V1
1170  ASSIGN F$[25,27],9,V1
1175  X=0
1180  FOR I1=2 TO 9
1190  PRINT #I1,1;X
1195  NEXT I1
1196  RETURN
1200  REM FILE NAME GENERATION
1210  CONVERT N1 TO X$
1215  X$=UPS$(X$)
1220  F$[1,2]="SP"
1230  F$[3,3]=X$
1240  F$[4,5]="DR"
1250  F$[6,6]=X$
1260  F$[7,8]="DI"
1270  F$[7,7]=X$
```

```
1280  F$[10,11]="EX"
1290  F$[12,12]=X$
1295  F$[13,14]="sh"
1300  F$[15,15]=X$
1305  F$[16,17]="pb"
1310  F$[18,18]=X$
1315  F$[19,20]="pl"
1320  F$[21,21]=X$
1325  F$[22,23]="bf"
1330  F$[24,24]=X$
1335  F$[25,26]="RB"
1340  F$[27,27]=X$
1400  RETURN
1450  REM creating files
1460  CREATE V1,F$[1,3],10
1470  CREATE V1,F$[4,6],100
1480  CREATE V1,F$[7,9],50
1490  CREATE V1,F$[10,12],100
1500  CREATE V1,F$[13,15],50
1510  CREATE V1,F$[16,18],50
1520  CREATE V1,F$[19,21],50
1530  CREATE V1,F$[22,24],50
1540  CREATE V1,F$[25,27],50
1600  RETURN
1650  REM   continuing with the project
1660  FOR J=2 TO N1+1
1670  READ #1,J;E1$,E0$
1680  IF E$=E1$ THEN 1720
1690  NEXT J
1700  PRINT TAB(5);"** ERROR - ESTIMATE REFERANCE ";E$;" IS NOT
                                                                STORE
1710  GOTO 115
1720  N1=J-1
1730  GOSUB 1200
1740  RETURN
1800  REM
1810  B$=UPS$(B$)
1820  P$=UPS$(P$)
1830  I$=UPS$(I$)
1840  X=2*N1
1850  PRINT #2,X;B$,P$,I$
1860  RETURN
2000  REM            decoding I$
2010  MAT C=ZER
2020  IF I$[1,1]="I" THEN 2080
2030  IF I$[1,1]="J" THEN 2095
2040  IF I$[1,1]="K" THEN 2060
2050  IF I$[1,1]="l" THEN 2060
2060  C[10]=1
2067  MAT  PRINT #3,N1;D,M
2070  RETURN
2080  C[1]=C[2]=C[3]=C[4]=C[5]=1
2085  GOSUB 3000
2090  RETURN
2095  C[6]=1
```

```
2096  RETURN
2100  REM operation coverage
2105  DIM C1$[14]
2106  C1$="EXSHPBPLBFRBMH"
2110  PRINT TAB(10);"OPERATION COVERAGE ('?' for code list )
2120  INPUT C$
2121  C$=UPS$(C$)
2130  IF C$[1,1] <> "?" THEN 2160
2140  GOSUB 9000
2150  GOTO 2110
2160  GOSUB 9200
2170  FOR J1=1 TO 6
2180  IF X[J1]=0 THEN 2260
2190  J2=POS(C1$,C$[X[J1],Y[J1]])
2200  IF J2>0 THEN 2230
2210  PRINT TAB(5);"** ERROR OPERATION ";C$[X[J1],Y[J1]];" NOT F
2220  GOTO 2110
2230  J2=(J2+1)/2
2240  C[J2]=1
2250  NEXT J1
2260  RETURN
3000  REM assigning code numbers to class i
3010  CONVERT I$[2,2] TO X1,3190
3020  M[7]=X1
3050  CONVERT I$[4,4] TO X1,3190
3060  M[15]=X1
3180  GOTO 3200
3190  PRINT TAB(5);"** ITEM DOES NOT CONFORM TO CESMM **"
3195  C[10]=1
3200  RETURN
3250  REM data for excavation
3260  PRINT TAB(10);"Number of pipes in the trench";TAB(30);
3270  INPUT M[1]
3280  IF M[15]=0 THEN 3310
3290  GOSUB 4000
3300  GOTO 3330
3310  PRINT TAB(10);"PIPE 1 - Depth to invert";TAB(30);
3320  INPUT D[1,3]
3330  PRINT TAB(10);"PIPE 1 - Diameter";TAB(30);
3340  INPUT D[1,2]
3350  IF M[7]>0 THEN 3400
3360  PRINT TAB(10);"PIPE 1 - Material (0 for code list)";TAB(3C
3370  INPUT M[7]
3380  IF M[7]>0 THEN 3400
3390  GOSUB 4200
3395  GOTO 3360
3400  IF M[1]=2 THEN 3430
3410  GOSUB 4650
3420  GOTO 3560
3430  PRINT TAB(10);"PIPE 2 - Depth to invert";TAB(30);
3440  INPUT D[2,3]
3450  PRINT TAB(10);"PIPE 2 - Diameter";TAB(30);
3460  INPUT D[2,2]
3470  PRINT TAB(10);"PIPE 2 - Material (0 for code list)";TAB(2C
```

```
3480  INPUT M[8]
3490  IF M[8]>0 THEN 3520
3500  GOSUB 4200
3510  GOTO 3470
3520  PRINT TAB(10);"PIPE 1 - Trench Width";TAB(30);
3530  INPUT D[1,4]
3540  PRINT TAB(10);"PIPE 2 - Treench Width";TAB(30);
3550  INPUT D[2,4]
3560  MAT  PRINT #3,N1;D,M
3570  RETURN
4000  REM depths from cesmm
4010  IF M[15] >= 8 THEN 3310
4020  GOTO M[15] OF 3310,4030,4050,4070,4090,4110,4130
4030  D[1,3]=1
4040  GOTO 4140
4050  D[1,3]=1.5
4060  GOTO 4140
4070  D[1,3]=2
4080  GOTO 4140
4090  D[1,3]=3
4100  GOTO 4140
4110  D[1,3]=4
4120  GOTO 4140
4130  D[1,3]=6
4140  PRINT TAB(10);"Max Pipe depth = ";D[1,3];" m."
4150  RETURN
4200  REM pipe material types
4210  PRINT TAB(10);"CODE";TAB(30);"DESCRIPTION"
4220  PRINT TAB(12);"1";TAB(30);"CLAY"
4230  PRINT TAB(12);"2";TAB(30);"PRESTRESSED CONCRETE"
4240  PRINT TAB(12);"3";TAB(30);"OTHER CONCRETE"
4250  PRINT TAB(12);"4";TAB(30);"CAST OR SPUN IRON"
4260  PRINT TAB(12);"5";TAB(30);"STEEL"
4270  PRINT TAB(12);"6";TAB(30);"PLASTICS"
4279  PRINT TAB(12);"7";TAB(30);"ASBESTOS CEMENT"
4290  PRINT TAB(12);"8";TAB(30);"PITCH FIBRE"
4300  RETURN
4350  REM finding and assigning "s" & "o"
4360  ASSIGN F$[1,3],1,V1
4380  READ #1,8;I1
4382  FOR I1=1 TO 20
4384  FOR J1=1 TO 5
4385  READ #1;G[I1,J1]
4386  NEXT J1
4388  NEXT I1
4390  MAT  READ #1,10;S
4400  READ #1,1;X1
4410  IF M[2] <= X1 THEN 4460
4420  PRINT TAB(5);"** ERROR - ONLY ";X);" PIPE RUNS IN STORE
4430  PRINT TAB(5);"ENTER RUN NUMBER   ";
4440  INPUT M[2]
4450  GOTO 4410
4460  I=S[M[2]]
4463  M[illegible]
```

```
4470  M[4]=G[I,2]
4475  M[12]=I
4480  PRINT TAB(10);"RUN NUMBER - ";M[2];" GROUND TYPE - ";M[12
4490  PRINT TAB(10);"STRATA GRADING - ";M[3];" OBSTRUCTION GRAD
4500  PRINT TAB(5);"CORRECT    ";
                                                       -- ";
4510  INPUT R$
4515  R$=UPS$(R$)
4520  IF R$="NO" THEN 4535
4525  IF R$="YES" THEN 4620
4530  GOTO 4500
4535  PRINT TAB(10);"GROUND TYPE";TAB(30);
4540  INPUT M[12]
4550  PRINT TAB(10);"STRATA GRADING";TAB(30);
4555  INPUT M[3]
4560  PRINT TAB(10);"OBSTRUCTION GRADING";TAB(30);
4565  INPUT M[4]
4620  RETURN
4650  REM single trench widths
4660  DIM T[14,3]
4670  MAT  READ #1,6;T
4675  FOR J=1 TO 14
4680  IF D[1,2] <= T[J,1] THEN 4700
4685  NEXT J
4690  D[1,4]=D[1,2]+1.2
4695  GOTO 4740
4700  X1=T[J,3]-T[J-1,3]
4710  X2=D[1,2]-T[J-1,1]
4715  X3=T[J,1]-T[J-1,1]
4720  D[1,4]=T[J-1,3]+((X1*X2)/X3)
4740  PRINT TAB(10);"MAX TRENCH WIDTH = ";D[1,4];" M."
4750  RETURN
5000  REM    run control
5010  PRINT TAB(10);"RUN CONTROL (Co/Ti/Sh/Bq/st/?)    ";
5015  INPUT R$
5020  R$=UPS$(R$)
5030  IF R$="?" THEN 5070
5040  IF R$="ST" THEN 5120
5050  IF R$="SH" THEN 5115
5060  IF R$="TI" THEN 5130
5065  IF R$="CO" THEN 5140
5066  IF R$="BQ" THEN 5150
5070  PRINT TAB(10);"RUN CONTROL"
5075  PRINT TAB(15);"You have four options available"
5080  PRINT TAB(15);"CO - Load the COST sub-system"
5090  PRINT TAB(15);"TI - Load the TIME sub-system"
5100  PRINT TAB(15);"SH - generate the time schedule"
5110  PRINT TAB(15);"ST - STOP execution of the system"
5112  GOTO 5010
5115  CHAIN "dshed"
5120  STOP
5130  RETURN
5140  CHAIN "price"
5150  CHAIN V1,"price4",600
6000  REM [illegible]
```

```
6010  PRINT TAB(10);"ITEM QUANTITY";TAB(30);
6020  INPUT M[17]
6030  PRINT TAB(10);"UNITS (m/m2/m3)";TAB(30);
6040  INPUT A$
6045  A$=UPS$(A$)
6050  IF A$="M" THEN 6075
6060  IF A$="M2" THEN 6085
6070  IF A$="M3" THEN 6095
6072  PRINT TAB(5);"** ERROR - UNITS ";A$;" NOT RECOGNISED [m/m
6074  GOTO 6030
6075  M[18]=1
6080  GOTO 6100
6085  M[18]=2
6090  GOTO 6100
6095  M[18]=3
6100  RETURN
9000  REM operation codes
9010  PRINT TAB(15);"OPERATION CODES"
9020  PRINT TAB(12);"EX - EXCAVATION"
9030  PRINT TAB(12);"SH - SHORE"
9040  PRINT TAB(12);"PB - PIPE BEDDING"
9050  PRINT TAB(12);"PL - PIPE LAYING"
9060  PRINT TAB(12);"BF - BACKFILL"
9070  PRINT TAB(12);"RB - ROAD BREAKOUT"
9080  PRINT TAB(12);"MH - MANHOLE"
9085  RETURN
9200  REM decoding c$
9210  MAT X=ZER
9220  MAT Y=ZER
9230  Z=LEN(C$)
9240  IF C$[Z,Z] <> "," THEN 9280
9260  C$[Z,Z]=" "
9270  GOTO 9230
9280  J1=J2=0
9290  J2=J2+1
9300  X[J2]=J1+1
9310  J1=J1+1
9320  IF C$[J1,J1]="," THEN 9350
9330  IF J1=Z THEN 9370
9340  GOTO 9310
9350  Y[J2]=J1-1
9360  GOTO 9290
9370  Y[J2]=Z
9380  RETURN
9999  END
```

SPEC

```
5   COM N,FO$[30]
10  REM       SPECIFICATION PROGRAMME
20  REM        N.  Bartram                Jan '79
30  FILES SHO,*,*
35  ASSIGN FO$[1,3],2,V1
40  DIM E$[60],S$[240],F$[240],R$[3],B[4,10],C[15,3]
45  DIM G[20,10],S[50],S1$[240],F1$[240]
46  DIM E1$[10]
50  PRINT TAB(20);"CONTRACT SPECIFICATION"
60  PRINT TAB(20)"**********************"
70  PRINT
90  GOSUB 700
91  REM 700   -   Geography data input
100  GOSUB 900
101  REM 900 - Client specification input
110  GOSUB 2000
111  REM 2000 = Ground data input
120  GOSUB 2700
121  REM 2700 = sorting data into run numbers
122  PRINT TAB(5);"DO you want a print of this data   ";
124  INPUT R$
125  R$=UPS$(R$)
126  IF R$="YES" THEN 130
127  IF R$="NO" THEN 140
128  GOTO 122
130  GOSUB 2910
131  REM 2900 is out put to l/p file
140  GOSUB 4500
141  REM 4500 = output subroutine to system file
143  CHAIN V1,"drepo",260
150  STOP
700  REM      GEOGRAPHY DATA INPUT
710  PRINT TAB(10);"GEOGRAPHY"
720  PRINT
730  PRINT TAB(10);"Geography input consists of (a) the start p
735  PRINT TAB(10);"finish point of each pipe run. Allow a maxi
740  PRINT TAB(10);"per break point. Terminate input with start
745  N=0                                            and (b) the
750  N=N+1                                         of 8 characte
760  PRINT TAB(10);"RUN NUMBER ";N                 nt 'NONE'."
765  IF N <= 30 THEN 820
770  N2=N-30
775  N2=8*N2-7
780  PRINT TAB(10);"START POINT";TAB(30);
785  INPUT S1$[N2,N2+7]
790  S1$=UPS$(S1$)
795  IF S1$[N2,N2+7]="NONE    " THEN 860
800  PRINT TAB(10);"FINISH POINT";TAB(30);
810  INPUT F1$[N2,N2+7]
815  GOTO 750
820  N2=8*N-7
825  PRINT TAB(10);"START POINT";TAB(30);
```

```
830   INPUT S$[N2,N2+7]
835   S$=UPS$(S$)
840   IF S$[N2,N2+7]="NONE     " THEN 860
845   PRINT TAB(10);"FINISH POINT";TAB(30);
850   INPUT F$[N2,N2+7]
855   GOTO 750
860   N1=N-1
865   RETURN
900   REM   CLIENT SPECIFICATION
905   PRINT
910   PRINT TAB(15);"CLIENT SPECIFICATION"
915   PRINT
920   GOSUB 1000
921   REM 1000 - Bedding input
930   GOSUB 1600
931   REM   1600 - single trench widths
940   PRINT TAB(15);"BACKFILL"
950   PRINT
960   PRINT TAB(10);"Backfill layer thickness (m)    ";
970   INPUT B1
980   RETURN
1000  REM   BEDDING DIMENSIONS
1010  PRINT
1020  PRINT TAB(15);"PIPE SUPPORT"
1030  PRINT
1040  MAT  READ B
1050  PRINT TAB(10);"Bedding class 1, CONCRETE CRADLE"
1060  N=1
1070  GOSUB 1200
1080  PRINT
1090  PRINT TAB(10);"Bedding class 2, CONCRETE ARCH"
1099  N=2
1100  GOSUB 1200
1105  PRINT
1110  PRINT TAB(10);"Bedding class 3, GRANULAR BED"
1119  N=3
1120  GOSUB 1200
1130  PRINT
1140  PRINT TAB(10);"Bedding class 4, GRANULAR BED & SURROUND"
1149  N=4
1150  GOSUB 1200
1160  RETURN
1161  DATA 1.25,.2,.25,.1,.25,.1,.25,.1,.3,0
1162  DATA 1.25,.2,.25,.2,.1667,.1,.5,0,.25,.1
1163  DATA 0,0,.25,.2,.16667,.1,.5,0,.3,0
1164  DATA 0,0,1,.15,1,.15,.5,0,1,.15
1200  REM-CHANGING THE BEDDING DIMENSIONS
1205  PRINT
1210  PRINT "standard dimensions as follows (metres),for notati
1215  PRINT                                             ee handbo
1220  IF N>2 THEN 1240
1230  PRINT TAB(3);"1";TAB(10);"Bw = Bc * ";B[N,1];"- MIN = Bc
1240  IF N=1 THEN 1290
1250  IF N=4 THEN 1290
```

```
1260 PRINT TAB(3);"2";TAB(10);"Y1 = Bc * ";B[N,3];"- MIN = ";B
1270 PRINT TAB(3);"3";TAB(10);"Y1 = Bc * ";B[N,5];"- MIN = ";B
1280 GOTO 1310
1290 PRINT TAB(3);"2";TAB(10);"Y1 = d  * ";B[N,3];"- MIN = ";B
1300 PRINT TAB(3);"3";TAB(10);"Y1 = d  * ";B[N,5];"- MIN = ";B
1310 IF N>1 THEN 1340
1320 PRINT TAB(3);"4";TAB(10);"Y2 = Bc * ";B[N,7];"- MIN = ";B
1330 GOTO 1350
1340 PRINT TAB(3);"4";TAB(10);"Y2 = Bc * ";B[N,7]
1350 IF N=1 THEN 1390
1360 IF N=3 THEN 1390
1370 PRINT TAB(3);"5";TAB(10);"Cv = d  * ";B[N,9];"- MAX/MIN =
1380 GOTO 1400                                                  [N
1390 PRINT TAB(3);"5";TAB(10);"Cv = ";B[N,9]
1400 PRINT
1402 IF N>2 THEN 1410
1404 PRINT "Do you want the concrete to the trench sides   ";
1406 INPUT R$
1407 IF R$="no" THEN 1410
1408 B[N,1]=99.9
1409 PRINT " A value of 99.9, signifies full width concrete"
1410 PRINT "Do you want to change any of this data   ";
1420 INPUT R$
1425 R$=UPS$(R$)
1430 IF R$="NO" THEN 1560
1435 IF R$="YES" THEN 1440
1436 GOTO 1410
1440 PRINT "Enter line number, revised figure and m for min/ma
1445 PRINT "or w for working dimension      ";
1450 INPUT X,Y,X$
1460 IF X$="m" THEN 1490
1470 B[N,2*X-1]=Y
1480 GOTO 1500
1490 B[N,2*X]=Y
1500 PRINT "Any more changes  ";
1510 INPUT R$
1515 R$=UPS$(R$)
1520 IF R$="NO" THEN 1530
1525 PRINT "Enter revision as before"
1527 GOTO 1450
1530 PRINT "Do you want to inspect the data again   ";
1540 INPUT R$
1545 R$=UPS$(R$)
1550 IF R$="YES" THEN 1220
1560 RETURN
1600 REM  SINGLE TRENCH WIDTH SUBROUTINE
1610 MAT  READ C
1620 PRINT
1630 PRINT TAB(15);"SINGLE TRENCH WIDTHS"
1634 PRINT
1640 PRINT TAB(15);"DIA";TAB(30);"MIN";TAB(45)"MAX"
1650 FOR N=1 TO 13
1660 PRINT TAB(5);N;TAB(15);C[N,1];TAB(30);C[N,2];TAB(45);C[N,
1670 NEXT N
```

```
1680  PRINT TAB(5);"15";TAB(15);"> 1.2";TAB(30);"O.D.  +";C[15,2
1690  PRINT
1700  PRINT "Do you want to change any of this data    ";         B(45);"O.D.  +";C[
1710  INPUT R$
1715  R$=UPS$(R$)
1717  IF R$="YES" THEN 1730
1720  IF R$="NO" THEN 1850
1730  PRINT "Enter line number,revised figure, and min or max"
1740  INPUT X,Y,R$
1750  IF R$="max" THEN 1780
1760  C[X,2]=Y
1770  GOTO 1790
1780  C[X,3]=Y
1790  PRINT "Any more changes     ";
1800  INPUT R$
1805  R$=UPS$(R$)
1806  IF R$="YES" THEN 1730
1810  IF R$="NO" THEN 1820
1815  GOTO 1790
1820  PRINT "Do you want to inspect the trench width table agai
1830  INPUT R$
1835  R$=UPS$(R$)
1840  IF R$="YES" THEN 1620
1845  IF R$="NO" THEN 1850
1846  GOTO 1820
1850  RETURN
1851  DATA .1,.43,.63
1852  DATA .15,.49,.69
1853  DATA .225,.58,.78
1854  DATA .3,.68,.88
1855  DATA .375,.95,1.15
1856  DATA .45,1.03,1.23
1857  DATA .525,1.12,1.32
1858  DATA .6,1.24,1.44
1859  DATA .675,1.33,1.53
1860  DATA .75,1.4,1.6
1861  DATA .825,1.49,1.69
1862  DATA .9,1.92,2.12
1863  DATA 1.05,2.1,2.32
1864  DATA 1.2,2.29,2.49
1865  DATA 99,.8,1
2000  REM    GROUND CONDITIONS
2005  MAT G=ZER
2006  MAT S=ZER
2010  PRINT
2020  PRINT TAB(10);"GROUND CONDITIONS"
2030  PRINT
2040  PRINT TAB(5);"The required ground conditions are - STRATA
2045  PRINT TAB(5);"and the values of DENSITY (Kg/m3), COHESION
2050  PRINT TAB(5);"ANGLE OFINTERNAL FRICTION (degrees). If any
2055  PRINT TAB(5);"parameters are unknown then enter 99."
2065  PRINT                                   BSTRUCTION GRADI
2070  N=0                                     /m2) and the "
2080  N=N+1                                   these last three
```

```
2090  PRINT TAB(10)"GROUND TYPE ";N
2100  PRINT TAB(5);"Strata Grading";TAB(30);
2110  INPUT G[N,1]
2120  PRINT TAB(5);"Obstruction Grading";TAB(30);
2130  INPUT G[N,2]
2135  PRINT TAB(5);"Density (Kg/m3)";TAB(30);
2140  INPUT G[N,3]
2145  PRINT TAB(5);"Cohesion (Kn/m2)";TAB(30);
2150  INPUT G[N,4]
2155  PRINT TAB(5);"Phi (degrees)";TAB(30);          this ground t
2160  INPUT G[N,5]                                  th '0'. "
2170  PRINT TAB(5);"Input the numbers of the pipe runs which ar
2175  PRINT TAB(5);"Enter each one on a seperate line, terminat
2180  INPUT X
2185  IF X=0 THEN 2220
2190  IF S[X]=0 THEN 2210
2195  PRINT TAB(5);"** ERROR - RUN NUMBER ";X;" WAS ASSIGNED TO
2200  GOTO 2180                                      UND ";S[X];"
2210  S[X]=N
2215  GOTO 2180
2220  PRINT TAB(5);"Any more ground types   ";
2225  INPUT R$
2226  R$=UPS$(R$)
2227  IF R$="YES" THEN 2080
2228  IF R$="NO" THEN 2250
2230  GOTO 2220
2250  PRINT TAB(10);"SUMMARY OF GROUND DATA"
2260  PRINT                                         TAB(40);"DENSI
2270  PRINT TAB(4);"GROUND";TAB(15);"STRATA";TAB(25);"OBSTRUCTI
2275  PRINT TAB(50);"COHESION";TAB(60);"PHI"
2280  PRINT TAB(40);"(Kg/m3)";TAB(50);"(Kn/m2)";TAB(60);"(degre
2285  PRINT TAB(17);"1";TAB(28);"2";TAB(43);"3";TAB(53);"4";TAB
2300  PRINT TAB(4);"----------------------------------------------
2310  PRINT
2320  I=0
2330  I=I+1
2335  IF G[I,1]=0 THEN 2370
2340  PRINT  USING 2350;I,G[I,1],G[I,2],G[I,3],G[I,4],G[I,5]
2350  IMAGE 6x,dd,8x,dd,10x,d,10x,dddd.d,4x,dddd.d,3x,dd
2360  GOTO 2330
2370  PRINT TAB(5);"Do you want to amend any of this data   ";
2375  INPUT R$
2380  R$=UPS$(R$)
2385  IF R$="NO" THEN 2560
2390  IF R$="YES" THEN 2400
2395  GOTO 2370
2400  PRINT TAB(5);"Enter ground type , 'I', column number, 'J'
2410  PRINT "I, J, X ";                           d revised figure
2420  INPUT I,J,X
2430  G[I,J]=X
2440  PRINT TAB(5);"Any more revisions   ";
2450  INPUT R$
2460  R$=UPS$(R$)
2470  IF R$="YES" THEN 2400
```

```
2480  IF R$="NO" THEN 2500
2490  GOTO 2440
2500  PRINT TAB(5);"Do you want to inspect this data again    ";
2510  INPUT R$
2520  R$=UPS$(R$)
2530  IF R$="YES" THEN 2270
2540  IF R$="NO" THEN 2560
2550  GOTO 2500
2560  RETURN
2700  REM sorting run data
2705  X2=0
2710  REM - has a ground type associated with it
2715  PRINT TAB(20);"RUN NUMBER";TAB(40);"GROUND TYPE"
2720  PRINT
2730  X2=0
2740  FOR I=1 TO N1
2750  IF S[I]>0 THEN 2770
2760  PRINT TAB(5);"*";
2765  X2=1
2770  PRINT TAB(20);I;TAB(40);S[I]
2775  NEXT I
2780  IF X2=0 THEN 2790                                           round t
2785  PRINT TAB(5);"* Denotes runs which have not been assigned
2790  PRINT TAB(5);"Do you want to amend any of this data   .";
2795  INPUT R$
2800  R$=UPS$(R$)
2810  IF R$="NO" THEN 2900
2815  IF R$="YES" THEN 2830
2820  GOTO 2790
2830  PRINT TAB(5);"Enter run number, I, and ground type, J"
2840  PRINT "I, J  ";
2850  INPUT I,J
2855  IF G[J,1]>0 THEN 2880
2860  PRINT TAB(5);"** ERROR - NO SUCH GROUND TYPE AS ";J;" **"
2870  GOTO 2830
2875  GOTO 2890
2880  S[I]=J
2881  PRINT TAB(5);"Any more revisions    ";
2882  INPUT R$
2884  R$=UPS$(R$)
2886  IF R$="YES" THEN 2830
2888  IF R$="NO" THEN 2892
2890  GOTO 2880
2891  IF X2=0 THEN 2896
2892  PRINT TAB(5);"Do you want to list this data again    ";
2894  INPUT R$
2896  R$=UPS$(R$)
2897  IF R$="YES" THEN 2715
2898  IF R$="NO" THEN 2900
2899  GOTO 2892
2900  RETURN
2905  REM output to l/p file
2910  PRINT #1
2920  PRINT #1;TAB(50);"CONTRACT SPECIFICATION"
```

```
2925  GOSUB 4700
2930  PRINT #1;TAB(50);"**********************"
2940  PRINT #1
2950  PRINT #1;TAB(25);"ESTIMATE REFERENCE";TAB(60);E1$
2960  PRINT #1;TAB(25);"CONTRACT";TAB(60);E$
2990  PRINT #1
3000  PRINT #1;TAB(25);"GEOGRAPHY"
3010  PRINT #1;TAB(25);"*********"               ";TAB(30);"GROUNI
3020  PRINT #1                                   **";TAB(80);"***
3030  PRINT #1;TAB(25);"RUN NUMBER";TAB(45);"START";TAB(60);"FI
3040  PRINT #1;TAB(25);"***********";TAB(45);"*****";TAB(60);"
3060  PRINT #1
3070  FOR I=1 TO N1
3071  IF I>30 THEN 3090
3072  N2=8*I-7
3080  PRINT #1;TAB(25);I;TAB(45);S$[N2,N2+7];TAB(60);F$[N2,N2+7
3085  GOTO 3094                                          B(80);
3090  N2=8*(I-30)-7
3092  PRINT #1;TAB(25);I;TAB(45);S1$[N2,N2+7];TAB(60);F1$[N2,N2
3094  NEXT I                                            |TAB(80);
3095  PRINT #1
3100  PRINT #1;TAB(50);"GROUND CONDITIONS"
3110  PRINT #1;TAB(50);"*****************"
3130  PRINT #1                             ON";TAB(60);"DENSI
3140  PRINT #1;TAB(15);"ground";TAB(30);"STRATA";TAB(45);"OBSTR
3145  PRINT #1;TAB(75);"COHESION";TAB(90);"PHI"
3150  PRINT #1;TAB(15);"TYPE";TAB(60);"[Kg/m3]";TAB(75);"[kn/m2
3155  PRINT #1                                   AB(90);"DEGRE
3160  FOR I=1 TO 20
3165  IF G[I,1]=0 THEN 3180
3170  PRINT #1; USING 3175;I,G[I,1],G[I,2],G[I,3],G[I,4],G[I,5]
3175  IMAGE 17x,dd,12x,dd.d,15x,d,9x,dddd.d,9x,dddd.d,10x,dd.d
3180  NEXT I
3190  PRINT #1
3200  PRINT #1;TAB(50);"TRENCH WIDTHS"
3210  PRINT #1;TAB(50);"*************"
3220  PRINT #1
3240  PRINT #1;TAB(25);"DIAMETER";TAB(50);"MINIMUM";TAB(75);"MA
3245  PRINT #1
3250  FOR I=1 TO 14
3260  PRINT #1;TAB(25);C[I,1];TAB(50);C[I,2];TAB(75);C[I,3]
3270  NEXT I
3280  PRINT #1;TAB(25);"> 1.2";TAB(50);"O.D +";C[15,2];TAB(75);
3290  PRINT #1                                        + ";C[1
3291  PRINT #1;TAB(30);"backfill layer thickness   =   ";B1
3292  PRINT #1
3300  PRINT #1;TAB(50);"BEDDING COEFFICIENTS"
3310  PRINT #1;TAB(50);"********************"
3320  PRINT #1
3330  PRINT #1;TAB(25);"BEDDING CLASS 1,  CONCRETE CRADLE"
3340  I=1
3350  GOSUB 4000
3360  PRINT #1;TAB(25);"BEDDING CLASS 2,  CONCRETE ARCH"
3370  I=2
```

```
3375  GOSUB 4000
3380  PRINT #1;TAB(25);"BEDDING CLASS 3,   GRANULAR BED"
3390  I=3
3410  GOSUB 4000
3420  PRINT #1;TAB(25);"BEDDING CLASS 4,   GRANULAR BED & SURROU
3430  I=4
3450  GOSUB 4000
3460  RETURN
4000  REM - printing bedding coefficient table
4010  IF I>2 THEN 4030
4020  PRINT #1;TAB(15);"BW = BC * ";B[I,1];"- MINUMUM = BC+ ";B
4030  IF I=1 THEN 4080
4040  IF I=4 THEN 4080
4050  PRINT #1;TAB(15);"Y1 = BC * ";B[I,3];"- MINIMUM = ";B[I,4
4060  PRINT #1;TAB(15);"Y1 = BC * ";B[I,5];"- MINIMUM = ";B[I,6
4070  GOTO 4100
4080  PRINT #1;TAB(15);"Y1 = D  * ";B[I,3];"- MINIMUM = ";B[I,4
4090  PRINT #1;TAB(15);"Y1 = D  * ";B[I,5];"- MINIMUM = ";B[I,6
4100  IF I>1 THEN 4130
4110  PRINT #1;TAB(15);"Y2 = BC * ";B[I,7];"- MINIMUM = ";B[I,8
4120  GOTO 4140
4130  PRINT #1;TAB(15);"Y2 = BC * ";B[I,7]
4140  IF I=1 THEN 4180
4150  IF I=3 THEN 4180
4160  PRINT #1;TAB(15);"CV = D  * ";B[I,9];"- MIN / MAX = ";B[I
4170  GOTO 4190
4180  PRINT #1;TAB(15);"CV = ";B[I,10]
4190  PRINT #1
4200  RETURN
4500  REM OUTPUT TO SYSTEM DATA FILE
4520  PRINT #2,1;N1,B1
4530  PRINT #2,2;S$
4540  PRINT #2,3;S1$
4550  PRINT #2,4;F$
4560  PRINT #2,5;F1$
4570  MAT  PRINT #2,6;C
4575  MAT  PRINT #2,7;B
4580  PRINT #2,8;I
4582  FOR I1=1 TO 20
4584  FOR J1=1 TO 5
4586  PRINT #2;G[I1,J1]
4588  NEXT J1
4589  NEXT I1
4590  MAT  PRINT #2,10;S
4600  RETURN
4700  REM
4710  CONVERT F0$[3,3] TO X,4750
4730  ASSIGN "master",3,V1
4740  X1=X+1
4745  READ #3,X1;E1$,E$
4750  RETURN
4800  END
```

EXC

```
5   COM T1,F$[30]
10  REM                    EXCAVATION PROGRAMME
20  REM                    N. Bartram              Jan '79
40  DIM A[5,9],B[2,23],I[9],R$[3],F[10],W[10]
45  DIM V[2],E[9,7],M$[64],X[9,2]
46  DIM P[10],H[20,5]
47  DIM Y[9]
50  FILES *,*,*,*,*,exco
51  ASSIGN F$[1,3],1,V1
53  ASSIGN F$[4,6],2,V1
55  ASSIGN F$[7,9],3,V1
57  ASSIGN F$[10,12],4,V1
60  PRINT TAB(30);"EXCAVATION"
70  PRINT TAB(30);"**********"
75  MAT E=ZER
80  GOSUB 1000
81  REM  1000 reads data statements
82  S2=0
100  IF V1 <> 3 THEN 160
110  S2=1
130  GOSUB 2000
140  REM  2000 = NON-SYSTEM use input
150  GOTO 180
160  S1=1
170  GOSUB 7000
180  MAT I=CON
190  PRINT
200  PRINT TAB(30);"MACHINE SELECTION"
210  PRINT TAB(30);"*****************"
211  PRINT TAB(5);"Do you want the machine list   ";
212  INPUT R$
213  R$=UPS$(R$)
215  IF R$="NO" THEN 300
217  IF R$="YES" THEN 230
219  GOTO 211
230  PRINT TAB(10);"Machines considered;"
240  GOSUB 3000
250  REM 3000= machine listing subroutine
260  PRINT
261  PRINT TAB(10);"Do you want to remove any machines from this
                                                                    st
270  INPUT R$
271  R$=UPS$(R$)
280  IF R$="NO" THEN 300
285  IF R$="YES" THEN 290
287  GOTO 261
290  GOSUB 3210
300  GOSUB 3300
310  REM 3300 = depth checks
320  GOSUB 3450
321  REM  3450 = Loading dimensions check
330  GOSUB 3600
340  REM   3600 = bucket width checks
```

```
350   FOR I1=1 TO 10
360   W[I1]=W1+W2
370   NEXT I1
375   Z6=0
380   GOSUB 4000
390   REM      4000 = excavation rate computation
400   GOSUB 4600
401   REM 4600 = revising outputs
410   GOSUB 4850
420   REM -4850 = straight sided volume and durations
430   PRINT TAB(10);"Do you want to consider a battered trench"
435   V[2]=0
436   INPUT R$
437   R$=UPS$(R$)
440   IF R$="NO" THEN 515
442   IF R$="YES" THEN 450
444   GOTO 430
450   Z6=3
460   GOSUB 5000
470   REM 5000 Bat trench volume calcs
480   GOSUB 4000
490   GOSUB 4600
500   GOSUB 5400
510   REM 5400 = battered trench duration calcs
515   GOSUB 5800
516   REM 5800 = printing summary of calcs
520   IF S2=0 THEN 610
530   PRINT TAB(5);"Do you want a print of these calculations  ";
535   INPUT R$
540   R$=UPS$(R$)
545   IF R$="YES" THEN 560
550   IF R$="NO" THEN 570
560   GOSUB 5550
570   PRINT TAB(5);"Any more cases to consider   ";
575   INPUT R$
580   R$=UPS$(R$)
585   IF R$="YES" THEN 130
590   IF R$="NO" THEN 630
600   GOTO 570
610   GOSUB 8000
630   STOP
1000  REM reading data statements
1010  MAT  READ A
1020  MAT  READ B
1025  M$="JCB 3JCB 3cJCB 3dJCB 805JCB 806JCB 807HY-MAC 5800 & K
                                                               JCB 8
1026  MAT  READ X
1028  MAT  READ P
1029  MAT  READ Y
1030  RETURN
1050  DATA .35,.35,.35,.508,.508,.508,.405,.7,.61
1051  DATA .95,.95,.95,.914,.914,.914,.91,1.2,1.12
1052  DATA 3.72,4.12,4.69,5.81,5.81,6.36,6.46,6.7,6.8
1053  DATA 5.31,5.47,6.17,9.02,9.07,9.75,9.09,9.9,10.18
1054  DATA 3.42,3.35,4.24,5.74,5.77,6.11,[illegible]
```

```
1055  DATA .35,.4,.5,.65,.8,.95,.508,.61,.762,.914,.61,.762,.914
1056  DATA 1.12,1.5,.7,.8,.95,1.2,.405,.61,.76,.91,.07,.09,.18,.
1057  DATA .24,.3,.2,.36,.4,.6,.4,.6,.7,1,1.4,.4,.5,.6,.9,.2
1058  DATA .38,.48,.58
1060  DATA 1,5,6,11,12,17,18,24,25,31,32,38,39,48,49,57,58,64
1065  DATA .4,.42,.45,.47,.6,.63,.65,.67,.68,.69
1066  DATA 1,1.1,1.2,.9,.95,1,1,1,1
2000  REM      NON-SYSTEM use variable input
2010  PRINT TAB(10);"Number of pipes in trench";TAB(40);
2020  INPUT N1
2030  PRINT TAB(10);"Depth";TAB(40);
2040  INPUT D1
2045  PRINT TAB(10);"Width";TAB(40);
2046  INPUT W1
2050  IF N1=1 THEN 2096
2060  PRINT TAB(10);"Depth pipe 2";TAB(40);
2070  INPUT D2
2080  PRINT TAB(10);"Width pipe 2";TAB(40);
2090  INPUT W2
2095  GOTO 2100
2096  D2=0
2097  W2=0
2100  PRINT TAB(10);"Loading height";TAB(40);
2110  INPUT H1
2120  PRINT TAB(10);"Loading reach";TAB(40);
2130  INPUT R1
2140  PRINT TAB(10);"Bucket width";TAB(40);
2150  INPUT B2
2160  PRINT TAB(10);"Strata Grading";TAB(40);
2170  INPUT S1
2180  PRINT TAB(10);"Obstruction grading";TAB(40);
2190  INPUT O1
2220  RETURN
2630  REM****************************************************
3000  REM      Machine listing
3010  PRINT TAB(20);"CODE";TAB(40);"MACHINE"
3011  PRINT
3020  FOR I1=1 TO 9
3030  IF I[I1]=0 THEN 3050
3040  PRINT TAB(22);I1;TAB(40);M$[X[I1,1],X[I1,2]]
3050  NEXT I1
3200  RETURN
3201  REM *****************************************
3210  REM removing machines from list
3220  PRINT TAB(10);"Enter code numbers of machines NOT require
3230  INPUT X                               ne per line terminate with
3240  IF X=99 THEN 3270
3250  I[X]=0
3260  GOTO 3230
3270  RETURN
3291  REM*********************************************
3300  REM Checking depths against stored maxima
3310  FOR I1=1 TO 9
3350  IF D1 <= A[2,I1] THEN [illegible]
```

```
3370  I[I1]=0
3380  NEXT I1
3390  PRINT TAB(10);"the following machines will dig the requir
3391  PRINT                                              epth ";D1;"
3400  GOSUB 3000
3410  RETURN
3420  REM**********************************************************
3450  REM    Loading dimensions check
3460  FOR I1=1 TO 9
3470  IF H1 <= A[4,I1] THEN 3500
3480  I[I1]=0
3490  GOTO 3520
3500  IF R1 <= A[5,I1] THEN 3520
3510  I[I1]=0
3520  NEXT I1
3530  PRINT TAB(10);"The following machines satisfy the unloadir
3531  PRINT                                                equirement
3540  GOSUB 3000
3550  RETURN
3560  REM?*********************************************************
3600  REM Bucket width checks
3610  FOR I1=1 TO 9
3620  IF I[I1]=0 THEN 3710
3630  IF B2<A[1,I1] THEN 3660
3640  IF B2>A[2,I1] THEN 3690
3650  G[I1]=B2
3651  GOTO 3710
3660  PRINT "ERROR - m/c";I1;"required bucket too small";A[1,I1]
3670  G[I1]=A[1,I1]                                          ssum
3680  GOTO 3710
3690  PRINT "ERROR - m/c";I1;"required bucket too large";A[2,I1]
3700  G[I1]=A[2,I1]                                          ssum
3710  NEXT I1
3720  RETURN
3730  REM**********************************************************
4000  REM EXCAVATION RATE COMPUTATION
4010  I1=0
4015  R=R1*R1
4016  H=H1*H1
4017  T=SQR(R+H)
4020  I1=I1+1
4030  IF I[I1]=0 THEN 4420
4040  GOSUB 6000
4041  REM 6000 = bucket capacities
4050  B4=P[S1]
4090  IF I1 <= 3 THEN 4130
4110  U1=.017437+.038475*T+2.7197E-03*T*T-.000249*T*T*T
4120  GOTO 4140
4130  U1=.005527-.010534*T+.039124*T*T-4.2776E-03*T*T*T
4140  Q1=B4*B3
4150  Z3=D1/10
4160  FOR I2=1 TO 10
4165  Z2=(I2*Z3)/W[I2]
4170  IF O1=1 THEN 4230
```

```
4180  IF O1=2 THEN 4250
4190  IF O1=3 THEN 4270
4200  IF O1=4 THEN 4290
4210  F[I2]=.027574+.1385*Z2-.0195*Z2*Z2+.001449*Z2*Z2*Z2
4220  GOTO 4300
4230  F[I2]=.050219+.7925*Z2-.1437*Z2*Z2+.008855*Z2*Z2*Z2
4240  GOTO 4300
4250  F[I2]=.028858+.3703*Z2-.042*Z2*Z2+.004138*Z2*Z2*Z2
4260  GOTO 4300
4270  F[I2]=.04437+.1466*Z2-.0236*Z2*Z2+.001756*Z2*Z2*Z2
4280  GOTO 4300
4290  F[I2]=.022984+.1552*Z2-.0242*Z2*Z2+.001856*Z2*Z2*Z2
4300  NEXT I2
4310  S3=0
4320  FOR I2=1 TO 10
4330  S3=S3+(F[I2]/1.12)+(U1/1.11)
4340  NEXT I2
4350  R4=S3/10
4360  R5=50.7099*Q1/R4
4361  R5=R5*Y[I1]
4380  E[I1,Z6+2]=R5
4400  E[I1,1]=1
4410  GOTO 4500
4420  E[I1,1]=0
4500  IF I1=9 THEN 4520
4510  GOTO 4020
4520  RETURN
4525  REM*********************************************************
4600  REM revising outputs
4610  PRINT TAB(30);"EXCAVATION RATES"
4611  PRINT TAB(30);"****************"
4612  PRINT
4620  IF Z6=0 THEN 4650
4630  PRINT TAB(20);"Battered trench"
4640  GOTO 4660
4650  PRINT TAB(15);"Vertically sided trench"
4651  PRINT
4660  PRINT TAB(20);"Machine code";TAB(40);"Standard output"
4661  PRINT TAB(25);"No.";TAB(45);"m3/hr"
4662  PRINT
4665  N=0
4670  N=N+1
4680  IF E[N,1]=0 THEN 4760
4700  PRINT TAB(25);N;TAB(40);E[N,Z6+2]
4710  PRINT "Do you want to amend this output";TAB(50);
4720  E[N,Z6+3]=E[N,Z6+2]
4725  INPUT R$
4726  R$=UPS$(R$)
4730  IF R$="NO" THEN 4760
4735  IF R$="YES" THEN 4740
4737  GOTO 4710
4740  PRINT "Enter preferred output (m3/hr)";TAB(40);
4750  INPUT E[N,Z6+3]
4760  IF N=9 THEN 4780
```

```
4770  GOTO 4670
4780  RETURN
4790  REM****************************************************
4850  REM VERTICALLY SIDED TRENCH VOLUME & DURATION
4860  V[1]=D1*W1
4870  V[1]=V[1]+(D2*W2)
4880  N=0
4890  N=N+1
4910  IF I[N]=0 THEN 4940
4930  E[N,4]=V[1]/E[N,3]
4940  IF N=9 THEN 4960
4950  GOTO 4890
4960  RETURN
4970  REM****************************************************
5000  REM     battered trench volume calculations
5010  PRINT TAB(10);"Battered trench volume caculations"
5020  PRINT TAB(10);"Enter depth to start of batter"TAB(45);
5030  INPUT H3
5035  PRINT TAB(10);"Enter batter angle (degrees)";TAB(45);
5036  INPUT P1
5040  A1=((W1+W2)*D1)-(W2*(D1-D2))
5050  P1=P1*3.14159/180
5060  W5=H3/TAN(P1)
5070  V[2]=H3*W5
5080  V[2]=V[2]+A1
5090  IF N1=2 THEN 5220
5100  Z3=D1/10
5110  N=0
5120  N=N+1
5140  H2=N*Z3
5150  IF H3>H2 THEN 5180
5160  W[N]=W1
5170  GOTO 5200
5180  W5=(H3-H2)/TAN(P1)
5190  W[N]=2*W5+W1
5200  IF N=10 THEN 5340
5210  GOTO 5120
5220  Z3=D1/10
5230  N=0
5240  N=N+1
5250  H2=N*Z3
5260  IF H2<H3 THEN 5300
5270  W5=(H2-H3)/TAN(P1)
5280  W[N]=2*W5+W1+W2
5290  GOTO 5320
5300  IF H2>D2 THEN 5310
5301  W[N]=W1+W2
5305  GOTO 5320
5310  W[N]=W1
5320  IF N=10 THEN 5340
5330  GOTO 5240
5340  PRINT TAB(5);"BATTERED TRENCH = ";V[2];" M3/ML"
5350  RETURN
5400  REM battered trench duration
```

```
5410  N=0
5420  N=N+1
5430  IF I[N]=0 THEN 5470
5450  E[N,7]=V[2]/E[N,6]
5470  IF N=9 THEN 5490
5480  GOTO 5420
5490  RETURN
5550  REM printing results of calculations
5555  N=6
5560  PRINT #N;TAB(50);"EXCAVATION"
5570  PRINT #N;TAB(50);"**********"                          TD";TAB(4
5580  PRINT #N                                               33);
5590  PRINT #N;TAB(25);"VERTICAL TRENCH";TAB(65);"BATTERED TRENC
5600  PRINT #N;TAB(5);"ITEM";TAB(15);"M/C";TAB(25);"VOL";TAB(33)
5610  PRINT #N;"REV";TAB(51);"DUR";TAB(65);"VOL";TAB(74);"STD";T
5615  PRINT #N;TAB(92);"DUR"
5620  PRINT #N;TAB(25);"M3/m";TAB(42);"M3/hr";TAB(51);"HR/ml";
5630  PRINT #N;TAB(65);"M3/m";TAB(74);"m3/hr";TAB(83);"M3/hr";TA
5640  PRINT #N                                               2);"Hr/
5650  M=0
5660  M=M+1
5690  IF E[M,1]=0 THEN 5730
5700  PRINT #N;TAB(16);M;TAB(25);V[1];TAB(33);E[M,2];TAB(42);E[M
5710  PRINT #N;TAB(51);E[M,4];
5715  IF V[2]=0 THEN 5730
5720  PRINT #N;TAB(65);V[2];TAB(74);E[M,5],TAB(83);E[M,6];TAB(93
5730  PRINT #N                                                 [M
5735  IF M=9 THEN 5750
5740  GOTO 5660
5750  PRINT #N
5790  RETURN
5800  REM summary of data
5810  PRINT TAB(20);"SUMMARY OF CALCULATIONS"
5820  PRINT
5830  PRINT TAB(10);"Vertical Trench = ";V[1];" M3/mL"
5840  PRINT TAB(10);"m/c";TAB(25);"Std. output";TAB(45);"Rev ou
5845  PRINT "Duration"
5846  PRINT TAB(25);"m3/hr";TAB(45);"m3/hr";TAB(60);"hr/ml"
5850  FOR I1=1 TO 9
5870  IF E[I1,1]=0 THEN 5900
5880  PRINT  USING 5885;I1,E[I1,2],E[I1,3],E[I1,4]
5885  IMAGE 10x,d,14x,dd.dd,14x,dd.dd,14x,dd.dd
5900  NEXT I1
5910  IF V[2]=0 THEN 5998
5920  PRINT TAB(10);"BATTERED TRENCH - ";V[2];" M3/ML"
5940  FOR I1=1 TO 9
5950  N=7*I1-6
5970  IF E[I1,1]=0 THEN 5990
5980  PRINT  USING 5885;I1,E[I1,5],E[I1,6],E[I1,7]
5990  NEXT I1
5998  RETURN
6000  REM   bucket capacities
6010  REM         array b(2,23),    i=1 width,    i=2 capacity
6011  REM  j=1 to 6 - jcb 3. 3c. 3C
```

```
6012  REM     J =7 to 10 - jcb 805, 806, 807
6013  REM     J =11 to 15 - jcb 808
6014  REM     J =16 to 19 - rh 6
6015  REM     J =20 to 23 hy-mac 580
6020  IF I1 <= 3 THEN 6080
6030  IF I1 <= 6 THEN 6100
6040  IF I1=9 THEN 6120
6050  IF I1=7 THEN 6140
6060  X1=15
6070  GOTO 6150
6080  X1=0
6090  GOTO 6150
6100  X1=6
6110  GOTO 6150
6120  X1=10
6130  GOTO 6150
6140  X1=19
6150  X1=X1+1
6160  IF G[I1] <= B[1,X1] THEN 6180
6170  GOTO 6150
6180  R4=B[2,X1]-B[2,X1-1]
6190  R2=B[1,X1]-B[1,X1-1]
6200  R2=R4/R2
6210  R3=G[I1]-B[1,X1-1]
6220  B3=(R3*R2)+B[2,X1-1]
6270  RETURN
7000  REM system use variable input
7010  DIM D[2,7],M[20]
7020  READ #2,1;N
7030  MAT  READ #3,N;D,M
7040  N1=M[1]
7050  D1=D[1,3]
7060  D2=D[2,3]
7070  W1=D[1,4]
7080  W2=D[2,4]
7090  S1=M[3]
7100  O1=M[4]
7110  PRINT TAB(10);"LOADING HEIGHT ";TAB(35);
7120  INPUT H1
7130  D[1,1]=H1
7140  PRINT TAB(10);"REQUIRED REACH";TAB(35);
7150  INPUT R1
7160  D[2,1]=R1
7165  READ #1,8;I1
7167  FOR I1=1 TO 20
7170  FOR J1=1 TO 5
7172  READ #1;H[I1,J1]
7174  NEXT J1
7175  NEXT I1
7176  P1=H[M[12],5]
7190  PRINT TAB(10);"ESTIMATE OF BUCKET WIDTH    ";
7200  INPUT B2
7205  D[1,6]=B2
7210  MAT  PRINT #3,N;D,M
```

```
7220  RETURN
8000  REM printing data to system file
8010  DIM C[10]
8015  READ #4,1;N
8020  N=N+1
8030  PRINT #4,1;N
8040  READ #2,1;N1
8050  N1=2*N1+1
8060  MAT  READ #2,N1;C
8070  C[1]=N+1
8080  MAT  PRINT #2,N1;C
8090  MAT  PRINT #4,N+1;V,E
8100  IF C[2]=0 THEN 8120
8110  CHAIN "shore"
8120  IF C[3]=0 THEN 8140
8130  CHAIN "bed"
8140  IF C[4]=0 THEN 8160
8150  CHAIN "play"
8160  IF C[5]=0 THEN 8180
8170  CHAIN "bfill"
8180  IF C[6]=0 THEN 8200
8190  CHAIN "bfill"
8200  CHAIN V1,"drepo",280
9000  END
```

SHORE

```
10   COM D1,F$[30]
15   REM                   DRAINAGE SYNTHESIS - TRENCH SHORING
20   REM                   N.  BARTRAM                FEB '79
30   FILES *,*,*,*,*,*,*,*,*
35   DIM S[5,4],D[2,7],M[20],R$[3],N$[10],R[5,5],C[10]
40   G9=LEN(F$)
105   ASSIGN F$[4,6],2,V1
110   ASSIGN F$[7,9],3,V1
115   ASSIGN F$[10,12],4,V1
120   ASSIGN F$[13,15],5,V1
130   ASSIGN "speo",6,V1
150   PRINT TAB(25);"SHORING"
160   PRINT TAB(25);"*******"
170   IF G9=0 THEN 200
180   GOSUB 1000
185   REM   1000=system variables
190   GOTO 210
200   GOSUB 1400
205   REM    1400=non-system variables
210   GOSUB 1800
215   REM 1800=shoring types required
220   IF D1 <= 6 THEN 250
225   GOSUB 7000
250   GOSUB 2000
255   REM 2000 = materials req.
260   GOSUB 3000
270   REM 3000=standard times
280   GOSUB 500
290   GOSUB 4000
300   REM 4000 = review data
310   IF G9=0 THEN 340
320   GOSUB 3700
325   REM 3700 = print to system files
340   PRINT TAB(5);"Do you want a print of these calculations
350   GOSUB 5000
360   GOTO P OF 400,410,340
400   GOSUB 6000
410   PRINT TAB(5);"Any more cases to consider   ";
420   GOSUB 5000
430   GOTO P OF 170,450,410
450   STOP
500   REM shorco boxes
510   PRINT TAB(10);"SHORCO BOXES"
515   N1=0
520   IF D1 <= 2.6 THEN 570
525   I=2
530   I=I+1
535   D2=1.3*I
540   IF D1 <= D2 THEN 570
550   N1=N1+1
560   GOTO 530
570   N1=N1+1
```

```
575  PRINT TAB(5);N1;"Boxes are required - 1 No. 2.6 * 3.4 ";
577  R[5,1]=N1
580  IF N1=1 THEN 590
585  PRINT "+ ";N1-1;" No. 1.3 * 3.4"
590  PRINT
600  PRINT TAB(10);"METHODS"
610  PRINT TAB(10);"[1]   Using a pre-dug pilot trench, OR"
620  PRINT TAB(10);"[2]   Excavate inside the box."
630  PRINT TAB(10);"Which method do you want to consider   ";
640  INPUT M1
650  IF M1=1 THEN 730
660  IF M1=2 THEN 680
670  GOTO 630
680  REM method 2
690  S1=15.25+.8295*D1
700  N2=N1-1
710  S1=S1+N2*8.8
715  GOTO 770
730  REM method 1
740  S1=14.5+.8295*D1
750  N2=N1-1
760  S1=S1+(N2*9.98)
770  S1=S1*1.1834
775  S[5,2]=S1/3.4
780  RETURN
1000  REM system variables
1005  READ #2,1;N
1010  MAT  READ #3,N;D,M
1020  IF D[1,3]>0 THEN 1060
1030  PRINT TAB(10);"SUPPORTED DEPTH   =   ";
1040  INPUT D1
1045  D[1,3]=D1
1050  GOTO 1070
1060  D1=D[1,3]
1070  IF D[1,4]>0 THEN 1110
1080  PRINT TAB(10);"TRENCH WIDTH      =   ";
1090  INPUT W1
1100  GOTO 1120
1110  W1=D[1,4]+D[2,4]
1120  IF D1 <= 6 THEN 1200
1125  REM space for ground parameters
1200  MAT  PRINT #3,N;D,M
1210  RETURN
1400  REM non-system variables
1410  PRINT TAB(10);"SUPPORTED DEPTH   =   ";
1420  INPUT D1
1430  PRINT TAB(10);"TRENCH WIDTH      =   ";
1440  INPUT W1
1450  IF D1 <= 6 THEN 1600
1455  REM ground parameters
1600  RETURN
1800  REM shoring types
1810  MAT S=ZER
1820  PRINT TAB(10);"THE FOLLOWING SHORING TYPES ARE CONSIDERED
```

```
1830  PRINT TAB(10);"[1]   CLOSE SHEETING  {Sheets @ 0.33 m ctr
1840  PRINT TAB(10);"[2]   MEDIUM SHEETING {Sheets @ 0.76 m ctr
1850  PRINT TAB(10);"[3]   OPEN SHEETING   {Sheets @ 1.1  m ctr
1860  PRINT TAB(10);"[4]   PINCHERS        {Sheets @ 1.5  m ctr
1870  PRINT TAB(10);"[5]   'SHORCO'  LINING SYSTEMS"
1875  PRINT
1880  PRINT TAB(5);"Enter the numbers of any types you do NOT w
1885  PRINT TAB(5);"All on one line seperated by commas   ?";
1890  LINPUT N$
1895  FOR J=1 TO 5
1900  CONVERT N$[2*J-1,2*J-1] TO I,1910
1905  S[I,1]=1
1910  NEXT J
1915  RETURN
2000  REM materials req,
2010  MAT R=ZER
2020  PRINT TAB(10);"DESIGN BAY LENGTH    =   ";
2030  INPUT L1
2040  C1=L1-.38
2050  REM    SHEETS
2052  DIM J[4]
2054  J[1]=.33
2056  J[2]=.78
2058  J[3]=1.14
2060  J[4]=1.5
2070  FOR I=1 TO 4
2072  S1=J[I]
2074  IF S1=0 THEN 2088
2076  R1=C1/S1
2078  G2=R1-INT(R1)
2080  R[I,1]=INT(R1)+1
2082  IF G2<.5 THEN 2086
2084  R[I,1]=R[I,1]+1
2086  R[I,1]=2*R[I,1]
2088  NEXT I
2130  REM walers
2140  IF D1 <= 1.5 THEN 2200
2160  IF D1 <= 4.5 THEN 2230
2170  R[1,2]=R[2,2]=R[3,2]=R[4,2]=.1
2180  R[1,3]=R[2,3]=R[3,3]=R[4,3]=.3
2190  GOTO 2250
2200  R[1,2]=R[2,2]=R[3,2]=R[4,2]=.075
2210  R[1,3]=R[2,3]=R[3,3]=R[4,3]=.225
2220  GOTO 2250
2230  R[1,2]=R[2,2]=R[3,2]=R[4,2]=.1
2240  R[1,3]=R[2,3]=R[3,3]=R[4,4]=.15
2250  R[4,3]=R[4,2]=.075
2254  FOR J=1 TO 5
2255  G2=J*1.2
2260  IF D1-G2>.4 THEN 2280
2270  N=J
2275  GOTO 2285
2280  NEXT J
2285  N=2*N
```

```
2290  R[1,4]=R[2,4]=R[3,4]=N
2295  R[4,4]=N*R[4,1]/2
2300  REM struts
2310  N=N/2
2320  FOR J=1 TO 5
2325  G2=J*1.5
2330  IF L1-G2 >= .5 THEN 2350
2340  N1=J
2345  GOTO 2360
2350  NEXT J
2360  R[1,5]=R[2,5]=R[3,5]=N1*N
2370  IF S[4,1]=1 THEN 2400
2380  REM pincher struts
2390  R[4,5]=R[4,4]/2
2400  PRINT TAB(10);"MATERIAL REQUIREMENTS"
2410  PRINT TAB(10);"SHEETS  -  CLOSE  =  ";R[1,1]
2420  PRINT TAB(10);"        -  MED    =  ";R[2,1]
2430  PRINT TAB(10);"        -  OPEN   =  ";R[3,1]
2440  PRINT TAB(10);"        -  PINCH  =  ";R[4,1]
2445  PRINT
2450  PRINT TAB(10);"WALERS  -  SIZE   =  ";R[1,2];"*";R[1,3];"*
2455  PRINT                                          R[1,4];"N
2460  PRINT TAB(10);"STRUTS  -  CLOSE  =  ";R[1,5]
2470  PRINT TAB(10);"        -  MED    =  ";R[2,5]
2480  PRINT TAB(10);"        -  OPEN   =  ";R[3,5]
2490  PRINT TAB(10);"        -  PINCH  =  ";R[4,5]
2500  RETURN
3000  REM standard times
3010  REM sheets
3020  S2=.15*D1+.13+.4+(.003*D1)+1
3030  REM walers
3035  L2=L1
3040  FOR J=1 TO 4
3050  B1=R[J,2]*R[J,3]
3052  IF J<4 THEN 3060
3056  L1=.25
3060  S3=.029+(.25*B1)
3070  S4=.343+(.37*B1)
3080  S5=.235+(.13*B1)
3090  S3=(S3*L1)+.254+(.0017*B1)
3100  S4=(S4*L1)+.773+(.08*B1)
3110  S5=(S5*L1)+.385+(.121*B1)
3112  IF J <= 2 THEN 3120
3114  S4=S4-.773
3120  S[J,2]=(S3+S4+S5)*R[J,4]
3130  NEXT J
3135  L1=L2
3140  REM sum remaining elements
3150  FOR J=1 TO 4
3160  S[J,2]=S[J,2]+(S2*R[J,1])+(1.53*R[J,5])
3170  NEXT J
3180  FOR J=1 TO 4
3185  S[J,2]=S[J,2]*1.204
3190  S[J,2]=S[J,2]/L1
```

```
3200  S[J,2]=S[J,2]/60
3210  S[J,2]=1/S[J,2]
3230  NEXT J
3240  RETURN
3500  PRINT TAB(5);"Do you want to amend this output  ";
3510  GOSUB 5000
3520  GOTO P OF 3560,3590,3500
3560  PRINT TAB(10);"Eter the revised output (mlin/hr)   ";
3570  INPUT R1
3580  GOTO 3600
3590  R1=0
3600  RETURN
3700  REM system file storage
3710  READ #5,1;N1
3720  N1=N1+1
3730  PRINT #5,1;N1
3740  MAT  PRINT #5,N1+1;S,R
3745  PRINT #5;L1
3750  READ #2,1;N
3760  R1=2*N+1
3770  MAT  READ #2,R1;C
3780  C[2]=N1+1
3790  MAT  PRINT #2,R1;C
3800  IF C[3]=0 THEN 3820
3810  CHAIN "bed"
3820  IF C[4]=0 THEN 3840
3830  CHAIN "play"
3840  IF C[5]=0 THEN 3860
3850  CHAIN "bfill"
3860  IF C[6]=0 THEN 3880
3870  CHAIN "bfill"
3880  CHAIN V1,"drepo",280
4000  REM revising outputs
4010  PRINT TAB(10);"STANDARD OUTPUTS"
4020  PRINT
4030  IF S[1,1]=1 THEN 4100
4040  PRINT TAB(10);"CLOSE SHEETING = ";S[1,2];"  Mlin/hr"
4050  S[1,3]=S[1,2]
4060  GOSUB 3500
4070  IF R1=0 THEN 4090
4080  S[1,3]=R1
4090  S[1,4]=1/S[1,3]
4100  IF S[2,1]=1 THEN 4170
4110  PRINT TAB(10);"MEDIUM SHEETING = ";S[2,2];"  Mlin/hr"
4120  GOSUB 3500
4130  S[2,3]=S[2,2]
4140  IF R1=0 THEN 4160
4150  S[2,3]=R1
4160  S[2,4]=1/S[2,3]
4170  IF S[3,1]=1 THEN 4240
4180  PRINT TAB(10);"OPEN SHEETING  =  ";S[3,2];"  Mlin/hr"
4190  S[3,3]=S[3,2]
4200  GOSUB 3500
4210  IF R1=0 THEN 4230
```

```
4220  S[3,3]=R1
4230  S[3,4]=1/S[3,3]
4240  IF S[4,1]=1 THEN 4310
4250  PRINT TAB(10);"PINCHERS         =  ";S[4,2];"  Mlin/hr"
4260  S[4,3]=S[4,2]
4270  GOSUB 3500
4280  IF R1=0 THEN 4300
4290  S[4,3]=R1
4300  S[4,4]=1/S[4,3]
4310  PRINT TAB(10);"SHORCO BOXES - 1 No. 2.6 * 3.4 ";
4320  IF N1=1 THEN 4340
4330  PRINT " + ";N1-1;" No. 1.3 * 3.4 ";
4340  S[5,2]=S[5,2]/60
4350  S[5,2]=1/S[5,2]
4360  PRINT TAB(20);S[5,2];"  Mlin/hr"
4370  S[5,3]=S[5,2]
4380  GOSUB 3500
4390  IF R1=0 THEN 4410
4400  S[5,3]=R1
4410  S[5,4]=1/S[5,3]
4420  RETURN
5000  INPUT R$
5010  R$=UPS$(R$)
5020  P=0
5030  IF R$="YES" THEN 5070
5040  IF R$="NO" THEN 5060
5050  P=P+1
5060  P=P+1
5070  P=P+1
5080  RETURN
6000  REM printing to line printer
6001  DIM W$[20],X$[10]
6005  I$="!"
6020  N=6
6030  PRINT #N;TAB(30);"SHORING"
6040  PRINT #N;TAB(30);"*******"
6045  GOSUB 6400
6050  PRINT #N; USING 6060
6060  IMAGE 4x,"--------------------------------------------------
6070  IMAGE 4x,"!",9x,"!",24x,"!  std     ! rev     ! duration !"
6080  PRINT #N; USING 6070
6090  PRINT #N;TAB(4);"!   type  !   requirements";TAB(39);"! o
6095  PRINT #N;"! mlin/hr  !"                              jt  ! output
6100  PRINT #N;TAB(4);"!";TAB(14);"!";TAB(39);"! mlin/hr ! mlin
6110  PRINT #N; USING 6060
6120  IMAGE 4x,a,9x,a,x,9a,dd,3x,3a,6x,a,9x,a,9x,a,10x,a
6125  W$="sheets - "
6126  X$="no."
6130  PRINT #N; USING 6120;I$,I$,W$,R[1,1],X$,I$,I$,I$,I$
6140  IMAGE 4x,a,x,7a,x,"! walers ",.ddd,x,.ddd," - ",dd,xx,a,x
                          dd,xxx,a,x,dd.dd,xxx,a,x,dd.dd.4
6145  W$="close"
6150  PRINT #N; USING 6140;I$,W$,R[1,2],R[1,3],R[1,4],I$,S[1,2]
6160  IMAGE 4x,"!",9x,"! struts - ",dd," no",9x,"!",9x,"!",9x,"
                                                 S[1,3],I$,S[1,4
6170  PRINT #N; USING 6160;R[1,5]
                                                 0x,"!"
```

```
6180  PRINT #N; USING 6060
6185  W$="sheets - "
6190  PRINT #N; USING 6120; I$, I$, W$, R[2, 1], X$, I$, I$, I$, I$
6195  W$="medium"
6200  PRINT #N; USING 6140; I$, W$, R[2, 2], R[2, 3], R[2, 4], I$, S[2, 2],
6210  PRINT #N; USING 6160; R[2, 5]                         S[2, 3], I$, S[2, 4]
6220  PRINT #N; USING 6060
6225  W$="sheets - "
6230  PRINT #N; USING 6120; I$, I$, W$, R[3, 1], X$, I$, I$, I$, I$
6235  W$="open"
6240  PRINT #N; USING 6140; I$, W$, R[3, 2], R[3, 3], R[3, 4], I$, S[3, 2],
6250  PRINT #N; USING 6160; R[3, 5]                         S[3, 3], I$, S[3, 4],
6260  PRINT #N; USING 6060
6265  W$="sheets - "
6270  PRINT #N; USING 6120; I$, I$, W$, R[4, 1], X$, I$, I$, I$, I$
6275  W$="pinchers"
6280  PRINT #N; USING 6140; I$, W$, R[4, 2], R[4, 3], R[4, 4], I$, S[4, 2],
6290  PRINT #N; USING 6160; R[4, 5]                         S[4, 3], I$, S[4, 4],
6300  PRINT #N; USING 6060
6310  PRINT #N; TAB(4); "! shorco  !  1 no 2.6 * 3.4          !";
6315  PRINT #N; USING 6320; S[5, 2], I$, S[5, 3], I$, S[5, 4], I$
6320  IMAGE x, dd.dd, 3x, a, x, dd.dd, 3x, a, x, dd.dd, 3x, a
6330  IF R[5, 1]=1 THEN 6370
6340  N1=R[5, 1]-1
6350  PRINT #N; USING 6360; I$, I$, N1, I$, I$, I$, I$
6360  IMAGE 4x, a, 9x, a, 3x, d, " no 1.3 * 3.4", 7x, a, 9x, a, 9x, a, 10x, a
6370  PRINT #N; USING 6060
6380  RETURN
6400  PRINT #N; TAB(20); "depth    =  "; D1; " m."
6410  PRINT #N; TAB(20); "bay length = "; L1; " m."
6420  RETURN
7000  REM
7010  CHAIN "shore1"
7090  END
```

BED

```
5   COM T1,F$[30]
10  REM                    BEDDING TIME ANALYSIS
15  REM                    N. Bartram            April '79
20  FILES *,*,*,*,*,*,*,*,od,bedo
25  DIM B[28],C[28],U[4,10],O[28,2],R$[3]
30  DIM R[20],Y[6],X[4],T[6]
35  DIM D[2,7],M[20],M$[80]
50  FOR J=1 TO 4
55  I=3*J-2
60  ASSIGN F$[I,I+2],J,V1
65  NEXT J
70  ASSIGN F$[16,18],5,V1
72  MAT  READ #9,9;O,U
75  MAT  READ #9,5;B
76  MAT R=ZER
77  PRINT TAB(10);"PIPE BEDDING"
80  Z9=0
85  IF V1=3 THEN 105
90  GOSUB 4700
95  Z9=1
100  GOTO 115
105  MAT D=ZER
110  MAT M=ZER
115  GOSUB 500
116  MAT X=ZER
117  MAT Y=ZER
120  N=0
125  N=N+1
130  PRINT TAB(15);"Analysis of pipe number  ";N
140  IF M[N+12] <= 5 THEN 185
150  PRINT TAB(5);"** ERROR - BEDDING SHAPE CODE OUT OF RANGE **
160  PRINT TAB(10);"Shape code (0 for code list )  ";
165  INPUT M[N+12]
170  IF M[N+12]>0 THEN 140
175  GOSUB 1100
180  GOTO 140
185  IF M[N+12] <> 5 THEN 200
190  GOSUB 3000
195  GOTO 220
200  IF Z9=1 THEN 210
205  GOSUB 1300
210  GOSUB 2500
215  GOSUB 3000
220  GOSUB 5000
225  GOSUB 5200
230  IF N<M[1] THEN 125
235  R[18]=R[15]+R[16]
236  PRINT TAB(5);"TOTAL DURATION FOR TRENCH = ";R[18];" HRS'N"
240  IF Z9=1 THEN 305
245  PRINT TAB(5);"Do you want a print of this data   ".
250  GOSUB 850
255  GOTO K OF 275,300,245
```

```
275   GOSUB 7000
280   PRINT TAB(5);"Any more cases to consider    ";
285   GOSUB 850
290   GOTO K OF 105,315,280
305   GOSUB 5600
315   STOP
500   IF M[1]>0 THEN 590
570   PRINT TAB(10);"How many pipes in the trench    ";
580   INPUT M[1]
590   FOR N=1 TO M[1]
595   PRINT
600   PRINT TAB(15);"DATA FOR PIPE NUMBER ";N
610   PRINT
615   IF D[N,2]>0 THEN 635
620   PRINT TAB(10);"Diameter";TAB(35);
630   INPUT D[N,2]
635   IF D[N,3]>0 THEN 655
640   PRINT TAB(10);"Depth";TAB(35);
650   INPUT D[N,3]
655   IF D[N,4]>0 THEN 675
660   PRINT TAB(10);"Trench Width";TAB(35);
670   INPUT D[N,4]
675   IF M[N+6]>0 THEN 735
680   PRINT TAB(10);"Pipe Material Code"
690   PRINT TAB(10);"(0 for code list)";TAB(35);
700   INPUT M[N+6]
710   IF M[N+6]>0 THEN 735
720   GOSUB 1000
730   GOTO 680
735   IF M[N+12]>0 THEN 800
740   PRINT TAB(10);"Shape Code"
750   PRINT TAB(10);"(0 for code list)";TAB(35);
760   INPUT M[N+12]
770   IF M[N+12]>0 THEN 800
780   GOSUB 1100
790   GOTO 740
800   NEXT N
805   PRINT
810   RETURN
850   K=1
855   INPUT R$
860   R$=UPS$(R$)
865   IF R$="YES" THEN 910
880   IF R$="NO" THEN 900
890   K=K+1
900   K=K+1
910   RETURN
1000   M$="CLAY,STRESSED CONCRETE,OTHER CONCRETE,IRON,STEEL,PLAST
1005   PRINT TAB(15);"CODE";TAB(35);"MATERIAL"     A/CEMENT,P/FIBR
1010   K=L=0
1020   K=K+1
1030   PRINT TAB(16);K,TAB(35);
1040   L=L+1
1050   IF M$[L,L]=","  THEN [illegible]
```

```
1060 PRINT M$[L,L];
1070 GOTO 1040
1080 PRINT
1085 IF K<8 THEN 1020
1090 RETURN
1100 PRINT TAB(15);"CODE";TAB(35);"DESCRIPTION"
1110 PRINT TAB(16);"1";TAB(35);"Concrete Cradle"
1120 PRINT TAB(16);"2";TAB(35);"Concrete Arch"
1130 PRINT TAB(16);"3";TAB(35);"Granular Bed"
1140 PRINT TAB(16);"4";TAB(35);"Granular Bed & Surround"
1145 PRINT TAB(16);"5";TAB(35);"SPECIAL"
1150 PRINT TAB(15);"(see handbook for detailed descriptions)"
1160 RETURN
1200 REM shape 1
1210 PRINT TAB(10);"SHAPE CODE 1; STANDARD DIMENSIONS"
1220 PRINT TAB(15);"X1 = Bc * ";U[1,1];"MIN = Bc + ";U[1,2]
1230 PRINT TAB(15);"Y1 = D  * ";U[1,3];"MIN = ";U[1,4];"MIXED S
1240 PRINT TAB(15);"Y1 = d  * ";U[1,5];"MIN = ";U[1,6];"UNIFORM
1250 PRINT TAB(15);"Y2 = Bc * ";U[1,7];"MIN = ";U[1,8]
1260 PRINT TAB(15);"Y3 = ";U[1,9]
1265 RETURN
1300 GOSUB M[N+12] OF 1200,1600,1700,1800
1305 GOTO M[N+12] OF 1310,1310,1350,1350
1310 PRINT
1320 PRINT TAB(5);"DO you want the concrete to extend to the tr
1330 GOSUB 850                                              h sides
1335 GOTO K OF 1340,1350,1320
1340 U[M[N+12],1]=99
1350 PRINT TAB(5);"Do you want to revise any of these dimension
1360 GOSUB 850
1365 GOTO K OF 1370,1590,1350
1370 PRINT TAB(10);"Instructions  ";
1380 GOSUB 850
1390 GOTO K OF 1430,1440,1370
1430 GOSUB 2000
1440 GOSUB 2100
1450 PRINT TAB(10);"Any more revisions  ";
1460 GOSUB 850
1470 GOTO K OF 1370,1510,1450
1510 PRINT TAB(10);"DO you want to inspect this data again   ";
1520 GOSUB 850
1530 GOTO K OF 1570,1590,1510
1570 GOSUB M[N+12] OF 1200,1600,1700,1800
1580 GOTO 1360
1590 RETURN
1600 REM shape 2
1610 PRINT TAB(10);"SHAPE CODE 2; STANDARD DIMENSIONS"
1620 PRINT TAB(15);"X1 = Bc * ";U[2,1];"MIN = Bc + ";U[2,2]
1630 PRINT TAB(15);"Y1 = Bc * ";U[2,3];"MIN = ";U[2,4];"MIXED S
1640 PRINT TAB(15);"Y1 = Bc * ";U[2,5];"MIN = ";U[2,6];"UNIFORM
1650 PRINT TAB(15);"Y2 = Bc * ";U[2,7];"MIN = ";U[2,8]
1660 PRINT TAB(15);"Y3 = D  * ";U[2,9];"MIN = ";U[2,10]
1670 RETURN
1700 REM shape 3
```

```
1710  PRINT TAB(10);"SHAPE CODE 3; STANDARD DIMENSIONS"
1720  PRINT TAB(15);"X1 = Tw"
1730  PRINT TAB(15);"Y1 = Bc * ";U[3,3];"MIN = ";U[3,4];"MIXED S
1740  PRINT TAB(15);"Y1 = Bc * ";U[3,5];"MIN = ";U[3,6];"UNIFORM
1750  PRINT TAB(15);"Y2 = Bc * ";U[3,7]
1760  PRINT TAB(15);"Y3 = ";U[3,9]
1770  RETURN
1800  REM shape 4
1810  PRINT TAB(10);"SHAPE CODE 4; STANDARD DIMENSIONS;"
1820  PRINT TAB(15);"X1 = Tw"
1830  PRINT TAB(15);"Y1 = D  * ";U[4,3];"MAX = ";U[4,4];"MIXED S
1840  PRINT TAB(15);"Y1 = D  * ";U[4,5];"MAX = ";U[4,6];"UNIFORM
1860  RETURN
2000  PRINT TAB(10);"Revising standard dimensions"
2010  PRINT TAB(10);"1 - Dimension (y1,y2 etc...)"
2020  PRINT TAB(10);"2 - Standard or min/max (s/m)"
2030  PRINT TAB(10);"3 - Ground , Uniform, Mixed, Not applicable
2040  PRINT TAB(10);"4 - Revised figure"                    /m/
2050  PRINT TAB(10);"Example to change Y1 to 0.5 * Bc, standard
2060  PRINT TAB(15);"y1,s,m,0.5"                          ixed grou
2070  PRINT
2080  RETURN
2100  DIM A$[2],AO$[12]
2110  PRINT TAB(5);"REVISION";TAB(15);
2115  INPUT AO$
2120  AO$=UPS$(AO$)
2121  A$=AO$[1,2]
2122  B$=AO$[4,4]
2123  D$=AO$[6,6]
2124  CONVERT AO$[8,12] TO X,2192
2126  I=1
2130  IF A$="X1" THEN 2280
2140  IF A$="Y1" THEN 2270
2150  IF A$="Y2" THEN 2260
2160  IF A$="y3" THEN 2250
2170  PRINT "ERROR - ";A$;"  Should be x1, y1,y2, or y3, Re-type
2180  INPUT A$
2185  A$=UPS$(A$)
2190  GOTO 2130
2192  PRINT "Error - ";AO$[8,8];"  Should be a number "
2194  GOTO 2110
2250  I=I+2
2260  I=I+4
2270  I=I+2
2280  IF B$="S" THEN 2340
2290  IF B$="M" THEN 2330
2300  PRINT "ERROR - ";B$;" should be s or m, Re-type   ";
2310  INPUT B$
2315  B$=UPS$(B$)
2320  GOTO 2280
2330  I=I+1
2340  IF D$="U" THEN 2400
2350  IF D$="M" THEN 2410
2360  IF D$="N" THEN 2410
```

```
2370  PRINT "ERROR - ";D$;"  should be u,m or n, Re-type   ";
2380  INPUT D$
2385  D$=UPS$(D$)
2390  GOTO 2340
2400  I=I+2
2410  U[M[N+12],I]=X
2420  RETURN
2500  REM pipe Bc
2510  FOR I=1 TO 28
2520  IF D[N,2] <= B[I] THEN 2540
2530  NEXT I
2540  IF M[N+6] <= 8 THEN 2602
2550  PRINT "ERROR - Pipe material code, is out of range"
2560  PRINT "Enter pipe material code number (0 for code list)
2570  INPUT M[N+6]
2580  IF M[N+6]>0 THEN 2602
2590  GOSUB 1000
2600  GOTO 2560
2602  R1=B[I]-B[I-1]
2604  R2=D[N,2]-B[I-1]
2606  R2=R2/R1
2610  IF M[N+6] <> 5 THEN 2660
2620  PRINT "Sorry I don't have any data for steel pipes "
2630  PRINT "Enter the pipe outside diameter (m)    ";
2640  INPUT B1
2650  GOTO 2750
2660  B1=M[N+6]
2670  MAT  READ #9,B1;C
2675  IF C[I]>0 THEN 2690
2680  PRINT "Sorry I don't have data on this pipe diameter "
2685  GOTO 2630
2690  R3=C[I]-C[I-1]
2695  B1=C[I-1]+R3
2700  PRINT TAB(5);"PIPE OUTSIDE DIAMETER = ";B1;" (m)"
2750  RETURN
3000  REM dimensions & Volumes
3010  PRINT TAB(10);"Working Dimensions"
3020  P1=3.14159
3030  A1=P1*B1*B1/4
3040  PRINT TAB(4);"Which ground condition (u/m/n)  ";
3050  INPUT B$
3055  B$=UPS$(B$)
3060  IF B$="U" THEN 3110
3070  IF B$="M" THEN 3130
3080  IF B$="N" THEN 3130
3100  GOTO 3040
3110  F1=5
3120  GOTO 3140
3130  F1=3
3140  GOSUB M[N+12] OF 3300,4100,4300,4500,4500
3150  A6=D[N,4]*(Y[N]+B1+Y[N+4])
3160  R[N+12]=A6
3170  R[17]=R[17]+A6
3180  PRINT TAB(15);"SUMMARY OF BEDDING DIMENSIONS & VOLUMES
```

```
3190  PRINT "Y1";Y[N];"y2";Y[N+2];"y3";Y[N+4];"x1 ";X[N];"x2 ";X
3200  PRINT "Bc ";B1
3220  PRINT "Volumes  - Bedding ";R[N];"Cover  ";R[N+2];"m3/ml
3230  PRINT "Total displaced volume =";R[12+N]
3240  PRINT "Total displaced volume for trench = ";R[17]
3250  RETURN
3300  REM shape code 1 Volumes
3310  T[N+2]=1
3320  T[N+4]=3
3330  GOSUB 3500
3340  X[N+2]=D[N,4]
3350  Y[N]=U[1,F1]*D[N,2]
3360  GOSUB 3600
3370  GOSUB 3700
3380  Y[N+4]=U[1,9]
3390  GOSUB 4000
3400  GOSUB 3800
3405  A6=D[N,4]*(Y[N]+B1+Y[N+4])
3410  A3=A6-A2-A1
3420  R[N]=A2
3430  R[N+2]=A3
3440  RETURN
3500  REM assigns & checks x(n)
3510  IF U[M[N+12],1]=99 THEN 3570
3520  X[N]=U[M[N+12],1]*B1
3530  Z=U[M[N+12],2]+B1
3540  IF Z<X[N] THEN 3580
3550  X[N]=Z
3560  GOTO 3580
3570  X[N]=D[N,4]
3580  RETURN
3600  REM Checking y(n) against min
3610  Z=U[M[N+12],F1+1]
3620  IF Z<Y[N] THEN 3640
3630  Y[N]=Z
3640  RETURN
3700  REM assigning & checking y(2)
3710  Y[N+2]=U[M[N+12],7]*B1
3720  Z=U[M[N+12],8]
3730  IF Z<Y[N+2] THEN 3750
3740  Y[N+2]=Z
3750  REM
3760  RETURN
3800  REM   area a2 ie Bedding material
3810  A2=(Y[N]+Y[N+2])*X[N]
3820  R1=B1/2
3830  Z1=R1-Y[N+2]
3840  IF Z1=0 THEN 3910
3850  Z2=SQR((R1*R1)-(Z1*Z1))
3860  T1=Z2/Z1
3870  T1=ATN(T1)
3880  A7=R1*R1*T1
3890  A7=A7-(Z2*Z1)
3900  GOTO 3920
```

```
3910  A7=R1*P1*R1/2
3920  A2=A2-A7
3930  PRINT "BEDDING MATERIAL ";A2;"m3/m";""
3940  RETURN
4000  REM checking y(n+4)
4010  Z=U[M[N+12],10]
4020  IF Z<Y[N+4] THEN 4040
4030  Y[N+4]=Z
4040  PRINT "Y(n+4) = ";Y[N+4]
4050  RETURN
4100  REM shape code2
4110  T[N+2]=2
4120  T[N+4]=1
4130  GOSUB 3500
4140  X[N+2]=D[N,4]
4150  Y[N]=U[2,F1]*D[N,2]
4160  GOSUB 3600
4170  GOSUB 3700
4180  Y[N+4]=U[2,9]*D[N,2]
4190  GOSUB 4000
4200  A3=X[N]*(Y[N+4]+(B1/2))
4205  A3=A3-(A1/2)
4220  A2=X[N+2]*(Y[N]+(B1/2))
4225  A2=A2-(A1/2)
4250  R[N]=A2
4260  R[N+2]=A3
4270  RETURN
4300  REM shape code 3
4310  T[N+2]=2
4320  T[N+4]=3
4330  GOSUB 3500
4340  X[N+2]=X[N]
4350  X[N]=D[N,4]
4360  Y[N]=U[3,F1]*B1
4370  GOSUB 3600
4380  GOSUB 3700
4390  Y[N+4]=U[3,9]
4400  GOSUB 4000
4410  GOSUB 3800
4420  R[N]=A2
4440  A6=X[N]*(Y[N]+B1+Y[N+4])
4450  A4=A6-A1-A2
4455  R[N+2]=A4
4470  RETURN
4500  REM   SHAPE CODE 4
4510  T[N+2]=2
4515  T[N+4]=0
4520  Y[N]=U[4,F1]*D[N,2]
4530  Z=U[4,F1+1]
4540  IF Z>Y[N] THEN 4560
4550  Y[N]=Z
4560  Y[N+4]=U[4,9]*D[N,2]
4570  Z=U[4,10]
4580  IF Z>Y[N+4] THEN 4600
```

```
4590  Y[N+4]=Z
4600  A2=D[N,4]*(Y[N]+B1+Y[N+4])
4610  A3=A2-A1
4620  A2=0
4630  R[N]=A3
4640  R[N+12]=A2
4650  RETURN
4700  REM system use input
4710  READ #2,1;N
4730  MAT  READ #3,N;D,M
4740  RETURN
5000  REM outputs
5005  FOR I=1 TO 27
5010  IF D[N,2] <= B[I] THEN 5020
5015  NEXT I
5020  R1=B[I]-B[I-1]
5025  R2=D[N,2]-B[I-1]
5030  R2=R2/R1
5035  R8=10
5040  R1=O[I,1]-O[I-1,1]
5045  R7=(R1*R2)+O[I-1,1]
5050  R1=O[I,2]-O[I-1,2]
5055  R6=(R1*R2)+O[I-1,2]
5056  GOSUB 6000
5065  R7=3/R7
5070  R6=3/R6
5072  R[19]=3
5075  J=0
5077  J2=N+2
5080  J=J+1
5085  J1=2*J+N
5087  J2=J2+2
5090  IF T[J1]=0 THEN 5150
5100  GOTO T[J1] OF 5115,5130,5140
5115  R[J2]=R7
5120  GOTO 5150
5130  R[J2]=R6
5135  GOTO 5150
5140  R[J2]=R8
5150  IF J=2 THEN 5160
5155  GOTO 5080
5160  RETURN
5200  REM revising outputs
5205  PRINT TAB(10);"BEDDING OUTPUTS & DURATIONS"
5210  PRINT TAB(5);"PIPE NUMBER ";N
5215  PRINT
5220  PRINT TAB(5);"BEDDING MATERIAL  ";
5225  GOTO T[N+2] OF 5230,5240,5250
5230  PRINT "CONCRETE"
5235  GOTO 5255
5240  PRINT "GRANULAR"
5243  GOTO 5255
5250  PRINT "SELECTED FILL"
5255  PRINT TAB(10);"VOLUME    = [illegible]
```

```
5260  PRINT TAB(10);"OUTPUT    = ";R[N+4];" M3/hr"
5265  R[N+8]=R[N+4]
5270  PRINT TAB(5);"Do you want to change this output   ";
5275  GOSUB 850
5280  GOTO K OF 5300,5315,5270
5300  PRINT TAB(10);"Input the preffered output (m3/hr)    ";
5310  INPUT R[N+8]
5315  R[N+14]=R[N]/R[N+8]
5320  IF T[N+4]=0 THEN 5420
5325  PRINT TAB(5);"Cover material ";
5330  GOTO T[N+4] OF 5335,5345,5355
5335  PRINT "CONCRETE"
5340  GOTO 5360
5345  PRINT "GRAVEL"
5350  GOTO 5360
5355  PRINT "SELECTED FILL"
5360  PRINT TAB(5);"Volume    ";R[N+2];" [m3/m]"
5365  PRINT TAB(5);"Output    ";R[N+6];" [m3/hr]"
5370  PRINT TAB(5);"Do you want to revise this output   ";
5375  R[N+10]=R[N+6]
5380  GOSUB 850
5385  GOTO K OF 5400,5415,5370
5400  PRINT TAB(10);"Input the preffered output (m3/hr)    ";
5410  INPUT R[N+10]
5415  R[N+14]=R[N+14]+(R[N+2]/R[N+10])
5420  PRINT TAB(5);"TOTAL DURATION   = ";R[N+14];" Hours / m"
5430  RETURN
5600  REM system output
5601  READ #2,1;N
5602  MAT  PRINT #3,N;D,M
5605  MAT C=ZER[10]
5610  READ #2,1;N1
5630  N2=2*N1+1
5640  MAT  READ #2,N2;C
5650  READ #5,1;I1
5660  I1=I1+1
5670  PRINT #5,1;I1
5675  I1=I1+1
5680  C[3]=I1
5690  MAT  PRINT #2,N2;C
5695  MAT  PRINT #5,I1;R
5700  IF C[4]=0 THEN 5720
5710  CHAIN "play"
5720  IF C[5]=0 THEN 5740
5730  CHAIN "bfill"
5740  IF C[6]=0 THEN 5760
5750  CHAIN "bfill"
5760  CHAIN V1,"drepo",280
5770  RETURN
6000  REM
6010  R1=D[N,3]-D[N,2]
6020  R2=R6
6025  R3=R7
6030  R4=R8
```

```
6040  R2=R2*(R1+.1)/2
6050  R3=R3*(R1+.1)/2
6060  R4=R4*(R1+.1)/2
6070  IF R2>R6 THEN 6080
6075  R6=R2
6080  IF R3>R7 THEN 6090
6085  R7=R3
6090  IF R4>R8 THEN 6100
6095  R8=R4
6100  RETURN
7000  REM printing to l/p
8000  REM
8010  GOSUB 2500
8015  PRINT TAB(10);"Enter the following dimensions [m] "
8030  PRINT TAB(10);"Bw    ";
8040  INPUT B2
8045  PRINT TAB(10);"Y1    ";
8046  INPUT Y1
8050  A1=B2*Y1
8060  PRINT TAB(10);"Y2    ";
8065  INPUT Y2
8070  A=(3.14159*B1*B1)/4
8072  A2=B2*Y2
8075  R1=B1/2
8076  A3=A
8080  IF Y2>B1 THEN 8115
8085  Y=ABS(Y2-R1)
8090  X=SQR((R1*R1)-(Y*Y))
8091  T1=0
8092  IF Y=0 THEN 8100
8095  T1=ATN(X/Y)
8100  A3=(R1*R1*T1)-(X*Y)
8105  IF Y2 <= R1 THEN 8115
8110  A3=A-A3
8115  A2=A2-A3
8120  PRINT TAB(10);"Theta    ";
8125  INPUT T1
8126  T1=(3.14159*T1)/180
8130  PRINT TAB(10);"R    ";
8135  INPUT R
8140  A4=0
8145  IF R=0 AND T1=0 THEN 8300
8150  IF T1=0 AND R>0 THEN 8210
8155  IF T1>0 AND R=0 THEN 8250
8160  H2=B2*TAN(T1)/2
8165  A4=B2*H2/2
8170  H3=H2+Y2-R1
8175  X=SQR(H3*H3-R*R)
8180  T2=ATN(X/R)
8185  A5=R*R*T2
8190  A6=R*X
8195  A6=A6-A5
8200  A4=A4-A6
8202  GOTO 8250
```

```
8210  H2=Y2-R1
8220  T2=ATN(B2/(H2*2))
8225  A4=R*R*T2
8230  A4=A4-(H2*B2/2)
8235  A5=A-A3
8240  A4=A4-A5
8245  GOTO 8300
8250  H2=R1-Y2
8255  A4=H2*B2/2
8260  T2=(3.14159/2)-T1
8265  A4=A4-(R1*R1*T2)+A3
8300  R[N]=A4+A2+A1
8310  PRINT TAB(5);"BED MATERIAL CODE (0 FOR LIST)    ";
8320  INPUT R2
8325  IF R2>0 THEN 8350
8330  PRINT TAB(10);"1  -  CONCRETE"
8335  PRINT TAB(10);"2  -  GRANULAR"
8340  PRINT TAB(10);"3  -  SELECTED FILL"
8345  GOTO 8310
8350  T[N+2]=R2
8354  R[N+12]=R[N]+A
8355  T[N+4]=0
8356  PRINT "bed  =";R[N];"displaced = ";R[N+12]
8360  RETURN
9017  END
```

PLAY

```
10   COM N1,F1$[30]
15   REM                      PIPELAYING TIME ANALYSIS
20   REM                     n.bartram         jan'79
30   FILES *,*,*,*,*,*,*,playo,pw
40   ASSIGN F1$[1,3],1,V1
50   ASSIGN F1$[4,6],2,V1
60   ASSIGN F1$[7,9],3,V1
70   ASSIGN F1$[19,21],7,V1
80   DIM R$[3],A$[2],K$[80],H[18,8],K[6],X[28],C[28]
90   DIM T[18],M$[80],C$[80],D[2,7],M[20],G[6,2]
100   PRINT TAB(25);"PIPELAYING"
105   PRINT TAB(25);"**********"
106   GOSUB 1300
110   MAT D=ZER
120   MAT M=ZER
135   J2=0
140   J1=0
145   Z=0
150   IF V1=3 THEN 170
155   Z=1
160   GOSUB 1500
170   GOSUB 500
175   J1=J1+1
180   MAT G=ZER
185   GOSUB 1700
190   GOSUB 2200
195   IF Z=0 THEN 205
200   GOSUB 5000
205   PRINT TAB(5);"Do you want a print of these calculations
210   INPUT R$
220   R$=UPS$(R$)
225   IF R$="YES" THEN 245
230   IF R$="NO" THEN 250
240   GOTO 205
245   GOSUB 3500
250   PRINT TAB(10);"Do you want to analyse anything else    ";
255   INPUT R$
260   R$=UPS$(R$)
265   IF R$="YES" THEN 110
266   IF R$="NO" THEN 280
270   GOTO 250
280   STOP
500   REM   checking input data & input for non system use
510   IF M[1]>0 THEN 525
515   PRINT TAB(10);"Number of pipes in trench";TAB(40);
520   INPUT M[1]
525   I=1
530   IF D[I,3]>0 THEN 550
535   PRINT TAB(10);"Pipe ";I;"Depth [m]";TAB(40);
540   INPUT D[I,3]
550   IF D[I,2]>0 THEN 565
555   PRINT TAB(10);"Pipe ";I;"Diameter [m]";TAB(40);
```

```
560   INPUT D[I,2]
565   IF D[I,5]>0 THEN 580
570   PRINT TAB(10);"Pipe ";I;"Length [m]";TAB(40);
575   INPUT D[I,5]
580   IF M[I+6]>0 THEN 620
585   PRINT TAB(10);"Pipe ";I;"Material [0 for code list]";TAB(4
590   INPUT M[I+6]
600   IF M[I+6]>0 THEN 620
610   GOSUB 1000
615   GOTO 585
620   IF M[I+4]>0 THEN 655
625   PRINT TAB(10);"Pipe ";I;"Bed Material [0 for code list]";T
630   INPUT M[I+4]
640   IF M[I+4]>0 THEN 655
645   GOSUB 1150
650   GOTO 625
655   IF M[1]=I THEN 675
660   I=I+1
670   GOTO 530
675   PRINT TAB(10);"Laser Setting Out";TAB(40);
680   INPUT R$
690   R$=UPS$(R$)
700   IF R$="NO" THEN 725
710   IF R$="YES" THEN 735
720   GOTO 675
725   L3=0
730   GOTO 740
735   L3=1
740   RETURN
1000  REM pipe material code listing
1010  PRINT
1020  PRINT TAB(20);"CODE";TAB(40);"MATERIAL"
1025  PRINT
1030  PRINT TAB(22);"1";TAB(40);"Clay"
1040  PRINT TAB(22);"2";TAB(40);"Prestressed concrete"
1050  PRINT TAB(22);"3";TAB(40);"Concrete"
1060  PRINT TAB(22);"4";TAB(40);"Cast or spun iron"
1070  PRINT TAB(22);"5";TAB(40);"Steel"
1080  PRINT TAB(22);"6";TAB(40);"Plastic"
1090  PRINT TAB(22);"7";TAB(40);"Asbestos cement"
1100  PRINT TAB(22);"8";TAB(40);"Pitch fibre"
1105  PRINT
1110  RETURN
1150  REM Bed material code listing
1160  PRINT
1170  PRINT TAB(20);"CODE";TAB(40);"MATERIAL"
1175  PRINT
1180  PRINT TAB(22);"1";TAB(40);"Sand"
1190  PRINT TAB(22);"2";TAB(40);"Selected Granular"
1200  PRINT TAB(22);"3";TAB(40);"Imported Granular"
1210  PRINT TAB(22);"4";TAB(40);"Mass Concrete"
1220  PRINT TAB(22);"5";TAB(40);"Reinforced Concrete"
1225  PRINT
1230  RETURN
```

```
1300  REM  reading data statements
1301  FOR N2=1 TO 8
1302  P=10*N2-9
1303  READ M$[P,P+9]
1304  NEXT N2
1305  MAT  READ #9,5;X
1310  MAT  READ H,K
1311  DATA "JCB 805   ","JCB 806   ","HY-MAC 580","O&K RH6   ",
1312  DATA "JCB 808   ","CRANE     ","ANY M/C   "            ; 807
1313  DATA .1,.3,.6,.9,1.2,1.5,1.8,2.1
1314  DATA .4,1.15,2.3,3.3,3.9,4.25,4.45,4.5
1315  DATA .22,.95,1.2,1.2,1.2,1.2,1.2,1.2
1316  DATA 2,5.6,6.8,6.95,6.95,6.95,6.95,6.95
1317  DATA .44,.94,1.36,1.6,1.76,1.92,2.08,2.23
1318  DATA .4,1.15,2.28,3.42,4.55,5.7,6.82,7.95
1319  DATA .12,.33,.66,.99,1.34,1.67,2,2.33
1320  DATA .25,.8,1.57,2.37,3.17,3.95,4.75,5.6
1321  DATA .4,1.16,2.35,3.5,4.69,5.58,7.03,8.2
1322  DATA .45,1.25,2.43,3.64,4.85,6.05,7.25,8.45
1323  DATA .14,.36,.72,1.06,1.42,1.78,2.13,2.48
1324  DATA .14,.38,.75,1.12,1.41,1.86,2.23,2.61
1325  DATA 1.16,1.16,1.16,1.16,1.16,1.16,1.16,1.16
1326  DATA .1,.3,.58,.86,1.16,1.45,1.74,2.02
1327  DATA .1,.4,1,1.4,3.1,4.3,5.35,5.4
1328  DATA .5,.9,1.24,1.44,1.6,1.76,1.92,2.08
1329  DATA .14,.39,.75,1.12,1.49,1.86,2.23,2.61
1330  DATA 1.05,1.05,1.05,1.05,1.05,1.05,1.05,1.05
1331  DATA .86,.98,1.02,1.23,1.32,1.66
1341  RETURN
1500  REM    system use variables
1520  READ #2,1;N
1530  MAT  READ #3,N;D,M
1540  RETURN
1700  REM pipelaying outputs
1710  I=0
1720  I=I+1
1730  N=0
1740  N=N+1
1750  IF D[I,2] <= H[1,N] THEN 1770
1760  GOTO 1740
1770  FOR N3=2 TO 18
1780  T[N3]=H[N3,N]-H[N3,N-1]
1790  NEXT N3
1800  R1=H[1,N]-H[1,N-1]
1810  R2=D[I,2]-H[1,N-1]
1820  R2=R2/R1
1830  FOR N3=2 TO 18
1840  T[N3]=H[N3,N-1]+T[N3]*R2
1845  NEXT N3
1850  T[3]=T[3]*D[I,3]/2
1860  L6=T[6]
1870  G=D[I,3]-D[I,2]
1880  T[6]=T[6]*(G+.1)/2
1890  IF L6<T[6] THEN 1910
```

```
1900  T[6]=L6
1910  Z6=D[I,5]/2.44
1920  T[2]=T[2]*Z6
1930  T[3]=T[3]*Z6
1940  T[4]=T[4]*Z6
1950  T[17]=T[17]*Z6
1960  B3=T[18]
1970  IF L3=1 THEN 2000
1990  B3=T[12]+T[13]+T[14]
2000  IF M[I+4] <= 3 THEN 2020
2010  B3=B3+T[2]+T[3]+T[4]
2020  B3=B3+T[8]
2030  IF M[I+6]=2 OR M[I+6]=3 OR M[I+6]=7 THEN 2050
2040  GOTO 2060
2050  B3=B3-T[8]
2060  B3=B3+T[5]+T[6]+T[7]+T[9]+T[10]+T[11]+T[15]+T[16]+T[17]
2070  B3=B3*1.18
2080  B3=B3*1.02
2090  G[3,I]=D[I,5]*60/B3
2100  G[5,I]=1/G[3,I]
2120  GOSUB 3000
2140  G[1,I]=3
2150  IF M[1]=I THEN 2160
2155  GOTO 1720
2160  RETURN
2161  STOP
2200  REM     Revising outputs
2210  PRINT TAB(10);"Pipelaying Data"
2220  PRINT TAB(10);"***************"
2225  G[4,1]=G[3,1]
2226  G[4,2]=G[3,2]
2230  PRINT
2240  PRINT TAB(10);"Pipe";TAB(20);"Men";TAB(30);"M/C";TAB(45);
2250  PRINT                                          ndard out
2260  N=1
2270  Q=10*G[2,N]-9
2280  PRINT TAB(10);N;TAB(20);G[1,N];TAB(30);M$[Q,Q+9];TAB(45);
2290  IF M[1]=N THEN 2294
2291  N=2
2293  GOTO 2270
2294  PRINT TAB(5);"Do you want to amend any of this data   ";
2295  INPUT R$
2296  R$=UPS$(R$)
2297  IF R$="YES" THEN 2300
2298  IF R$="NO" THEN 2770
2299  GOTO 2294
2300  PRINT TAB(5);"DO you want any help   ";
2302  INPUT R$
2304  R$=UPS$(R$)
2306  IF R$="NO" THEN 2390
2308  IF R$="YES" THEN 2310
2309  GOTO 2300
2310  PRINT TAB(5);"Revisions to pipelaying data - required in
2320  PRINT TAB(10);"1st line = pipe number"
```

```
2330  PRINT TAB(10);"2nd line = code gs - gang size,mc - machin
2340  PRINT TAB(10);"3rd line = Revised value"          op - outp
2350  PRINT TAB(10);"Example to change machine to JCB 808;"
2360  PRINT "?1"
2370  PRINT "?mc"
2380  PRINT "?6"
2390  PRINT TAB(5);"Enter revision"
2400  INPUT I
2450  INPUT A$
2455  A$=UPS$(A$)
2460  IF A$="GS" THEN 2510
2470  IF A$="MC" THEN 2590
2480  IF A$="OP" THEN 2550
2490  PRINT TAB(5);"Error - code ";A$;" not recognised, please
2500  GOTO 2450                                                ;y
2510  INPUT R
2525  I=1
2530  G[1,N]=R
2540  GOTO 2700
2550  INPUT R
2560  G[4,N]=R
2580  GOTO 2700
2590  PRINT TAB(5)"Enter m/c code number (0 for code list)    ";
2600  INPUT R
2610  IF R>0 THEN 2672
2620  FOR N=1 TO 7
2630  Q=10*N-9
2640  PRINT TAB(10);N;TAB(20);M$[Q,Q+9]
2650  NEXT N
2660  PRINT TAB(10);"For any other machine enter 9"
2670  PRINT TAB(5);"Enter m/c code   ";
2671  INPUT R
2672  IF R=9 THEN 2710
2690  G[2,N]=R
2700  GOTO 2740
2710  PRINT TAB(5);"Enter description of special m/c"
2720  J2=J2+1
2725  Q=10*J2-9
2726  G[6,N]=J2
2730  INPUT C$[Q,Q+9]
2740  PRINT TAB(5);"Any more revisions  ";
2750  INPUT R$
2752  R$=UPS$(R$)
2755  IF R$="NO" THEN 2770
2760  IF R$="YES" THEN 2280
2765  GOTO 2740
2770  G[5,1]=1/G[4,1]
2780  PRINT TAB(10);"DATA SUMMARY"
2790  PRINT TAB(10);"Pipe";TAB(20);"Men";TAB(30);"M/C";TAB(45);
2800  PRINT TAB(12);"1";TAB(20);G[1,1];     put";TAB(60);"durati
2810  IF G[2,1]=9 THEN 2850
2820  Q=10*G[2,1]-9
2830  PRINT M$[Q,Q+9];TAB(45);G[4,1];TAB(60);G[5,1]
2840  GOTO 2870
```

```
2850  Q=10*J1-9
2860  PRINT C$[Q,Q+9];TAB(45);G[4,1];TAB(60);G[5,1]
2870  IF M[1]=1 THEN 2920
2875  G[5,2]=1/G[4,2]
2880  PRINT TAB(12);"2";TAB(20);G[1,2];TAB(30);
2890  IF G[2,2]=9 THEN 2930
2900  Q=10*G[2,2]-9
2910  PRINT M$[Q,Q+9];TAB(45);G[4,2];TAB(60);G[5,2]
2920  RETURN
2930  Q=10*J1-9
2940  PRINT C$[Q,Q+9];TAB(45);G[4,2];TAB(60);G[5,2]
2950  RETURN
3000  REM pipe wts
3010  IF M[I+6] <> 5 THEN 3040
3020  PRINT "The pipelaying times for steel pipes do not incluc
3030  GOTO 3100                                      r welding etc
3040  FOR N2=1 TO 28
3050  IF D[I,2] <= X[N2] THEN 3070
3060  NEXT N2
3070  MAT  READ #9,M[I+6];C
3080  IF C[N2]>0 THEN 3130
3090  PRINT "Sorry I do'nt shave data on this pipe diameter"
3100  PRINT "Enter the pipe weigtht (Kg/m)    ";
3110  INPUT W3
3120  GOTO 3180
3130  X1=C[N2]-C[N2-1]
3140  X2=X[N2]-X[N2-1]
3150  X1=X1/X2
3160  X1=X1*(D[I,2]-X[N2-1])
3170  W3=X1+C[N2-1]
3180  W3=W3*D[I,5]/1000
3190  PRINT TAB(5);"TOTAL PIPE WEIGHT = ";W3;" TONNES"
3195  N2=8
3200  IF W3 <= 1 THEN 3250
3210  FOR N2=1 TO 6
3220  IF W3 <= K[N2] THEN 3250
3230  NEXT N2
3240  N2=7
3250  PRINT TAB(5);"THIS PIPE CAN BE LIFTED BY ";M$[10*N2-9,10
3260  G[2,I]=N2
3270  RETURN
3500  REM printing to line printer file playo
3505  N=8
3510  PRINT #N;TAB(50);"PIPELAYING"
3520  PRINT #N;TAB(50);"**********"
3530  PRINT #N
3540  PRINT #N;TAB(20);"PIPE";TAB(30);"DIA";TAB(40);"DEPTH";
3550  PRINT #N;TAB(50);"GANG";TAB(60);"M/C";TAB(75);"STD OUTP.
3560  PRINT #N;"REV OUTP.";TAB(105);"DURATION"
3570  PRINT #N;TAB(31);"m";TAB(42);"m";TAB(75);"Mlin/hr";TAB(9
3580  PRINT #N;TAB(105);"hrs/mlin"                          Mlin
3590  PRINT #N
3600  I=0
3610  I=I+1
```

```
3620  PRINT #N; TAB(21); I; TAB(30); D[I, 2]; TAB(40); D[I, 3]; TAB(50);
3640  IF G[2, I]=9 THEN 3680
3650  Q=G[2, I]*10-9
3660  PRINT #N; TAB(60); M$[Q, Q+9];
3675  GOTO 3690
3680  Q=G[6, I]*10-9
3685  PRINT #N; TAB(60); C$[Q, Q+9];
3690  PRINT #N; TAB(75); G[3, I]; TAB(90); G[4, I]; TAB(105); G[5, I]
3695  IF M[1]=I THEN 3705
3700  GOTO 3610
3705  RETURN
5000  REM data to file
5010  MAT A=ZER[10]
5015  READ #2, 1; N
5020  N1=2*N+1
5030  MAT  READ #2, N1; A
5040  MAT  PRINT #3, N; D, M
5050  READ #7, 1; J1
5060  J1=J1+1
5070  PRINT #7, 1; J1
5080  J1=J1+1
5090  MAT  PRINT #7, J1; G
5100  PRINT #7; C$
5110  A[4]=J1
5120  MAT  PRINT #2, N1; A
5130  IF A[5]=0 THEN 5150
5140  CHAIN "bfill"
5150  IF A[6]=0 THEN 5170
5160  CHAIN "bfill"
5170  CHAIN V1, "drepo", 280
9999  END
```

BFILL

```
5   COM N1,F1$[30]
10   REM               BACKFILL & ROADBREAKOUT TIME ANALYSIS
15   REM               N. Bartram              June '79
20   FILES *,*,*,*,*,*,*,*,*,bedo
30   DIM D[2,7],M[20],V[2],C[10],A[2],R$[3],M$[30],S$[100]
40   DIM A$[10],P$[20],X$[20]
45   DIM B[4,8]
60   ASSIGN F1$[1,3],1,V1
70   ASSIGN F1$[4,6],2,V1
80   ASSIGN F1$[7,9],3,V1
90   ASSIGN F1$[10,12],4,V1
100   ASSIGN F1$[16,18],6,V1
110   ASSIGN F1$[22,24],8,V1
120   ASSIGN F1$[25,27],9,V1
130   MAT D=ZER
140   MAT V=ZER
150   MAT M=ZER
155   V2=B1=J1=0
160   MAT C=ZER
170   Z1=1
175   IF V1 <> 3 THEN 190
180   Z1=2
190   GOSUB Z1 OF 1000,1050
210   IF C[5]=0 THEN 350
215   PRINT TAB(20);"BACKFILL"
220   PRINT TAB(20);"********"
225   GOTO Z1 OF 230,235
230   GOSUB 1200
235   GOSUB 1300
240   GOSUB 1500
250   GOSUB 2000
269   GOTO Z1 OF 340,270
270   GOSUB 3400
280   PRINT TAB(5);"Do you want to analyse any more cases    ";
290   INPUT R$
300   R$=UPS$(R$)
310   IF R$="YES" THEN 130
320   IF R$="NO" THEN 540
330   GOTO 280
340   GOSUB 3200
350   IF C[6]=0 THEN 530
360   PRINT TAB(10);"ROAD BREAKOUT"
370   PRINT TAB(10);"*************"
380   MAT B=ZER[2,6]
390   P$="COMPRESSORI.P.H.      "
400   GOSUB 4000
410   GOSUB R3 OF 4200,4250
420   GOSUB 4300
430   GOSUB 4400
440   GOTO Z1 OF 520,450
450   GOSUB 5200
460   PRINT TAB(5);"Do you want to analyse any more cases    "
```

```
470   INPUT R$
480   R$=UPS$(R$)
490   IF R$="YES" THEN 360
500   IF R$="NO" THEN 540
510   GOTO 460
520   GOSUB 6000
530   CHAIN V1,"drepo",280
540   STOP
1000  REM read control array
1010  READ #2,1;N
1020  N1=2*N+1
1030  MAT  READ #2,N1;C
1040  RETURN
1050  REM non system use ***************************:
1060  PRINT TAB(5);"BACKFILL or ROAD BREAKOUT (bf/rb)    ";
1070  INPUT A$
1075  A$=UPS$(A$)
1080  IF A$="BF" THEN 1095
1085  IF A$="RB" THEN 1105
1090  GOTO 1060
1095  C[5]=1
1100  GOTO 1110
1105  C[6]=1
1110  RETURN
1200  REM    read system data
1205  V1=0
1210  J1=C[1]
1220  IF J1=0 THEN 1235
1230  MAT  READ #4,J1;V
1235  J1=C[3]
1236  PRINT "1236  record number ";J1
1240  IF J1=0 THEN 1260
1245  MAT  READ #6,J1;M
1250  V2=M[17]
1255  MAT M=ZER
1260  READ #1,1;J1,B1
1265  RETURN
1300  REM check system data & input non-system
1310  MAT A=ZER
1320  IF V[1]=0 THEN 1350
1330  IF V2=0 THEN 1350
1335  A[1]=V[1]-V2
1340  GOTO 1365
1350  PRINT TAB(5);"VOLUME OF BACKFILL (m3/m)    ";
1360  INPUT A[1]
1365  IF V[2]=0 THEN 1385
1370  IF V2=0 THEN 1385
1375  A[2]=V[2]-V2
1380  GOTO 1440
1385  GOTO Z1 OF 1440,1390
1390  PRINT TAB(5);"Do you want to consider a battered trench
1395  INPUT R$
1400  R$=UPS$(R$)
1410  IF R$="YES" THEN 1430
```

```
1420  IF R$="NO" THEN 1440
1425  GOTO 1390
1430  PRINT TAB(5);"VOLUME OF BATTERED TRENCH BAKFILL (m3/m)    "
1435  INPUT A[2]
1440  IF B1>0 THEN 1460
1450  PRINT TAB(5);"BACKFILL LAYER THICKNESS  (m)    ";
1455  INPUT B1
1460  RETURN
1500  REM backfill outputs
1510  MAT B=ZER
1520  M$="DUMPER    JCB 3c    DROTT(175)"
1530  I=1
1535  B[I,1]=2
1540  IF B1 <= .307 THEN 1560
1550  O1=.32
1555  GOTO 1565
1560  O1=1.8575-(5*B1)
1565  GOSUB 1700
1570  I=2
1575  B[I,1]=2
1576  B[I,2]=1
1580  IF B1 <= .5 THEN 1595
1585  O1=.105
1590  GOTO 1600
1595  O1=.155-(.1*B1)
1600  GOSUB 1700
1605  I=3
1610  B[I,1]=2
1615  B[I,2]=2
1620  IF B1 <= .5 THEN 1635
1625  O1=.08
1630  GOTO 1640
1635  O1=.13-(.1*B1)
1640  GOSUB 1700
1645  I=4
1650  B[I,1]=2
1655  B[I,2]=3
1660  IF B1 <= .5 THEN 1675
1665  O1=.05
1670  GOTO 1680
1675  O1=.1-(.1*B1)
1680  GOSUB 1700
1685  RETURN
1700  REM times
1705  O2=O1/B[I,1]
1710  O3=1/O2
1720  B[I,3]=O3
1725  B[I,4]=B[I,3]
1726  B[I,5]=A[1]/O3
1730  IF A[2]=0 THEN 1740
1735  B[I,6]=A[2]/O3
1740  RETURN
2000  REM displauy and AMEND
2010  PRINT TAB(10);"BACKFILL OUTPUTS"
```

```
2015 PRINT
2020 PRINT TAB(10);"LAYER THICKNESS ";TAB(30);B1;"m"
2025 PRINT TAB(10);"VOLUME ";TAB(30);A[1];"(m3/m)"
2030 IF A[2]=0 THEN 2040
2035 PRINT TAB(10);"BATTERED VOLUME";TAB(30);A[2];"(m3/m)"
2040 PRINT
2045 PRINT TAB(5);"GANG";TAB(15);"LAB";TAB(25);"PLANT";TAB(40);
2050 PRINT TAB(50);"DURATION";                                PU
2060 IF A[2]=0 THEN 2075
2070 PRINT TAB(60);"BATTERED"
2075 PRINT
2080 PRINT TAB(40);"(m3/hr)";TAB(50);"(hr/m)";
2082 IF A[2]=0 THEN 2084
2083 PRINT TAB(60);"(hr/m)"
2084 PRINT
2085 FOR I=1 TO 4
2090 PRINT TAB(6);I;TAB(15);B[I,1];
2100 IF B[I,2]=0 THEN 2142
2110 IF B[I,2]=9 THEN 2135
2120 I1=B[I,2]
2125 PRINT TAB(25);M$[10*I1-9,10*I1];
2130 GOTO 2145
2135 I1=B[I,7]
2140 PRINT TAB(25);S$[10*I1-9,10*I1];
2142 PRINT TAB(35);
2145 PRINT  USING 2150;B[I,4],B[I,5]
2150 IMAGE #,7x,dd.dd
2160 IF A[2]=0 THEN 2180
2170 PRINT  USING 2150;B[I,6]
2180 PRINT
2185 NEXT I
2190 PRINT TAB(5);"A pegson rammer is required in all the above
2195 PRINT
2200 PRINT TAB(5);"Do you want to amend any of this data   ";
2210 INPUT R$
2215 R$=UPS$(R$)
2220 IF R$="YES" THEN 2250
2230 IF R$="NO" THEN 2520
2240 GOTO 2200
2250 PRINT TAB(5);"Enter the gang number   ";
2260 INPUT I1
2270 PRINT TAB(5);"Preffered gang size   ";
2280 INPUT B[I1,1]
2290 PRINT TAB(5);"Do you want to change the plant    ";
2300 INPUT R$
2310 R$=UPS$(R$)
2320 IF R$="YES" THEN 2350
2330 IF R$="NO" THEN 2360
2340 GOTO 2290
2350 GOSUB 3000
2360 PRINT TAB(5);"Revised output (m3/hr)   ";
2365 INPUT B[I1,4]
2370 B[I1,5]=A[1]/B[I1,4]
2380 IF A[2]=0 THEN 2400
```

```
2390  B[I1,6]=A[2]/B[I1,4]
2400  PRINT TAB(5);"Any more revisions    ";
2410  INPUT R$
2420  R$=UPS$(R$)
2430  IF R$="YES" THEN 2250
2440  IF R$="NO" THEN 2460
2450  GOTO 2400
2460  PRINT TAB(5);"Do you want to review this data     ";
2470  INPUT R$
2480  R$=UPS$(R$)
2490  IF R$="YES" THEN 2010
2500  IF R$="NO" THEN 2520
2510  GOTO 2460
2520  RETURN
3000  REM revising plant types
3010  B[I1,2]=9
3030  I3=LEN(S$)
3040  PRINT TAB(5);"Enter description of preffered plant [max 10
3050  INPUT A$                                                  aracters
3060  A$=UPS$(A$)
3065  IF I3=0 THEN 3090
3070  L=POS(S$,A$)
3080  IF L>0 THEN 3120
3090  S$[I3+1,I3+10]=A$
3100  B[I1,7]=(I3+10)/10
3110  GOTO 3130
3120  B[I1,7]=(L+9)/10
3130  RETURN
3200  REM backfill data to file
3210  READ #8,1;N
3220  N=N+1
3230  PRINT #8,1;N
3240  N1=N+1
3250  MAT  PRINT #8,N1;A,B
3260  PRINT #8;S$
3270  C[5]=N1
3280  READ #2,1;N
3285  N1=2*N+1
3290  MAT  PRINT #2,N1;C
3300  RETURN
3400  REM printing
3420  PRINT TAB(5);"Do you want a print of this data    ";
3430  INPUT R$
3450  R$=UPS$(R$)
3460  IF R$="NO" THEN 3770
3470  IF R$="YES" THEN 3480
3475  GOTO 3420
3480  N=10
3490  PRINT #N;CTL(1)
3500  PRINT #N;TAB(50);"BACKFILL"
3510  PRINT #N;TAB(50);"********"
3520  PRINT #N
3530  PRINT #N;TAB(40);"vertical trench volume          = ";A[1];"
3540  IF A[2]=0 THEN 3560
```

```
3550  PRINT #N;TAB(40);"battered trench volume         = ";A[2];"
3560  PRINT #N
3565  PRINT #N;TAB(40);"layer thickness                 = ";B1;"[m
3566  PRINT #N
3570  PRINT #N;TAB(10);"gang no. ";TAB(25);"gang size";TAB(40);"p
3580  PRINT #N;TAB(55);"standard ";TAB(70);"revised";TAB(85);"du
3590  PRINT #N;TAB(100);"duration"
3600  PRINT #N;TAB(55);"output";TAB(70);"output";TAB(85);"vertic
3610  PRINT #N;TAB(55);"[m3/hr]";TAB(70);"[m3/hr]";TAB(85);"[hr/
3620  PRINT #N;TAB(10);"-------";TAB(25);"---------";TAB(40);"--
3630  PRINT #N;TAB(55);"--------";TAB(70);"-------";TAB(85);"---
3640  PRINT #N;TAB(100);"--------"
3650  PRINT #N                                   TAB(100);"batte
3660  FOR I1=1 TO 4                              TAB(100);"[hr/m]
3670  PRINT #N;TAB(12);I1;TAB(27);B[I1,1];
3680  IF B[I1,2]=9 THEN 3720
3690  I2=B[I1,2]
3692  IF I2>0 THEN 3700
3694  PRINT #N;TAB(55);
3696  GOTO 3740
3700  PRINT #N;TAB(40);M$[10*I2-9,10*I2];TAB(55);
3710  GOTO 3740
3720  I2=B[I1,7]
3730  PRINT #N;TAB(40);S$[10*I2-9,10*I2];TAB(55);
3740  PRINT #N; USING 3750;B[I1,3],B[I1,4],B[I1,5],B[I1,6]
3750  IMAGE ddd.dd,9x,ddd.dd,9x,ddd.dd,9x,ddd.dd
3760  NEXT I1
3770  RETURN
4000  REM roadbreakout data
4010  PRINT TAB(5);"BREAKOUT MATERIAL  (C/F/?)  ";
4015  R3=0
4020  INPUT A$
4030  A$=UPS$(A$)
4040  IF A$="C" THEN 4120
4050  IF A$="F" THEN 4110
4060  PRINT TAB(10);"ROAD BREAKOUT MATERIAL CODES"
4070  PRINT TAB(10);"C  -  CONCRETE"
4080  PRINT TAB(10);"F  -  FLEXIBLE"
4090  GOTO 4010
4104  INPUT W1
4110  R3=R3+1
4120  R3=R3+1
4130  PRINT TAB(10);"BREAKOUT WIDTH  (m)    ";
4140  INPUT W1
4150  PRINT TAB(10);"DEPTH OF ROAD (m)      ";
4160  INPUT D1
4170  R2=W1*D1
4180  RETURN
4200  REM  concrete road construction
4210  B[1,3]=.4
4220  B[2,3]=1.29
4230  RETURN
4250  REM   flexible road construction
4260  B[1,3]=.6
```

```
4270  B[2,3]=1.74
4280  RETURN
4300  REM resources & durations
4310  B[1,1]=B[2,2]=2
4320  B[1,2]=B[2,1]=1
4330  B[1,4]=B[1,3]
4340  B[2,4]=B[2,3]
4350  B[1,5]=R2/B[1,4]
4360  B[2,5]=R2/B[2,4]
4370  RETURN
4400  REM     rsults
4410  GOTO R3 OF 4420,4440
4420  PRINT TAB(10);"CONCRETE ROAD CONSTRUCTION"
4430  GOTO 4450
4440  PRINT TAB(10);"FLEXIBLE ROAD CONSTRUCTION"
4450  PRINT TAB(10);"**************************"
4460  PRINT
4470  PRINT TAB(10);"BREAKOUT VOLUME = ";R2;"m3/m"
4480  PRINT
4490  PRINT TAB(5);"GANG";TAB(15);"LABOUR";TAB(25);"PLANT";TAB(4
4500  PRINT TAB(60);"DURATION"
                                                          "OUTPU
4510  PRINT TAB(40);"[m3/hr]";TAB(60);"[m/hr]"
4520  PRINT
4530  FOR I=1 TO 2
4540  PRINT TAB(6);I;TAB(15);B[I,1];
4550  IF B[I,2]=9 THEN 4580
4560  PRINT TAB(25);P$[10*B[I,2]-9,10*B[I,2]];TAB(40);
4570  GOTO 4590
4580  PRINT TAB(25);X$[10*B[I,6]-9,10*B[I,6]];TAB(40);
4590  PRINT  USING 4600;B[I,4],B[I,5]
4600  IMAGE dd.dd,15x,dd.dd
4610  NEXT I
4615  PRINT
4620  PRINT TAB(5);"Do you want to amend any of this data   ";
4630  INPUT R$
4640  R$=UPS$(R$)
4650  IF R$="YES" THEN 4680
4660  IF R$="NO" THEN 4950
4670  GOTO 4620
4680  PRINT TAB(5);"Enter the gang number    ";
4685  INPUT I1
4690  PRINT TAB(5);"Preffered gang size      ";
4700  INPUT B[I1,1]
4710  PRINT TAB(5);"Do you want to change the plant   ";
4720  INPUT R$
4730  R$=UPS$(R$)
4740  IF R$="YES" THEN 4770
4750  IF R$="NO" THEN 4780
4760  GOTO 4710
4770  GOSUB 5000
4780  PRINT TAB(5);"Enter preffered output (m3/hr)    ";
4790  INPUT B[I1,4]
4800  B[I1,5]=B[I1,4]*R2
4810  PRINT TAB(5);"Any more revisions    ";
```

```
4820  INPUT R$
4830  R$=UPS$(R$)
4840  IF R$="YES" THEN 4680
4850  IF R$="NO" THEN 4870
4860  GOTO 4810
4870  PRINT TAB(5);"Do you want to review this data   ";
4880  INPUT R$
4890  R$=UPS$(R$)
4900  IF R$="YES" THEN 4400
4910  IF R$="NO" THEN 4950
4920  GOTO 4870
4950  RETURN
5000  REM changing r/b plant
5010  B[I1,2]=9
5020  INPUT A$
5030  A$=UPS$(A$)
5040  I3=LEN(X$)
5050  IF I3=0 THEN 5080
5060  L=POS(X$,A$)
5070  IF L>0 THEN 5110
5080  X$[I3+1,I3+10]=A$
5090  B[I1,6]=(I3+10)/10
5100  GOTO 5120
5110  B[I1,6]=(L+9)/10
5120  RETURN
5200  REM printing to lp
5220  N=10
5230  PRINT TAB(5);"Do you want a print of this data   ";
5240  INPUT R$
5250  R$=UPS$(R$)
5260  IF R$="YES" THEN 5290
5270  IF R$="NO" THEN 5590
5280  GOTO 5230
5290  PRINT #N;CTL(1)
5300  PRINT #N;TAB(50);"ROAD BREAKOUT"
5310  PRINT #N;TAB(50);"*************"
5320  PRINT #N
5330  GOTO R3 OF 5340,5360
5340  PRINT #N;TAB(40);"CONCRETE ROAD CONSTRUCTION"
5350  GOTO 5370
5360  PRINT #N;TAB(40);"flexible road construction"
5370  PRINT #N;TAB(40);"**************************"
5380  PRINT #N
5390  PRINT #N;TAB(30);"WIDTH ";TAB(50);W1;" [m]"
5400  PRINT #N;TAB(30);"DEPTH";TAB(50);D1;" [m]"
5410  PRINT #N;TAB(30);"VOLUME";TAB(50);R2;" [m3/m]"
5420  PRINT #N
5430  PRINT #N;TAB(10);"gang";TAB(20);"LABOUR";TAB(40);"PLANT";T
5440  PRINT #N;TAB(80);"REVISED";TAB(100);"DURATION"
5450  PRINT #N;TAB(60);"output";TAB(80);"output"     60);"STANDAR
5460  PRINT #N;TAB(60);"[m3/hr]";TAB(80);"[m3/hr]";TAB(100);"[hr
5470  PRINT #N;TAB(10);"-------";TAB(20);"-------";TAB(40);"-----
5480  PRINT #N;TAB(80);"-------";TAB(100);"--------"B(60),"---
5490  PRINT #N
```

```
5500  FOR I=1 TO 2
5510  PRINT #N; TAB(I2); I; TAB(20); B[I, 1]; TAB(40);
5515  IF B[I, 2]=9 THEN 5540
5520  PRINT #N; P$[10*B[I, 2]-9, 10*B[I, 2]]; TAB(60);
5530  GOTO 5550
5540  PRINT #N; X$[10*B[I, 6]-9, 10*B[I, 6]]; TAB(60)
5550  PRINT #N;  USING 5560; B[I, 3], B[I, 4], B[I, 5]
5560  IMAGE dd.dd, 15x, dd.dd, 15x, dd.dd
5570  PRINT #N
5580  NEXT I
5590  RETURN
6000  REM r/b data to file
6010  READ #9, 1; N
6020  N=N+1
6030  N1=N+1
6040  PRINT #9, 1; N
6050  C[6]=N1
6055  MAT  PRINT C
6060  PRINT #9, N1; R2, R3
6070  MAT  PRINT #9; B
6080  PRINT #9; X$
6090  READ #2, 1; N
6100  N1=2*N+1
6110  MAT  PRINT #2, N1; C
6120  RETURN
9999  END
```

DSHED

```
10   COM N1,F1$[30]
15   REM      DRAINAGE SCHEDULE
20   REM      N.BARTRAM  APRIL '79
30   FILES *,*,*,*,*,*,*,*,*,report,master
40   FOR J=1 TO 9
50   ASSIGN F1$[3*J-2,3*J],J,V1
60   NEXT J
100   DIM E1$[10],E0$[60],A[20],B$[10],P$[10],D[2,7],M[20],V[2]
110   DIM M$[80],X[9,2],S[5,5],R[30],C$[100]
120   DIM E[9,9],R$[20],S$[240],F$[240]
130   N=10
140   A$="!"
150   GOSUB 1000
190   READ #2,1;J
200   I2=0
210   I2=I2+1
211   PRINT "211 i2",I2
212   PRINT #N;CTL(1)
215   GOSUB 1200
220   GOSUB 1400
225   PRINT #N;CTL(1)
230   IF A[1]=0 THEN 250
240   GOSUB 1500
250   IF A[2]=0 THEN 270
260   GOSUB 2200
270   IF A[3]=0 THEN 290
280   GOSUB 3200
290   IF A[4]=0 THEN 310
300   GOSUB 3800
310   IF A[5]=0 THEN 320
315   GOSUB 4200
320   IF A[6]=0 THEN 500
330   GOSUB 5000
500   GOSUB 1450
505   IF I2<J THEN 210
510   CHAIN V1,"drepo",280
520   STOP
1000   REM contract name
1010   CONVERT F1$[3,3] TO X,1020
1015   GOTO 1030
1020   PRINT "** FILE ERROR DETECTED IN DSHED **"
1025   GOTO 510
1030   X=X+1
1040   READ #11,X;E1$,E0$
1045   N=10
1050   PRINT #N;TAB(40);"BILL ITEM TIME ANALYSIS"
1060   PRINT #N;TAB(40);"***********************";TAB(80);"DATE"
1070   D1=TIM(2)
1080   D2=TIM(3)
1090   MAT A=ZER[12]
1100   MAT  READ A
1110   DATA 31,28,31,30,31,30,31,31,30,31,30,31
```

```
1120  D3=(D2+1900)/4
1140  D4=INT(D3)
1150  IF D3-D4>0 THEN 1165
1160  A[2]=29
1165  FOR I1=1 TO 12
1170  IF D1 <= A[I1] THEN 1184
1180  D1=D1-A[I1]
1182  NEXT I1
1184  PRINT #N; USING 1186;D1,I1,D2
1186  IMAGE dd,";",dd,";",dd
1188  PRINT #N
1190  PRINT #N;TAB(50);"ESTIMATE REFERENCE      ";E1$
1192  PRINT #N;TAB(50);"CONTRACT                ";E0$
1193  MAT  READ X
1194  RETURN
1196  DATA 1,5,6,11,12,17,18,24,25,31,32,38,39,48,49,57,58,64
1200  REM item desc.
1220  I1=2*I2
1230  READ #2,I1;E1$,B$,P$
1235  MAT A=ZER[10]
1240  MAT  READ #2,I1+1;A
1250  PRINT #N;TAB(30);"[ item count ";I2;" ]"
1260  PRINT #N;TAB(30);"BILL NUMBER";TAB(50);E1$
1270  PRINT #N;TAB(30);"PAGE NUMBER";TAB(50);B$
1280  PRINT #N;TAB(30);"ITEM NUMBER";TAB(50);P$
1290  RETURN
1400  REM control arrays
1410  MAT  READ #3,I2;D,M
1420  PRINT #N;TAB(30);"RUN NUMBER";TAB(50);M[2];
1425  IF M[2] <= 30 THEN 1437
1428  READ #1,3;S$
1430  READ #1,5;F$
1432  P=(8*(M[2]-30))-7
1435  GOTO 1445
1437  READ #1,2;S$
1440  READ #1,4;F$
1442  P=(8*M[2])-7
1445  PRINT #N;"  =   ";S$[P,P+7];"   -   ";F$[P,P+7]
1446  RETURN
1448  RETURN
1450  REM
1460  PRINT #N;"    ";
1470  FOR L=1 TO 110
1480  PRINT #N;"-";
1485  NEXT L
1486  PRINT #N
1490  RETURN
1500  REM excavation
1510  GOSUB 1450
1515  M$="jcb 3jcb 3cjcb 3djcb 805jcb 806jcb 807hy-mac 580c & k
                                                          jcb
1520  MAT E=ZER[9,7]
1540  MAT  READ #4,A[1];V,E
1550  PRINT #N;"    !   EXCAVATION";TAB(29);"!";
1560  PRINT #N;"        VOLUMES       !";
```

```
1570 PRINT #N;"          resource       !";
1575 PRINT #N;"  STD OUTPUT  !  REV OUTPUT  !   DURATION    !"
1600 PRINT #N;TAB(4);"!";TAB(29);"!          [m3/m]          !";TAB(6
1610 PRINT #N;"      [m3/hr]     !     [m3/hr]     !    [hr/m]      !"
1615 GOSUB 1450
1620 PRINT #N; USING 1622;A$,M[3],A$,V[1],A$
1622 IMAGE#,4x,a,2x,"STRATA",8x,dd,6x,a,2x,"VERTICAL",3x,dd.d,2
1630 I1=0
1635 I1=I1+1
1640 IF E[I1,1]=1 THEN 1670
1650 IF I1<9 THEN 1635
1660 GOTO 1700
1670 PRINT #N;SPA(3);M$[X[I1,1],X[I1,2]];TAB(69);"!";
1680 PRINT #N; USING 1690;E[I1,2],A$,E[I1,3],A$,E[I1,4],A$
1690 IMAGE 4x,dd.dd,5x,a,4x,dd.dd,5x,a,4x,dd.dd,5x,a
1700 PRINT #N;TAB(4);"!  obstruction  ";M[4];TAB(29);"!";TAB(49
1710 IF I1=9 THEN 1760
1720 I1=I1+1
1725 PRINT #N;SPA(3);M$[X[I1,1],X[I1,2]];TAB(69);"!";
1730 PRINT #N; USING 1690;E[I1,2],A$,E[I1,3],A$,E[I1,4],A$
1750 GOTO 1780
1760 PRINT #N; USING 1770
1770 IMAGE 14x,"!",14x,"!",14x,"!"
1780 PRINT #N;TAB(4);"!  depth  ";D[1,3];TAB(29);"!";TAB(49);"!
1790 IF I1=9 THEN 1830
1800 I1=I1+1
1810 PRINT #N;SPA(3);M$[X[I1,1],X[I1,2]];TAB(69);"!";
1815 PRINT #N; USING 1690;E[I1,2],A$,E[I1,3],A$,E[I1,4],A$
1820 GOTO 1840
1830 PRINT  USING 1770
1840 PRINT #N;TAB(4);"!  width  ";D[1,4]+D[2,4];TAB(29);"!";TAB
1850 IF I1=9 THEN 1900
1860 I1=I1+1
1870 PRINT #N;SPA(3);M$[X[I1,1],X[I1,2]];TAB(69);"!";
1880 PRINT #N; USING 1690;E[I1,2],A$,E[I1,3],A$,E[I1,4],A$
1890 GOTO 1920
1900 PRINT #N; USING 1770
1910 GOTO 1970
1920 I1=I1+1
1930 FOR J1=I1 TO 9
1935 IF E[I1,1]=0 THEN 1960                        1,2]];TAB(69);"
1940 PRINT #N;TAB(4);"!";TAB(29);"!";TAB(49);"!    ";M$[X[J1,1],
1950 PRINT #N; USING 1690;E[J1,2],A$,E[J1,3],A$,E[J1,4],A$
1960 NEXT J1
1970 IF V[2]=0 THEN 2060
1980 PRINT #N; USING 1985;A$,A$,V[2],A$
1985 IMAGE #,4x,a,24x,a,2x,"BATTERED",3x,dd.d,2x,a
1990 FOR I1=1 TO 9
2000 IF E[I1,1]=0 THEN 2040
2010 PRINT #N;SPA(3);M$[X[I1,1],X[I1,2]];TAB(69),"!";
2020 PRINT #N; USING 1690;E[I1,5],A$,E[I1,6],A$,E[I1,7],A$
2030 PRINT #N;TAB(4);"!";TAB(29);"!";TAB(49);"!",
2040 NEXT I1
2050 PRINT #N;TAB(69);"!";TAB(84);"!";TAB(99);"!";TAB(114);"!"
```

```
2060  RETURN
2200  REM shoring
2220  MAT E=ZER[5,5]
2230  MAT S=ZER[5,4]
2235  MAT  READ #5,A[2];S,E
2240  GOSUB 1450
2250  PRINT #N;TAB(4);"! shoring";TAB(14);"! type";TAB(25);"! ma
2255  PRINT #N;TAB(54);"! resources";TAB(69);"! std output";TAB(
2260  PRINT #N;TAB(99);"! DURATION";TAB(114);"!"
2265  PRINT #N;TAB(4);"!";TAB(14);"!";TAB(25);"!";TAB(54);"!";TA
2270  PRINT #N;TAB(84);"! m/hr";TAB(99);"! hr/m";TAB(114);"!"
2275  GOSUB 1450
2280  PRINT #N;TAB(4);"! depth ";D[1,3];TAB(25);"!";
2285  I=1
2290  GOSUB 3000
2300  PRINT #N;TAB(4);"!";TAB(14);"! close";TAB(25);"!";
2310  GOSUB 3050
2320  GOSUB 3100
2330  I=2
2335  PRINT #N; USING 2336
2336  IMAGE #,3x,"!",9x,"!",10x,"!"
2340  GOSUB 3000
2350  PRINT #N;TAB(4);"!";TAB(14);"! MEDIUM";TAB(25);"!";
2360  GOSUB 3050
2370  GOSUB 3100
2380  I=3
2385  PRINT #N; USING 2336
2390  GOSUB 3000
2400  PRINT #N;TAB(4);"!";TAB(14);"! open";TAB(25);"!";
2410  GOSUB 3050
2420  GOSUB 3100
2430  I=4
2435  PRINT #N; USING 2336
2440  GOSUB 3000
2450  PRINT #N;TAB(4);"!";TAB(14);"! pinchers";TAB(25);"!";
2460  GOSUB 3050
2470  GOSUB 3100
2475  I=5
2480  PRINT #N;TAB(4);"!";TAB(14);"! shorco";TAB(25);"! 1 no 2.6
2485  PRINT #N;TAB(54);"! 3 men jcb 807!";
2490  PRINT #N; USING 1690;S[I,2],A$,S[I,3],A$,S[I,4],A$
2495  IF E[5,1] <= 1 THEN 2530
2500  PRINT #N; USING 2510;A$,A$,A$,E[5,1]-1
2510  IMAGE #,4x,a,9x,a,10x,a,d," no 1.3 * 3.4"
2520  GOSUB 3010
2530  RETURN
3000  PRINT #N; USING 3005;E[I,1]
3005  IMAGE #,x,"sheets",x,dd,x,"no"
3010  PRINT #N;TAB(54);"!";TAB(69);"!";TAB(84);"!";TAB(99);"!";T
3020  RETURN
3050  PRINT #N; USING 3060;E[I,2],E[I,3],E[I,4]
3060  IMAGE #,x,"walers",x,d.dd," * ",d.dd," - ",dd," no"
3065  PRINT #N;" ! 3 men";
3068  IF D[1,3] <= 3 THEN 3075
```

```
3070  PRINT #N;" + m/c   ";
3075  PRINT #N;TAB(69);"!";
3080  PRINT #N; USING 1690;S[I,2],A$,S[I,3],A$,S[I,4],A$
3090  RETURN
3100  PRINT #N;TAB(4);"!";TAB(14);"!";TAB(25);"!";
3105  PRINT #N; USING 3110;E[I,5]
3110  IMAGE #,x,"struts",x,dd," no"
3115  GOTO 3010
3120  RETURN
3200  REM bedding
3215  MAT R=ZER[20]
3220  MAT  READ #6,A[3];R
3230  GOSUB 1450
3240  PRINT #N;TAB(4);"! BEDDING";TAB(14);"! PIPE !";TAB(30);"VC
3250  PRINT #N;TAB(42);"! DISPLACED ! RESOURCES";TAB(69);"! STD
3260  PRINT #N;TAB(84);"! REV OUTPUT";TAB(99);"! DURATION";TAB(
3270  PRINT #N;TAB(4);"!";TAB(14);"!  no  !";TAB(30);"[m3/m]";TA
3280  PRINT #N;" [m3/m]";TAB(54);"!";TAB(69);"! [m3/hr]";TAB(84
3290  PRINT #N;TAB(99);"! [hr/m]";TAB(114);"!"
3300  GOSUB 1450
3310  M$="concretegranularsel fill"
3320  FOR I=1 TO M[1]
3340  PRINT #N; USING 3350;M[I+12],I
3350  IMAGE #,4x,"! shape ",d,x,"!",2x,d,3x,"!"
3360  GOTO M[I+12] OF 3370,3390,3405,3420
3370  X1=1
3375  X2=9
3380  GOTO 3430
3390  X1=9
3395  X2=1
3400  GOTO 3430
3405  X1=9
3410  X2=17
3415  GOTO 3430
3420  X1=9
3425  X2=0
3430  PRINT #N; USING 3435;M$[X1,X1+7],R[I]
3435  IMAGE #,x,8a,3x,dd.dd,3x,"!"
3440  PRINT #N; USING 3445;R[I+12]
3445  IMAGE #,2x,ddd.dd,3x,"!"
3450  PRINT #N;" 1 gngr 2 lab ";
3500  PRINT #N;TAB(69);"!";
3510  PRINT #N; USING 1690;R[I+4],A$,R[I+8],A$,R[I+14],A$
3520  IF M[I+12]=4 THEN 3600
3540  PRINT #N;TAB(4);"!";TAB(14);"!";
3545  PRINT #N; USING 3550;I
3550  IMAGE #,2x,d,3x,"!"
3560  PRINT #N; USING 3435;M$[X2,X2+7],R[I+2]
3570  PRINT #N;TAB(54);"!";TAB(69);"!";
3580  PRINT #N; USING 3590;R[I+6],R[I+10]
3590  IMAGE 4x,dd.dd,5x,"!",4x,dd.dd,5x,"!",14x,"!"
3600  NEXT I
3620  PRINT #N;TAB(4);"!";TAB(14);"!";TAB(21);"!";TAB(42);"!----
3630  PRINT #N;TAB(31);"!";TAB(77);"!-------------
```

```
3640  PRINT #N;TAB(4);"!";TAB(14);"!";TAB(21);"!";TAB(42);"!";
3650  PRINT #N; USING 3445;R[17]
3660  PRINT #N;TAB(69);"!";TAB(84);"!";TAB(99);"!";
3665  PRINT #N; USING 3670;R[18]
3670  IMAGE 4x,dd.dd,5x,"!"
3690  RETURN
3800  REM pipelaying
3810  MAT E=ZER[6,2]
3830  MAT  READ #7,A[4];E                                /fibre"
3840  READ #7;E0$                                              crane      any m/c
3850  C$="clay     concreteconcreteiron     steel    plastic a/ceme
3860  M$="jcb 805    jcb 806    hy-mac 580o&k rh6    jcb 807    jcb
3870  GOSUB 1450
3880  PRINT #N;TAB(4);"! pipelaying";TAB(17);"! depth";TAB(25);"
3885  PRINT #N;"! material !";TAB(46);"resources";TAB(69);"! STD
3890  PRINT #N;TAB(84);"! rev output";TAB(99);"! duration";TAB(1
3895  PRINT #N;TAB(4);"!";TAB(17);"!  [m]  ! [m]";TAB(35);"!";TA
3900  PRINT #N;"! [m/hr]";TAB(84);"! [m/hr]";TAB(99);"! [hr/m]";
3910  GOSUB 1450                                         IA";TAB(35)
3920  I=0                                                TPUT";
3930  I=I+1                                              ;"!"
3940  PRINT #N; USING 3950;I                             5);"!";TAB(
3950  IMAGE #,4x,"!",4x,d,7x,"!"                         (114);"!"
3960  PRINT #N; USING 3970;D[I,3],D[I,2]
3970  IMAGE #,x,dd.dd,x,"!",x,dd.ddd,xx,"!"
3980  I1=M[I+6]
3990  PRINT #N; USING 3995;C$[8*I1-7,8*I1],E[1,I]
3995  IMAGE #,x,8a,x,"!",x,d,x,"lab"
4000  IF E[2,I]=0 THEN 4060
4010  IF E[2,I]=9 THEN 4050
4020  I1=E[2,I]
4030  PRINT #N; USING 4040;M$[10*I1-9,10*I1]
4040  IMAGE #,x,"+",x,8a
4045  GOTO 4060
4050  I1=E[6,I]
4055  PRINT #N; USING 4040;E0$[10*I1-9,10*I1]
4060  PRINT #N;TAB(69);"!";
4070  PRINT #N; USING 1690;E[3,I],A$,E[4,I],A$,E[5,I],A$
4080  IF M[1]=I THEN 4100
4090  GOTO 3930
4100  RETURN
4200  REM backfill
4220  MAT E=ZER[4,8]
4230  MAT  READ #8,A[5];V,E
4240  READ #8;C$
4250  M$="DUMPER     JCB #3c     DROTT       "             SOURCES";TAB(69
4260  GOSUB 1450                                         ATION";TAB(114)
4265  READ #1,1;B1,B1
4270  PRINT #N;TAB(4);"! BACKFILL";TAB(24);"! VOLUME";TAB(39);"
4280  PRINT #N;"! std output";TAB(84);"! REV output";TAB(99);"!
4300  PRINT #N; USING 4310;B1
4310  IMAGE #,4x,"! layers = ",d.dd," m    "
4320  PRINT #N;TAB(24);"! [m3/m]";TAB(39);"!";TAB(69);"! [m3/hr
4330  PRINT #N;TAB(114);"!"                               AB(24);"! [m3/
```

```
4340  GOSUB 1450
4350  J1=0
4360  J1=J1+1
4365  I=0
4370  IF J1=2 THEN 4400
4380  PRINT #N;TAB(4);"! vertical";TAB(24);"!";
4390  GOTO 4410
4400  PRINT #N;TAB(4);"! BATTERED";TAB(24);"!";
4410  PRINT #N; USING 4420;V[J1]
4420  IMAGE #,5x,ddd.dd,3x,"!"
4430  I=I+1
4440  PRINT #N; USING 4450;E[I,1]
4450  IMAGE #,x,d,x,"lab"
4460  IF E[I,2]=0 THEN 4530
4470  IF E[I,2]=9 THEN 4510
4480  J2=E[I,2]
4490  PRINT #N; USING 4040;M$[10*J2-9,10*J2]
4500  GOTO 4530
4510  J2=E[I,7]
4520  PRINT #N; USING 4040;C$[10*J2-9,10*J2]
4530  PRINT #N;TAB(69);"!";
4540  PRINT #N; USING 1690;E[I,3],A$,E[I,4],A$,E[I,J1+4],A$
4550  IF I=4 THEN 4580
4560  PRINT #N;TAB(4);"!";TAB(24);"!";TAB(39);"!";
4570  GOTO 4430
4580  IF J1=2 THEN 4610
4590  IF E[1,6]=0 THEN 4610
4600  GOTO 4360
4610  RETURN
5000  REM roadbreakout
5010  MAT E=ZER[2,6]
5030  READ #9,A[6];R2,R3
5040  MAT  READ #9;E
5050  READ #9;R$
5060  GOSUB 1450
5070  PRINT #N;TAB(4);"! road breakout ! volume";TAB(39);"! RES
5080  PRINT #N;"! std output";TAB(84);"! rev output";TAB(99);"!
5085  PRINT #N;TAB(114);"!"
5090  PRINT #N;TAB(4);"!";TAB(24);"! [m3/m]";TAB(39);"!";TAB(69
5100  PRINT #N;TAB(84);"! [m3/hr]";TAB(99);"! [hr/m]";TAB(114);
5110  GOSUB 1450                                       ES";TAB(
5120  M$="compressori.p.h.     "                       ation";
5130  IF R3=1 THEN 5160
5140  PRINT #N;TAB(4);"! FLEXIBLE";TAB(24);"!";          [m3/hr]
5150  GOTO 5170
5160  PRINT #N;TAB(4);"! CONCRETE";TAB(24);"!";
5170  I=1
5180  PRINT #N; USING 4420;R2
5190  PRINT #N; USING 4450;E[I,1]
5200  IF E[I,2]=0 THEN 5260
5210  IF E[I,2]=9 THEN 5240
5220  I1=E[I,2]
5225  PRINT #N; USING 4040;M$[10*I1-9,10*I1]
5230  GOTO 5260
```

```
5240   I1=E[I,6]
5250   PRINT #N; USING 4040;R$[10*I1-9,10*I1]
5260   PRINT #N;TAB(69);"!";
5270   PRINT #N; USING 1690;E[I,3],A$,E[I,4],A$,E[I,5],A$
5280   IF I=2 THEN 5320
5290   PRINT #N;TAB(4);"!";TAB(24);"!";TAB(39);"!";
5300   I=2
5310   GOTO 5190
5320   RETURN
9999   END
```

PRICE

```
5   COM N1,F1$[30],Z1,N
10  REM          PIPELINE PRICING      -    CONTROL PROGRAMME
15  REM          N. Bartram                 June '79
20  FILES *,*,*,*,*,*,*,*,pr,ucd
25  DIM P$[80],C[40],M$[100],E[15,3],P1$[40],Q[10],R[10,2]
30  DIM M[20],A[30],V[2],Z[9,7],S[10,6],B[10,4],P[10,3],F[10,2]
40  DIM G[5,2],A$[2],H[20,3],C$[20]
50  GOSUB 800
54  MAT M=ZER
65  MAT G=ZER
80  MAT C=ZER
95  PRINT TAB(20);"PIPELINE PRICING"
96  PRINT TAB(20);"****************"
100  Z1=1
110  J1=LEN(F1$)
120  IF J1=0 THEN 220
130  GOSUB 910
200  GOSUB 3000
205  MAT  PRINT #9,2;C
206  PRINT #9;P$
210  GOSUB 1000
215  GOTO 230
220  GOSUB 4000
230  GOSUB 6000
240  GOSUB 7000
250  CHAIN "price1"
260  STOP
500  REM return price2
510  ASSIGN "pr",9,V1
520  ASSIGN "ucd",10,V1
530  GOSUB 6500
600  REM auto price
605  GOSUB 800
610  GOSUB 910
630  GOSUB 1022
640  CHAIN V1,"price1",600
800  REM zeroes
805  MAT G=ZER
810  MAT E=ZER
820  MAT S=ZER
830  MAT B=ZER
840  MAT P=ZER
850  MAT F=ZER
900  RETURN
910  FOR J=2 TO 8
920  J1=3*J
930  ASSIGN F1$[J1-2,J1],J,V1
940  NEXT J
950  RETURN
1000  REM system use data
1010  PRINT TAB(5);"Enter the pipe run number     ";
1020  INPUT N1
```

```
1022  MAT R=ZER[2,7]
1025  MAT A=ZER[10]
1030  READ #2,1;N2
1040  FOR I=1 TO N2
1050  MAT  READ #3,I;R,M
1060  IF M[2] <> N1 THEN 2090
1070  J=2*I+1
1080  MAT  READ #2,J;A
1090  IF A[10]=0 THEN 1120
1100  Q[1]=Q[1]+M[17]
1110  GOTO 1130
1120  Q[1]=M[17]
1130  REM excavation data
1135  MAT Z=ZER[9,7]
1140  IF A[1]=0 THEN 1210
1145  MAT  READ #4,A[1];V,Z
1150  Q[2]=Q[2]+(V[1]*M[17])
1160  Q[3]=Q[3]+(V[2]*M[17])
1170  FOR J=1 TO 9
1180  E[J,1]=J
1190  E[J,2]=E[J,2]+(Z[J,4]*M[17])
1195  E[J,3]=E[J,3]+(Z[J,7]*M[17])
1200  NEXT J
1210  REM shoring data
1220  IF A[2]=0 THEN 1280
1225  MAT Z=ZER[5,4]
1230  J=A[2]
1235  MAT  READ #5,J;Z
1240  I1=4
1242  FOR L=1 TO 6
1245  I1=I1+1
1247  S[L,1]=I1
1250  FOR J=2 TO 6
1255  S[L,J]=S[L,J]+(Z[J-1,4]*M[17])
1260  NEXT J
1270  NEXT L
1280  REM bedding
1290  IF A[3]=0 THEN 1610
1295  MAT C=ZER[20]
1300  MAT  READ #6,A[3];C
1310  Q[4]=Q[4]+(C[1]*M[17])
1320  Q[5]=Q[5]+(C[3]*M[17])
1330  Q[6]=Q[6]+(C[2]*M[17])
1340  Q[7]=Q[7]+(C[4]*M[17])
1350  S1=M[13]
1360  S2=M[14]
1370  REM outputs
1380  B[1,1]=4
1385  B[2,1]=11
1390  FOR J=1 TO 2
1400  IF M[J+12]=0 THEN 1600
1410  GOTO M[J+12] OF 1420,1450,1480,1510,1540
1420  B[1,2]=B[1,2]+(C[J+8]*M[17])
1425  B[2,J]=[illegible]
```

```
1430  B[1,4]=B[1,4]+(C[J+10]*M[17])
1435  G[4,J]=3
1440  GOTO 1600
1450  B[1,3]=B[1,3]+(C[J+8]*M[17])
1455  G[3,J]=2
1460  B[1,2]=B[1,2]+(C[J+10]*M[17])
1465  G[4,J]=1
1470  GOTO 1600
1480  B[1,3]=B[1,3]+(C[J+8]*M[17])
1485  G[3,J]=2
1490  B[1,4]=B[1,4]+(C[J+10]*M[17])
1495  G[4,J]=3
1500  GOTO 1600
1510  B[1,3]=B[1,3]+(C[J+8]*M[17])
1515  G[3,J]=2
1520  GOTO 1600
1530  REM shpe 5 mats
1600  NEXT J
1602  FOR J=2 TO 4
1604  B[2,J]=B[1,J]
1605  NEXT J
1610  REM  pipelaying
1615  IF A[4]=0 THEN 1850
1620  P2=Q[10]=M[1]
1625  G[1,1]=R[1,2]
1630  G[1,2]=R[2,2]
1635  G[2,1]=M[7]
1640  G[2,2]=M[8]
1645  MAT Z=ZER[6,2]
1650  MAT  READ #7,A[4];Z
1655  IF Z[2,1]=9 THEN 1755
1660  M1=3
1665  GOTO Z[2,1] OF 1695,1690,1680,1675,1685,1670,1667,1725
1667  M1=M1+1
1670  M1=M1+1
1675  M1=M1+1
1680  M1=M1+1
1685  M1=M1+1
1690  M1=M1+1
1695  M1=M1+1
1700  P[1,1]=M1
1710  P[1,2]=P[1,2]+(Z[5,1]*M[17])
1715  P[1,3]=P[1,3]+(Z[5,2]*M[17])
1720  GOTO 1850
1725  FOR J=1 TO 7
1730  P[J,1]=J+3
1735  P[J,2]=P[J,2]+(Z[5,1]*M[17])
1740  P[J,3]=P[J,3]+(Z[5,2]*M[17])
1745  NEXT J
1750  GOTO 1850
1755  READ #7;P1 [illegible]
1760  PRINT "PIPE BEDDING - [illegible]
      [illegible]"
1765  [illegible]
```

```
1775  J=POS(P$,A$)
1780  IF J=0 THEN 1830
1785  [illegible]
1790  IF [illegible]
1795  I1=LEN(P$)
1800  P$[I1+1,I1+2]=A$
1810  J1=(I1+2)/2
1815  P[1,1]=[illegible]
1820  [illegible]
1825  [illegible]
1830  J=(J+1)/2
1835  P[1,1]=J
1840  GOTO 1710
1850  REM backfill
1860  IF [illegible]=0 THEN 2090
1870  MAT Z=ZER[4,8]
1880  MAT  READ #8,A[5];V,Z
1890  Q[8]=Q[8]+(V[1]*M[17])
1900  Q[9]=Q[9]+(V[2]*M[17])
2000  F[1,1]=1
2010  F[2,1]=11
2020  FOR J=1 TO 2
2030  F[J,2]=F[J,2]+(Z[J+2,4]*M[17])
2040  NEXT J
2090  NEXT I
2100  MAT C=ZER[40]
2120  MAT  READ #9,2;C
2130  READ #9;P$
2132  FOR I=2 TO 9
2134  IF Q[I]=0 THEN 2138
2136  Q[I]=Q[I]/Q[1]
2138  NEXT I
2140  PRINT TAB(5);"SUMMARY OF 'PLEP' DATA FOR RUN NUMBER ";N1
2150  PRINT TAB(10);"RUN LENGTH";TAB(40);"= ";Q[1]
2170  PRINT TAB(10);"MEAN VERTICAL EXCAVATION VOLUME";TAB(40);"
2180  IF Q[3]=0 THEN 2210                                 Q[2];" m
2200  PRINT TAB(10);"MEAN BATTERED EXCAVATION VOLUME";TAB(40);"
2210  PRINT TAB(10);"PIPE DIAMETER";TAB(40);"= ";G[1,1]
2220  IF G[1,2]=0 THEN 2230                               Q[3];" m
2225  PRINT TAB(10);"2nd PIPE DIAMETER";TAB(40);"= ";G[1,2];" m
2230  PRINT TAB(10);"BEDDING VOLUMES"
2240  PRINT TAB(10);"Bedding";TAB(20);"Cover";TAB(30);"Bedding"
2290  PRINT TAB(10);Q[4],Q[5],Q[6],Q[7]                  (40);"Co
2300  PRINT TAB(10);"BACKFILL"
2320  PRINT TAB(10);"VERTICAL TRENCH";TAB(40);"= ";Q[8];" m3/m"
2330  IF Q[9]=0 THEN 2360
2350  PRINT TAB(10);"BATTERED TRENCH";TAB(40);"= ";Q[9];" m3/m"
2360  FOR J=1 TO 15
2370  IF E[J,1]=0 OR E[J,2]=0 THEN 2410
2380  E[J,2]=(Q[2]*Q[1])/E[J,2]
2390  IF Q[3]=0 THEN 2410
2400  E[J,3]=(Q[3]*Q[1])/E[J,3]
2410  NEXT J
2415  FOR [illegible] TO [illegible]
```

```
2420 FOR J=2 TO 6
2425 IF S[I,J]=0 THEN 2440
2430 S[I,J]=Q[1]/S[I,J]
2440 NEXT J
2450 NEXT I
2460 FOR I=1 TO 10
2470 IF B[I,1]=0 THEN 2520
2480 FOR J=2 TO 4
2490 IF B[I,J]=0 THEN 2510
2500 B[I,J]=B[I,J]/Q[1]
2510 NEXT J
2520 NEXT I
2530 FOR J=1 TO 10
2540 IF P[J,1]=0 THEN 2590
2550 FOR I=2 TO 3
2560 IF P[J,I]=0 THEN 2580
2570 P[J,I]=Q[1]/P[J,I]
2580 NEXT I
2590 NEXT J
2600 FOR J=1 TO 10
2610 IF F[J,1]=0 THEN 2630
2620 F[J,2]=F[J,2]/Q[1]
2630 NEXT J
2640 RETURN
3000 REM drepo exc's
3010 M$="JCB 3,JCB 3c,JCB 3d,JCB 805,JCB 806,jcb 807,HY-MAC 59
3060 PRINT TAB(5);"Enter the UCD codes for the following excav
3070 READ #10,4;P1$                                           & K RH 6,JCB 80
3080 MAT  READ #10,3;H                                        s"
3085 I1=0
3090 FOR I=1 TO 9
3100 I1=I1+1
3102 IF M$[I1,I1]="," THEN 3107
3104 PRINT M$[I1,I1];
3106 GOTO 3100
3107 PRINT TAB(25);
3110 INPUT A$
3111 IF LEN(A$) <> 2 THEN 3150
3120 A$=UPS$(A$)
3130 J=POS(P1$,A$)
3140 IF J>0 THEN 3170
3150 PRINT TAB(5);"** ERROR - CODE ";A$;" IS NOT IN THE UCD FI
3160 PRINT "Re-type code  ";
3165 GOTO 3110
3170 P$[2*I-1,2*I]=A$
3180 J=(J+1)/2
3190 C[I]=H[J,3]
3210 NEXT I
3215 GOSUB 8000
3220 RETURN
4000 REM    non system physical data
4010 PRINT TAB(10);"ENTER THE FOLLOWING INFORMATION FOR THIS P
4020 PRINT TAB(10);"RUN NUMBER    ";
4030 INPUT N1
```

```
4040  PRINT TAB(10);"RUN LENGTH (m)                          ";
4050  INPUT Q[1]
4060  PRINT TAB(10);"VERTICAL TRENCH VOLUME (m3/m)           ";
4070  INPUT Q[2]
4080  PRINT TAB(10);"BATTERED TRENCH VOLUME (m3/m)           ";
4090  INPUT Q[3]
4100  PRINT TAB(10);"NUMBER OF PIPES                         ";
4110  INPUT P2
4115  Q[10]=P2
4120  FOR J=1 TO P2
4130  PRINT TAB(10);"PIPE ",J
4140  PRINT TAB(10);"DIAMETER (m)                            ";
4150  INPUT G[1,J]
4160  PRINT TAB(10);"MATERIAL (0 for code list)              ";
4170  INPUT G[2,J]
4180  IF G[2,J]>0 THEN 4210
4190  GOSUB 4510
4200  GOTO 4160
4210  NEXT J
4220  PRINT TAB(10);"BEDDING"
4225  J=2
4230  FOR I=1 TO P2
4235  J=J+2
4240  PRINT TAB(10);"PIPE ";I
4250  PRINT TAB(10);"BED MATERIAL (0 for code list)  ";
4260  INPUT G[3,I]
4270  IF G[3,I]=4 THEN 4330
4280  IF G[3,I]>0 THEN 4310
4290  GOSUB 4630
4300  GOTO 4250
4310  PRINT TAB(10);"VOLUME (m3/m)                           ";
4320  INPUT Q[J]
4330  PRINT TAB(10);"COVER MATERIAL (0 for code list)";
4340  INPUT G[4,I]
4350  IF G[4,I]=4 THEN 4410
4360  IF G[4,I]>0 THEN 4390
4370  GOSUB 4630
4380  GOTO 4330
4390  PRINT TAB(10);"VOLUME (m3/m)                           ";
4400  INPUT Q[J+1]
4410  NEXT I
4420  PRINT TAB(10);"BACKFILL"
4430  PRINT TAB(10);"VERTICAL TRENCH BACKFILL (m3/m)    ";
4440  INPUT Q[8]
4445  IF Q[2]=0 THEN 4470
4450  PRINT TAB(10);"BATTERED TRENCH BACKFILL (m3/m)    ";
4460  INPUT Q[9]
4470  RETURN
4510  PRINT TAB(10);"CODE";TAB(30);"MATERIAL"
4511  PRINT TAB(10);"----";TAB(30);"--------"
4520  M$="CLAY,PS CONCRETE,CONCRETE,IRON,STEEL,PLASTIC,A/CEMENT
4530  I1=0
4540  FOR J1=1 TO 8
4550  PRINT TAB(12);J1,TAB(30
```

```
4555  I1=I1+1
4560  IF M$[I1,I1]="," THEN 4585
4570  PRINT M$[I1,I1];
4580  GOTO 4555
4585  PRINT
4586  NEXT J1
4595  RETURN
4630  PRINT TAB(10);"CODE";TAB(30);"MATERIAL"
4631  PRINT TAB(10);"----";TAB(30);"--------"
4640  M$="CONCRETE,GRANULAR,SELECTED FILL,NONE REQUIRED,"
4645  P1=0
4650  FOR P=1 TO 4
4655  PRINT TAB(12);P;TAB(30);
4656  P1=P1+1
4660  IF M$[P1,P1]="," THEN 4690
4670  PRINT M$[P1,P1];
4680  GOTO 4656
4690  PRINT
4700  NEXT P
4710  RETURN
6000  REM materials
6010  PRINT TAB(10);"ENTER THE FOLLOWING MATERIALS COSTS"
6020  PRINT TAB(10);"CONCRETE BEDDING (#/m3)";TAB(45);
6030  INPUT M[1]
6040  PRINT TAB(10);"GRANULAR BEDDING (#/m3)";TAB(45);
6050  INPUT M[2]
6060  M[3]=0
6070  PRINT TAB(10);"PIPE PRICES (#/m)"
6080  FOR I=1 TO P2
6100  PRINT TAB(10);G[1,I];" dia";
6110  GOTO G[2,I] OF 6120,6130,6130,6150,6160,6170,6180,6185
6120  PRINT "   CLAY";TAB(45);
6125  GOTO 6190
6130  PRINT "   CONCRETE";TAB(45);
6140  GOTO 6190
6150  PRINT "   IRON";TAB(45);
6155  GOTO 6190
6160  PRINT "   STEEL";TAB(45);
6165  GOTO 6190
6170  PRINT "   PLASTIC";TAB(45)
6175  GOTO 6190
6180  PRINT "   ASBESTOS CEMENT";TAB(45);
6182  GOTO 6190
6185  PRINT "   PITCH FIBRE";TAB(45);
6190  INPUT M[3+I]
6210  NEXT I
6220  PRINT TAB(10);"SHORING MATERIALS - ALL IN COST OF MATERIA
6225  PRINT TAB(10);"CLOSE SHEETING";TAB(45);                    LY (#/
6230  INPUT M[6]
6240  PRINT TAB(10);"MEDIUM SHEETING";TAB(45);
6250  INPUT M[7]
6260  PRINT TAB(10);"OPEN SHEETING";TAB(45);
6265  INPUT M[8]
6270  PRINT TAB(10);"PINCHERS";TAB(45);
```

```
6290  INPUT M[9]
6300  PRINT TAB(10);"SHORCO BOXES";TAB(45);
6310  INPUT M[10]
6320  RETURN
6500  REM proceed options
6510  PRINT TAB(10);"CONTROL COMMAND [A/C/R/S/P/B/?]    ";
6520  INPUT A$
6525  A$=UPS$(A$)
6526  IF A$="S" THEN 6600
6530  IF A$="A" THEN 6700
6535  IF A$="C" THEN 6690
6540  IF A$="R" THEN 6710
6542  IF A$="P" THEN 6720
6550  PRINT TAB(5);"AT THIS STAGE YOU HAVE FIVE OPTIONS "
6551  PRINT TAB(5);"A  -  ACCEPT. i.e. you are satisfied with a
6560  PRINT TAB(5);"                 and want that method adopting
6565  PRINT TAB(5);"C  -  CHANGE. i.e. you want to make some ch
6570  PRINT TAB(5);"                 method for re-analysis."
6575  PRINT TAB(5);"R  -  REVIEW. Take a detailed look at an al
6585  PRINT TAB(5);"S  -  SUMMARY. Tabulate the the cost figure
6590  PRINT TAB(5);"                  analysed up to now."
6591  PRINT TAB(5);"P  -  PRINT. Generate a print of a method"
6595  GOTO 6510
6600  REM summary
6605  PRINT TAB(5);"No.";TAB(10);"DURATION";TAB(20);"LABOUR";TA
6610  PRINT TAB(40);"PLANT";TAB(50);"TOTAL"
6615  PRINT TAB(10);"[mins/m]";TAB(20);"[#/m]";TAB(30);"[#/m]";
6620  PRINT "[#/m]";TAB(50);"[#/m]"                    ));"MATERIA
6630  MAT E=ZER[3,4]
6640  FOR I=1 TO N                                        40);
6645  J=(2*I)+8
6650  READ #9,J;T1
6655  MAT  READ #9;E
6665  PRINT  USING 6670;I,T1,E[1,1],E[1,2],E[1,3],E[1,4]
6670  IMAGE 4x,d,5x,ddd,7x,4(dddd.dd,3x)
6675  NEXT I
6680  GOTO 6510
6690  CHAIN V1,"price1",400
6700  CHAIN V1,"price3",200
6710  CHAIN V1,"price2",400
6720  CHAIN "price3"
7000  REM data to file
7010  MAT  PRINT #9,1;G,Q
7040  MAT  PRINT #9,3;E
7050  MAT  PRINT #9,4;S
7060  MAT  PRINT #9,5;B
7070  MAT  PRINT #9,6;P
7080  MAT  PRINT #9,7;F
7090  MAT  PRINT #9,8;M
7100  RETURN
8000  REM crane and drott codes
8010  READ #10,2;C$
8020  PRINT TAB(5);"Enter the code of crane for pipelaying v s
8030  PRINT TAB(5);"CRANE CODE   ";
```

```
8035  INPUT A$
8040  GOSUB 8200
8045  IF A1=1 THEN 8030
8050  P$[19,20]=A$
8060  C[10]=H[J,3]
8070  PRINT TAB(5);"Enter code of Drott   ";
8075  INPUT A$
8080  GOSUB 8200
8090  IF A1=1 THEN 8070
8100  P$[21,22]=A$
8110  C[11]=H[J,3]
8120  RETURN
8200  REM access ucd
8210  A1=0
8220  A$=UPS$(A$)
8230  IF LEN(A$)=2 THEN 8250
8235  PRINT TAB(5);"** ERROR two digit code required  **"
8240  A1=1
8245  GOTO 8360
8250  J=POS(C$,A$[1,1])
8260  IF J=0 THEN 8340
8270  J=(J*2)+1
8280  MAT  READ #10,J;H
8290  READ #10,J+1;P1$
8300  J=POS(P1$,A$)
8310  IF J=0 THEN 8340
8320  J=(J+1)/2
8330  GOTO 8360
8340  PRINT TAB(5);"** ERROR code ";A$;" is not in UCD file  **
8350  A1=1
8360  RETURN
9999  END
```

PRICE1

```
5   COM N1,F1$[30],Z1,N
10   REM            PIPELINE PRICING - METHODS
15   REM            N. BARTRAM          JUNE '79
30   FILES *,*,*,*,*,*,*,UCD,PR
40   DIM G[5,2],Q[10],O[6],M1$[60],M$[20]
50   DIM O$[10],A$[2],R$[3],C[40],P$[80],G$[20],K[20,3],P1$[40]
60   DIM X[10,3],E[10,6],T[10],X$[50],Y[5,4],L[10]
65   DIM N$[10],S[5],B[3,2]
100  GOSUB 500
110  PRINT TAB(10);"METHOD OF CONSTRUCTION"
120  PRINT TAB(10);"**********************"
130  PRINT
140  N=1
150  GOSUB 1000
160  GOSUB 1600
170  GOSUB 2200
180  GOSUB 2700
200  GOSUB 3600
210  GOSUB 5000
211  PRINT "END OF PRICE1"
300  CHAIN "PRICE2"
400  REM CHANGING METHOD
410  ASSIGN "UCD",8,V1
420  ASSIGN "PR",9,V1
440  N=N+1
450  PRINT TAB(15);"METHOD NUMBER ";N
460  GOSUB 6000
500  REM READ DATA
501  MAT  READ #9,1;G,Q
505  MAT  READ #9,2;C
506  READ #9;P$
510  RETURN
600  REM ADTO PRICING
610  ASSIGN "UCD",8,V1
615  ASSIGN "PR",9,V1
620  GOSUB 500
625  J6=(2*N)+7
630  MAT  READ #9,J6;T,O,Y,S
635  READ #9;O$,N$
640  GOSUB 1800
645  GOSUB 5000
650  CHAIN V1,"PRICE2",600
1000  REM INITIAL METHOD
1010  PRINT TAB(5);"ENTER THE FOLLOWING INFORMATION TO DEFINE TH
                                                  IRST TRIAL METH
1020  MAT O=ZER
1060  PRINT TAB(10);"OPERATIONS OPTIONS"
1065  PRINT TAB(10);"------------------"
1070  PRINT TAB(5);"TRENCH X-SECTION [V/B]    ";
1075  M$="CMOPSN?"
1080  INPUT A$
1090  A$=UPS$(A$)
1100  IF A$="V" THEN 1130
```

```
1110  IF A$="B" THEN 1150
1120  GOTO 1070
1130  O[1]=1
1140  GOTO 1160
1150  O[1]=2
1160  PRINT TAB(5);"SHORING METHOD [C/M/O/P/S/N/?]    ";
1170  INPUT A$
1175  A$=UPS$(A$)
1180  J1=POS(M$,A$)
1190  IF J1=0 THEN 1160
1200  GOTO J1 OF 1250,1240,1230,1220,1210,1260,1270
1210  O[2]=O[2]+1
1220  O[2]=O[2]+1
1230  O[2]=O[2]+1
1240  O[2]=O[2]+1
1250  O[2]=O[2]+1
1260  GOTO 1350
1270  PRINT TAB(10);"SHORING OPTIONS ARE ;"
1280  PRINT TAB(15);"C  -  CLOSE SHEETING"
1290  PRINT TAB(15);"M  -  MEDIUM SHEETING"
1300  PRINT TAB(15);"O  -  OPEN SHEETING"
1310  PRINT TAB(15);"P  -  PINCHERS"
1320  PRINT TAB(15);"S  -  SHORCO BOXES"
1330  PRINT TAB(15);"N  -  NO SHORING"
1340  GOTO 1160
1350  PRINT TAB(5);"SUMMARY"
1360  IF O[1]=1 THEN 1390
1370  PRINT TAB(5);"BATTERED TRENCH   ";
1380  GOTO 1400
1390  PRINT TAB(5);"VERTICAL TRENCH   ";
1400  IF O[2]>0 THEN 1430
1410  PRINT TAB(10);"NO SHORING"
1420  GOTO 1530
1430  GOTO O[2] OF 1440,1460,1480,1500,1520
1440  PRINT "CLOSE SHEETING"
1450  GOTO 1530
1460  PRINT "MEDIUM SHEETING"
1470  GOTO 1530
1480  PRINT "OPEN SHEETING"
1490  GOTO 1530
1500  PRINT "PINCHERS"
1510  GOTO 1530
1520  PRINT "SHORCO BOXES"
1530  PRINT TAB(5);"CORRECT   ";
1535  INPUT R$
1540  R$=UPS$(R$)
1550  IF R$="NO" THEN 1020
1560  IF R$="YES" THEN 1570
1565  GOTO 1530
1570  RETURN
1600  REM  PLANT
1610  M1$="EXCAVATIONSHORINGPIPE BEDDINGPIPE LAYINGBACKFILL"
1620  MAT X=ZER[5,2]
1625  PRINT TAB(10);"PLANT"
```

```
1630  MAT  READ X
1640  DATA 1,10,11,17,18,29,30,40,41,48
1645  PRINT TAB(10);"-----"
1650  PRINT TAB(5);"ENTER THE CODE OF THE ITEM OF PLANT YOU WAN
1660  PRINT TAB(5);"OF THE FOLLOWING OPERATIONS, IF NONE THEN E
1670  FOR I1=1 TO 5                                          R EAC
1680  PRINT TAB(5);M1$[X[I1,1],X[I1,2]];"    ";              'NO'
1690  INPUT A$
1700  A$=UPS$(A$)
1710  IF A$ <> "NO" THEN 1720
1715  O$[2*I1-1,2*I1]="XX"
1716  GOTO 1790
1720  J1=POS(P$,A$)
1730  IF J1>0 THEN 1770
1740  GOSUB 9010
1750  IF J2=0 THEN 1680
1770  O$[2*I1-1,2*I1]=A$
1790  NEXT I1
1795  PRINT O$
1800  MAT T=ZER
1805  MAT E=ZER[15,3]
1810  MAT  READ #9,3;E
1815  I=1
1820  I1=15
1825  A$=O$[1,2]
1830  IF A$="XX" THEN 1885
1835  GOSUB 5300
1840  J=O[1]
1845  IF E[J3,J+1]<>0 THEN 1870
1850  PRINT TAB(5);"EXCAVATION"
1855  PRINT  USING 1860;A$
1860  IMAGE #,"ENTER OUTPUT FOR PLANT TYPE ",2A
1865  INPUT E[J3,J+1]
1870  T[1]=E[J3,J+1]
1880  GOTO 1890
1885  GOSUB 5400
1890  MAT  PRINT #9,3;E
1895  IF O[2]=0 THEN 1980
1900  MAT E=ZER[10,6]
1905  MAT  READ #9,4;E
1910  I=2
1920  A$=O$[3,4]
1925  IF A$="XX" THEN 1975
1926  I1=10
1930  GOSUB 5300
1935  J=O[2]
1940  IF E[J3,J+1]<>0 THEN 1960
1945  PRINT "SHORING"
1950  PRINT  USING 1960;A$
1955  INPUT E[J3,J+1]
1960  T[2]=E[J3,J+1]
1965  MAT  PRINT #9,4;E
1970  GOTO 1980
1975  GOSUB 5400
```

```
1980  X$="CONCRETEGRAVELSELECTED FILL"
1990  MAT  READ B
1995  DATA 1,8,9,14,15,27
2000  GOSUB 5450
2005  MAT E=ZER[10,3]
2010  MAT  READ #9,6;E
2015  GOSUB 5650
2017  I=9
2020  A$=O$[9,10]
2030  IF A$="XX" THEN 2085
2032  I1=10
2035  GOSUB 5300
2040  IF E[J3,2]>0 THEN 2075
2050  PRINT TAB(5);"BACKFILL"
2060  PRINT  USING 1860;A$
2070  INPUT E[J3,2]
2075  T[I]=E[J3,2]
2080  GOTO 2090
2085  GOSUB 5400
2090  MAT  PRINT #9,7;E
2095  RETURN
2200  REM LABOUR
2205  MAT Y=ZER[5,4]
2210  PRINT TAB(5);"LABOUR"
2220  PRINT TAB(5);"------"
2230  PRINT TAB(5);"ENTER THE LABOUR REQUIREMENTS FOR EACH OPERA
2240  PRINT TAB(5);"IF NONE ARE REQUIRED THEN ENTER 'NO'."
2245  MAT L=ZER[10]
2250  MAT  READ #8,43;L
2260  READ #8,44;G$
2270  FOR I1=1 TO 5
2280  PRINT TAB(5);M1$[X[I1,1],X[I1,2]]
2290  FOR J1=1 TO 2
2300  PRINT TAB(10);"LABOUR CODE   ";
2310  INPUT A$
2314  IF LEN(A$) <> 2 THEN 2300
2315  A$=UPS$(A$)
2320  IF A$="NO" THEN 2440
2340  L1=POS(G$,A$)
2350  IF L1>0 THEN 2380
2360  PRINT TAB(5);"** ERROR - LABOUR CODE ";A$;" IS NOT IN THE
                                                        ]' FILE
2370  GOTO 2300
2380  L1=(L1+1)/2
2390  Y[I1,J1]=L1
2410  PRINT TAB(10);"NUMBER REQUIRED   ";
2420  INPUT Y[I1,J1+2]
2430  NEXT J1
2440  NEXT I1
2450  RETURN
2700  REM  NON - MEASURABLE PLANT
2720  PRINT TAB(5);"NON - MEASURABLE PLANT"
2730  PRINT TAB(5);"----------------------"
2740  PRINT
2750  PRINT TAB(5);"ENTER THE CODES OF ANY NON - MEASURABLE PLAN
                                                       G.  PUMP
```

```
2760 PRINT TAB(5);"WHICH YOU WANT TO ALLOW AGAINST THIS METHOD,
2765 PRINT TAB(5);"REQUIRED ENTER 'NO'."
2770 FOR I1=1 TO 5
                                                          JONE AR
2780 PRINT TAB(10);"PLANT CODE    ";
2790 INPUT A$
2800 A$=UPS$(A$)
2805 IF A$="NO" THEN 2895
2806 N$[2*I1-1,2*I1]=A$
2810 J1=POS(P$,A$)
2820 IF J1>0 THEN 2870
2830 GOSUB 9010
2840 IF J2=0 THEN 2780
2870 NEXT I1
2895 RETURN
3000 REM CHANGING MATERIALS
3005 DIM M[10]
3010 MAT  READ #9,8;M
3015 PRINT TAB(10);"DO YOU WANT TO CHANGE THE BEDDING MATERIAL
                                                             ES
3020 GOSUB 7000
3025 GOTO J1 OF 3030,3095,3015
3030 PRINT TAB(10);"BEDDING MATERIALS"
3035 FOR J1=1 TO Q[10]
3040 PRINT TAB(5);"PIPE ";J1;" BED MATERIAL (0 FOR CODE LIST )
3045 INPUT G[3,J1]
3050 IF G[3,J1]>0 THEN 3065
3055 GOSUB 3300
3060 GOTO 3040
3065 PRINT TAB(5);"PIPE ";J1;" COVER MATERIAL (0 FOR CODE LIST)
3070 INPUT G[4,J1]
3075 IF G[4,J1]>0 THEN 3090
3080 GOSUB 3300
3085 GOTO 3065
3090 NEXT J1
3095 PRINT TAB(5);"DO YOU WANT TO CHANGE THE BEDDING MATERIALS
3100 GOSUB 7000                                               CES
3105 GOTO J1 OF 3110,3130,3095
3110 PRINT TAB(10);"CONCRETE BEDDING (#/M3)    ";
3115 INPUT M[1]
3120 PRINT TAB(10);"GRANULAR BEDDING (#/M3)    ";
3125 INPUT M[2]
3130 PRINT TAB(10);"DO YOU WANT TO CHANGE THE PIPE MATERIALS
3140 GOSUB 7000
3145 GOTO J1 OF 3150,3200,3130
3150 PRINT TAB(10);"PIPE MATERIALS"
3155 FOR J1=1 TO Q[10]
3160 PRINT TAB(5);"PIPE ",J1,G[1,J1];" DIA. MATERIAL CODE (0 FO
3165 INPUT G[2,J1]                                     JDE LIST)
3170 IF G[2,J1]>0 THEN 3180
3172 GOSUB 3400
3175 GOTO 3160
3180 PRINT TAB(5);"COST (#/M)    ";
3185 INPUT M[J1+3]
3190 NEXT J1
3200 PRINT TAB(5);"DO YOU WANT TO CHANGE THE  SHORING MATERIAL
                                                            DES
```

```
3205  GOSUB 7000
3210  GOTO J1 OF 3215,3270,3200
3215  PRINT TAB(5);"ENTER AN ALL IN MATERIAL COST (#/HR) FOR TH
3220  PRINT TAB(10);"CLOSE SHEETING";TAB(30);                  _LOW
3225  INPUT M[6]
3230  PRINT TAB(10);"MEDIUM SHEETING";TAB(30);
3235  INPUT M[7]
3240  PRINT TAB(10);"OPEN SHEETING";TAB(30);
3245  INPUT M[8]
3250  PRINT TAB(10);"PINCHERS";TAB(30);
3255  INPUT M[9]
3260  PRINT TAB(10);"SHORCO BOXES";TAB(30);
3265  INPUT M[10]
3270  MAT  PRINT #9,8;M
3275  RETURN
3300  REM BEDDING TYPES
3305  PRINT TAB(10);"CODE      MATERIAL"
3310  PRINT TAB(10);"----      --------"
3315  PRINT TAB(12);"1      CONCRETE"
3320  PRINT TAB(12);"2      GRANULAR"
3325  PRINT TAB(12);"3      SELECTED FILL"
3330  PRINT TAB(12);"4      NO MATERIAL REQUIRED"
3335  RETURN
3400  REM PIPE TYPES
3410  PRINT TAB(20);"CODE      MATERIAL"
3415  PRINT TAB(20);"----      --------"
3420  PRINT TAB(22);"1      CLAY"
3425  PRINT TAB(22);"2      PRESTRESSED CONCRETE"
3430  PRINT TAB(22);"3      OTHER CONCRETE"
3435  PRINT TAB(22);"4      CAST OR SPUN IRON"
3440  PRINT TAB(22);"5      STEEL"
3445  PRINT TAB(22);"6      PLASTIC"
3450  PRINT TAB(22);"7      ASBESTOS CEMENT"
3455  PRINT TAB(22);"8      PITCH FIBRE"
3460  RETURN
3600  REM COMBINED OPERATIONS
3605  MAT S=ZER
3610  PRINT TAB(10);"COMBINED OPERATIONS"
3620  PRINT TAB(10);"-------------------
3625  M1$="EXSHPBPLBF"
3630  PRINT
3640  PRINT TAB(5);"DO YOU WANT AN EXAMPLE OF THE COMBINED OPER
3650  INPUT R$                                             NS INPUT
3651  R$=UPS$(R$)
3652  IF R$="YES" THEN 3660
3653  IF R$="NO" THEN 3800
3654  GOTO 3640
3660  PRINT TAB(10);"THE METHOD IS DEFINED BY SPECIFYING THE CO
3665  PRINT TAB(5);"THESE ARE THE OPERATIONS WHICH ARE PERFORME
3670  PRINT TAB(5);"OPERATION CODES ARE EX SH PB PL BF.  THIS IN
3675  PRINT TAB(5);"BY AN ASTERISK.  TERMINATE THE INPUT WITH 'N
3680  PRINT TAB(10);"EXAMPLE BAR CHART"                  ED OPERATIC
3685  PRINT TAB(5)                                         NSECUTIVLY.
3690  PRINT TAB(5);"EXCAVATION    !************            IS PROMPTED
```

```
3695  PRINT TAB(5);"SHORING       !            **********"
3700  PRINT TAB(5);"BEDDING       !                   ********"
3705  PRINT TAB(5);"PIPE LAYING  !**************"
3710  PRINT TAB(5);"BACKFILL      !              ************"
3715  PRINT
3720  PRINT TAB(10);"THE INPUT FOR THIS METHOD WOULD BE "
3725  PRINT TAB(10);"* EX,SH,PB"
3730  PRINT TAB(10);"* PL,BF"
3740  PRINT TAB(10);"* NO"
3750  PRINT
3800  I1=0
3810  I1=I1+1
3820  PRINT TAB(10);"* ";
3830  LINPUT P1$
3840  P1$=UPS$(P1$)
3850  IF P1$="NO" THEN 3980
3860  J1=LEN(P1$)
3870  I2=1
3880  J2=POS(M1$,P1$[I2,I2+1])
3890  IF J2>0 THEN 3920
3900  PRINT TAB(5);"** ERROR - OPERATION ";P1$[I2,I2+2];" NOT RE
                                                              NISED
3910  GOTO 3820
3920  J2=(J2+1)/2
3930  S[J2]=I1
3940  IF I2+1=J1 THEN 3810
3960  I2=I2+3
3970  GOTO 3880
3980  FOR I1=1 TO 5
3990  IF S[I1]>0 THEN 4040
4000  PRINT TAB(5);"** ERROR - OPERATION ";M1$[2*I1-1,2*I1];" HA
4010  PRINT TAB(5);"** START AGAIN"               OT BEEN SPECIFIED
4020  MAT S=ZER
4030  GOTO 3800
4040  NEXT I1
4050  RETURN
5000  REM DATA TO FILE
5010  MAT  PRINT #9,1;G,Q
5020  MAT  PRINT #9,2;C
5030  PRINT #9;P$
5040  J6=(2*N)+7
5050  MAT  PRINT #9,J6;T,O,Y,S
5060  PRINT #9;O$,N$
5200  RETURN
5300  J2=POS(P$,A$)
5305  J2=(J2+1)/2
5310  FOR J3=1 TO I1
5315  IF E[J3,1]=0 THEN 5340
5320  IF E[J3,1]=J2 THEN 5350
5330  NEXT J3
5340  E[J3,1]=J2
5350  RETURN
5400  PRINT M1$[X[I,1],X[I,2]];" ENTER LABOUR ONLY OUTPUT   ";
5410  INPUT T[I]
5420  RETURN
```

```
5450  REM BEDDING
5455  MAT E=ZER[10,4]
5460  MAT  READ #9,5;E
5465  A$=O$[5,6]
5470  IF A$="XX" THEN 5490
5475  I1=10
5480  GOSUB 5300
5490  I=2
5495  FOR J=1 TO 2
5500  J1=3
5505  I=I+1
5510  J2=G[J1,J]
5515  IF J2=0 OR J2=4 THEN 5555
5516  IF A$="XX" THEN 5530
5520  IF E[J3,J2+1]>0 THEN 5550
5530  PRINT TAB(5);X$[B[J2,1],B[J2,2]];" BEDDING"
5531  IF A$ <> "XX" THEN 5535
5532  PRINT TAB(5);"ENTER LABOUR ONLY OUTPUT (M3/HR)    ";
5533  INPUT T[I]
5534  GOTO 5555
5535  PRINT  USING 1860;A$
5540  INPUT E[J3,J2+1]
5550  T[I]=E[J3,J2+1]
5555  IF J1=4 THEN 5570
5560  J1=4
5565  GOTO 5505
5570  NEXT J
5580  MAT  PRINT #9,5;E
5590  RETURN
5650  REM PIPELAYING
5660  A$=O$[7,8]
5665  IF A$="XX" THEN 5675
5666  I1=10
5670  GOSUB 5300
5675  I=6
5680  FOR J=1 TO Q[10]
5685  I=I+1
5690  IF A$="XX" THEN 5710
5700  IF E[J3,J+1]>0 THEN 5740
5710  PRINT TAB(5);"PIPELAYING ";G[1,J];" M DIA"
5715  IF A$="XX" THEN 5760
5720  PRINT  USING 1860;A$
5730  INPUT E[J3,J+1]
5740  T[I]=E[J3,J+1]
5750  GOTO 5775
5760  PRINT TAB(59);"ENTER LABOUR ONLY RATE    (M/HR)    ";
5770  INPUT T[I]
5775  NEXT J
5780  MAT  PRINT #9,6;E
5785  MAT E=ZER[10,2]
5790  MAT  READ #9,7;E
5795  RETURN
6000  REM CHANGING METHOD
6005  GOSUB 500
```

```
6006  I=2*(N-1)+7                                                   JD NO. ;";N-
6008  MAT  READ #9,I;T,O,Y,S                                         THE CONDITIO
6009  READ #9;O$,N$                                                  LY."
6020  PRINT TAB(5);"TO DEFINE THIS METHOD ANY DIFFERENCES FROM M
6030  PRINT TAB(5);"MUST BE SPECIFIED. IF NO CHANGES ARE MADE TH
6040  PRINT TAB(5);"IN METHOD NUMBER ";N-1;" WILL BE ASSUMED TO
6045  PRINT
6050  PRINT TAB(5);"DO YOU WANT TO CHANGE THE OPERATIONS OPTIONS
6060  GOSUB 7000
6070  GOTO J1 OF 6160,6140,6050
6140  GOSUB 1360
6150  GOTO 6240
6160  GOSUB 1000
6240  PRINT TAB(5);"DO YOU WANT TO CHANGE THE PLANT    ";
6250  GOSUB 7000
6260  GOTO J1 OF 6350,6420,6240
6350  GOSUB 1600
6420  PRINT TAB(5);"DO YOU WANT TO CHANGE THE LABOUR    ";
6430  GOSUB 7000
6440  GOTO J1 OF 6520,6540,6420
6520  GOSUB 2200
6540  PRINT TAB(5);"DO YOU WANT TO CHANGE THE NON-MEASURED PLANT
6550  GOSUB 7000
6560  GOTO J1 OF 6640,6660,6540
6640  GOSUB 2700
6660  PRINT TAB(5);"DO YOU WANT TO CHANGE THE MATERIALS    ";
6690  GOSUB 7000
6700  GOTO J1 OF 6780,6800,6660
6780  GOSUB 3000
6800  PRINT TAB(5);"DO YOU WANT TO CHANGE THE COMBINED OPERATION
6810  GOSUB 7000
6820  GOTO J1 OF 6900,6910,6800
6900  GOSUB 3600
6910  GOSUB 5000
6920  CHAIN "PRICE2"
7000  REM
7005  INPUT R$
7010  R$=UPS$(R$)
7020  J1=1
7030  IF R$="YES" THEN 7070
7040  J1=2
7050  IF R$="NO" THEN 7070
7060  J1=3
7070  RETURN
9010  READ #8,2;G$
9020  J2=POS(G$,A$[1,1])
9030  IF J2>0 THEN 9060
9040  PRINT TAB(5);"## ERROR - PLANT CODE ";A$," IS NOT IN THE
                                                                FILE
9050  RETURN
9060  J2=(2*J2)+1
9070  MAT  READ #8,J2;K
9090  J2=J2+1
[illegible]  READ #8,J2;P1$
9100  J2=POS(P1$,A$)
```

```
9110  IF J2=0 THEN 9040
9120  J3=LEN(P$)
9130  P$[J3+1,J3+2]=A$
9140  J3=LEN(P$)/2
9160  J2=(J2+1)/2
9170  C[J3]=K[J2,3]
9190  RETURN
9999  END
```

PRICE2

```
5  COM N1,F1$[30],Z1,N
10  REM              PIPELINE PRICING - 3
15  REM              N. Bartram     JUNE '79
20  FILES ucd,pr
30  DIM G[5,2],Q[10],T[10],O[6],S[5],O$[10],N$[10]
40  DIM C[40],P$[80],M[5],B[5],X[10,3],Y[5,4]
50  DIM M$[64],R[5,2],A[3,2],L$[20],L[10],Z[5,6]
60  DIM P[5,60],H[5,2],D[3,4],S$[10],Y$[10]
65  DIM A$[2]
70  PRINT TAB(10);"ANALYSING METHOD NUMBER ";N
80  GOSUB 800
160  GOSUB 4000
170  CHAIN V1,"price",500
300  STOP
400  REM reviewing method
405  ASSIGN "ucd",1,V1
410  ASSIGN "pr",2,V1
415  PRINT TAB(4);"Enter the number of the method you want to r
420  INPUT I
430  IF I <= N THEN 450
440  PRINT TAB(4);"** ERROR WE ONLY HAVE ";N;" METHODS IN STORE
445  GOTO 415
450  Z6=N
455  N=I
460  GOSUB 800
540  N=Z6
550  CHAIN V1,"price",500
560  STOP
600  REM auto pricing
601  PRINT "PRICE2"
605  ASSIGN "ucd",1,V1
610  ASSIGN "pr",2,V1
615  GOSUB 800
630  CHAIN V1,"price3",600
800  REM
810  GOSUB 1000
820  GOSUB 1300
830  GOSUB 1700
840  GOSUB 1900
850  GOSUB 2400
860  GOSUB 2900
870  GOSUB 3300
880  RETURN
1000  REM read initial data
1010  MAT  READ #2,1;G,Q
1020  MAT  READ #2,2;C
1030  READ #2;P$
1035  J=2*N+7
1040  MAT  READ #2,J;T,O,Y,S
1050  READ #2;O$,N$
1200  RETURN
1300  REM operation times
```

```
1310  MAT M=ZER
1340  PRINT TAB(10);"EXCAVATION   OUTPUT = ";T[1];" m3/hr",
1345  M[1]=(Q[O[1]+1]/T[1])*60
1380  PRINT "DURATION = ";M[1];" mins/m"
1390  PRINT TAB(10);"SHORING       ";
1400  IF O[2]>0 THEN 1430
1410  PRINT "NONE REQUIRED"
1420  GOTO 1450
1430  M[2]=(1/T[2])*60
1440  PRINT "OUTPUT = ";T[2];" m/hr   DURATION = ";M[2];" hr/m"
1450  PRINT TAB(10);"BEDDING"
1460  I=2
1470  FOR J=1 TO Q[10]
1480  I=I+1
1490  IF T[I]=0 THEN 1530
1495  PRINT TAB(5);
1500  PRINT "PIPE ";J;" BED MATERIAL OUTPUT = ";T[I];" m3/hr";
1510  M1=(Q[I+1]/T[I])*60
1515  M[3]=M[3]+M1
1520  PRINT "DURATION = ";M1;" mins/m"
1530  I=I+1
1540  IF T[I]=0 THEN 1580
1550  M1=(Q[I+1]/T[I])*60
1560  PRINT TAB(5);"PIPE ";J;"COVER MATERIAL OUTPUT = ";T[I];"m
1561  PRINT "DURATION = ";M1;" mins/m"
1570  M[3]=M[3]+M1
1580  NEXT J
1590  PRINT TAB(10);"BEDDING DURATION = ";M[3];"mins/m"
1600  PRINT TAB(10);"PIPELAYING"
1610  I=6
1620  FOR J=1 TO Q[10]
1625  I=I+1
1640  M1=(1/T[I])*60
1650  M[4]=M[4]+M1
1660  PRINT TAB(5);"PIPE ";J;"OUTPUT = ";T[I];" hrs/m DURATION
                                                        M1;" min
1662  NEXT J
1664  PRINT TAB(10);"PIPELAYING DURATION = ";M[4];"mins/m"
1668  PRINT TAB(10);"BACKFILL    ";
1670  I=9
1672  M[5]=(Q[O[1]+7]/T[9])*60
1674  PRINT "OUTPUT = ";T[9];" m3/hr   DURATION = ";M[5];" mins
1676  RETURN
1700  REM   gang times
1710  MAT B=ZER
1720  FOR I1=1 TO 5
1730  B[S[I1]]=B[S[I1]]+M[I1]
1740  NEXT I1
1750  T1=0
1760  FOR I1=1 TO 5
1770  IF T1>B[I1] THEN 1790
1780  T1=B[I1]
1790  NEXT I1
1800  PRINT TAB(5);"TOTAL DURATION = ";T1;" mins/m"
1820  RETURN
```

```
1900  REM  bar chart
1905  MAT P=ZER
1910  PRINT TAB(10);"BAR CHART"
1920  PRINT
1930  PRINT TAB(5);"OPERATION";TAB(19);"!    TIME ->    (mins/m)"
1940  A=1
1950  IF T1 <= 50 THEN 1970
1960  A=2
1970  PRINT TAB(19);"!0";
1980  FOR I1=1 TO 5
1990  A1=10*A*I1
2010  PRINT  USING 2020;A1
2020  IMAGE #,7x,ddd
2030  NEXT I1
2035  PRINT
2040  PRINT TAB(5);"--------------!";
2050  FOR I1=1 TO 5
2060  PRINT "---------+";
2070  NEXT I1
2075  PRINT
2080  M$="EXCAVATESHOREBEDDINGPIPE LAYBACKFILL"
2090  MAT X=ZER[5,2]
2100  MAT  READ X
2110  DATA 1,8,9,13,14,20,21,28,29,36
2120  I1=0
2130  MAT B=ZER
2140  I1=I1+1
2150  IF I1=6 THEN 2270
2170  PRINT TAB(5);M$[X[I1,1],X[I1,2]];TAB(19);"!";
2180  FOR J1=1 TO B[S[I1]]
2190  PRINT " ";
2195  P[I1,J1]=0
2200  NEXT J1
2205  X=B[S[I1]]
2210  FOR J1=1 TO (M[I1]/A)
2220  PRINT "*";
2225  P[I1,X+J1]=1
2230  NEXT J1
2240  PRINT
2250  B[S[I1]]=B[S[I1]]+(M[I1]/A)
2260  GOTO 2140
2270  PRINT TAB(5);
2280  FOR J1=1 TO 65
2290  PRINT "-";
2295  NEXT J1
2296  SYSTEM V1,"pause-10"
2300  RETURN
2400  REM labour requirements & costs
2410  MAT A=ZER
2420  PRINT TAB(10);"LABOUR REQUIREMENTS BY OPERATION"
2430  READ #1,44;L$
2435  MAT  READ #1,43;L
2440  FOR I=1 TO 5
2450  PRINT TAB(10),M$[X[I,1],X[I,2]];
```

```
2460  FOR J=1 TO 2
2470  L1=Y[I,J]
2480  L2=Y[I,J+2]
2490  IF L1=0 THEN 2510
2500  PRINT TAB(30);L$[2*L1-1,2*L1];" * ";L2;"no"
2510  NEXT J
2520  NEXT I
2530  PRINT TAB(5);"FROM THE COMBINED OPERATIONS AS SHOWN ABOVE
2540  PRINT TAB(5);"THIS REDUCES TO A GANG SIZE AS FOLLOWS"
2550  FOR J=1 TO 60
2560  MAT H=ZER[3,2]
2570  FOR I=1 TO 5
2580  IF P[I,J]=0 THEN 2665
2585  FOR J1=1 TO 2
2590  L1=Y[I,J1]
2595  L2=Y[I,J1+2]
2600  IF L1=0 THEN 2660
2610  FOR J2=1 TO 3
2615  IF H[J2,1]=0 THEN 2640
2620  IF H[J2,1]=L1 THEN 2655
2630  NEXT J2
2640  H[J2,1]=L1
2645  H[J2,2]=L2
2650  GOTO 2660
2655  H[J2,2]=H[J2,2]+L2
2660  NEXT J1
2665  NEXT I
2670  FOR J1=1 TO 3
2680  L1=H[J1,1]
2685  IF L1=0 THEN 2740
2690  FOR J2=1 TO 3
2695  IF A[J2,1]=0 THEN 2715
2700  IF A[J2,1]=L1 THEN 2730
2710  NEXT J2
2715  A[J2,1]=L1
2720  A[J2,2]=H[J1,2]
2725  GOTO 2740
2730  IF A[J2,2]>H[J1,2] THEN 2740
2735  A[J2,2]=H[J1,2]
2740  NEXT J1
2750  NEXT J
2760  MAT D=ZER
2770  FOR I=1 TO 3
2780  L1=A[I,1]
2790  IF L1=0 THEN 2815
2795  PRINT TAB(5);L$[2*L1-1,2*L1];" * ";A[I,2];" no";
2797  C1=L[L1]
2800  PRINT " @ ";C1;" = ";C1*A[I,2];" #/hr"
2810  D[1,1]=D[1,1]+C1*A[I,2]
2815  NEXT I
2820  PRINT TAB(10);"TOTAL LABOUR COST = ";D[1,1];" #/hr"
2830  D[1,1]=D[1,1]*T1/60
2835  PRINT TAB(10);"                             = ";D[1,1];" #/m"
2840  RETURN
```

```
2900  REM materials
2905  MAT  READ #2,8;T
2910  PRINT TAB(10);"MATERIALS"
2920  PRINT TAB(15);"SHORING MATERIALS";
2925  IF O[2]>0 THEN 2940
2930  PRINT "   NONE REQUIRED"
2935  GOTO 2970
2940  PRINT " = ";T[O[2]+5];" #/hr";
2950  T2=T[O[2]+5]*T1/60
2960  PRINT " = ";T2;" #/m"
2965  D[1,2]=D[1,2]+T2
2970  PRINT TAB(10);"BEDDING MATERIALS"
2975  MAT B=ZER
2980  I1=G[3,1]
2985  IF I1=0 OR I1=4 THEN 2995
2990  B[I1]=B[I1]+Q[4]
2995  I1=G[3,2]
3000  IF I1=0 OR I1=4 THEN 3010
3005  B[I1]=B[I1]+Q[6]
3010  I1=G[4,1]
3015  IF I1=0 OR I1=4 THEN 3022
3020  B[I1]=B[I1]+Q[5]
3022  I1=G[4,2]
3023  IF I1=0 OR I1=4 THEN 3026
3024  B[I1]=B[I1]+Q[7]
3026  T2=0
3028  IF B[1]=0 THEN 3034
3030  PRINT TAB(5);"CONCRETE = ";B[1];" m3 @ ";T[1];" = ";B[1]*
3032  T2=T2+(B[1]*T[1])
3034  IF B[2]=0 THEN 3042
3036  PRINT TAB(5);"GRAVEL   = ";B[2];" m3 @ ";T[2];" = ";B[2]*
3040  T2=T2+(B[2]*T[2])
3042  PRINT TAB(5);"TOTAL = ";T2;" #/m"
3045  D[1,2]=D[1,2]+T2
3050  PRINT TAB(5);"PIPES"
3052  PRINT TAB(5);G[1,1];"dia @ ";T[4];" #/m"
3054  T2=T[4]
3056  IF Q[10]=1 THEN 3064
3058  PRINT TAB(5);G[1,2];"dia @ ";T[5];" #/m"
3060  T2=T2+T[5]
3062  PRINT TAB(5);"PIPE TOTAL COST = ";T2;" #/m"
3064  D[1,2]=D[1,2]+T2
3070  PRINT TAB(5);"TOTAL MATERIALS COST = ";D[1,2];" #/m"
3080  RETURN
3300  REM    measurable plant
3305  MAT R=ZER
3310  PRINT TAB(10);"MEASURED PLANT"
3315  PRINT TAB(10);"PLANT REQUIRED FOR EACH OPERATION "
3320  FOR I=1 TO 5
3321  A$=O$[2*I-1,2*I]
3325  PRINT TAB(10);M$[X[I,1],X[I,2]];TAB(20);
3326  IF A$="XX" THEN 3329
3327  PRINT A$
3328  GOTO 3330
```

```
3329  PRINT "NONE REQUIRED"
3330  NEXT I
3335  PRINT TAB(10);"TOTAL MEASURED PLANT REQUIREMENT AS FOLLOWS
3345  FOR J=1 TO 50
3350  MAT H=ZER[5,2]
3355  FOR I=1 TO 5
3360  IF P[I,J]=0 THEN 3405
3362  A$=O$[2*I-1,2*I]
3364  IF A$="XX" THEN 3405
3365  P1=POS(P$,A$)
3370  P1=(P1+1)/2
3375  FOR J1=1 TO 5
3380  IF H[J1,1]=0 THEN 3395
3385  IF H[J1,1]=P1 THEN 3400
3390  NEXT J1
3395  H[J1,1]=P1
3400  H[J1,2]=H[J1,2]+1
3405  NEXT I
3410  FOR J1=1 TO 5
3415  IF H[J1,1]=0 THEN 3470
3420  P1=H[J1,1]
3425  FOR J2=1 TO 5
3430  IF R[J2,1]=0 THEN 3445
3435  IF R[J2,1]=P1 THEN 3460
3440  NEXT J2
3445  R[J2,1]=P1
3450  R[J2,2]=H[J1,2]
3455  GOTO 3470
3460  IF R[J2,2]>H[J1,2] THEN 3470
3465  R[J2,2]=H[J1,2]
3470  NEXT J1
3472  NEXT J
3475  T2=0
3480  FOR I=1 TO 5
3485  IF R[I,1]=0 THEN 3510
3490  P1=R[I,1]
3495  PRINT TAB(5);P$[2*P1-1,2*P1];" * ";R[I,2];" NO. @ ";C[P1],
                                                       ";C[P1]*R[I,2];" #/
3500  T2=T2+(C[P1]*R[I,2])
3510  NEXT I
3515  PRINT TAB(5);"TOTAL MEASURED PLANT = ";T2;" #/hr"
3520  T3=0
3525  PRINT TAB(10);"NON-MEASURED PLANT"
3530  J=LEN(N$)
3535  IF J>0 THEN 3550
3540  PRINT TAB(10);"NONE REQUIRED"
3545  GOTO 3582
3550  FOR I=1 TO J/2
3555  P1=POS(P$,N$[2*I-1,2*I])
3560  P1=(P1+1)/2
3565  PRINT TAB(5);N$[2*I-1,2*I];" @ ";C[P1];" #/hr"
3570  T3=T3+C[P1]
3575  NEXT I
3580  PRINT TAB(10);"TOTAL NON-MEASURED PLANT = ";T3
3582  D[1,3]=T2+T3
```

```
3585  PRINT TAB(10);"TOTAL PLANT COST = ";D[1,3];" #/hr"
3595  D[1,3]=D[1,3]*T1/60
3600  PRINT TAB(10);"                  = ";D[1,3];" #/m"
3605  PRINT
3610  PRINT TAB(5);"SUMMARY"
3611  PRINT TAB(5);"*******"
3615  PRINT TAB(5);"METHOD NUMBER";TAB(30);N
3620  PRINT TAB(5);"DURATION";TAB(30);"= ";T1;" mins/m"
3625  PRINT TAB(30);"= ";(T1*Q[1])/60;" hours total"
3630  PRINT TAB(5);"COSTS"
3635  PRINT TAB(5);"LABOUR";TAB(30);"= ";D[1,1];" #/m"
3640  PRINT TAB(5);"MATERIALS";TAB(30);"= ";D[1,2];" #/m"
3645  PRINT TAB(5);"PLANT";TAB(30);"= ";D[1,3];" #/m"
3650  D[1,4]=D[1,1]+D[1,2]+D[1,3]
3655  PRINT TAB(5);"TOTAL COST ";TAB(30);"= ";D[1,4];" #/m"
3660  PRINT TAB(30);"= ";D[1,4]*Q[1];" # total"
3665  RETURN
4000  REM data to file
4010  I=2*N+8
4020  PRINT #2,I;T1
4025  MAT  PRINT #2;D,R,A,M
4100  RETURN
9999  END
```

PRICE3

```
5   COM N1,F1$[30],Z1,N
10  REM          PIPELINE PRICING - PRICING NOTES
20  REM          N. Bartram           JUNE '79
30  FILES *,*,*,*,*,*,*,ucd,pr,report
40  DIM T[10],O[6],Y[5,4],S[5],O$[10],D[3,4],R[5,2]
50  DIM A[3,2],M[10],G[5,2],Q[10],C[40],P$[80],B[10]
55  DIM N$[10],M$[120],U[5,2],L$[30],R$[3]
56  DIM A$[2]
60  PRINT TAB(5);"Enter the number of the method to be printed
70  INPUT J3
75  IF J3 <= N THEN 90
80  PRINT "** ERROR ONLY GOT ";N;" METHODS IN STORE **"
85  GOTO 60
90  Z6=N
95  MAT B=ZER
100  GOSUB 7300
105  N=Z6
110  GOSUB 400
118  CHAIN V1,"price",500
200  REM accepting method
205  PRINT TAB(5);"Enter the number of the method to be accepted
210  INPUT J3
215  IF J3 <= N THEN 230
220  PRINT "** ERROR - ONLY GOT ";N;" METHODS IN STORE ** "
225  GOTO 205
230  MAT B=ZER
235  B[2]=N1
240  IF Z1=0 THEN 305
245  PRINT TAB(5);"Do you want to use this method for any other
                                                          e runs
250  INPUT R$
255  R$=UPS$(R$)
260  IF R$="YES" THEN 275
265  IF R$="NO" THEN 305
270  GOTO 245
275  PRINT TAB(5);"Enter the numbers of the other runs which are
280  PRINT TAB(5);"using this method. One per line, terminate wi
                                                          be priced
285  I=2                                                  '0'"
290  I=I+1
295  INPUT B[I]
300  IF B[I]>0 THEN 290
305  B[1]=2
310  GOSUB 900
315  MAT  READ #9,8;Q
330  MAT  PRINT #9;B
335  GOSUB 400
338  N=J3
340  IF Z1=0 THEN 350
345  CHAIN "price4"
350  CHAIN "price"
400  REM
410  I=2*N1+8
415  D[2,2]=D1
```

```
420   PRINT #9, I; T1
430   MAT  PRINT #9; D, R, A, M
440   RETURN
600   REM
610   J3=N
620   GOSUB 900
626   N=J3
630   CHAIN "price4"
890   REM
900   ASSIGN "ucd", 8, V1
910   ASSIGN "pr", 9, V1
915   ASSIGN "report", 10, V1
920   GOSUB 7300
930   RETURN
5000  REM resource totals
5005  PRINT #N; TAB(4); "! totals"; TAB(18); "!";
5010  I1=1
5020  IF A[I1, 1]=0 THEN 5050
5025  GOSUB 6300
5030  PRINT #N; USING 5040; A[I1, 2], D$, L[I2]
5040  IMAGE #, x, d, " no ", 10a, " @ ", d. dd
5050  PRINT #N; TAB(43); "!";
5060  PRINT #N; TAB(50); "bedding + pipes = ";
5065  M2=D[1, 2]-(F[O[2]+5]*T1/60)
5070  PRINT #N; M2; " $/m"; TAB(89); "!";
5075  P1=R[I1, 1]
5080  A$=P$[2*P1-1, 2*P1]
5090  GOSUB 6000
5100  PRINT #N; USING 5110; R[I1, 2], D$, C[P1]
5110  IMAGE #, x, d, " no ", 9a, " @ ", dd. dd
5120  PRINT #N; TAB(114); "!"
5125  FOR I1=2 TO 3
5130  IF A[I1, 1]=0 AND R[I1, 1]=0 THEN 5230
5135  PRINT #N; TAB(4); "!"; TAB(18); "!";
5140  IF A[I1, 1]=0 THEN 5155
5145  GOSUB 6300
5150  PRINT #N; USING 5040; A[I1, 2], D$, L[I2]
5155  PRINT #N; TAB(43); "!"; TAB(89); "!";
5160  IF R[I1, 1]=0 THEN 5180
5165  P1=R[I1, 1]
5166  A$=P$[2*P1-1, 2*P1]
5170  GOSUB 6000
5175  PRINT #N; USING 5110; R[I1, 2], D$, C[P1]
5180  PRINT #N; TAB(114); "!"
5185  NEXT I1
5190  FOR I1=4 TO 5
5195  IF R[I1, 1]=0 THEN 5230
5200  PRINT #N; TAB(4); "!"; TAB(18); "!"; TAB(43); "!"; TAB(89); "!",
5205  P1=R[I1, 1]
5206  A$=P$[2*P1-1, 2*P1]
5210  GOSUB 6000
5215  PRINT #N; USING 5110; R[I1, 2], D$, C[P1]
5220  PRINT #N; TAB(114); "!"
5225  NEXT I1
```

```
5230  REM hourly totals if req
5400  GOSUB 9800
5410  RETURN
6000  REM plant names
6010  DIM G$[20],P1$[60],PO$[250],X[20,3],D$[20]
6012  MAT X=ZER[20,3]
6015  READ #8,2;G$
6020  I2=POS(G$,A$[1,1])
6025  I2=(2*I2)+1
6030  MAT  READ #8,I2;X
6035  MAT X=ZER[20,2]
6040  MAT  READ #8;X
6045  I2=I2+1
6050  READ #8,I2;P1$,PO$
6055  I2=POS(P1$,A$)
6060  I2=(I2+1)/2
6065  D$=PO$[X[I2,1],X[I2,2]]
6070  RETURN
6100  REM pipe types
6110  GOTO G[2,J] OF 6115,6125,6125,6135,6145,6155,6165,6175
6115  D$="clay  "
6120  RETURN
6125  D$="conc  "
6130  RETURN
6135  D$="iron  "
6140  RETURN
6145  D$="STEEL "
6150  RETURN
6155  D$="PLAST "
6160  RETURN
6165  D$="ACEMNT"
6170  RETURN
6175  D$="PFIBRE"
6180  RETURN
6200  REM bedding materials
6210  GOTO J1 OF 6215,6225
6215  D$="CONC"
6220  RETURN
6225  D$="GRAV"
6230  RETURN
6300  REM labour descriptions
6305  MAT X=ZER[10,2]
6310  READ #8,44;L$,PO$
6315  MAT  READ #8,43;L,X
6320  I2=A[I1,1]
6325  D$=PO$[X[I2,1],X[I2,2]]
6330  RETURN
7300  REM pricing notes
7320  N=10
7324  GOSUB 8800
7325  IF  END #N THEN 7334
7326  LINPUT #N;M$
7327  IF  END #N THEN 7334
7330  REM advance the required number of pages on the file
```

```
7331  GOTO 7326
7334  PRINT #N;CTL(1)
7335  PRINT #N;TAB(50);"PRICING NOTES"
7340  PRINT #N;TAB(50);"*************"
7345  PRINT #N
7350  PRINT #N;TAB(25);"RUN NUMBER(S)   ";N1;
7358  PRINT #N;TAB(50);"METHOD NUMBER ";J3;TAB(75);"RUN LENGTH ";(
7360  PRINT #N                                                    1];"M
7365  GOSUB 9800
7370  PRINT #N;TAB(4);"!   operation";TAB(19);"!   option";TAB(34
7375  PRINT #N;TAB(49);"!  output";TAB(64);"!      time   ->      m
7380  PRINT #N;TAB(4);"!";TAB(19);"!";TAB(34);"! m3/m";TAB(49);"!
7385  PRINT #N;TAB(64);"!0";                      "!  volumes";
7390  A1=1                                        s/m";TAB(114);"!
7395  IF T1 <= 50 THEN 7405                       per hour";
7400  A1=2
7405  FOR I1=1 TO 4
7410  PRINT #N; USING 7415;A1*10*I1
7415  IMAGE #,8x,dd
7420  NEXT I1
7425  PRINT #N;TAB(114);"!"
7430  GOSUB 9800
7435  MAT Z=ZER[5]
7440  I1=1
7450  PRINT #N;TAB(4);"! excavate";TAB(19);"!";
7455  IF O[1]=1 THEN 7470
7460  PRINT #N;" battered";TAB(34);"!   ";Q[3];TAB(49);"!   ";
7465  GOTO 7475
7470  PRINT #N;" vertical";TAB(34);"!   ";Q[2];TAB(49);"!   ";
7475  PRINT #N;T[1];TAB(64);"!";
7478  A2=M[1]/A1
7480  FOR I2=1 TO A2
7485  PRINT #N;"*";
7490  NEXT I2
7495  PRINT #N;TAB(114);"!"
7500  Z[S[I1]]=Z[S[I1]]+M[I1]/A1
7510  PRINT #N;TAB(4);"! shore";TAB(19);"! ";
7520  M$="closemediumopenpinchersshorco"
7535  MAT  READ U
7540  DATA 1,5,6,11,12,15,16,23,24,29
7550  I1=2
7555  IF O[2]=0 THEN 7568
7560  PRINT #N;M$[U[O[2],1],U[O[2],2]];TAB(34);"!";TAB(49);"!  ";[
                                                  ];TAB(64);"!
7565  GOTO 7570
7568  PRINT #N;"nil";TAB(34);"!";TAB(49);"!";TAB(64);"!";
7570  GOSUB 9860
7575  Z[S[I1]]=Z[S[I1]]+M[I1]/A1
7580  I1=3
7585  PRINT #N;TAB(4);"! BEDDING";TAB(19);"!";TAB(34);"!";
7586  PRINT #N; USING 7587;V[1,1],V[2,1],V[3,1]
7587  IMAGE #,dd.d,x,dd.d,x,dd.d
7588  PRINT #N; USING 7589;V[1,2],V[2,2],V[3,2]
7589  IMAGE #,dd.d,x,dd.d,x,dd.d,"!"
7590  GOSUB 9860
```

```
7595  Z[S[I1]]=Z[S[I1]]+M[I1]/A1
7600  I1=4
7605  PRINT #N;TAB(4);"! pipelay";TAB(19);"!";TAB(34);"!";TAB(49);
7606  PRINT #N; USING 7607;T[7],T[8]
7607  IMAGE #,x,dd.dd,x,dd.dd,xx,"!"
7610  GOSUB 9860
7615  Z[S[I1]]=Z[S[I1]]+M[I1]/A1
7620  I1=5
7625  PRINT #N;TAB(4);"! backfill";TAB(19);"!";TAB(34);"!    ";
7630  I2=Q[O[1]+7]
7635  PRINT #N;I2;TAB(49);"!     ";T[9];TAB(64);"!";
7660  GOSUB 9860
7665  GOSUB 9800
7670  GOSUB 9800                                               ";TAB(60
7675  PRINT #N;TAB(4);"! RESOURCES    !";TAB(30);"LABOUR";TAB(43);
7676  PRINT #N;"MATERIALS";TAB(89);"!";TAB(100);"PLANT";TAB(114);
7678  GOSUB 9800
7680  PRINT #N;TAB(4);"! excavation";TAB(18);"!";
7685  I1=1
7690  READ #8,44;L$
7695  MAT  READ #8,43;L
7700  GOSUB 9900
7705  MAT  READ #9,8;F
7710  A$=O$[1,2]
7712  IF A$="XX" THEN 7722
7715  GOSUB 6000
7720  PRINT #N;TAB(89);"!";TAB(95);D$;
7722  PRINT #N;TAB(114);"!"
7725  I1=2
7730  PRINT #N;TAB(4);"! shoring";TAB(18);"!";
7735  IF O[2]>0 THEN 7750
7740  PRINT #N;"NON REQUIRED";TAB(43);"!";TAB(89);"!";TAB(114);"!
7745  GOTO 7790
7750  GOSUB 9900
7755  PRINT #N;TAB(60);F[O[2]+5];"$/hr";TAB(89);"!";
7756  A$=O$[3,4]
7760  IF A$="XX" THEN 7785
7770  GOSUB 6000
7780  PRINT #N;TAB(95);D$;
7785  PRINT #N;TAB(114);"!"
7786  GOTO 7860
7790  I1=4
7795  PRINT #N;TAB(4);"! pipelay";TAB(18);"!";
7800  GOSUB 9900
7805  FOR J=1 TO Q[10]
7810  GOSUB 6100
7815  PRINT #N; USING 7820;G[1,J],D$,F[3+J]
7820  IMAGE #,x,d.ddd,x,6a,x,"@",x,dd.dd,x
7825  NEXT J
7830  PRINT #N;TAB(89);"!";
7835  A$=O$[7,8]
7840  IF A$="XX" THEN 7855
7845  GOSUB 6000
7850  PRINT #N;TAB(95);D$;
```

```
7855  PRINT #N;TAB(114);"!"
7856  GOTO 7940
7860  I1=3
7865  PRINT #N;TAB(4);"! bedding";TAB(18);"!";
7870  GOSUB 9900
7875  FOR J1=1 TO 2
7880  IF V[J1,1]=0 THEN 7900
7885  GOSUB 6200
7890  PRINT #N; USING 7895;V[J1,1],D$,F[J1]
7895  IMAGE #,x,d.dd," m3 ",4a," @ ",dd.dd,x
7900  NEXT J1
7905  PRINT #N;TAB(89);"!";
7910  A$=O$[5,6]
7920  IF A$="XX" THEN 7935
7925  GOSUB 6000
7930  PRINT #N;TAB(95);D$;
7935  PRINT #N;TAB(114);"!"
7936  GOTO 7790
7940  I1=5
7945  PRINT #N;TAB(4);"! backfill";TAB(18);"!";
7950  GOSUB 9900
7955  PRINT #N;TAB(89);"!";
8000  A$=O$[9,10]
8005  IF A$="XX" THEN 8020
8010  GOSUB 6000
8015  PRINT #N;TAB(95);D$;
8020  PRINT #N;TAB(114);"!"
8025  GOSUB 9800
8030  GOSUB 5000
8060  GOSUB 9800
8070  PRINT #N;TAB(4);"!  NON - MEASURED PLANT";TAB(30);"!";
8075  I2=LEN(N$)/2
8080  FOR I1=1 TO I2
8085  A$=N$[2*I1-1,2*I1]
8090  GOSUB 6000
8095  I3=(POS(P$,A$)+1)/2
8096  PRINT #N; USING 8100;D$,C[I3]
8100  IMAGE #,xx,10a," @ ",dd.dd,x
8105  NEXT I1
8106  PRINT #N;TAB(114);"!"
8125  GOSUB 9800
8130  PRINT #N
8135  GOSUB 9800
8140  PRINT #N;TAB(4);"!     DURATION";TAB(30);"!
8145  PRINT #N;"     PREDICTED S.P.I.";TAB(84);"!
8147  GOSUB 8300
8150  PRINT #N;TAB(4);"!";TAB(30);"!";TAB(35);T1;TAB(54);"!
8154  PRINT #N;"!     ";T1/S1;TAB(114);"!"
8155  GOSUB 9800
8160  PRINT #N
8165  GOSUB 9800
8170  PRINT #N;TAB(4);"!     COSTS #/m";TAB(24);"!
8175  PRINT #N;"MATERIALS";TAB(64);"!
8176  GOSUB 9800
```

```
8180  PRINT #N;TAB(4);"!   standard time";TAB(24);"!    ";;TAB(84
8195  PRINT #N;D[1,1];TAB(44);"!     ";D[1,2];TAB(64);"!     ";D[1,
8200  PRINT #N;"!     ";D[1,4];TAB(114);"!"
8210  PRINT #N;TAB(4);"!   s.p.i. addition";TAB(24);"!     ";
8212  D[2,1]=D[1,1]*((1/S1)-1)
8213  D[2,2]=0
8215  D[2,3]=D[1,3]*((1/S1)-1)
8217  PRINT #N;D[2,1];TAB(44);"!";TAB(64);"!     ";D[2,3];TAB(84);
8219  D[2,4]=D[2,1]+D[2,3]
8221  PRINT #N;D[2,4];TAB(114);"!"
8223  FOR L2=1 TO 4
8224  D[3,L2]=D[2,L2]+D[1,L2]
8225  NEXT L2
8227  PRINT #N;TAB(4);"!    totals";TAB(24);"!     ";D[3,1];
8228  PRINT #N;TAB(44);"!     ";D[3,2];TAB(64);"!     ";D[3,3];TAB
8230  PRINT #N;D[3,4];TAB(114);"!"
8232  GOSUB 9800
8234  RETURN
8240  RETURN
8245  IMAGE #,6x,ddd.dd,7x,"!"
8299  PRINT #N;TAB(44);"!     ";D[3,2];TAB(64);"!     ";D[3,3];TAB
8300  REM
8310  PRINT TAB(5);"ENTER THE PREDICTED S.P.I    ";
8320  INPUT S1
8323  GOSUB 9800
8330  S1=S1/100
8340  RETURN
8800  REM collect data for bar chart
8801  MAT M=ZER[5]
8805  I=2*J3+7
8806  MAT M=ZER[5]
8810  MAT  READ #9,I;T,O,Y,S
8815  READ #9;O$,N$
8820  I=I+1
8825  READ #9,I;T1
8830  MAT  READ #9;D,R,A,M
8835  MAT  READ #9,1;G,Q
8840  MAT  READ #9,2;C
8845  READ #9;P$
8850  MAT V=ZER
8860  I=3
8865  FOR J=1 TO 2
8866  I1=3
8870  I=I+1
8875  I2=G[I1,J]
8880  IF I2=0 OR I2=4 THEN 8890
8885  V[I2,1]=V[I2,1]+Q[I]
8886  V[I2,2]=V[I2,2]+(Q[I]/T[I-1])
8890  IF I1=4 THEN 8905
8895  I1=4
8900  GOTO 8870
8905  NEXT J
8910  FOR J=1 TO 3
8915  IF V[J,1]=0 THEN 8925
```

```
8920  V[J,2]=V[J,1]/V[J,2]
8925  NEXT J
8930  RETURN
9800  REM
9810  PRINT #N;TAB(4);
9820  FOR J2=1 TO 110
9830  PRINT #N;"-";
9840  NEXT J2
9845  PRINT #N
9850  RETURN
9860  REM
9862  A2=Z[S[I1]]
9865  FOR I2=1 TO A2
9870  PRINT #N;" ";
9875  NEXT I2
9877  A2=M[I1]/A1
9880  FOR I2=1 TO A2
9885  PRINT #N;"*";
9890  NEXT I2
9892  PRINT #N;TAB(114);"!"
9895  RETURN
9900  REM labour listing
9910  FOR J1=1 TO 2
9915  I2=Y[I1,J1]
9920  IF I2=0 THEN 9955
9925  R1=Y[I1,J1+2]
9930  R2=(2*I2)-1
9940  PRINT #N;  USING 9950;R1,L$[R2,R2+1]
9950  IMAGE #,x,d,x,"no",x,aa,x
9955  NEXT J1
9960  PRINT #N;TAB(43);"!";
9970  RETURN
9999  END
```

PRICE4

```
5   COM N1,F1$[30],Z1,N
10  REM     PIPELINE PRICING  -  BILL ITEM PRICING
15  REM     N. Bartram               June '79
30  FILES *,*,*,*,*,*,*,*,ucd,pr                                    5
35  DIM B[10],I$[10],T[10],O[6],Y[5,4],S[5],O$[10],N$[10],D[3,4],
40  DIM A[3,2],M[5],E[15,3],C[40],P$[80],N[6,9],L[10],L$[30],A$[2
45  DIM M$[120],Z[20],X[6],F[10],H[2],K[20,3],PO$[10]
90  GOSUB 9000
100  MAT  READ #10,8;B
120  MAT N=ZER
130  GOSUB 1000
140  GOSUB 1100
150  GOSUB 1400
160  GOSUB 1600
170  GOSUB 1800
175  MAT  READ #10,8;B,B
180  REM  data for next run with this method
185  B[1]=B[1]+1
190  IF B[B[1]]=0 THEN 500
195  N1=B[B[1]]
196  MAT  READ #10,8;L
198  MAT  PRINT #10;B
200  CHAIN V1,"price",600
500  CHAIN V1,"drepo",280
600  REM printing priced bill
610  ASSIGN "report",8,V1
620  ASSIGN F1$[4,6],2,V1
630  READ #2,1;N
635  N=8
640  GOSUB 3000
650  READ #2,2;N$,PO$
660  GOSUB 3100
670  I=T1=T2=0
680  I=I+1
690  IF I>N1  THEN 870
700  I1=2*I
710  READ #2,I1;N$,O$,I$
720  IF O$=PO$ THEN 800
730  GOSUB 3700
770  PRINT #N;CTL(1)
780  PO$=O$
785  GOSUB 3100
790  T1=0
800  MAT  READ #2,I1+1;F,X
810  T1=T1+X[6]
820  T2=T2+X[6]
830  PRINT #N;TAB(4);"!   ";I$;TAB(19);"!";
840  PRINT #N; USING 850;X[1],X[2],X[3],X[4],X[5],X[6]
850  IMAGE 5(4x,ddd.dd,4x,"!"),6x,dddd.dd,6x,"!"
860  GOTO 680
870  GOSUB 3700
880  PRINT #N;TAB(50);"GRAND TOTAL = ",TAB(100),
```

```
890  PRINT #N; USING 3750;T2
900  PRINT #N;TAB(95);"------------------"
910  CHAIN V1,"drepo",280
1000  REM data for contribution factors
1010  I=2*N+7
1015  MAT  READ #10,I;T,O,Y,S
1020  READ #10;O$,N$
1025  I=I+1
1030  READ #10,I;T1
1035  MAT  READ #10;D,R,A,M
1036  MAT  READ #10,2;C
1040  READ #10;P$
1050  READ #9,44;L$
1055  MAT  READ #9,43;L
1090  RETURN
1100  REM contribution factors
1110  REM operation times
1120  FOR I=1 TO 5
1130  N[I,3]=M[I]
1140  NEXT I
1150  REM maesured plant
1160  FOR I=1 TO 5
1165  A$=O$[2*I-1,2*I]
1170  IF A$="XX" THEN 1190
1175  A=POS(P$,A$)
1180  A=(A+1)/2
1185  N[I,2]=C[A]
1190  NEXT I
1195  REM labour costs
1200  FOR I=1 TO 5
1210  FOR A=1 TO 2
1220  IF Y[I,A]=0 THEN 1240
1225  I2=Y[I,A]
1230  N[I,1]=N[I,1]+(Y[I,A+2]*L[I2])
1240  NEXT A
1250  NEXT I
1255  REM contribution factors
1256  FOR I=1 TO 5
1260  N[I,4]=(N[I,1]+N[I,2])*N[I,3]
1265  N[6,4]=N[6,4]+N[I,4]
1270  NEXT I
1275  REM multiplication factors
1280  FOR I=1 TO 5
1285  N[I,5]=N[I,4]/N[6,4]
1290  NEXT I
1300  RETURN
1400  REM costs per operation
1410  G1=D[3,1]
1411  S1=D[2,2]
1412  REM labour
1415  FOR I=1 TO 5
1420  N[I,6]=N[I,5]*G1
1425  NEXT I
1430  REM N M plant
```

```
1440  I=LEN(N$)
1450  G3=0
1455  IF I=0 THEN 1500
1460  I=I/2
1465  FOR A=1 TO I
1470  A$=N$[2*A-1,2*A]
1475  A1=POS(P$,A$)
1480  G3=G3+C[(A1+1)/2]
1485  NEXT A
1490  G3=G3/S1
1500  G2=D[3,3]-G3
1505  REM measured plant by operation
1510  FOR I=1 TO 5
1515  N[I,7]=N[I,5]*G2
1520  NEXT I
1525  REM materials by operation
1530  G4=G5=G6=0
1540  IF O[2]=0 THEN 1560
1550  G4=B[O[2]+5]*(T1/60)
1555  N[2,8]=G4
1560  G6=B[4]+B[5]
1565  N[4,8]=G6
1570  G5=D[3,2]-G4-G6
1575  N[3,8]=G5
1580  RETURN
1600  REM N M plant
1610  IF G3=0 THEN 1760
1615  PRINT TAB(10);"RUN NUMBER ";N1;"NON-MEASURED PLANT"
1620  PRINT TAB(10);"How do you want to assign the n-m plant cost
1625  PRINT TAB(10);"Enter one of the following codes (ex,sh,pb,p
1630  INPUT A$                                    bf,pr,eq,?) "
1635  A$=UPS$(A$)
1640  IF A$ <> "?" THEN 1695
1645  PRINT TAB(5);"The non-measured plant cost of ";G3;"#/m can
1650  PRINT TAB(5);"in the following way"            e assigne
1655  PRINT TAB(5);"EX  -  Allow all the cost against the EXCAVAT
1660  PRINT TAB(5);"SH  -  Ditto SHORING"              ON operation
1665  PRINT TAB(5);"PB  -  Ditto PIPE BEDDING"
1670  PRINT TAB(5);"PL  -  Ditto PIPE LAYING"
1675  PRINT TAB(5);"BF  -  Ditto BACKFILL"                 erations
1680  PRINT TAB(5);"EQ  -  Divide this cost equally between all c
1685  PRINT TAB(5);"PR  -  Record this cost as a Preliminary item
1690  GOTO 1625
1695  M$="EXSHPBPLBFPREQ"
1700  A=POS(M$,A$)
1710  IF A=0 THEN 1645
1715  A=(A+1)/2
1720  IF A=7 THEN 1740
1725  N[A,9]=G3
1730  GOTO 1760
1740  FOR I=1 TO 5
1750  N[I,9]=G3/5
1755  NEXT I
1760  RETURN
```

```
1800  REM bill items
1810  READ #2, 1; N6
1815  MAT E=ZER[2, 7]
1820  FOR I=1 TO N6
1826  MAT  READ #3, I; E, Z
1830  IF Z[2] <> N THEN 1910
1840  MAT X=ZER
1845  I1=(2*I)+1
1850  MAT  READ #2, I1; F
1855  FOR A=1 TO 5
1860  IF F[A]=0 THEN 1890
1865  X[1]=X[1]+N[A, 6]
1870  X[2]=X[2]+N[A, 8]
1875  X[3]=X[3]+N[A, 7]+N[A, 9]
1880  X[4]=X[4]+N[6, 9]*Z[17]
1885  IF F[10]=0 THEN 1890
1886  N[6, 9]=0
1890  NEXT A
1895  X[5]=X[1]+X[2]+X[3]
1900  X[6]=X[5]*Z[17]
1905  MAT  PRINT #2; X
1910  NEXT I
1920  RETURN
2000  REM
3000  REM heading
3010  IF  END #N THEN 3040
3020  LINPUT #N; M$
3030  GOTO 3010
3040  PRINT #N; CTL(1)
3050  PRINT #N; TAB(50); "BILL OF QUANTITIES"
3060  PRINT #N; TAB(50); "******************"
3065  PRINT #N
3070  RETURN
3100  REM page heading
3105  PRINT #N; TAB(4); "BILL NUMBER......"; N$
3110  PRINT #N; TAB(4); "PAGE NUMBER......"; P0
3120  GOSUB 3200
3125  PRINT #N; TAB(4); "!   item no      !     LABOUR       !";
3130  PRINT #N; "   MATERIAL    !     PLANT       !   PRELIMS      !";
3140  PRINT #N; "      RATE      !          TOTAL"; TAB(114); "!"
3150  GOSUB 3200
3160  RETURN
3200  REM
3210  PRINT #N; TAB(4);
3220  FOR P=1 TO 110
3230  PRINT #N; "-";
3235  NEXT P
3240  PRINT #N
3245  RETURN
3700  REM
3710  PRINT #N; TAB(80); "PAGE TOTAL = "; TAB(100);
3720  PRINT #N; USING 3750; T1
3740  PRINT #N; TAB(95); "--------------------"
3750  IMAGE ddddd.dd
```

```
3760  RETURN
9000  REM assign files
9010  ASSIGN F1$[4,6],2,V1
9020  ASSIGN F1$[7,9],3,V1
9030  ASSIGN F1$[10,12],4,V1
9040  ASSIGN F1$[13,15],5,V1
9050  ASSIGN F1$[16,18],6,V1
9060  ASSIGN F1$[19,21],7,V1
9070  ASSIGN F1$[22,24],8,V1
9080  RETURN
9999  END
```

SUCD

```
5   COM N1
10  REM
                              STANDARD UNIT COST DATA
15  REM
                              N. Bertram           JUNE '79
20  FILES ucd,pucd
30  DIM I[20],G$[20],GO$[250],X[20,2],P[20,3],Y[20,2],P1$[40],PO$
40  DIM R$[3],A$[2],AO$[20],L[10],L1$[20]
100  PRINT TAB(20);"LABOUR AND PLANT RATES"
110  PRINT TAB(20);"***********************"
115  PRINT
120  READ #1,1;D1,D2,D3
130  PRINT  USING 140;D1,D2,D3
140  IMAGE 5x,"These rates were last amended on ",2x,dd,"/",dd,"/
150  MAT  READ #1;I
160  READ #1,2;G$,GO$
170  MAT  READ #1;X
172  IF I[1]>0 THEN 180
173  PRINT TAB(5);"** NONE SPECIFIED  **"
175  GOTO 270
180  FOR I1=1 TO 20
190  IF I[I1]=0 THEN 210
195  P1=I1
200  GOSUB 1000
210  NEXT I1
220  PRINT TAB(5);"Do you want to add any more plant classes to th
                                                             is list  "
225  INPUT R$
230  R$=UPS$(R$)
240  IF R$="NO" THEN 280
250  IF R$="YES" THEN 270
260  GOTO 220
270  GOSUB 2000
280  GOSUB 3000
285  GOSUB 6000
290  STOP
1000  REM   existing dat.
1010  I2=I1*2+1
1020  MAT  READ #1,I2;P,Y
1030  I2=I2+1
1040  READ #1,I2;P1$,PO$
1050  PRINT TAB(10);"CLASS ";I1;"CODE LETTER ";G$[I1,I1];" - ";GO$
1060  PRINT                                            ;X[I1,1],X[I1,2]
1070  PRINT TAB(5);"CODE";TAB(15);"DESCRIPTION";TAB(30);"RATE";TA
1075  PRINT TAB(60);"TOTAL"                                  45);"FUEL"
1080  PRINT TAB(30);"[#/hr]";TAB(45);"[#/hr]";TAB(60);"[#/hr]"
1090  PRINT
1100  FOR L=1 TO I[1]
1120  PRINT TAB(5);P1$[2*L-1,2*L];TAB(15);PO$[Y[L,1],Y[L,2]];TAB(3
1130  PRINT  USING 1140;P[L,1],P[L,2],P[L,3]
1140  IMAGE ddd.dd,9x,ddd.dd,7x,ddd.dd
1150  NEXT L
1160  PRINT
1170  PRINT TAB(5);"Do you want to amend any of these rates   ";
1180  INPUT R$
```

```
1185  R$=UPS$(R$)
1190  IF R$="NO" THEN 1390
1200  IF R$="YES" THEN 1220
1210  GOTO 1170
1220  PRINT TAB(5);"PLANT CODE   ";
1225  INPUT A$
1230  PRINT TAB(5);"RATE, FUEL   ";
1235  INPUT D1,D2
1245  A$=UPS$(A$)
1250  L=POS(P1$,A$)
1260  IF L>0 THEN 1290
1270  PRINT TAB(5);"** ERROR - CODE ";A$;" NOT RECOGNISED **"
1280  GOTO 1220
1290  L=(L+1)/2
1300  P[L,1]=D1
1310  P[L,2]=D2
1320  P[L,3]=D1+D2
1330  PRINT TAB(10);"Any more revisions   ";
1340  INPUT R$
1350  R$=UPS$(R$)
1360  IF R$="YES" THEN 1220
1370  IF R$="NO" THEN 1390
1380  GOTO 1330
1390  PRINT TAB(5);"Do you want to add any more plant to this list
1400  INPUT R$
1410  R$=UPS$(R$)
1420  IF R$="YES" THEN 1450
1430  IF R$="NO" THEN 1690
1440  GOTO 1390
1450  PRINT TAB(10);"ENTER PLANT CODE-  ";
1460  INPUT A$
1465  A$=UPS$(A$)
1467  IF A$[1,1]=G$[P1,P1] THEN 1470
1468  PRINT TAB(5);"** ERROR - CODE SHOULD BEGIN WITH '";G$[P1,P1]
1469  GOTO 1450
1470  L=POS(P1$,A$)
1475  IF L=0 THEN 1490
1480  PRINT "** ERROR - THIS CODE HAS ALREADY BEEN USED **"
1485  GOTO 1450
1490  PRINT TAB(5);"DESCRIPTION   ";
1495  L1=LEN(P1$)
1496  L1=L1+1
1497  P1$[L1,L1+1]=A$
1500  INPUT A0$
1510  A0$=UPS$(A0$)
1515  J1=LEN(A0$)
1520  J2=I[I1]+1
1525  I[I1]=J2
1530  IF J2=1 THEN 1570
1540  Y[J2,1]=Y[J2-1,2]+1
1550  Y[J2,2]=Y[J2,1]+J1
1560  GOTO 1590
1570  Y[J2,1]=1
1580  GOTO 1590
```

```
1590  PO$[Y[J2,1],Y[J2,2]]=AO$
1600  PRINT TAB(5);"RATE , FUEL = ";
1610  INPUT P[J2,1],P[J2,2]
1620  P[J2,3]=P[J2,1]+P[J2,2]
1630  PRINT TAB(5);"Any more additions   ";
1640  INPUT R$
1650  R$=UPS$(R$)
1660  IF R$="YES" THEN 1450
1670  IF R$="NO" THEN 1690
1680  GOTO 1630
1690  PRINT TAB(5);"Do you want to review this data again   ";
1700  INPUT R$
1710  R$=UPS$(R$)
1720  IF R$="YES" THEN 1050
1730  IF R$="NO" THEN 1740
1735  GOTO 1690
1740  I2=2*I1+1
1750  MAT  PRINT #1,I2;P,Y
1760  I2=I2+1
1770  PRINT #1,I2;P1$,PO$
1780  RETURN
2000  REM       new classifications
2010  PRINT TAB(10);"NEW CLASSIFICATION CODE LETTER = ";
2020  INPUT A$
2030  A$=UPS$(A$)
2040  J1=POS(G$,A$)
2050  IF J1=0 THEN 2080
2060  PRINT TAB(5);"** ERROR - THIS CODE LETTER HAS ALLREADY BEEN
                                                            USED **
2070  GOTO 2010
2080  P1=LEN(G$)
2090  P1=P1+1
2095  I1=P1
2100  G$[P1,P1]=A$
2110  PRINT TAB(10);"DESCRIPTION   ";
2120  INPUT AO$
2130  AO$=UPS$(AO$)
2135  L1=LEN(AO$)
2140  IF P1=1 THEN 2170
2150  X[P1,1]=X[P1-1,2]+1
2160  GOTO 2180
2170  X[P1,1]=1
2180  X[P1,2]=X[P1,1]+L1
2190  GO$[X[P1,1],X[P1,2]]=AO$
2200  MAT P=ZER
2210  MAT Y=ZER
2220  P1$=""
2230  PO$=""
2240  GOSUB 1450
2250  PRINT TAB(5);"Any more classes   ";
2260  INPUT R$
2270  R$=UPS$(R$)
2275  IF R$="YES" THEN 2010
2280  IF R$="NO" THEN 2300
2290  GOTO 2250
```

```
2300   PRINT #1,2;G$,GO$
2310   MAT  PRINT #1;X
2320   RETURN
3000   REM   printing ti line printer
3010   GOSUB 5000
3020   PRINT #1,1;D1,D2,D3
3030   MAT  PRINT #1;I
3040   N=2
3050   PRINT #N;TAB(50);"LABOUR AND PLANT RATES"
3060   PRINT #N;TAB(50);"**********************"
3070   PRINT #N
3075   PRINT #N; USING 140;D1,D2,D3
3080   GOSUB 4000                                                        ;TAB(69
3090   PRINT #N;TAB(4);"!";TAB(9);"CLASS";TAB(39);"!";TAB(45);"TYPE
3100   PRINT #N;"!  RATE [#/hr] !  fuel [#/hr] ! total [#/hr] !"
3105   GOSUB 4000
3110   FOR I=1 TO 20
3120   IF I[I]=0 THEN 3320
3130   I2=2*I+1
3140   MAT  READ #1,I2;P,Y
3150   I2=I2+1
3160   READ #1,I2;P1$,PO$                                              ;"!";TAB(45
3170   PRINT #N;TAB(4);"! ";G$[I,I];" - ";GO$[X[I,1],X[I,2]];TAB(3
3180   PRINT #N;P1$[1,2];" - ";PO$[Y[1,1],Y[1,2]];TAB(69);"!";
3190   A$="!"
3200   PRINT #N; USING 3210;P[1,1],A$,P[1,2],A$,P[1,3],A$
3210   IMAGE 5x,dd.dd,4x,a,5x,dd.dd,4x,a,5x,dd.dd,4x,a
3250   FOR J=2 TO 20
3260   IF P[J,1]=0 THEN 3300
3270   PRINT #N;TAB(4);"!";TAB(39);"!";TAB(45);P1$[2*J-1,2*J];" -
3280   PRINT #N;PO$[Y[J,1],Y[J,2]];TAB(69);"!";
3290   PRINT #N; USING 3210;P[J,1],A$,P[J,2],A$,P[J,3],A$
3300   NEXT J
3310   GOSUB 4000
3320   NEXT I
3330   RETURN
4000   REM
4010   PRINT #N;TAB(4);
4020   FOR I1=1 TO 110
4030   PRINT #N;"-";
4040   NEXT I1
4045   PRINT #N
4050   RETURN
5000   REM  date
5010   DIM A[12]
5020   MAT  READ A
5030   DATA 31,28,31,30,31,30,31,31,30,31,30,31
5040   D1=TIM(2)
5050   D2=TIM(3)
5060   D3=D2+1900
5065   D3=D3/4
5070   D4=INT(D3)
5075   IF D3-D4>0 THEN 5090
5080   A[2]=29
```

```
5090  FOR I=1 TO 12
5100  IF D1 <= A[I] THEN 5140
5110  D1=D1-A[I]
5120  NEXT I
5140  D3=D2
5150  D2=I
5160  RETURN
6000  REM  labour
6005  MAT Y=ZER[10,2]
6010  MAT  READ #1,43;L,Y
6020  READ #1,44;L1$,PO$
6030  PRINT TAB(15);"LABOUR"
6040  PRINT TAB(15);"******"
6050  PRINT
6060  FOR I=1 TO 10
6070  IF L[I]=0 THEN 6090                          ));L[I];" #/hr
6080  PRINT TAB(5);L1$[2*I-1,2*I];TAB(15);PO$[Y[I,1],Y[I,2]];TAB(
6090  NEXT I
6100  PRINT TAB(5);"Do you want to amend any of this data   ";
6110  INPUT R$
6120  R$=UPS$(R$)
6130  IF R$="NO" THEN 6300
6140  IF R$="YES" THEN 6160
6150  GOTO 6100
6160  PRINT TAB(10);"LABOUR CODE   ";
6165  INPUT A$
6170  PRINT TAB(10);"ALL IN RATE   ";
6175  INPUT X
6180  A$=UPS$(A$)
6185  J=POS(L1$,A$)
6200  IF J>0 THEN 6230
6210  PRINT TAB(5);"** ERROR - code ";A$;" Not known **"
6220  GOTO 6160
6230  J=(J+1)/2
6240  L[J]=X
6250  PRINT TAB(5);"Any more revisions   ";
6260  INPUT R$
6270  R$=UPS$(R$)
6280  IF R$="NO" THEN 6300
6285  IF R$="YES" THEN 6160
6290  GOTO 6250
6300  PRINT TAB(10);"Do you want to add any more labour types   ";
6310  INPUT R$
6320  R$=UPS$(R$)
6330  IF R$="YES" THEN 6360
6340  IF R$="NO" THEN 6600
6350  GOTO 6300
6360  PRINT TAB(10);"LABOUR CODE   ";
6370  INPUT A$
6375  A$=UPS$(A$)
6380  J=POS(L1$,A$)
6390  IF J=0 THEN 6420
6400  PRINT TAB(5);"** ERROR - This code has allready been assig
6410  GOTO 6360
```

```
6420  J=LEN(L1$)
6430  J=J+1
6440  L1$[J,J+1]=A$
6450  PRINT TAB(10);"DESCRIPTION    ";
6460  INPUT A0$
6470  J1=LEN(P0$)
6480  J=(J+1)/2
6490  Y[J,1]=J1+1
6500  Y[J,2]=Y[J,1]+J1+LEN(A0$)
6510  P0$[Y[J,1],Y[J,2]]=A0$
6520  PRINT TAB(10);"ALL IN RATE/HR = ";
6530  INPUT L[J]
6540  PRINT TAB(5);"ANY MORE ADDITIONAL LABOUR RATES ";
6550  INPUT R$
6560  R$=UPS$(R$)
6570  IF R$="NO" THEN 6600
6580  IF R$="YES" THEN 6360
6590  GOTO 6540
6600  MAT  PRINT #1,43;L,Y
6610  PRINT #1,44;L1$,P0$
6620  PRINT #N
6630  PRINT #N;TAB(35);"LABOUR"
6640  PRINT #N;TAB(35);"******"
6650  FOR J=1 TO 10
6660  IF L[J]=0 THEN 6680
6670  PRINT #N;TAB(15);L1$[2*J-1,2*J];TAB(40);P0$[Y[J,1],Y[J,2]];
6675  PRINT #N;L[J];"   #/hr"
6680  NEXT J
6690  RETURN
9999  END
```

```
5   COM C$[30],M$[250],J,F$[100],D$[60],N1
10   REM                   MANHOLE ANALYSIS PROGRAMME
15   REM                   N. Bartram                    JAN '79
20   FILES mandat,mans
30   DIM Y[50,10],X[50,4],R$[3]
35   DIM O[50],V[50]
40   DIM C[50,5],S[50,5],G[50],K[50],N[50,4],H[5],F[50]
50   GOSUB 1600
60   PRINT TAB(20);"PRE-CAST CONCRETE MANHOLE ANALYSIS"
70   PRINT TAB(20);"**********************************"
80   PRINT
90   PRINT TAB(10);"Contract";TAB(25);
100   INPUT C$
110   GOSUB 1300
130   GOSUB 1000
145   J=0
150   J=J+1
160   GOSUB 1700
180   IF N[J,1]=0 THEN 210
190   GOSUB 2100
210   PRINT TAB(10);"Any more manholes";TAB(20);
220   INPUT R$
222   R$=UPS$(R$)
225   IF R$="NO" THEN 240
230   IF R$="YES" THEN 150
235   GOTO 210
240   GOSUB 8000
250   CHAIN "mshed"
275   GOSUB 8000
280   STOP
1000   REM         STANDARD DIMENSIONS SUBROUTINE
1005   PRINT
1010   PRINT TAB(20);"STANDARD DIMENSIONS"
1011   PRINT TAB(20);"*******************"
1012   PRINT                                  cify all dimensions in meter
1020   PRINT TAB(5);"Standard dimensions common to all manholes, s
1025   PRINT
1030   PRINT TAB(10);"Depth of base below pipe ";TAB(55);
1040   INPUT Y[1,1]
1050   PRINT TAB(10);"Height of base above pipe";TAB(55);
1060   INPUT Y[1,2]
1070   PRINT TAB(10);"Do the rings sit on an upstand";TAB(55);
1080   INPUT R$
1090   IF R$="yes" THEN 1093
1091   Y[1,3]=0
1092   GOTO 1095
1093   PRINT TAB(10);"Height of upstand";TAB(55);
1094   INPUT Y[1,3]
1095   PRINT TAB(10);"Thickness of concrete ring surround";TAB(55);
1096   INPUT X[1,1]
1097   PRINT "We will assume that the base is the same diameter as
1098   PRINT "Is this correct";TAB(55);               he ring surroun
```

```
1099  INPUT R$
1100  IF R$="yes" THEN 1150
1120  PRINT TAB(10);"Base overhang";TAB(55);
1130  INPUT X[1,2]
1140  GOTO 1160
1150  X[1,2]=0
1160  PRINT TAB(10);"Minimum chamber height";TAB(55);
1170  INPUT C1
1180  RETURN
1300  REM MANHOLE TYPE DESCRIPTION INPUT
1304  PRINT
1305  PRINT TAB(10);"MANHOLE DESCRIPTIONS"
1306  PRINT
1310  PRINT TAB(5);"Three types of manhole are considered;"
1320  PRINT
1330  PRINT TAB(10);"MANHOLE TYPE 1, CHAMBER ONLY"
1340  PRINT TAB(10);"Description";TAB(40);
1350  INPUT D$[1,20]
1351  PRINT
1360  PRINT TAB(10);"MANHOLE TYPE 2, CHAMBER + SHAFT + REDUCING SL
1370  PRINT TAB(10);"Descrption ";TAB(40);
1380  INPUT D$[21,40]
1381  PRINT
1390  PRINT TAB(10);"MANHOLE TYPE 3, CHAMBER + SHAFT + TAPER"
1400  PRINT TAB(10);"Description";TAB(40);
1410  INPUT D$[41,60]
1411  PRINT
1420  PRINT TAB(10);"COVERS & FRAMES"
1430  PRINT TAB(5);"How many do you want to specify";TAB(40);
1440  INPUT N1
1450  FOR I=1 TO N1
1460  PRINT TAB(10);"COVER AND FRAME TYPE";I
1465  PRINT TAB(10);"Description";TAB(40);
1470  P=20*I-19
1480  INPUT F$[P,P+19]
1481  PRINT
1490  NEXT I
1500  RETURN
1600  REM   zeroing
1605  MAT N=ZER
1610  MAT Y=ZER
1615  MAT X=ZER
1620  MAT C=ZER
1630  MAT S=ZER
1635  MAT G=ZER
1640  MAT F=ZER
1645  MAT K=ZER
1650  MAT O=ZER
1665  MAT V=ZER
1670  RETURN
1700  REM   DATA FOR MANHOLE NUMBER 'J'
1710  FOR I=1 TO 3
1720  Y[J,I]=Y[1,I]
1730  NEXT I
```

```
1740  X[J,1]=X[1,1]
1750  X[J,2]=X[1,2]
1760  PRINT TAB(20);"MANHOLE ANALYSIS"
1770  PRINT TAB(20);"****************"
1780  PRINT
1790  PRINT TAB(10);"Manhole number";TAB(40);
1800  P=5*J-4
1810  INPUT M$[P,P+4]
1820  PRINT TAB(10);"Type  (special = 0)";TAB(40);
1830  INPUT N[J,1]
1835  PRINT TAB(10);"Cover Level";TAB(30);
1840  INPUT O[J]
1842  PRINT TAB(10);"Invert Level";TAB(30);
1843  INPUT V[J]
1850  IF N[J,1]=0 THEN 2050
1860  PRINT TAB(10);"Pipe diameter";TAB(40);
1870  INPUT Y[J,10]
1880  PRINT TAB(10);"Chamber diameter";TAB(40);
1890  INPUT X[J,3]
1895  X[J,4]=0
1900  IF N[J,1]=1 THEN 1930
1910  PRINT TAB(10);"Shaft diameter";TAB(40);
1920  INPUT X[J,4]
1930  PRINT TAB(10);"Cover & Frame type ";TAB(40);
1940  INPUT N[J,4]
1950  PRINT TAB(10);"Cover slab type (h/l)";TAB(40);
1960  INPUT X$
1970  IF X$="h" THEN 1985
1975  N[J,2]=1
1980  GOTO 1990
1985  N[J,2]=2
1990  IF N[J,1]=2 THEN 2010
2000  GOTO 2050
2010  PRINT TAB(10);"Reducing slab type (h/l)";TAB(40);
2020  INPUT X$
2030  IF X$="h" THEN 2045
2035  N[J,3]=1
2040  GOTO 2050
2045  N[J,3]=2
2050  RETURN
2100  REM    TAKING OFF SUBROUTINES
2110  FOR I=1 TO 5
2120  C[J,I]=0
2130  S[J,I]=0
2140  NEXT I
2150  GOSUB 3000
2160  REM 3000 = Ring width subroutine
2170  GOSUB 3500
2180  REM 3500 = PIPE WALL THICKNESS SUBROUTINE
2190  GOSUB 3900
2200  REM 3900 = BASE CONCRETE
2210  IF N[J,1]=2 THEN 2330
2220  IF N[J,1]=3 THEN 2430
2230  REM               MANHOLE TYPE 1
```

```
2231  REM
2240  Y[J,5]=0
2250  Y[J,6]=0
2260  Y[J,9]=.15
2270  GOSUB 4100
2280  REM 4100= COVER SLAB THICKNESS
2290  V1=O[J]-V[J]-B1-Y[J,5]-Y[J,6]-Y[J,7]-Y[J,9]
2300  GOSUB 4400
2310  REM 4400 = RING SORTING SUBROUTINE
2311  Y[J,4]=C[J,1]
2320  GOTO 2530
2330  REM               MANHOLE TYPE 2
2331  REM
2340  GOSUB 4100
2350  GOSUB 5000
2360  REM 5000 = REDUCING SLAB THICKNESS
2370  Y[J,9]=.15
2380  GOSUB 5100
2390  REM 5100 = CHAMBER HEIGHT SUBROUTINE
2400  V1=O[J]-V[J]-B1-Y[J,5]-Y[J,6]-Y[J,7]-Y[J,9]
2410  GOSUB 4400
2420  GOTO 2530
2430  REM             MANHOLE TYPE 3
2431  REM
2440  GOSUB 4100
2450  IF X[J,3]>1.2 THEN 2480
2460  Y[J,5]=.61
2470  GOTO 2490
2480  Y[J,5]=.915
2490  Y[J,9]=.15
2500  GOSUB 5100
2510  V1=O[J]-V[J]-B1-Y[J,4]-Y[J,5]-Y[J,7]-Y[J,9]
2520  GOSUB 4400
2530  GOSUB 5350
2540  REM       5350 = CONCRETE SURROUND
2550  RETURN
3000  REM    RING WIDTH SUBROUTINE
3010  IF J>1 THEN 3060
3020  DIM R[12,2]
3021  R[1,1]=0
3022  R[1,2]=0
3030  FOR I=2 TO 12
3040  READ R[I,1],R[I,2]
3050  NEXT I
3060  C2=X[J,3]
3070  I=0
3080  I=I+1
3090  IF C2 <= R[I,1] THEN 3150
3100  IF I<11 THEN 3080
3110  PRINT "ERROR - CHAMBER DIAMETER";C2;"NOT IN STORE"
3120  PRINT "PLEASE SPECIFY RING WALL THICKNESS";TAB(30);
3130  INPUT C3
3140  GOTO 3200
3150  D1=R[I,2]-R[I-1,2]
```

```
3160   D2=R[I,1]-R[I-1,1]
3170   Z=D1/D2
3180   C3=Z*(C2-R[I-1,1])
3190   C3=C3+R[I-1,2]
3195   PRINT "Chamber wall =";C3
3200   S1=X[J,4]
3210   IF S1=0 THEN 3370
3220   I=0
3230   I=I+1
3240   IF S1 <= R[I,1] THEN 3290
3245   IF I<3 THEN 3230
3250   PRINT "ERROR - SHAFT DIAMETER";S1;"NOT IN STORE"
3260   PRINT "SPECIFY SHAFT WALL THICKNESS";TAB(30);
3270   INPUT S3
3280   GOTO 3340
3290   D1=R[I,2]-R[I-1,2]
3300   D2=R[I,1]-R[I-1,1]
3310   Z=D1/D2
3320   S3=Z*(S1-R[I-1,1])
3330   S3=S3+R[I-1,2]
3340   PRINT "Shaft wall ";S3;"Chamber wall ";C3                .35,.097
3350   DATA .675,.057,.75,.063,.825,.063,.9,.07,1.05,.075,1.2,.087,
3351   DATA 1.5,.102,1.8,.11,2.1,.199,2.4,.133
3370   RETURN
3500   REM     PIPE WALL THICKNESS
3510   IF J>1 THEN 3560
3520   DIM P[28,2]
3530   FOR I=1 TO 27 STEP 3
3540   READ P[I,1],P[I,2],P[I+1,1],P[I+1,2],P[I+2,1],P[I+2,2]
3550   NEXT I
3555   READ P[28,1],P[28,2]
3560   I=0
3570   D1=Y[J,10]
3580   I=I+1
3590   IF D1 <= P[I,1] THEN 3650
3600   IF I<28 THEN 3580
3610   PRINT "ERROR - PIPE DIAMETER ";D1;"NOT IN STORE"
3620   PRINT "PLEASE SPECIFY PIPE WALL THICKNESS";TAB(30);
3630   INPUT D2
3640   GOTO 3710
3650   X1=P[I,2]-P[I-1,2]
3660   X2=P[I,1]-P[I-1,1]
3670   Z=X1/X2
3680   D2=Z*(D1-P[I-1,1])
3690   D2=D2+P[I-1,2]
3700   PRINT "Pipe wall thickness ";D2
3710   RETURN
3711   DATA .1,.026,.15,.026,.225,.03
3712   DATA .3,.034,.375,.038,.45,.041
3713   DATA .525,.048,.6,.052,.675,.056
3714   DATA .75,.06,.825,.064,.9,.067
3715   DATA .975,.071,1.05,.078,1.125,.082
3716   DATA 1.2,.086,1.275,.086,1.35,.093
3717   DATA 1.425,.097,1.5,.101,1.575,.114
```

```
3718  DATA 1.65,.115,1.725,.115,1.8,.116
3719  DATA 1.875,.123,1.95,.13,2.02,.137
3720  DATA 2.1,.144
3900  REM        BASE CONCRETE
3910  B=Y[J,10]+2*(D2+C3+X[J,1]+X[J,2])
3920  B=B+X[J,3]
3930  B1=Y[J,1]+Y[J,2]+Y[J,3]
3940  B1=B1+Y[J,10]+2*D2
3950  B2=3.14159*B*B/4
3960  B2=B2*B1
3970  R1=D2+(Y[J,10]/2)
3980  A1=3.14159*R1*R1/8
3990  A2=Y[J,10]*(B1-Y[J,1]-Y[J,2]-Y[J,3])
4000  V3=(X[J,3]*X[J,3]*3.14159/4)*Y[J,3]
4010  A=A1+A2
4020  V1=A*B
4030  F[J]=B2-V3-V1
4040  PRINT "Base volume ";F[J];"m3"
4050  RETURN
4100  REM       COVER THICKNESS ROUTINE
4110  DIM Z[7,3]
4120  IF J>1 THEN 4160
4130  FOR I=1 TO 7
4140  READ Z[I,1],Z[I,2],Z[I,3]
4150  NEXT I
4160  N1=N[J,2]+1
4170  I=0
4180  I=I+1
4190  IF X[J,3] <= Z[I,1] THEN 4240
4200  IF I<7 THEN 4180
4210  PRINT "ERROR - PLEASE SPECIFY COVER SLAB THICKNESS";TAB(40);
4220  INPUT Y[J,7]
4230  GOTO 4310
4240  D1=Z[I,N1]-Z[I-1,N1]
4250  D2=Z[I,1]-Z[I-1,1]
4260  Z1=D1/D2
4270  Y[J,7]=Z1*(X[J,4]-Z[I-1,1])
4280  Y[J,7]=Y[J,7]+Z[I-1,N1]
4290  PRINT "Cover slab thickness";Y[J,7]
4301  DATA .675,.127,.076
4302  DATA 1.2,.127,.076
4303  DATA 1.35,.126,.09
4304  DATA 1.5,.15,.1
4305  DATA 1.8,.15,.1
4306  DATA 2.1,.175,.15
4307  DATA 2.4,.2,.2
4310  RETURN
4400  REM RING SORTING SUBROUTINE
4410  IF J>1 THEN 4460
4420  READ H[1],H[2],H[3],H[4],H[5]
4460  M=1
4470  V2=V1
4480  I=0
4490  I=I+1
```

```
4500  IF V1>H[I] THEN 4720
4510  IF I<5 THEN 4490
4520  IF V2<.31 THEN 4630
4530  V1=V1+C[J,M]
4540  I=0
4550  I=I+1
4560  IF N[J,1]>1 THEN 4600
4570  IF C[J,M]= NOT H[I] THEN 4550
4575  PRINT "4575",M,I
4580  C[J,M]=H[I-1]
4590  GOTO 4480
4600  IF S[J,M]= NOT H[I] THEN 4550
4610  S[J,M]=H[I-1]
4620  GOTO 4480
4630  PRINT "ERROR- The smallest ring 0.31 is too big therefore ma
                                                    e up in brickwork'
4650  IF N[J,1]=1 THEN 4690
4660  S[J,1]=V2
4670  G[J]=V2
4680  GOTO 4800
4690  C[J,1]=V2
4700  G[J]=V2
4710  GOTO 4800
4720  V1=V1-H[I]
4730  M=M+1
4740  IF N[J,1]=1 THEN 4770
4750  S[J,M]=H[I]
4760  GOTO 4780
4770  C[J,M]=H[I]
4780  IF V1>.225 THEN 4480
4790  G[J]=V1
4791  FOR P=2 TO 5
4792  S[J,1]=S[J,1]+S[J,P]
4793  NEXT P
4800  RETURN
4810  DATA 1.22,.915,.615,.459,.305
5000  REM REDUCING SLAB THICKNESS
5010  Y[J,5]=.152
5020  IF X[J,3]= NOT 2.025 THEN 5050
5030  Y[J,5]=.178
5050  RETURN
5100  REM
5101  REM       CHAMBER HEIGHT SUBROUTINE
5110  IF J>1 THEN 5130
5120  READ H[1],H[2],H[3],H[4],H[5]
5125  PRINT H[1];H[2];H[3];H[4];H[5]
5130  V1=C1
5135  PRINT V1
5140  M=1
5150  I=0
5160  I=I+1
5170  IF V1>H[I] THEN 5260
5180  IF I<5 THEN 5160
5185  PRINT V1;C[J,1];C[J,2];C[J,3];C[J,4];C[J,5]
5190  M=M+1
```

```
5200  C[J,M]=.305
5210  C[J,1]=0
5220  FOR Z1=2 TO 5
5230  C[J,1]=C[J,1]+C[J,Z1]
5235  NEXT Z1
5240  Y[J,4]=C[J,1]
5245  PRINT "Chamber rings";V1;C[J,1];C[J,2];C[J,3];C[J,4];C[J,5]
5246  PRINT "y(y,4) = ";Y[J,4]
5250  GOTO 5300
5260  M=M+1
5270  C[J,M]=H[I]
5280  V1=V1-H[I]
5285  PRINT V1;C[J,1];C[J,2];C[J,3];C[J,4];C[J,5]
5290  GOTO 5150
5291  DATA 1.22,.915,.61,.459,.305
5300  RETURN
5350  REM      CONCRETE SURROUND
5360  REM    CHAMBER SURROUND
5370  V7=0
5380  V8=0
5385  V5=0
5390  D3=X[J,3]+2*C3
5400  D4=D3+2*X[J,1]
5410  A4=3.14159*(D3*D3-D4*D4)/4
5420  V7=A4*Y[J,4]
5430  IF N[J,1]=1 THEN 5550
5440  IF N[J,1]=2 THEN 5520
5450  REM   TAPER SURROUND  (Equation obtained from R.B. Leask es
5460  R1=(X[J,3]+2*C3)/2
5470  R2=(X[J,4]+2*S3)/2
5480  H1=Y[J,5]
5490  V8=.5*H1*3.14159*(R1*R1+R2*R2+R1*R2)
5500  V9=3.14159*R1*R1*H1
5505  N=0
5510  V8=V9-V8
5515  REM  shaft surround
5520  D3=X[J,4]+(2*S3)
5530  D4=D3+(2*X[J,1])
5540  V5=3.14159*(D3*D3-D4*D4)/4
5550  K[J]=V7+V8+V5
5560  RETURN
8000  REM data to file
8010  N=0
8020  PRINT #1,1;N
8030  FOR I=1 TO 50
8040  FOR I1=1 TO 4
8050  PRINT #1;N[I,I1]
8060  NEXT I1
8070  NEXT I
8080  PRINT #1,3;N
8090  FOR I=1 TO 50
8100  FOR I1=1 TO 10
8110  PRINT #1;Y[I,I1]
8120  NEXT I1
```

```
8130  NEXT I
8140  PRINT #1,7;N
8150  FOR I=1 TO 50
8160  FOR I1=1 TO 4
8170  PRINT #1;X[I,I1]
8180  NEXT I1
8190  NEXT I
8200  PRINT #1,9;N
8210  FOR I=1 TO 50
8220  FOR I1=1 TO 5
8230  PRINT #1;C[I,I1]
8240  NEXT I1
8250  NEXT I
8260  PRINT #1,11;N
8270  FOR I=1 TO 50
8280  FOR I1=1 TO 5
8290  PRINT #1;S[I,I1]
8300  NEXT I1
8310  NEXT I
8315  MAT  PRINT #1,10;V
8320  MAT  PRINT #1,13;G
8330  MAT  PRINT #1,14;F
8340  MAT  PRINT #1,15;K
8350  MAT  PRINT #1,16;O
8360  MAT  PRINT #1,17;V
8370  RETURN
9000  END
```

MANTIM

```
5   COM C$[30],M$[250],J,F$[100],D$[60],N1
10  REM      manhole time analysis programme - MANTIM
15  REM      N. Bartram        jan '79
20  FILES mandat,mant
30  DIM N[50,4],Y[50,10],X[50,4],R[50,5],C[50],R$[3]
40  DIM T[20,5],M[50,10]
90  MAT M=ZER
100  GOSUB 1000
105  REM  1000 reads data statements
110  GOSUB 1100
120  REM 1100 = base concrete
130  GOSUB 1300
140  REM 1300 = chamber rings
150  GOSUB 1500
160  REM 1600 = shaft rings
170  GOSUB 1700
180  REM 1700 = tapers
190  GOSUB 1900
200  REM 1900 = reducing slabe
210  GOSUB 2100
215  REM 2100 = cover slabs
220  GOSUB 2300
225  REM 2300= cov & frames
230  GOSUB 2400
235  REM 2400 = concrete surround
240  PRINT TAB(25);"MANHOLE TIME ANALYSIS"
250  PRINT TAB(25);"*********************"
255  PRINT
270  GOSUB 3000
280  REM 3000=results to screen
290  GOSUB 5100
300  STOP
1000  REM read control data
1002  READ #1,1;N
1004  FOR I=1 TO 50
1006  FOR I1=1 TO 4
1008  READ #1;N[I,I1]
1010  NEXT I1
1012  NEXT I
1014  READ #1,3;N
1016  FOR I=1 TO 50
1018  FOR I1=1 TO 10
1020  READ #1;Y[I,I1]
1022  NEXT I1
1024  NEXT I
1026  READ #1,7;N
1028  FOR I=1 TO 50
1030  FOR I1=1 TO 4
1032  READ #1;X[I,I1]
1034  NEXT I1
1036  NEXT I
1040  RETURN
```

```
1100  REM    base concrete
1110  MAT  READ #1, 14; C
1120  FOR I=1 TO J
1130  REM formwork
1140  H1=Y[I,1]+Y[I,10]+Y[I,2]+Y[I,3]+.2
1150  D1=X[I,1]+X[I,2]+X[I,3]+.1
1160  A1=3.14159*H1*D1
1170  T1=A1*2.723/2
1180  T2=C[I]*2.692/2
1190  M[I,1]=T1+T2
1200  M[I,2]=A1
1210  NEXT I
1220  RETURN
1300  REM chamber rings
1302  READ #1, 9; M
1304  FOR I=1 TO 50
1306  FOR I1=1 TO 5
1308  READ #1; R[I, I1]
1309  NEXT I1
1310  NEXT I
1312  MAT T=ZER[6,2]
1315  MAT  READ T
1320  DATA .9,.56,1.05,.62,1.2,.68,1.35,.86,1.5,.96,1.8,1.06
1330  FOR I=1 TO J
1340  FOR I1=1 TO 5
1350  IF X[I,3] <= T[I1,1] THEN 1370
1360  NEXT I1
1370  T1=T[I1,2]
1380  T1=T1*R[I,1]
1390  M[I,3]=T1
1400  NEXT I
1410  RETURN
1500  REM shaft ringehs
1502  READ #1, 11; N
1504  FOR I=1 TO 50
1506  FOR I1=1 TO 5
1508  READ #1; R[I, I1]
1510  NEXT I1
1512  NEXT I
1515  FOR I=1 TO J
1520  IF N[I,1] <= 1 THEN 1580
1530  IF X[I,4]=.675 THEN 1560
1540  T1=.52*R[I,1]
1550  GOTO 1570
1560  T1=.48*R[I,1]
1570  M[I,4]=T1
1580  NEXT I
1590  RETURN
1700  REM tapers
1710  MAT T=ZER[6,2]
1720  MAT  READ T
1730  DATA .9,.34,1.05,.35,1.2,.39,1.35,.48,1.5,.59,1.8,.69
1740  FOR I=1 TO J
1750  IF N[I,1]=3 THEN 1770
```

```
1755  T1=0
1756  GOTO 1810
1770  FOR I1=1 TO 5
1780  IF X[I,3] <= T[I1,1] THEN 1800
1790  NEXT I1
1800  T1=T[I1,2]
1810  M[I,5]=T1
1820  NEXT I
1830  RETURN
1900  REM   reducing slabs
1910  MAT T=ZER[8,2]
1920  MAT  READ T
1930  DATA .675,.23,.75,.27,.9,.3,1.05,.34,1.2,.4,1.35,.45,1.5,.5
                                                             1.8,.
1940  FOR I=1 TO J
1950  IF N[I,1]=2 THEN 1970
1955  T1=0
1960  GOTO 2010
1970  FOR I1=1 TO 7
1980  IF X[I,3] <= T[I1,1] THEN 2000
1990  NEXT I1
2000  T1=T[I1,2]
2010  M[I,6]=T1
2020  NEXT I
2030  RETURN
2100  REM cover slabs
2103  DATA .675,.23,.75,.26,.9,.28,1.05,.33,1.2,.38,1.35,.42,1.5,
                                                          .7,1.8,.
2110  MAT T=ZER[8,2]
2120  MAT  READ T
2140  FOR I=1 TO J
2150  FOR I1=1 TO 7
2160  IF X[I,4] <= T[I1,1] THEN 2180
2170  NEXT I1
2180  T1=T[I1,2]
2190  M[I,7]=T1
2200  NEXT I
2210  RETURN
2300  REM covers and frames
2305  FOR I=1 TO J
2310  M[I,9]=.5
2320  NEXT I
2330  RETURN
2400  REM concrete surround
2405  MAT  READ #1,15;C
2410  MAT T=ZER[10,2]
2420  MAT  READ T
2430  DATA .675,3,.9,3,1.05,3,1.2,4,1.35,5,1.5,4,1.8,6,2.1,6,2.
                                                              2.7
2440  FOR I=1 TO J
2445  T2=0
2450  FOR I1=1 TO 9
2460  IF X[I,3] <= T[I1,1] THEN 2480
2470  NEXT I1
2480  T1=.75*T[I1,2]
2490  IF N[I,1] <= 1 THEN 2540
2500  FOR I1=1 TO 9
```

```
2510  IF X[I,4] <= T[I1,1] THEN 2530
2520  NEXT I1
2530  T2=.75*T[I1,2]
2540  T3=.5135*C[I]
2550  M[I,8]=T1+T2+T3
2560  NEXT I
2570  RETURN
3000  REM results
3050  GOSUB 5000
3060  PRINT " !    MH    ! BASE ! CHBR ! SHFT ! R/D  ! SURR ! SLAB
3070  GOSUB 5000                                    COV  ! TOTAL  !
3075  A$="!"
3080  FOR I=1 TO J
3100  M[I,10]=M[I,1]+M[I,2]+M[I,3]+M[I,4]+M[I,5]+M[I,6]+M[I,7]+M[
3110  PRINT  USING 3120;A$,M$[5*I-4,5*I-1]
3120  IMAGE #,x,a,x,5a,xx
3130  PRINT  USING 3140;A$,M[I,1],A$,M[I,2],A$,M[I,3],A$,M[I,4]
3140  IMAGE #,a,x,dd.d,x,a,x,dd.d,x,a,x,dd.d
3150  IF N[I,1]=1 THEN 3210
3160  IF N[I,1]=2 THEN 3200
3170  PRINT  USING 3180;A$,M[I,5]
3180  IMAGE #,a,x,dd.d,x
3190  GOTO 3210
3200  PRINT  USING 3180;A$,M[I,6]                          8]+M[I,'
3210  PRINT  USING 3220;A$,M[I,8],A$,M[I,7],A$,M[I,9],A$,M[I,10],
3220  IMAGE a,x,dd.d,x,a,x,dd.d,x,a,x,dd.d,x,a,x,ddd.dd,x,a
3230  NEXT I
3235  GOSUB 5000
3240  RETURN
5000  PRINT "    ";
5010  FOR I=1 TO 65
5020  PRINT "-";
5030  NEXT I
5035  PRINT
5040  RETURN
5100  REM to l/p
5110  N=2
5120  PRINT #N;TAB(50);"MANHOLE TIME ANALYSIS"
5130  PRINT #N;TAB(50);"*********************"
5140  PRINT #N
5150  PRINT #N;TAB(30);"CONTRACT   ";TAB(50);C$
5160  PRINT #N;TAB(30);"********";TAB(50);"**********************
5165  PRINT #N
5170  PRINT #N;TAB(30);"STANDARD DURATIONS EXPRESSED IN GANG HOUR
5180  PRINT #N;TAB(30);"GANG SIZES  [1] - 2 LABOURERS PLUS 1 EXCA
5190  PRINT #N;TAB(30);"            [2] - 2 LABOURERS"         ;TOF
5200  PRINT #N
5220  GOSUB 6000
5230  PRINT #N;" !   GANG   !";
5240  FOR I=1 TO 7
5250  PRINT #N;"     1      !";
5260  NEXT I
5270  PRINT #N;"     2      !              !"
5280  GOSUB 6000
```

```
5290  PRINT #N;" !   MH        !   BASE      !  CHAMBER   !   SHAFT     !
5300  PRINT #N;" R/D SLAB     !  SURRD.     ! COV SLAB   ! COV & FRM   !
5305  PRINT #N                                              'APER       !"
5310  FOR I=1 TO J                                           TOTAL      !"
5330  PRINT #N;" !   ";M$[5*I-4,5*I];"      !";
5340  IMAGE #,xxx,dd.dd,xxx,a
5350  PRINT #N; USING 5340;M[I,1],A$
5360  FOR I1=3 TO 6
5370  PRINT #N; USING 5340;M[I,I1],A$
5380  NEXT I1
5390  PRINT #N; USING 5340;M[I,8],A$
5400  PRINT #N; USING 5340;M[I,7],A$
5410  PRINT #N; USING 5340;M[I,9],A$
5420  PRINT #N; USING 5450;M[I,10],A$
5450  IMAGE #,xxx,ddd.dd,xx,a
5460  NEXT I
5470  GOSUB 6000
5480  RETURN
6000  REM
6010  PRINT #N;" ";
6020  FOR I=1 TO 119
6030  PRINT #N;"-";
6040  NEXT I
6045  PRINT #N
6050  RETURN
9999  END
```

MSHED

```
5   COM C$[30],M$[250],J,F$[100],D$[60],N1
10  REM       MANHOLE SCHEDULING & MATERIAL SORTING
20  REM        N. Bartram           Feb '79
30  FILES mandat,mans                                              F[50
40  DIM Y[50,10],X[50,4],R$[3],C[50,5],S[50,5],G[50],K[50],N[50,4]
60  GOSUB 1000
70  GOSUB 1200
80  GOSUB 6000
85  N=0
90  GOSUB 6500
100  GOSUB 7000
120  CHAIN "mantim"
300  STOP
1000  REM  read data
1010  READ #1,1;N
1020  FOR I=1 TO 50
1030  FOR I1=1 TO 4
1040  READ #1;N[I,I1]
1050  NEXT I1
1060  NEXT I
1065  READ #1,3;I
1070  FOR I=1 TO 50
1075  FOR I1=1 TO 10
1080  READ #1;Y[I,I1]
1085  NEXT I1
1090  NEXT I
1095  READ #1,7;N
1100  FOR I=1 TO 50
1105  FOR I1=1 TO 4
1110  READ #1;X[I,I1]
1115  NEXT I1
1120  NEXT I
1125  READ #1,9;N
1130  FOR I=1 TO 50
1135  FOR I1=1 TO 5
1140  READ #1;C[I,I1]
1145  NEXT I1
1150  NEXT I
1155  READ #1,11;N
1160  FOR I=1 TO 50
1170  FOR I1=1 TO 5
1175  READ #1;S[I,I1]
1177  NEXT I1
1180  NEXT I
1182  MAT  READ #1,13;G
1184  MAT  READ #1,14;F
1186  MAT  READ #1,15;K
1188  MAT  READ #1,16;O
1190  MAT  READ #1,17;V
1195  RETURN
1200  REM titles
1210  N=0
```

```
1220  PRINT #N;TAB(50);"MANHOLE SCHEDULE"
1230  PRINT #N;TAB(50);"****************"
1240  PRINT #N
1250  PRINT #N;TAB(30);"CONTRACT";TAB(60);C$
1260  PRINT #N
1270  PRINT #N;TAB(30);"MANHOLE TYPES"
1280  PRINT #N;TAB(30);"*************"
1290  PRINT #N
1300  FOR I=1 TO 3
1310  PRINT #N;TAB(30);I;TAB(50);D$[20*I-19,20*I]
1320  NEXT I
1330  PRINT #N
1340  PRINT #N;TAB(30);"COVERS & FRAMES"
1350  PRINT #N;TAB(30);"***************"
1360  PRINT #N
1365  FOR I=1 TO N1
1370  PRINT #N;TAB(30);I;TAB(60);F$[20*I-19,20*I]
1390  NEXT I
1400  PRINT #N
1410  RETURN
5500  PRINT #N;" ";
5510  FOR I=1 TO 118
5520  PRINT #N;"-";
5530  NEXT I
5540  PRINT #N
5550  RETURN
5590  N=0
5600  GOSUB 5500
5610  PRINT #N;" !  MH   !   COV   !    INV   !  DEPTH  ! TYPE   ! P
5620  PRINT #N;" MANHOLE RINGS ! SURR  !  R/D  !  COV   !  BWK   !
5630  PRINT #N;" !          !  LVL   !    LVL   !         !        !
5640  PRINT #N;"  DIA  ! LGTH  !         !        ! SLAB   !        ! F
5650  PRINT #N;" !";TAB(9);"!";TAB(19);"!";TAB(29);"!      M      !";T
5660  PRINT #N;"  M3   !   M   !  M3    !        !        !    M    !
5670  GOSUB 5500                                        PE  ! BASE  !";
5680  RETURN                                            OV  !"
6000  REM  schedule production                          (A  !       !";
6005  N=2                                               AME !"
6010  DIM E$[4],G$[16],H$[2]                            3(47);"!    M   !"
6015  G$="NIL SLABTAP LH"                                   !"
6060  GOSUB 5600
6070  A$="!"
6080  I=0
6090  I=I+1                                                              ],A
6100  P=5*I-4
6120  PRINT #N; USING 6130;A$,M$[P,P+4],A$,O[I],A$,V[I],A$,O[I]-V[
6130  IMAGE #,x,a,x,5a,x,a,x,ddd.ddd,x,a,x,ddd.ddd,x,a,x,ddd.ddd,x
6135  IF N[I,1]=0 THEN 6240
6140  PRINT #N; USING 6150;N[I,1],A$,Y[I,10],A$,F[I],A$,X[I,3],A$,
6150  IMAGE #,3x,d,3x,a,x,d.ddd,x,a,x,dd.dd,x,a,xd.ddd,x,a,x,d.ddd
6160  E$=G$[4*N[I,1]-3,4*N[I,1]]                        [I,1],A$,K[I],A
6170  H$[1,1]=G$[N[I,2]+12,N[I,2]+12]                   x,a,x,dd.dd,x,a
6175  H$[2,2]="D"
6180  PRINT #N; USING 6190;E$,A$,H$,A$,G[I],A$,N[I,4],A$
```

```
6190  IMAGE xx,4a,x,a,xx,aa,3x,a,x,d.ddd,x,a,3x,d,xx,a
6200  IF N[I,1]=1 THEN 6250
                                              .A$,A$,A$,A$,A$,A
6210  PRINT #N; USING 6220;A$,A$,A$,A$,A$,A$,A$,A$,X[I,4],A$,S[I,1
6220  IMAGE x,8[a,7x],x,d.ddd,x,a,x,d.ddd,x,a,5[7x,a]
6230  GOTO 6250
6240  PRINT #N;TAB(40);"SPECIAL"
6250  IF I<J THEN 6090
6260  GOSUB 5500
6270  RETURN
6500  REM materials sorting
6510  DIM P[11],Q[11],T[11],U[6],V[6]
6520  MAT Q=ZER
6525  C5=C6=C7=0
6527  MAT T=ZER
6528  MAT U=ZER
6529  MAT V=ZER
6530  MAT  READ P
6540  REM rings & cov slabs
6550  FOR I=1 TO J
6555  IF N[I,1]=0 THEN 6720
6560  FOR I1=1 TO 11
6570  IF P[I1] >= X[I,3] THEN 6590
6580  NEXT I1
6590  T[I1]=T[I1]+1
6595  Q[I1]=Q[I1]+C[I,1]
6600  IF N[I,1]=1 THEN 6650
6610  FOR I1=1 TO 11
6620  IF P[I1] >= X[I,4] THEN 6640
6630  NEXT I1
6640  Q[I1]=Q[I1]+S[I,1]
6650  REM concrete
6660  C5=C5+F[I]
6670  C6=C6+K[I]
6680  REM bricks
6690  C7=C7+G[I]
6700  REM covers & frames
6710  W[N[I,4]]=W[N[I,4]]+1
6720  NEXT I
6730  REM reducing slabs & tapers
6740  FOR I=1 TO J
6750  IF N[I,1] <= 1 THEN 6880
6760  IF N[I,1]=2 THEN 6830
6770  REM tapers
6780  FOR J1=1 TO 5
6785  X1=.9+((J1-1)*.15)
6790  IF X1 >= X[I,2] THEN 6810
6800  NEXT J1
6810  U[J1]=U[J1]+1
6820  GOTO 6880
6830  REM reducing slabs
6840  FOR J1=5 TO 10
6850  IF X[I,4] >= P[J1] THEN 6870
6860  NEXT J1
6870  V[J1-4]=V[J1-4]+1
```

```
6880  NEXT I
6900  RETURN
6910  DATA .675,.75,.825,.9,1.05,1.2,1.35,1.5,1.8,2.1,2.4
7000  REM materials quantities printing
7010  PRINT #N;TAB(50);"materials quantities"
7020  PRINT #N;TAB(50);"********************"
7030  PRINT #N
7040  PRINT #N;TAB(25);"MANHOLE RINGS"                                  .ENGTH
7050  PRINT #N;TAB(25);"-------------";TAB(45);"DIAMETER";TAB(60);
7060  FOR I=1 TO 11
7070  PRINT TAB(25);P[I];TAB(60);Q[I]
7080  NEXT I
7090  PRINT #N
7100  PRINT #N;TAB(25);"********"
7115  PRINT #N;TAB(45);"BASES";TAB(60);C5;TAB(80);"M3"
7120  PRINT #N;TAB(45);"SURROUNDS";TAB(60);C6;TAB(80);"M3"
7130  PRINT #N;TAB(45);"TOTAL";TAB(60);C5+C6;TAB(80);"M3"
7140  PRINT #N
7150  PRINT #N;TAB(25);"TAPERS"
7160  PRINT #N;TAB(25);"******"
7165  PRINT #N;TAB(45);"DIAMETER";TAB(60);"NUMBER"
7170  FOR I=4 TO 9
7175  PRINT #N;TAB(45);P[J];"/ 0.675";TAB(60);U[I-3]
7180  NEXT I
7190  PRINT #N
7200  PRINT #N;TAB(25);"REDUCING SLABS"
7210  PRINT #N;TAB(25);"**************"
7215  PRINT #N;TAB(45);"DIAMETER";TAB(60);"NUMBER"
7220  FOR I=5 TO 10
7230  PRINT #N;TAB(45);P[I];"/ 0.675";TAB(60);V[I-4]
7240  NEXT I
7250  PRINT #N
7260  PRINT #N;TAB(25);"COVER SLABS"
7270  PRINT #N;TAB(25);"***********"
7275  PRINT #N;TAB(45);"DIAMETER";TAB(60);"NUMBER"
7280  FOR I=1 TO 11
7290  PRINT #N;TAB(45);P[I];TAB(60);T[I]
7300  NEXT I
7310  PRINT #N
7320  PRINT #N;TAB(25);"COVERS & FRAMES"
7330  PRINT #N;TAB(25);"***************"
7335  PRINT #N;TAB(45);"TYPE";TAB(60);"NUMBER"
7340  FOR I=1 TO N1
7350  P=20*I-19
7360  PRINT #N;TAB(45);F$[P,P+19];TAB(60);W[I]
7370  NEXT I
7380  RETURN
8000  REM data to file
9000  END
```

SECTION 4

SITE RECORDS

1 SANDRIDGE SEWER - ST ALBANS

TRENCH WIDTHS

Pipe Diameter (mm)	Trench Width (m)
500 525	1.290 1.320

GROUND CONDITIONS

Strata* Grading	Obstruction* Grading	Pipe Runs
5	5	36,37,38,39,40.
6	5	1.10,11,12,13,14,15,16 32,32,33,34,35.
7.5	5	20,21,22,41,42,43,44,45, 46,47.
8	5	4, 5, 6, 7, 8, 9,17,18, 19,23,24,25,26,27,28, 2.
8.5	5	29,30,31.
9	5	49,50, 3.
10	5	48.

* See Tables 2.11 and 2.12 Volume 1.

LOCATION	LENGTH (m)	PIPE DIA. (MM)	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	M/C DAYS	
C116- LL1	104.5	500 S.I.	3.50	3.00	0.37 granular 0.62 Sel.fill	CLOSE SHEETING	12	Foreman Labourer.	12 42.5	JCB 806 JCB 5C CAT 951 2" pump. 2T dumper.	12 12 12 12 12	Restricted access.Very bad ground conditions.
LL1 - LL2	148.5	500 S.I.	4.50	3.14	0.37 granular 0.62 Sel.fill	CLOSE SHEETING	7	Foreman Ganger Labourer.	2 5 16	JCB 806 JCB 5C CAT 951 Hymac 590 Hymac 580 3T dumper. 4" pump. 2" pump.	2 2 2 3 3 3 8 5	
LL2- LL3	52.5	525 A/C	2.75	2.50	0.38 granular 0.63 Sel.fill	Pinchers	1.5	Ganger Labourer.	1.5 5.5	Hymac 590 Hymac 580 3T dumper	1½ 1½ 1½	
LL3- Heading.	55.0	525 A/C	4.25	3.30	0.38 granular 0.63 Sel.fill	Pinchers.	2	Ganger Labourer	2 7	Hymac 590 Hymac 580 3T dunper	2 2 2	

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	M/C DAYS	
LL4- LL5	95.0	525 A/C	4.00	3.30	0.38 granular 0.63 Sel fill.	Pinchers.	3	Ganger Labourer	3 8	Hymac 590 CAT 941 3T dumper 3" pump.	6 1 3 3	
LL5- LL6	95.0	525 A/C	3.25	3.10	0.38 granular 0.63 Sel fill	Pinchers.	2	Ganger Labourer	2 6	Hymac 590 Hymac 580 3T dumper 3" pump	2 2 2 2	
LL6- LL7	92.5	525 A/C	3.00	2.85	0.38 granular 0.63 Sel.fill.	Pinchers.	3	Ganger Labourer.	3 10	Hymac 590 Hymac 580 3T dumper	3 3 3	
LL7 - LL8	105.0	525 A/C	4.75	4.30	0.38 granular 0.63 Sel.fill	Battered+ pinchers.	7	Ganger Labourer	7 15	Hymac 590 3T dumper 3" pump	12 7 7	

LOCATION	LENGTH (m)	PIPE DIA. (MM)	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	M/C DAYS	
LL8- LL9	120.0	525	5.00	4.80	0.38 Granular 0.63 Sel.fill	Battered	4	Ganger Labourer.	4 13	Hymac 590 Hymac 580 CAT 941 4" pump 3" pump. Rammer.	5 3 4 1 2 4	
LL9 LL10	95.0	525 A/C	6.00	6.00	0.38 Granular 0.63 Sel.fill.	Battered	6	Ganger. Labourer.	6 24	Hymac 590 Hymac 580 3T dumper. 2" pump Rammer.	6 6 3 3 6	
LL10- LL11	112.5	525 A/C	6.00	6.00	0.38 granular 0.68 Sel.fill	Battered	9	Ganger Labourer.	9 13	Hymac 590 Hymac 580 Priestman Lion 3T dumper. 2" pump. Rammer.	6 12 3 9 11 9	

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
LL11- LL12	117.5	525 A/C	6.00	5.90	0.38 granular 0.63 Sel.fill	Shorco boxes.	6	Ganger Labourer.	6 12	Hymac 580 Priestman Lion. 3T dumper. 2" pump. Rammer.	12 6 6 12	
LL12- LL13	27.5	525 A/C	5.75	5.50	0.38 granular 0.63 Sel.fill	Shorco boxes.	4	Ganger. Labourer.	4 10	Hymac 580 Priestman Lion. 3T dumper. 2" pump 3" pump. Rammer.	7 4 4 5 3 4	
LL13 LL13/1	60.00	525 A/C	5.75	5.75	0.38 granular 0.63 Sel.fill	Shorco boxes.	13	Ganger. Labourer.	13 29	Hymac 590 Priestman Lion. 3T dumper 5T dumper 3" pump Rammer.	20 13 6 13 13 13	

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
LL13/1 - LL13/2	85.0	525 A/C	4.75	4.75	0.38 granular 0.63 Sel.fill	Shorco boxes + Batter.	12.0	Labourer.	42	Hymac 580 2" pump Crane	12 12 11½	
LL13/2- LL13/3	10.0	525 A/C	4.50	4.50	0.38 granular 0.63 Sel.fill	Shorco boxes + Batter.	9.0	Ganger. Labourer.	9 18	Hymac 580 Crane 2" pump.	9 6 9	
LL13/3- LL13/4	105.0	525 A/C	4.50	4.50	0.38 granular 0.63 Sel.fill	Shorco boxes + Batter.	12.0	Ganger Labourer.	12	Hymac 580 Poclain TC5 Hymac 590 2" pump 2T dumper. Rammer.	5 6 9 12 5 12	
LL13/4-	122.5	525 A/C	4.25	4.10	0.38 Granular 0.63 Sel.fill.	Shorco boxes + Batter.	11.0	Ganger Labourer.	11 21	Poclain TC5 Hymac 590 3" pump.	5 11 7	

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
LL14- LL15	111.75	525 A/C	3.75	3.75	0.38 granular 0.63 Sel.fill	Shorco boxes.	9	Ganger Labourer.	9 15	Hymac 580 Hymac 590 3" pump. Rammer.	5 9 9 9	
LL16- LL17	110	525 A/C	3.75	3.60	0.38 Granular 0.63 Sel.fill	Shorco boxes.	5	Ganger Labourer.	5 16	Hymac 590 Poclain TC5 2" pump. 3T dumper Rammer.	5 4 10 6 5	
LL17- LL18	97.5	525 A/C	3.75	3.75	0.38 granular 0.63 Sel.fill	Shorco boxes	5	Ganger Labourer	5 10	Poclain TC5 Hymac 590 2" pump T dumper Rammer.	$1\frac{1}{2}$ 5 9 8 5	
LL18- LL19	100.0	525 A/C	4.00	3.91	0.38 granular 0.63 Sel fill.	Shorco boxes.	8	Ganger Labourer.	8 16	Poclain TC5 Hymac 590 2" pump 3T dumper.	$5\frac{1}{2}$ 8 $15\frac{1}{2}$ 11	Running sand very wet.

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
LL 19 - LL 20	110.0	525 a/c	4.25	4.25	0.38 (granular) 0.63 sel.fill	Storco Boxes	5	Ganger Labourer	5 10	Poclain TC5 Hymac 590 2" Pump 2T dumper Rammer	3½ 5 10 5 5	
LL 20 - LL 21	65.0	525 a/c	4.25	4.25	0.38 (granular 0.63 sel.fill	Shorco Boxes	4½	Ganger Labourer	4½ 8	Hymac 590 2" Pump 2T dumper Rammer	4½ 9 4½ 4½	
LL 21 - LL 22	110.0	525 a/c	4.25	4.25	0.38 (granular 0.63 sel.fill	Shorco Boxes	6	Ganger Labourer	6 12	Hymac 580 2" Pump Rammer	12 4 6	
LL 22 - LL 23	105.0	525 a/c	4.75	4.35	0.38 (granular 0.63 sel.fill	Shorco	6	Ganger Labourer	6 12	Hymac 580 2" Pump Rammer	7 3 6	

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
LL 23 - LL 24	100.0	525 a/c	4.00	4.00	0.38 (granular) 0.63 sel.fill	Battered & pinchers	4	Ganger Labourer	4 10	Hymac 580 Poclain 2" Pump 3T dumper	4 3½ 4 4	
LL 24 - LL 25	85.0	525 a/c	3.50	3.50	0.38 (granular) 0.63 sel.fill	Batter & pinchers	3	Ganger Labourer	3 7	Hymac 580 Poclain TC5 2" Pump 3T dumper Rammer	3 2½ 3 3 3	
LL 25 - LL 26	120.0	525 a/c	3.75	3.75	0.38 granular 0.63 sel.fill	Batter & pinchers	4	Ganger Labourer	4 8	Hymac 580 Poclain 2" Pump 3" Pump Rammer	4 4 4 4 4	
LL 26 - LL 27	95.0	525 a/c	3.75	3.75	0.38 granular 0.63 sel.fill	Batter & pinches	4	Ganger Labourer	4 6	Hymac 580 Poclain TC5 2" Pump 2T dumper Rammer	4 2 5 4 4	

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
LL 27 - LL 28	60.0	525 a/c	3.75	3.75	0.38 granular 0.63 sel.fill	Batter & pinchers	2	Ganger Labourer	2 4	Hymac 580 Poclain TC5 2" Pump 3T dumper Rammer	2 ½ 2 2 2	
LL 28 - LL 29	100.0	525 a/c	3.50	3.50	0.38 granular 0.63 sel.fill	Batter & pinchers	3	Ganger Labourer	3 6.5	Hymac 580 Poclain 2" Pump 3T dumper Rammer	3 5 2 2 2	
LL 29 - LL 30	125.0	525 a/c	3.50	3.50	0.38 granular 0.63 sel.fill	Batter & pinchers	3	Ganger Labourer	3 6.5	Hymac 580 Poclain TC5 2" Pumps 3T dumper Rammer	3 2¼ 3 3 3	
LL 30 - LL 31	100.0	525 a/c	3.50	3.50	0.38 granular 0.63 sel.fill	Batter & pinchers	3.2	Ganger Labourer	3.2 6.6	Hymac 580 Poclain TC5 2" Pump 3T dumper Rammer	3.2 2.5 3.2 3.2 3.2	

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
LL 31 - LL 32	117.5	525 a/c	3.50	3.50	0.38 granular 0.63 sel.fill	Batter & pinchers	3.8	Ganger Labourer	3.8 5.6	Hymac 580 Poclain TC5 2" Pump 3T dumper Rammer	3.8 2.0 3.8 3.8 3.8	
LL 32 - LL 33	125.0	525 a/c	3.37	3.37	0.38 granular 0.63 sel.fill	Batter & pinchers	4	Ganger Labourer	4 8	Hymac 580 Poclain TC5 2" Pumps 3T dumper Rammer	3 4 4 4 4	
LL 33 - LL 34	90.0	525 a/c	4.75	4.30	0.38 granular 0.63 sel.fill	Batter & pinchers	4	Ganger Labourer	4 10	Hymac 580 Poclain TC5 2" Pump Rammer 3T dumper	1.6 4 4 4 4	
LL 34 - LL 35	30.0	525 a/c	4.00	3.65	0.38 granular 0.63 sel.fill	Close Sheeting	5	Ganger Labourer	5 12	Hymac 580 2" Pump Rammer 3T dumper 10m3 Lorry Compressor	5 5 5 5 5 5	Road crossing Hand dig due to services. Spoil off site by Lorry.

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
LL 35 - LL 36	95.0	525 a/c	3.75	3.75	0.38 granular 0.63 sel.fill	Battered & pinchers	4	Ganger Labourer	4 8	Hymac 580 Poclain TC5 2" Pump 3T dumper Rammer	4 3 4 4 4	
LL 36 - LL 37	100.0	525 a/c	3.50	3.15	0.38 granular 0.63 sel.fill	Battered & pinchers	3	Ganger Labourer	3 9	Hymac 580 Poclain TC5 3" Pump 2" Pump 3T dumper Rammer	3 3 3 3 3 3	
LL 37 - LL 38	105.0	525 a/c	3.00	3.00	0.38 granular 0.63 sel.fill	Pinchers	3	Ganger Labourers	3 9	Hymac 580 PoclainTC5 3" Pump 2" Pump 3T dumper Rammer	2.5 3 3 3 3 3	

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN	VOLUME (m3/m)			TYPE	DAYS	TYPE	DAYS	
LL 38 - LL 39	90.0	525 a/c	3.00	2.72	0.38 granular 0.63 sel.fill	Pinchers	3	Ganger Labourer	2 5	Hymac 580 PoclainTC5 3" Pump 2" Pump 3T dumper Rammer	2 2 3 2 2 2	
LL 39 - LL 40	80.0	525 a/c	2.50	2.33	0.38 granular 0.63 sel.fill	Pinchers	2	Ganger Labourer	2 4	Hymac 580 Poclain TC5 2" Pump 3T dumper Rammer	2 2 2 2 2	
LL 40 - LL 41	95.0	525 a/c	2.50	2.32	0.38 granular 0.63 sel.fill	Pinchers	2	Ganger Labourer	2 4	Hymac 580 PoclainTC5 2" Pump 3T dumper Rammer	½ 1½ 2 2 2	

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
LL 41 - LL 42	115.0	525 a/c	2.75	2.62	0.38 granular 0.63 sel.fill	Pinchers	2	Gangers Labourer	2 4	Hymac 580 PoclainTC5 2" Pump dumper Rammer	2 1½ 2 2 2	
LL 42 - LL 43	95.0	450 a/c	2.00	2.00	0.32 granular 0.57 sel.fill	Pinchers	1.5	Ganger Labourer	1.5 4.5	Hymac580 PoclainTC5 2" Pump 3T dumper Rammer	.5 1.5 1.5 1.5 1.5	
LL 43 - LL 44	105.0	450 a/c	3.00	2.41	0.32 granular 0.57 sel.fill	Pinchers	1.75	Ganger Labourers	1.75 5	Hymac 580 PoclainTC5 2" Pump 3T dumper Rammer	0.5 1.75 1.75 1.75 1.75	
LL 44 - LL 45	100.0	450 a/c	3.50	3.37	0.32 granular 0.57	Pinchers	2.25	Ganger Labourer	2.25 7	PoclainTC5 2" Pump 3T dumper Rammer	2.25 2.25 2.25 2.25	

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
LL 45 - LL 45/2	65.0	450 a/c	3.50	3.50	0.32 granular 0.57 sel.fill	Pinchers	2	Ganger Labourer	2 6½	PoclainTC5 2" Pump 3T dumper Rammer	2 2 2 2	

MANHOLE NUMBER	TYPE	DEPTH COVER-INVERT (m)	MANHOLE NUMBER	TYPE	DEPTH COVER-INVERT (m)
C11611	Special	3.480	LL21	G	4.305
LL1	F	2.605	LL22	G	4.400
LL2	Special	2.370	LL23	G	4.850
LL3	F	2.505	LL24	F	3.645
LL4	G	4.045	LL25	G	3.910
LL5	F	3.020	LL26	F	3.785
LL6	F	3.375	LL27	G	3.895
LL7	F	2.360	LL28	G	4.085
LL8	G	5.190	LL29	F	3.335
LL9	G	5.600	LL30	F	3.505
LL10	G	6.405	LL31	F	3.620
LL11	G	6.045	LL32	F	3.510
LL12	G	5.530	LL33	F	3.255
LL13	G	6.010	LL34	G	5.220
LL13/1	G	5.145	LL35	G	4.320
LL13/2	G	4.220	LL36	F	3.315
LL13/3	G	4.985	LL37	F	2.980
LL13/4	G	4.545	LL38	F	3.005
LL14	G	4.045	LL39	F	2.625
LL15	G	4.095	LL40	F	2.625
LL16	Special	4.005	LL41	F	2.800
LL17	G	4.125	LL42	F	2.695
LL18	G	3.935	LL43	C	1.670
LL19	G	4.430	LL44	C	3.185
LL20	G	4.320	LL45	D	3.635

Sandridge Sewer

Manhole Schedule

SANDRIDGE SEWER MANHOLE DETAILS

MANHOLE TYPE G - TAPER

Chamber Diameter	=	1.50 m
Shaft Diameter	=	0.89 m
Minimum Chamber height	=	1.80 m
Thickness of In-situ surround	=	0.10 m
In-situ base for 525 mm diameter pipe	=	2.0 m^3

MANHOLE TYPE F

Chamber Diameter	=	1.50 m
Thickness of In-situ surround	=	0.10 m
In-situ base for 525 mm diameter pipe	=	2.0 m^3

MANHOLE TYPE D - TAPER

Chamber Diameter	=	1.20 m
Shaft Diameter	=	0.69 m
Thickness of In-situ surround	=	0.10 m
Minimum Chamber height	=	1.80 m
In-situ base for 525 mm diameter base	=	1.50 m^3

MANHOLE TYPE B

Chamber Diameter	=	1.20 m
Thickness of In-situ surround	=	0.10 m
In-situ base for 525 mm diameter pipe	=	1.50 m^3

No.	Excavate	Base	Pre-Cast Rings	In-Situ Surround	Slab	Benching	Cover & Frame
LL 1	9. 5.77	14. 5.77	15. 5.77	15. 5.77			
LL 3	3. 6.77	10. 6.77	13. 6.77	13. 6.77	29. 6.77		29. 6.77
LL 4	4.11.77	14.11.77	16.11.77	17.11.77	18.11.77	1.12.77	21.11.77
LL 5	10. 5.77	19. 5.77	27. 5.77	30. 5.77	8. 6.77	10. 6.77	14. 6.77
LL 6	17. 5.77	23. 5.77	30. 5.77	30. 5.77	29. 6.77	10. 6.77	29. 6.77
LL 7	28. 5.77	3. 6.77	8. 6.77	13. 6.77	14. 6.77	13. 6.77	14. 6.77
LL 8	11. 5.77	24. 5.77	30. 5.77	15. 6.77	16. 6.77		26.10.77
LL 9	21. 5.77	16. 6.77	17. 6.77	17. 6.77		4.11.77	27. 6.77
LL IO	18. 6.77	5. 7.77	6. 7.77	7. 7.77	27. 7.77	4.11.77	27.10.77
LL 11	21. 7.77	5. 8.77	3. 8.77	8. 8.77	1.12.77	4.11.77	2.12.77
LL 12	29. 7.77	23.11.77	24.11.77	24.11.77	1.12.77	11.12.77	1.12.77
LL 13	7. 9.77	20.10.77	25.10.77	25.10.77	14.11.77	25.11.77	14.11.77
LL 13/1	28. 9.77	3.10.77	6.10.77	6.10.77	31.10.77	22.11.77	14.11.77
LL 13/2	20.10.77	6.11.77	7.11.77	7.11.77	14.11.77	17.11.77	14.11.77
LL 13/3	12. 9.77	1.11.77	4.11.77	4.11.77	15.11.77	18.11.77	15.11.77
LL 13/4	28. 9.77	6.10.77	11.10.77	27.10.77	28.10.77	10.11.77	28.10.77
LL 14	10.10.77	20.10.77	24.10.77	25.10.77	31.10.77	10.11.77	31.10.77
LL 15	31.10.77	3.11.77	8.11.77	8.11.77	10.11.77	11.11.77	10.11.77
LL 16							
LL 17	13. 7.77	2. 8.77	3. 8.77	3. 8.77	12. 8.77	13. 9.77	19. 9.77
LL 18	21. 7.77	12. 8.77	15. 8.77	15. 8.77	8. 9.77	22. 9.77	12. 9.77
LL 19	10. 8.77	23. 8.77	30. 8.77	30. 8.77	8. 9.77	29. 9.77	12. 9.77
LL 20	17. 8.77	20. 8.77	5. 9.77	5. 9.77	9. 9.77	21. 9.77	9. 9.77
LL 21	8. 8.77	1. 9.77	7. 9.77	7. 9.77	9. 9.77	16. 9.77	9. 9.77
LL 22	15. 8.77	26. 8.77	7. 9.77	7. 9.77	8. 9.77	15. 9.77	8. 9.77
LL 23	31. 5.77	30. 8.77	2. 9.77	5. 9.77	8. 9.77	16. 9.77	9. 9.77
LL 24	3. 6.77	21. 6.77	22. 6.77	23. 6.77	24. 6.77	4. 7.77	30. 7.77
LL 25	9. 6.77	20. 6.77	22. 6.77	29. 6.77	30. 6.77	4. 7.77	30. 7.77
LL 26	16. 6.77	24. 6.77	28. 6.77	29. 6.77	30. 6.77	4. 7.77	8. 7.77
LL 27	23. 6.77	27. 6.77	28. 6.77	29. 6.77	5. 7.77	7. 7.77	8. 7.77
LL 28	24. 6.77	1. 7.77	4. 7.77	4. 7.77	11. 7.77	7. 7.77	12. 7.77
LL 29	29. 6.77	7. 7.77	8. 7.77	8. 7.77	11. 7.77	11. 7.77	12. 7.77
LL 30	5. 7.77	11. 7.77	12. 7.77	12. 7.77	13. 7.77	14. 7.77	16. 7.77
LL 31	8. 7.77	18. 7.77	20. 7.77	21. 7.77	25. 7.77	8. 8.77	11. 8.77
LL 32	5. 5.77	19. 7.77	20. 7.77	22. 7.77	25. 7.77	8. 8.77	11. 8.77
LL 33	10. 5.77	16. 5.77	18. 5.77	20. 5.77	26. 5.77	19. 6.77	10. 8.77
LL 34	16. 5.77	23. 5.77	3. 6.77	3. 6.77	18. 7.77	19. 6.77	10. 8.77
LL 35	23. 5.77	2. 6.77	8. 6.77	8. 6.77	18. 7.77	19. 6.77	10. 8.77
LL 36	30. 3.77	24. 8.77	26. 8.77	26. 8.77	30. 8.77		
LL37	5. 4.77	14. 4.77	18. 4.77	19. 4.77	21. 4.77	24. 5.77	20. 6.77
LL 38	7. 4.77	15. 4.77	18. 4. 77	7. 5.77	7. 5.77	26. 5.77	20. 6.77
LL 39	13. 4.77	19. 4.77	18. 4.77	21. 4.77	25. 4.77	26. 5.77	21. 6.77
LL 40	15. 4.77	20. 4.77	23. 4.77	23. 4.77	2. 5.77	25. 5.77	21. 6.77
LL 41	19. 4.77	22. 4.77	25. 4.77	25. 4.77	2. 5.77	25. 5.77	21. 6.77
LL 42	21. 4.77	25. 4.77	26. 4.77	26. 4.77	2. 5.77	20. 5.77	22. 6.77
LL 43	25. 4.77	28. 4.77	3. 5.77	3. 5.77	7. 5.77	20. 5.77	22. 6.77
LL 44	27. 4.77	6. 5.77	6. 5.77	11. 5.77	18. 5.77	20. 5.77	22. 6.77
LL 45	2. 5.77	9. 5.77	13. 5.77	13. 5.77	18. 5.77	20. 5.77	18. 5.77

Sandridge Sewer

Manhole Construction Dates

DATE	LABOUR (no of men)	PLANT
13.4.77	2	2" poker vibrator
14.4.77	2	Hy-mac 580 ($\frac{1}{2}$)
		2" poker vibrator
15.4.77	1	Hy-mac 580 ($\frac{1}{2}$)
		2" poker vibrator
18.4.77	3	Hy-mac 580 ($\frac{1}{2}$)
		2" poker vibrator
19.4.77	2	Hy-mac 580 ($\frac{1}{2}$)
		2" poker vibrator
20.4.77	3	Hy-mac 580 ($\frac{1}{2}$)
21.4.77	3	Hy-mac 580 ($\frac{1}{2}$)
22.4.77	2	Hy-mac 580
23.4.77	2	Hy-mac 580 ($\frac{1}{2}$)
25.4.77	3	Hy-mac 580 ($\frac{1}{2}$)
26.4.77	3	Hy-mac 580 ($\frac{1}{2}$)
27.4.77	2	NIL
28.4.77	2	Hy-mac 580
29.4.77	NIL	NIL
2.5.77	3	Hy-mac 580
3.5.77	3	Hy-mac 580 ($\frac{1}{2}$)
5.5.77	2	NIL
6.5.77	2	Hy-mac 580 ($\frac{1}{2}$)
9.5.77	2	Hy-mac 580
10.5.77	2	NIL
11.5.77	2	Hy-mac 580 (1/3)
12.5.77	1	
13.5.77	1	Hy-mac 580
16.5.77	1	Hy-mac 580
18.5.77	1	LC 51 ($\frac{1}{2}$)
19.5.77	1	NIL
20.5.77	1	NIL
23.5.77	1	LC 51 ($\frac{1}{2}$)
24.5.77	1	NIL
25.5.77	2	NIL
26.5.77	1	LC 51 ($\frac{1}{2}$)
27.5.77	1	NIL
30.5.77	1	NIL
31.5.77	2	NIL
1.6.77	2	NIL
2.6.77	2	LC 51
3.6.77	2	LC 51 ($\frac{1}{2}$)
8.6.77	2	LC 51
9.6.77	2	LC 51 ($\frac{1}{2}$)
10.6.77	NIL	NIL
13.6.77	1	LC 51
14.6.77	NIL	NIL
15.6.77	NIL	NIL
16.6.77	1	Compressor
17.6.77	1	Compressor
20.6.77	2	LC 51
21.6.77	3	LC 51
22.6.77	2	LC 51
23.6.77	2	LC 51 ($\frac{1}{2}$)
24.6.77	2	NIL
27.6.77	3	LC 51 ($\frac{1}{4}$)
28.6.77	2	LC 51 ($\frac{1}{2}$)
29.6.77	2	LC 51 ($\frac{1}{2}$)
30.6.77	3	LC 51 ($\frac{1}{4}$)
1.7.77	3	LC 51 ($\frac{1}{4}$)
4.7.77	3	LC 51 ($\frac{1}{4}$)
5.7.77	1	LC 51 ($\frac{1}{4}$)
6.7.77	2	NIL
7.7.77	1	LC 51 ($\frac{1}{2}$)
8.7.77	1	LC 51 ($\frac{1}{2}$)
11.7.77	3	LC 51 ($\frac{1}{2}$)
12.7.77	3	LC 51 ($\frac{1}{2}$)
13.7.77	3	NIL
14.7.77	1	NIL

Sandridge Sewer

Manhole Construction Resources

Sheet 1 of 3

DATE	LABOUR (no of men)	PLANT
15.7.77	1	NIL
18.7.77	2	LC 51 ($\frac{1}{2}$)
19.7.77	2	LC 51
20.7.77	2	LC 51
21.7.77	2	LC 51
22.7.77		
25.7.77	NIL	NIL
26.7.77	NIL	NIL
27.7.77	NIL	NIL
28.7.77	NIL	NIL
29.7.77	NIL	NIL
1.8.77	2	NIL
2.8.77	2	LC 51 ($\frac{1}{2}$)
3.8.77	2	LC 51 ($\frac{1}{2}$)
4.8.77	NIL	NIL
5.8.77		
8.8.77	1	NIL
9.8.77	1	NIL
10.8.77	1	NIL
11.8.77	3	NIL
12.8.77	3	LC 51 ($\frac{1}{2}$)
15.8.77	2	LC 51 ($\frac{1}{2}$)
16.8.77	4	LC 51 ($\frac{1}{2}$)
17.8.77	3	NIL
18.8.77	4	LC 51
19.8.77	1	LC 51 ($\frac{1}{2}$)
22.8.77	4	NIL
23.8.77	4	Hy-mac 580
24.8.77	2	Hy-mac 580
25.8.77	3	LC 51 ($\frac{1}{2}$)
26.8.77	6	Hy-mac 580
30.8.77	6	Hy-mac 580 (2)
31.8.77	5	Hy-mac 580
1.9.77	3	Hy-mac 580
2.9.77	2	Hy-mac 580
5.9.77	3	Hy-mac 580
6.9.77	4	Hy-mac 580
7.9.77	5	Hy-mac 580
8.9.77	4	Hy-mac 580
9.9.77	5	Hy-mac 580
12.9.77	5	2T Dumper
13.9.77	2	2T Dumper
14.9.77	3	2T Dumper
15.9.77	1	NIL
16.9.77	1	2T Dumper
19.9.77	1	2T Dumper
20.9.77	1	2T Dumper
21.9.77	1	NIL
22.9.77	1	NIL
23.9.77	1	NIL
26.9.77	1	2T Dumper
27.9.77	1	NIL
28.9.77		
29.9.77	2	2T Dumper
30.9.77	1	2T Dumper
3.10.77	1	NIL
4.10.77	1	NIL
5.10.77	1	NIL
6.10.77	1	NIL
7.10.77	1	NIL
10.10.77	1	Hy-mac 580 ($\frac{1}{2}$)
11.10.77	2	Hy-mac 580 ($\frac{1}{2}$)
12.10.77	2	NIL
13.10.77	NIL	NIL
14.10.77	NIL	NIL
17.10.77	2	NIL
18.10.77	2	Hy-mac 580
19.10.77	2	Hy-mac 580

Sandridge Sewer

Manhole Construction Resources

Sheet 2 of 3

DATE	LABOUR (no of men)	PLANT
20.10.77	2	NIL
21.10.77	2	NIL
24.10.77	2	Hy-mac 580
25.10.77	2	Hy-mac 580
26.10.77		
27.10.77	2	Hy-mac 580
28.10.77	1	NIL
31.10.77	2	NIL
1.11.77	4	NIL
2.11.77	4	NIL
3.11.77	2	Hy-mac 580 (½)
4.11.77	7	Hy-mac 580
7.11.77	6	Hy-mac 580
8.11.77	4	Hy-mac 580 (½)
9.11.77		
10.11.77	5	NIL
11.11.77	6	Hy-mac 580
12.11.77	4	Hy-mac 580
14.11.77	4	Hy-mac 580
15.11.77	4	Hy-mac 580
17.11.77	4	Hy-mac 580
18.11.77	6	Hy-mac 580
21.11.77	2	Hy-mac 580

Sandridge Sewer

Manhole Construction Resources

Sheet 3 of 3

2 HORNINGLOW - BURTON ON TRENT

TRENCH WIDTHS

Pipe Diameter (mm)	Trench Width (m)
1050/300	2.50
1050/225	2.60
1050	1.80
675	1.5

Strata Grading 9

Obstruction Grading 1

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
MH 19 MH 20	70.0	1050 a/c 300 clay	2.50 2.50	2.25 2.25	1.13 granular	Close Sheeting	10.2	Ganger Labourer	10.2 40.80	Hymac 596 3T Dumper 2 TOOL comp Bomag Wacker JCB 3C	10.2. 20.4 10.2 10.2 10.2 10.2	Including road breakout 150mm black-top. Lots of house connections & cross services.
MH 20 MH 21	105.0	1050 a/c 300 clay	2.50 2.50	2.25 2.25	1.13 granular	Close Sheeting	12.90	Ganger Labourer	12.9 56.10	Hymac 596 3T Dumper 2 TOOL comp Bomag Wacker JCB 3C	12.9 25.8 12.9 12.9 12.9 12.9	As above
MH 21 MH 22	107.5	1050 a/c 225 clay	2.70 2.70	2.50 2.50	1.10 granular	Close Sheeting	11.75	Ganger Labourer	11.75 35.25	Hymac 596 3T Dumper 2 TOOL comp JCB 3C Bomag Wacker	11.75 23.50 11.75 11.75 11.75 11.75	As above

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
MH 22 MH 23	90.0	1050 a/c 225 clay	3.20 3.20	3.00 3.00	1.10 granular	Close sheeting	12.90	Ganger Labourer	12.90 50.50	Hymac 596 3T Dumper 2 TOOL comp Bomag Wacker JCB 3C	12.9 25.8 12.9 12.9 12.9 12.9	See MH 19 MH 20
MH 23 MH 24	22.50	1050 a/c	3.40	3.35	1.40 granular 1.80 sel.fill	Close Sheeting	5.5	Ganger Labourer	5.50 16.70	Hymac 596 3T Dumper 2 TOOL comp Bomag Wacker JCB 3C	5.5 11.0 5.5 5.5 5.5 5.5	See MH 19 MH 20
MH 24 MH 24a	52.0	675 a/c	3.80	3.40	0.57 granular 0.80 sel.fill	Close Sheeting	7.0	Ganger Labourer	7.0 28.65	Hymac 596 3T Dumper Tractair JCB 3C Bomag	7.0 7.0 7.0 7.0 7.0	See MH 19 MH 20

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
MH 24a MH 25	47.5	675 a/c	3.00	2.85	0.57 granular 0.80 sel.fill	Close Sheeting	6.40	Ganger Labourer	6.40 5.55	Hymac 596 JCB 3C 3T Dumper Tractair Bomag	6.40 6.40 6.40 6.40 6.40	See 'MH 19 - MH 20'
MH 26 MH 27	66.50	675 a/c	2.60	2.50	0.57 granular 0.80 sel.fill	Close Sheeting	9.20	Ganger Labourer	9.20 32.12	Hymac 596 JCB 3C 3T Dumper Tractair Bomag	9.20 9.20 9.20 9.20 9.20	See 'MH 19 - MH 20'

3 AUDNAM DRAINAGE - STOURBRIDGE

TRENCH WIDTHS

Pipe Diameter (mm)	Trench Width (m)
300	1.20
600	1.20
1200	2.70

GROUND CONDITIONS

Strata* Grading	Obstruction* Grading	Pipe Runs
9	1	1, 2,14, 5.
9	4	3, 4.
9	3	6, 7, 8, 9,11,12,13.
8	4	10,15,16.

* Refer to Tables 2.11 and 2.12 Volume 1.

Audnam Drainage - Stourbridge

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	MAN DAYS	TYPE	M/C DAYS	
MH 2 - MH 3	51.25	600 (conc)	6.0	5.75	0.46	3 No Shorco boxes	15	Labourer	39	JCB 806 JCB 808 2T Comprsr 3" Pump Bomag 35	1 14 7½ 15 13	Very bad ground loose fill material
SW 2 - SW 3	40.0	1200 (conc)	5.75	5.35	2.00 (granular	3 No Shorco boxes	11½	Labourer	33	JCB 808 2T comprsr 3" Pump Bomag 35	11½ 11½ 11½ 11½	Very bad ground. Brick rubble. Fill
MH 3 - DMH 4	85.0	600 (conc) 1200 (conc)	5.75 5.00	5.60 4.5	0.46 (conc) 2.00 (granular	2 No Shorco boxes	18	Ganger Labourer	18 54	JCB 808 3T dumper Bomag 35	18 18 18	Firm ground, sand
DMH 4 - Junction	20.0	600 (conc) 1200 (conc)	6.0 4.0	5.5 3.75	1.2 (conc) 2.7 (granular	2 No Shorco boxes	14	Ganger Labourer	14 30	JCB 808 3" Pump 3T dumper Bomag 35	14 14 14 14	Restricted working space. Between two buildings.

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING	SHORING	TOTAL	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN	VOLUME (m3/m)		DURATION (days)	TYPE	DAYS	TYPE	DAYS	
Junct - MH 5	21.0	600 (conc)	5.5	5.3	0.46 (conc)	2 No Shorco boxes	4	1. Ganger 2. Labourers		JCB 806 3T dumper Bomag 35	4 4	Exc through hardstanding b/top.
Junct - MH 5b	9.0	300 (conc) 1200 (conc)	5.3 4.4	5.0 4.0	0.46 (conc) 0.56 (granular	2 No Shorco boxes	3	1. ganger 2. Labourers		JCB 806 3T dumper Bomag 35	3 3 3	Exc through hardstanding. b/top.
MH 5b - MH 5a	15.0	300 (conc)	4.9	4.5	0.46 (granular	2 No Shorco boxes	3	1.ganger 2 Labourers	3 5	JCB 806 3T dumper Bomag		Exc through hardstanding b/top.
MH 5	25.0	0.600 (conc)	5.20	5.00	.46 (conc)	2 No Shorco boxes	6	Ganger Labourer	6 10	JCB 808 3T dumper Bomag 35	6 6 6	Excavate this hardstanding
MH 6 - MH 6a	20.0	600 (o/c)	4.1	3.85	0.82 (granular	1 No Shorco boxes	3	1. Ganger 2. Labourers	3 5	JCB 806 3T dumper	3 3	Restricted access

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
MH 6a MH 7	35.0	600 (a/c)	3.70	3.55	0.82 (granular	NIL	$3\frac{1}{2}$	1. Ganger 2.Labourers	$3\frac{1}{2}$ 6.0	JCB 806 3T dumper	$3\frac{1}{2}$ $3\frac{1}{2}$	Restricted access
MH 7 MH 7a	25.0	600 (a/c)	3.65	3.45	0.82 (granular	NIL	$2\frac{1}{2}$	Ganger Labourers	$2\frac{1}{2}$ 5.0	JCB 806 3T dumper	$2\frac{1}{2}$ $2\frac{1}{2}$	Restricted access
MH 7a- MH 8	35.0	600 (a/c)	4.50	4.05	0.82 (granular	1 No Shorco	6	Ganger Labourer	6 10	JCB 806 3T dumper	6 6	Restricted access
MH 8 - Road	40.0	600 (a/c)	4.75	4.5	0.82 (granular	2 No Shorco boxes	6	Ganger Labourer	6 10	JCB 806 3T dumper	6 6	
Road - MH 9	15.0	600 (A/C)	4.6	4.5	0.82 (granular	2 No Shorco boxes	3	Ganger Labourer	3 6	JCB 806 3T dumper	3 3	Road crossing
MH 9 - MH 10	70.0	600 (a/c)	2.0	1.5	0.28 (granular	NIL		Ganger Labourer	7 7	JCB 806 3T dumper	7 7	

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
MH 9 MH 10	70.0	600 (a/c)	2.0	1.5	0.28 (granular)	NIL	7	Ganger Labourer	7 7	JCB 806 3T dumper	7 7	
MH 10 - MH 11	70.0	600 (a/c)	2.1	1.5	0.28 (granular)	NIL	4	Ganger Labourer	4 4	As above	4 4	

4 SHAWBIRCH - TELFORD

TRENCH WIDTHS

Pipe Diameter (mm)	Trench Width (m)
375	1.05
1350	2.45
1350/375	3.30
1050/375	2.90
900/375	2.70
900/300	2.60

LOCATION	LENGTH (m)	PIPE DIA. (mm)	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
Ex FMH - F20	70	375 a/c	4.00	3.92	0.683 gran	Shorco Boxes	$11\frac{1}{4}$	Ganger Labourer	$10\frac{1}{4}$ $31\frac{3}{4}$	JCB 8D JCB 806	$11\frac{1}{4}$ $11\frac{1}{4}$	
F 20 - F 19	65	375 a/c	3.80	3.50	0.683 gran	Shorco Boxes	$2\frac{3}{4}$ $1\frac{3}{4}$	Ganger Labourer	$\frac{3}{4}$ $12\frac{1}{4}$	JCB 8D JCB 806 CAT 951	$5\frac{1}{2}$ $2\frac{3}{4}$ 1.0	
F19 - F18	70	375 a/c	3.90	3.30	0.683 gran	Shorco Boxes	$1\frac{3}{4}$	Labourer	7	JCB 8D JCB 806 CAT 951	$1\frac{3}{4}$ $1\frac{3}{4}$ $1\frac{3}{4}$	
F18 - F17	65	375 a/c	3.15	2.95	0.683 gran	Shorco Boxes	$2\frac{1}{4}$	Labourer	$8\frac{3}{4}$	JCB 8D JCB 806 CAT 951	$2\frac{1}{4}$ $2\frac{1}{4}$ $1\frac{1}{4}$	
F12 F12/1 S8 S811	80.0	375 a/c 1050 conc.	4.20 3.60	4.00 3.40	5.669 gran	Shorco Boxes	$8\frac{1}{2}$	Ganger Labourer	$5\frac{1}{2}$ 14	JCB 806 JCB 8D HC 200	7 $8\frac{1}{2}$ $8\frac{1}{2}$	Double Handle Exc Spoil

Shawbirch - Telford

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
F13 F12 S9 S8	65.0	375 a/c 1050 conc.	3.80 3.20	3.60 3.00	5.669 gran	Shorco Boxes	$5\frac{1}{2}$	Ganger Labourer	$5\frac{1}{2}$ $16\frac{1}{2}$	JCB 806B JC 51 CAT 951	$51\frac{1}{2}$ $51\frac{1}{2}$ $51\frac{1}{2}$	
S16 - S15	47	1350 conc.	2.35	2.18	4.66 gran	Shorco Boxes	$5\frac{1}{4}$	Labourer	21	JCB 806 JCB 3C Iron Fairy 3" Pump JCB 8D	$5\frac{1}{4}$ 2 $5\frac{1}{4}$ $3\frac{1}{4}$ $2\frac{1}{4}$	
S15 S14	42.5	1350 conc.	2.50	2.18	4.66 gran	Shorco Boxes	$2\frac{1}{2}$	Labourer	$10\frac{1}{4}$	JCB 806 Crane 3" Pump JCB 8D	$2\frac{1}{2}$ $2\frac{1}{2}$ $2\frac{1}{2}$	
S14 - S13	60.0	1350 conc.	2.50	2.45	4.66 gran	Shorco Boxes	$3\frac{1}{4}$	Labourer	$13\frac{3}{4}$	JCB 806 Crane 3" Pump JCB 8D CAT 951	$3\frac{1}{4}$ $3\frac{1}{4}$ $2\frac{1}{4}$ $\frac{1}{4}$ 1	

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
F17 - F16 S13 - S12	65.0	375 a/c 1350 conc.	2.90 2.30	2.77 2.17	5.669 gran	Shorco Boxes	$3\frac{1}{2}$	Labourer Ganger	$6\frac{1}{2}$ $1\frac{1}{2}$	JCB 806 Crane 3"Pump CAT 951	$3\frac{1}{2}$ 7 3 1	
F16 - F15 S12 S11	60.0	375 a/c 1350 conc.	3.30 2.70	2.90 2.30	5.67 gran	Shorco Boxes	$2\frac{1}{2}$	Ganger Labourer	$2\frac{1}{2}$ $7\frac{1}{2}$	JCB 806B Crane 3" Pump CAT 951	$2\frac{1}{2}$ 5 $\frac{1}{2}$ 1	
F15 F14 S11 S10	7.5	375 a/c 1350 conc.	3.60 3.00	3.40 2.80	5.67 gran	Shorco Boxes	$\frac{1}{4}$	Ganger Labourer	$\frac{1}{4}$ $\frac{3}{4}$	JCB 806B LC 51 CAT 951	$\frac{1}{4}$ $\frac{1}{4}$ $\frac{1}{4}$	Records incomplete
F14 - F13 S10 S9	72.5	375 a/c 1350 conc.	3.90 3.30	3.70 3.20	5.67 gran	Shorco Boxes	$3\frac{3}{4}$	Ganger Labourer	$3\frac{3}{4}$ $11\frac{1}{4}$	JCB 806B LC 51 CAT 951 12T crane	$3\frac{3}{4}$ $3\frac{3}{4}$ $3\frac{3}{4}$ $2\frac{1}{2}$	
F12/1 F12/2 S8/1 S8/2	80.0	375 a/c 1050 conc.	3.13 2.50	2.79 2.20	5.67 gran	Shorco Boxes	$3\frac{1}{2}$	Ganger Labourer	$3\frac{1}{2}$ $10\frac{1}{2}$	JCB 806B HC 200 CAT 951	$3\frac{1}{2}$ $3\frac{1}{2}$ $3\frac{1}{2}$	

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
F12/2 - F12/3 S8/2 S8/3	75.0	375 a/c 900 conc.	3.00 2.40	2.80 2.20	3.00 gran	Shorco Boxes	3½	Ganger Labourer	10½ 3½	JCB 806B HC 200 CAT 951 LC 51	3½ 2½ 3½ 3	
F12/3 F12/4 S8/3 S8/4	66.0	300 a/c 900 conc.	3.30 2.70	3.00 2.40	4.28 gran	Shorco Boxes	3 1/3	Ganger Labourer	3 1/3 10	JCB 806B CAT 951 LC 51	3 1/3 3 1/3 3 1/3	
F12/4 F12/5 S8/4 S8/5	40.0	300 a/c 900 conc	3.90 3.30	3.60 3.00	4.28 gran	Shorco Boxes	2	Ganger Labourer	2 6	JCB 806B CAT 951 LC 51	2 2 2	
F12/6 F12/7 S8/6 S8/7	40.0	300 a/c 825 conc.	4.00 3.40	3.70 3.10	3.76 gran	Shorco Boxes	2	Ganger Labourer	2 6	JCB 80 JCB 806 LC 51	2 2 2	

5 WOMBOURNE RE-SEWERAGE

TRENCH WIDTHS

Pipe Diameter (mm)	Trench Width (m)
225	0.925
300	0.975
450	1.150
525	1.200

GROUND CONDITIONS

Strata* Grading	Obstruction* Grading	Pipe Runs
9	4	1, 2, 3, 4, 5,18,19,20
8	3	6, 7, 8, 9,10,11,12,37,38.
4	4	14,15,16,17,18,39,40,41,42,43.
10	4	21.
8	4	22,23,24,25,26.
8	2	27,28,29,30,31,32,33,34,35,36.
9	3	44,45,46,47,48,49,50.

* Refer to Tables 2.11 and 2.12 Volume 1.

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
E1 - E2	81.0	0.450 conc	2.40	2.20	0.37 Granular 0.54 Sel.fill	Shorco boxes	5	Ganger Labourer	5 9	JCB 806 2T Dumper Bomag 75 Laser	5 5 5 5	Field
E2 - E3	90.0	0.450 conc	2.40	2.20	0.37 granular 0.54 Sel.fill	Shorco boxes	$3\frac{1}{2}$	Ganger Labourer	$3\frac{1}{2}$ 7	JCB 806 2T Dumper Bomag 75 Laser	$3\frac{1}{2}$ $3\frac{1}{2}$ $3\frac{1}{2}$ $3\frac{1}{2}$	Field
E3 - Syphon	89.0	0.450 conc	4.60	3.40	0.37 granular 0.54 Sel.fill	Shorco boxes	$7\frac{1}{2}$	Ganger Labourer	$7\frac{1}{2}$ 14	JCB 806 2T Dumper Bomag 75 Laser	$7\frac{1}{2}$ $7\frac{1}{2}$ $7\frac{1}{2}$ $7\frac{1}{2}$	Field
A1.- A2	79	0.400 SI	2.2	1.0	0.50 granular	Pinchers	$6\frac{1}{4}$	Ganger Labourer	$6\frac{1}{4}$ 13	JCB 806 2T Dumper Bomag 75 Laser	$6\frac{1}{4}$ $6\frac{1}{4}$ $6\frac{1}{4}$ $6\frac{1}{4}$	Field

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
A2 - A3	58.0	0.525 conc	2.40	1.20	0.40 granular 0.66 Sel.fill	Shorco boxes	6	Ganger Labourer	6 11	JCB 806 2T Dumper Bomag 75 Laser	6 6 6 6	Field including 22m in carriage-way
A3 - A4	57.0	0.525 conc	2.10	1.90	0.40 granular 0.665 Sel.fill	Shorco boxes	5½	Ganger Labourer	5½ 11	JCB 806 2T Dumper Bomag 75 Laser	5½ 5½ 5½ 5½	Road
A4 - A5	27.0	0.525 conc	2.80	2.40	0.40 granular 0.665 sel.fill	Shorco boxes	2½	Ganger Labourer	2½ 5½	JCB 806 2T Dumper Bomag 75 Laser	2½ 5½ 2½ 2½	Road
A5 - A6	80.0	0.525 conc	3.15	2.90	0.40 granular 0.665 Sel.fill	Shorco boxes	3½	Ganger Labourer	2½ 7	JCB 806 2T Dumper Bomag 75 Laser	3½ 2½ 3½ 3½	Road

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
A6 - A7	80.0	0.525 conc	3.15	3.10	0.40 granular 0.66 Sel.fill	Shorco boxes	5	Ganger Labourer	5 11	JCB 806 2T Dumper Bomag 75 Laser	5 5 5 5	Road
A7 - A8	54.0	0.525 conc	3.10	3.00	0.40 granular 0.66 Sel.fill	Shorco boxes	10	Ganger Labourer	9 21	JCB 806 2T Dumper Bomag 75 Laser	10 10 10 10	Road
A8 - A9	40.0	0.525 conc	4.20	3.55	0.40 Granular 0.66 Sel.fill	Shorco boxes	15	Ganger Labourer	15 28	JCB 806 2T Dumper Bomag 75 Laser Tractair	15 15 15 15 10	Road
A9 - A10	90.0	0.525 conc	4.20	3.60	0.40 granular 0.66 sel.fill	Shorco boxes	$13\frac{1}{2}$	Ganger Labourer	13 27	JCB 806 2T Dumper Bomag 75 Laser	$13\frac{1}{2}$ $13\frac{1}{2}$ $13\frac{1}{2}$ $13\frac{1}{2}$	Car Park

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
A10-A11	90.0	0.525 conc	2.80	2.20	0.40 granular 0.66 Sel.fill	Shorco boxes	$5\frac{1}{2}$	Ganger Labourer	$5\frac{1}{2}$ 10	JCB 806 2T Dumper Bomag 75 Laser	$5\frac{1}{2}$ $5\frac{1}{2}$ $5\frac{1}{2}$ $5\frac{1}{2}$	Field
A11-A12	90.0	0.525 conc	1.80	1.70	0.40 granular 0.66 Sel.fill	Pinchers	6	Ganger Labourer	6 12	JCB 806 2T Dumper Bomag 75 Laser	6 6 6 6	Field
A12-A13	82.0	0.450 conc	2.20	2.00	0.37 granular 0.54 Sel.fill	Shorco boxes	5	Ganger Labourer	5 10	JCB 806 2T Dumper Bomag 75 Laser	5 5 5 5	Field
A14-A15	90.0	0.450 conc	5.90	5.30	0.37 granular 0.54 sel.fill	Battered	6	Ganger Labourer	6 12	Mustang160 2T Dumper Wacker Laser	6 6 6 6	Field

Wombourne Re-Sewerage

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
A15-A16	70.0	0.450 conc	6.60	5.70	0.37 granular 0.54 sel.fill	Battered	$3\frac{1}{2}$	Ganger Labourer	$3\frac{1}{2}$ 7	Mustang 160 2T Dumper Wacker Laser	$3\frac{1}{2}$ $3\frac{1}{2}$ $3\frac{1}{2}$ $3\frac{1}{2}$	Field
A16-A17	90.0	0.450 conc	5.55	4.50	0.37 granular 0.54 sel.fill	Battered	3	Ganger Labourer	3 6	Mustang 160 2T Dumper Wacker Laser	3 3 3 3	Field
A17-A18	80.0	0.450 conc	4.10	3.80	0.37 granular 0.54 sel.fill	Battered	$2\frac{3}{4}$	Ganger Labourer	$2\frac{3}{4}$ $5\frac{1}{2}$	Mustang 160 2T Dumper Wacker Laser	$2\frac{3}{4}$ $2\frac{3}{4}$ $2\frac{3}{4}$ $2\frac{3}{4}$	Field
A18-A19	84.0	0.450 conc	3.60	3.20	0.37 granular 0.54	Battered	$4\frac{1}{2}$	Ganger Labourer	$4\frac{1}{2}$ 8	Mustang 160 2T Dumper Wacker Laser	$4\frac{1}{2}$ $4\frac{1}{2}$ $4\frac{1}{2}$ $4\frac{1}{2}$	Field

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
A19-A20	84.0	0.450 conc	3.80	3.00	0.37 granular 0.54 sel.fill	Shorco boxes	$4\frac{1}{2}$	Ganger Labourer	$4\frac{1}{2}$ 9	Mustang 160 2T Dumper Wacker Laser	$4\frac{1}{2}$ $4\frac{1}{2}$ $4\frac{1}{2}$ $4\frac{1}{2}$	Field 18m in car park
A20-A21	120.0	0.450 conc	1.90	1.40	0.37 granular 0.54 sel.fill	Shorco boxes	$4\frac{1}{2}$	Ganger Labourer	$4\frac{1}{2}$ 9	Mustang 160 2T Dumper Wacker Laser	$4\frac{1}{2}$ $4\frac{1}{2}$ $4\frac{1}{2}$ $4\frac{1}{2}$	Field
A21-A22	60.0	0.450 conc	2.40	1.80	0.37 Granular 0.54 sel.fill	Shorco boxes	$2\frac{1}{2}$	Ganger Labourer	$2\frac{1}{2}$ $4\frac{1}{2}$	Mustang 160 2T Dumper Wacker Laser	$2\frac{1}{2}$ $2\frac{1}{2}$ $2\frac{1}{2}$ $2\frac{1}{2}$	Gardens
A22-A23	80.0	0.450 conc	3.00	2.70	0.37 Granular 0.54 sel.fill	Shorco boxes	$3\frac{1}{2}$	Ganger Labourer	$3\frac{1}{2}$ $7\frac{1}{2}$	Mustang 160 2T Dumper Wacker Laser	$3\frac{1}{2}$ $3\frac{1}{2}$ $3\frac{1}{2}$ $3\frac{1}{2}$	Gardens

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
A24-A25	56.0	0.450 conc	4.45	4.30	0.37 granular 0.54 sel.fill	Shorco boxes	15	Ganger Labourer	14 30	JCB 806 2T Dumper Bomag 75 Laser	15 15 15 15	Field
A25-A26	7.0	0.450 conc	4.50	4.40	0.37 Granular 0.54 sel.fill	Close Sheeting	$2\frac{1}{2}$	Ganger Labourer	$2\frac{1}{2}$ 5	JCB 806 2T Dumper Bomag 75 Laser	$2\frac{1}{2}$ $2\frac{1}{2}$ $2\frac{1}{2}$ $2\frac{1}{2}$	Road Crossing
A26-A27	50.0	0.450 conc	4.90	4.50	0.37 granular 0.54 Sel.fill	Shorco boxes	$7\frac{1}{2}$	Ganger Labourer	7 16	JCB 806 2T Dumper Bomag 75 Laser	$7\frac{1}{2}$ $7\frac{1}{2}$ $7\frac{1}{2}$ $7\frac{1}{2}$	Road
A27-A28	50.0	0.450 conc	5.00	4.80	0.37 granular 0.54 sel.fill	Shorco boxes	$8\frac{3}{4}$	Ganger Labourer	$8\frac{3}{4}$ $17\frac{1}{2}$	JCB 806 2T Dumper Bomag 75 Laser	$8\frac{3}{4}$ $8\frac{3}{4}$ $8\frac{3}{4}$ $8\frac{3}{4}$	Road

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
A28-A29	68.0	0.450	4.70	4.50	0.37 granular 0.54 sel.fill	Shorco boxes	8	Ganger Labourer	8 16	JCB 806 2T Dumper Bomag 75 Laser	8 8 8 8	Road
A29-A30	27.0	0.450 conc	4.30	4.20	0.37 granular 0.54 sel.fill	Shorco boxes	3¼	Ganger Labourer	3¼ 6	JCB 806 2T Dumper Bomag 75 Laser	3¼ 3¼ 3¼ 3¼	Road
A30-A31	42.0	0.450 conc	4.10	3.95	0.37 granular 0.54 sel.fill	Shorco boxes	5	Ganger Labourer	5 9	JCB 806 2T Dumper Bomag 75 Laser	5 5 5 5	Road
A31-A32	40.0	0.450 conc	3.80	3.55	0.37 granular 0.54 sel.fill	Shorco boxes	5	Ganger Labourer	5 10	JCB 806 2T Dumper Bomag 75 Laser	5 5 5 5	Road

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
A32-A33	35.0	0.300 conc	3.30	3.25	0.28 granular 0.42 sel.fill	Shorco boxes	$6\frac{3}{4}$	Ganger Labourer	$6\frac{3}{4}$ $13\frac{1}{2}$	JCB 806 2T Dumper Bomag 75 Laser	$6\frac{3}{4}$ $6\frac{3}{4}$ $6\frac{3}{4}$ $6\frac{3}{4}$	Road
A33-A34	75.0	0.300 conc	3.20	3.20	0.28 granular 0.42 sel.fill	Shorco boxes	$5\frac{1}{2}$	Ganger Labourer	$5\frac{1}{2}$ 11	JCB 806 2T Dumper Bomag 75 Laser	$5\frac{1}{2}$ $5\frac{1}{2}$ $5\frac{1}{2}$ $5\frac{1}{2}$	Road
A34-A35	75.0	0.300 conc	3.20	2.80	0.28 granular 0.42 sel.fill	Shorco boxes	$6\frac{1}{2}$	Ganger Labourer	$6\frac{1}{2}$ 13	JCB 806 2T Dumper Bomag 75 Laser	$6\frac{1}{2}$ $6\frac{1}{2}$ $6\frac{1}{2}$ $6\frac{1}{2}$	Road
A35-A36	80.0	0.300 conc	2.40	2.10	0.28 granular 0.42 sel.fill	Shorco boxes	$10\frac{1}{4}$	Ganger Labourer	$10\frac{1}{4}$ 21	JCB 806 2T Dumper Bomag 75 Laser	$10\frac{1}{4}$ $10\frac{1}{4}$ $10\frac{1}{4}$ $10\frac{1}{4}$	Road

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
A36 - Existing	48.0	0.300 conc	1.80	1.40	0.28 granular 0.42 sel.fill	Pinchers	6	Ganger Labourer	6 11	JCB 806 2T Dumper Bomag 75 Laser	6 6 6 6	Road
A41-B1	66.0	0.300 conc	5.80	5.70	0.28 granular 0.42 sel.fill	Shorco boxes	$4\frac{3}{4}$	Ganger Labourer	$4\frac{3}{4}$ $9\frac{1}{2}$	JCB 806 2T Dumper Bomag 75 Laser	$4\frac{3}{4}$ $4\frac{3}{4}$ $4\frac{3}{4}$ $4\frac{3}{4}$	Field
B1 - B2	80.0	0.300 conc	5.75	5.60	0.28 granular 0.42 sel.fill	Shorco boxes	$5\frac{3}{4}$	Ganger Labourer	$5\frac{3}{4}$ 11	JCB 806 2T Dumper Bomag 75 Laser	$5\frac{3}{4}$ $5\frac{3}{4}$ $5\frac{3}{4}$ $5\frac{3}{4}$	Field
B2 - B3	90.0	0.300 conc	5.45	4.00	0.28 granular 0.42 sel.fill	Shorco boxes	$3\frac{1}{2}$	Ganger Labourer	$3\frac{1}{2}$ 7	JCB 806 2T Dumper Bomag 75 Laser	$3\frac{1}{2}$ $3\frac{1}{2}$ $3\frac{1}{2}$ $3\frac{1}{2}$	Field

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
B3 - B4	50.0	0.300	2.90	2.75	0.28 granular 0.42 sel.fill	Shorco boxes	$6\frac{1}{4}$	Ganger Labourer	$6\frac{1}{4}$ $12\frac{1}{2}$	JCB 806 2T Dumper Bomag 75 Laser	$6\frac{1}{4}$ $6\frac{1}{4}$ $6\frac{1}{4}$ $6\frac{1}{4}$	Field
B4 - Existing	46.0	0.300	2.80	2.65	0.28 granular 0.42 sel.fill	Shorco boxes	5	Ganger Labourer	5 10	JCB 806 2T Dumper Bomag 75 Laser	5 5 5 5	Car Park
D1 - D2	50.0	0.300	3.20	2.90	0.28 granular 0.42 sel.fill	Pinchers	5	Ganger Labourer	5 10	JCB 3C 2T Dumper Wacker Laser	5 5 5 5	Road
D2 - D3	90.0	0.300	2.60	2.30	0.28 granular 0.42 sel.fill	Pinchers	$7\frac{1}{2}$	Ganger Labourer	$7\frac{1}{2}$ 15	JCB 3C 2T Dumper Wacker Laser	$7\frac{1}{2}$ $7\frac{1}{2}$ $7\frac{1}{2}$ $7\frac{1}{2}$	Road

Wombourne Re-Sewerage

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
D3 - D4	41.0	0.300 conc	2.80	2.40	0.28 granular 0.47 sel.fill	Pinchers	$2\frac{1}{2}$	Ganger Labourer	$2\frac{1}{2}$ 6	JCB 3C 2T Dumper Wacker Laser	$2\frac{1}{2}$ $2\frac{1}{2}$ $2\frac{1}{2}$ $2\frac{1}{2}$	Road
D4 - D5	61.0	0.300 conc	2.80	2.70	0.28 granular 0.42 sel.fill	Pinchers	5	Ganger Labourer	5 11	JCB 3C 2T Dumper Wacker Laser	5 5 5 5	Road
D5 - D6	90.0	0.225 clay	2.60	2.40	0.24 Granular 0.39 sel.fill	Pinchers	$16\frac{3}{4}$	Ganger Labourer	$16\frac{3}{4}$ 35	JCB 3C 2T Dumper Wacker Laser	$16\frac{3}{4}$ $16\frac{3}{4}$ $16\frac{3}{4}$ $16\frac{3}{4}$	Road
D6 - D7	90.0	0.225 clay	2.20	1.80	0.24 granular 0.39 sel.fill	Pinchers	$2\frac{1}{4}$	Ganger Labourer	$2\frac{1}{4}$ 5	JCB 3C 2T Dumper Wacker Laser	$2\frac{1}{4}$ $2\frac{1}{4}$ $2\frac{1}{4}$ $2\frac{1}{4}$	Road

LOCATION	LENGTH (m)	PIPE DIA.	DEPTH (m)		BEDDING VOLUME (m3/m)	SHORING	TOTAL DURATION (days)	RESOURCE USAGE				REMARKS
								LABOUR		PLANT		
			MAX	MEAN				TYPE	DAYS	TYPE	DAYS	
D7 - D8	84.0	0.225 clay	3.20	2.75	0.24 granular 0.39 sel fill	Pinchers	5	Ganger Labourer	5 10	JCB 3C 2T Dumper Wacker Laser	5 5 5 5	Road

SECTION 5.

PROJECT ANALYSIS SUITE - 'SIM'

USERS HANDBOOK

CONTENTS

1.0 Introduction.

'SIM' is a suite of computer programmes for project analysis and simulation. The system is command driven in that the user controls the running of SIM by issuing commands which describe the task(s) to be performed.

The basic features of SIM are as follows:-

Resource definition - The user supplies descriptions of the basic resources of Labour, Materials and Plant.

Operations definition - Operations are defined by collecting together the resources required to complete the operation.

Network definition - Two types of network are used in the suite:-

Sub-networks - Collect together operations for a particular portion of the project and

Master-networks - Which collect the sub-networks to give the network of the total project.

Network analysis - To analyse a network with respect to time Resources, or cost.

Network Simulation - Applying a monte-carlo simulation to the networks to investigate the effects of changes in productivity levels.

2.0 BRIEF DESCRIPTION

The following are brief notes covering the way SIM considers a project, A graphical representation of this proceedure is shown in fig.2.1 For a more detailed description readers should refer to Vol 1 Chapter 3.

2.1 RESOURCES.

The basic resources of labour, materials and plant are defined by the user, each resource is assigned a unique, two digit alphanumeric code which is then used to identify that resource throughout the running of SIM for the particular project. Information is also required on the unit costs of these resources.

2.2 OPERATIONS.

The various operations are then entered by specifying the resource requirements for that particular operation. Each operation is assigned a two digit alphanumeric code for identification purposes.

2.3 NETWORKS.

Two types of networks are considered,

2.3.1. Sub-nets, these combine the various operations which comprise a section of the project.

2.3.2. Master-net. collects together the various sub-nets to give the total project network.

2.3.3. Networks are defined by specifying the precedence relationships between the various components. SIM checks the logic of the network to ensure that there are no loops present etc.,

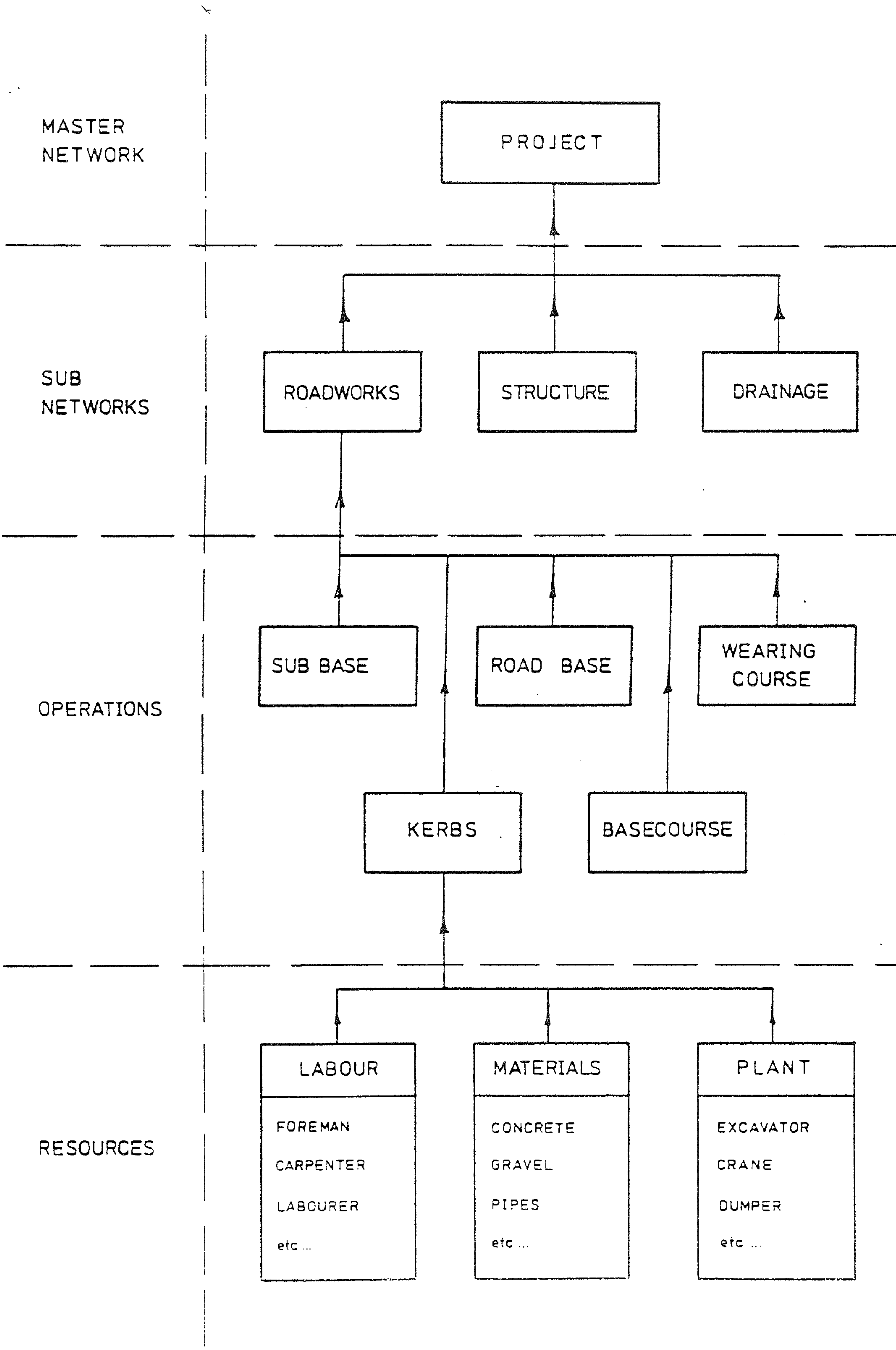


Fig. 2.1 Project Breakdown

2.4 NETWORK ANALYSIS

Networks are analysed using standard techniques, three different analyses are available:-

2.4.1 Time - the time analysis gives the Early and Late starts and finishes, together with total float of all the operations in the network.

2.4.2 Cost - Costs are reported for each operation under the categories of Labour, Materials and Plant.

2.4.3. Resources. - The resource requirements over time are presented, no attempt is made at resource levelling, this must be done by the user.

2.5 NETWORK SIMULATION

The effect of variable site productivity is investigated using a Monte-Carlo sampling technique from distributions of site performance data. Four distributions are required, for SPI, OPI, Productive Unmeasured time and the degree of absenteeism or gang overloading these distributions can be input by the user or selected from stored distributions within SIM. From this sampling procedure the mean operation time and operation time standard deviation are determined. From these figures the network analysis programme produces the mean overall duration and standard deviation, together with a criticallity index which shows the relative criticallity of each operation.

2.6 DATA STORAGE

All data entered into or generated by SIM is stored on files, a number of files are required each of which stores a particular type.

of data. Files are generated automatically by SIM and to ensure that the correct files are being used each project should be assigned a unique estimate reference. Thus the first input when using SIM is to input the estimate reference so that the correct files can be identified.

3.0 SIM COMMANDS

SIM is controlled by the user by issuing command words which instruct SIM to perform certain tasks, or to accept input data. A full instruction consists usually of a command, a sub-command and a number of parameters. A list of the instructions is shown in Table 3.1

3.1 PROMPTS

SIM is ready to receive an instruction when it displays a 'greater than' sign (>) in the left hand margin. In certain circumstances, when defining networks for example an asterisk (*) is displayed, and when SIM has given a written question, a question mark (?) is shown.

3.2 COMMAND INPUT

A full instruction consists of various commands, these can be input either successively or in one string. When inputting successively SIM will respond with a written query for the next item of information if a full instruction is input in one line no written prompts will be printed. As an example of this consider an instruction to define a basic resource. The users responses are underlined.

```
> DES
Sub-command (Lab/Mat/PL)   ? Lab
Labour Code                ? L1
Description                ? Ganger
Rate (£)                   ? 2.00
```

TABLE 3.1 SIM COMMANDS

	RESOURCE DESCRIPTIONS			OPERATION DEFINITIONS				NETWORK DEFINITION		NETWORK ANALYSIS			NETWORK SIMULATION	
MAIN COMMAND	DES			OPS				NETS		ANA			SIM	
SUB COMMAND	LAB	MAT	PL	DEF	LAB	MAT	PL	DEF	EDIT	SNET/ MNET			SNET/MNET	
PARAMETER [1]	Labour Code	Material Code	Plant Code	Operation Code	Operation Code	Operation Code	Operation Code	Snet or Mnet	Snet or Mnet	Network Code			Network Code	
[2]	Description	Description	Description	Description	Labour Code	Material Code	Plant Code	Network Code	Network Code	Time	Resource	Cost		
[3]	Cost	Cost	Cost	Standard Duration	Number Required	Quantity	Number Required	Description						
[4]	Units	Units	Units	Units		Units								

the above could be combined into:-

> DES, LAB, L1, GANGER, 2.00, HR.

It is advisable, when using SIM for the first time to use succesive input to take advantage of the written prompts, when the user becomes more familiar with SIM then a combined input can be used.

There is only one restriction on command input which is if a command ends with a comma, SIM will report an error condition and reject the command. This provides a way for the user to scratch a line of input if he recognises a typing error. As SIM progresses through an instruction various checks are made on logic etc. and any errors are reported.

3.3 THE DES COMMAND

The DEScription command is used for entering resource definitions, the type of resource is specified by the sub-command which can be:-

LAB - Labour

MAT - Material

PL - Plant.

The various parameters for this instruction specify the following information:-

Parameter 1 - Resource code, a unique two digit alphanumeric code which will be used to access the information for this resource.

Parameter 2 - Description, A fuller description for identification purposes. The length will vary but should be not more than 12 alphanumeric characters.

Parameter 3 - Rate (cost) in £

Parameter 4 - Units, the units will depend on the resource under consideration and will be one of the following:-

HR	)	
DAY	)	for Labour and Plant
WK	)	
M	)	
M2	)	for Materials.
M3	)	

Note - tonnes is not accepted for materials

3.3.1 RESTRICTIONS.

The maximum number of resources for each project is as follows

Labour - 10 types

Materials - 20 types

Plant - 20 types

3.3.2 Example

Supplying a labour definition:-

> DES (command)

Sub-command (Lab/Mat/PL)	? Lab
Labour code	? L1
Description	? Labourer
Rate (£)	? 2.00
Units	? Hr

3.4 The OPS command

The OPerationS command deals with operation input. There are four stages in operations definition, each of which is dealt with by a sub-command:-

3.4.1 Sub-command DEF

The DEFine sub-command opens storage space for the operation data in the file, the required parameters under this sub-command are:-

Parameter 1 - Operation code	-	A unique two digit alphanumeric code used to identify this operation in subsequent use of SIM
Parameter 2 - Description	-	A fuller description for the users identification purposes. The length of this description will obviously vary but should be not more than about 12 alphanumeric characters.
Parameter 3 - Standard Duration	-	The standard duration for this operation expressed in Gang hours.
Parameter 4 - Units	-	The units in which the standard duration is measured, time units are required on can be HR-hours, DAY-days or WK-weeks.

SIM will then request the total Activity quantity, and the quantity units, the units can be M,M2 or M3.

Example - defining an excavation operation.

```
 > OPS
Sub-command (DEF/LAB/MAT/PL)  ? DEF
Operation code                ? E1
Description                   ? EXCAVATE
Standard duration             ? 5
Units                         ? Hr
Total quantity                ? 150
```

3.4.2 Sub-commands LAB,MAT,PL

The remaining sub-commands under the OPS command detail the resource requirements for this operation. The parameters for there three sub-commands are similar in nature and consist of the following:-

Parameter 1 - Operation Code	-	The operation code entered under the OPS,DEF command. This identifies the operation to which the following resources apply.
Parameter 2 - Resource code	-	A Labour, Material or Plant code which must already have been entered using the DES command.
Parameter 3 - Requirement	-	The numbers of Labour and Plant required or the quantity of material.
Parameter 4 - Units	-	Only applies to Material input and gives the materials units, M, M2 or M3.

Example: Defining the resources for operation E1

```
> OPS
Sub-command (DEF/LAB/MAT/PL)  ?LAB
Operation code                ?E1
Labour Code                   ? L1
Number required               ? 2
```

3.4.3. Restrictions.

SIM can store data covering 100 operations, a maximum of 5 Labour types, 5 material types and 10 plant types are allowed per operation.

3.5 The NET command

The NETwork command is used for entering a network of operations into SIM. Two types of network are recognised;

3.5.1.1 Sub-Networks (SNET)

These networks are intended to collect together the individual operations which form a section of a project.

3.5.1.2 Master - Network (MNET)

The master network collects together the individual sub-networks to show the logic of the whole project.

The NET command has two sub-commands which deal with network definition and network editing.

3.5.2 The DEF sub-command

The DEFine sub-command instructs SIM to accept the various data needed to define a network. Before the actual network logic can be input various descriptive information is needed:-

Parameter 1 - Network type - SNET or MNET

Parameter 2 - Network Code - a unique two digit alphanumeric code used to identify this network in subsequent use of SIM

Parameter 3 - Description - A fuller description for the users purposes.

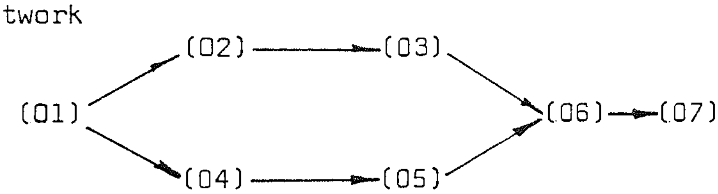
Example

```
> NET
Sub-command (DEF/EDIT)      ? DEF
Parameter 1 (Snet/Mnet)     ? Snet
Network code                ? N1
Description                 ? MH11 - 12
```

3.5.2.1 Network Logic Input.

The remaining part of the network definition is supplied from requests from SIM. SIM works with activity - on - the - node precedence networks, these are input be entering each operation, using its code followed by that operations immediate predeccessors. The first operation is entered using - (op.code), START. SIM shows that it is reaay to accept a set of precedence relationships by displaying an asterisk (*) in the left hand margin. When all the relationships have been entered type END to terminate this subroutine. SIM then prints the input so that the user can check it visually, and performs a logic check for loops.

Example Network



Input.

NETWORK INPUT

Need Help ? NO (brief notes are supplied by SIM if required).

*01, START

*02, 01

*03,02

*04, 01

*06,05,03

*07,06

*END

INPUT SUMMARY

01, START

02,01

03,02

04,01

05,04

06,05,03

07,06

** NETWORK LOGIC CHECK NO LOOPS IN THE NETWORK**

3.5.2.2 Restrictions.

The first restriction is that each operation can only appear once in the network, i.e. an operation cannot be repeated, if it is necessary to repeat an operation then it must be defined twice under the OPS, DEF command. A maximum of 30 operations are allowed in each network, and a maximum of 9 sub-networks are allowed, with 1 master - network. The same operation code can be used in different networks.

3.5.3 The EDIT Sub-command.

If an error is made on input or if the user wishes to change the logic of a network various EDITing commands are available. These various commands are:-

ADD, DELete, NODE, ARROW, and can be used in the following combinations.

ADD,NODE - to insert a Node, or operation into the network

ADD,ARROW - to insert a precedence relationship

DEL,NODE - to remove a node (operation), and its precedences.

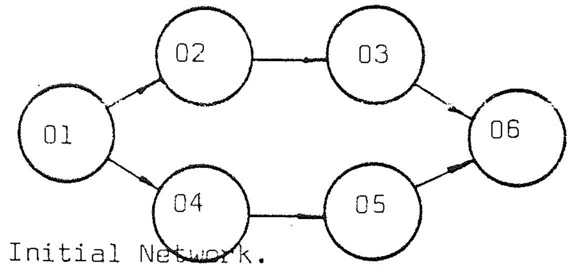
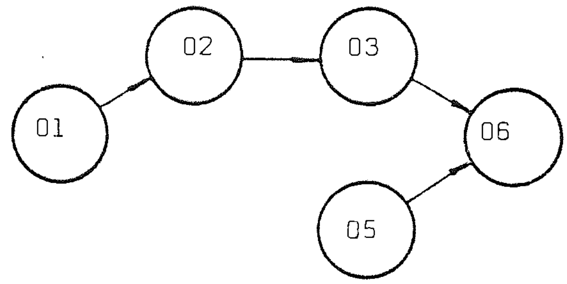
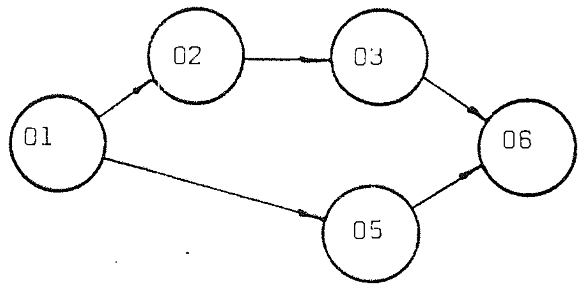
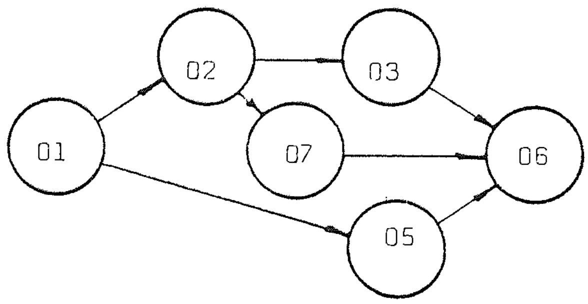
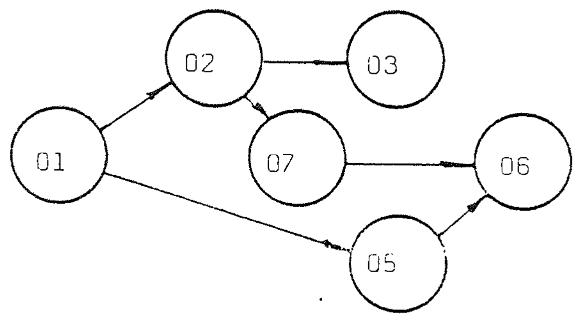
DEL,ARROW - to remove a precedence relationship

After these commands are entered SIM will request the information necessary to perform the task. Edit commands are prompted by an asterisk(*) to terminate an edit type END. An example of Network editing is shown in Table 3.2 After an edit is complete then SIM will perform the logic check to test for loops.

3.6 The ANA command

The ANAlyse command instructs SIM to perform various analyses of a network. The network must be identified and then the type of analysis required is specified. No sub-commands are present with this command the required information being supplies as parameters as follows:-

Table 3.2 Network Editing.

SIM INTERACTION	EFFECT ON NETWORK
> NETS. Sub-Command (Def/Edit) ? Edit. Editor is ready. Need Help ? No.	 Initial Network.
* DEL.NODE. Operation Code ? 04 Predecessors ? 01 Successor. ? 05	
* ADD,ARROW Start Node ? 01 Finish Node ? 05	
* ADD,NODE Operation Code ? 07 Predecessors ? 02 Successors. ? 06	
* DEL,ARROW Start Node ? 03 Finish Node ? 06 * END (Finish network edit). > (NEXT COMMAND)	

Parameter 1 - Snet/Mnet - See section 3.5.2

Parameter 2 - Network Code - See section 3.5.2

Parameter 3 - Analysis - TIME, RESource or COST

Example:-

> ANA

Parameter 1 (Snet/mnet)	? Snet
Network Code	? N1
Required Analysis	? TIME

Examples of the output obtained from the Various analyses is shown in table 3.3

3.6.1 Restrictions.

The TIME analysis must be the first type to be performed on any network.

NOTE during the execution of the TIME analysis the required data is retrieved from the resources files for the subsequent cost and resource analyses. Thus if any changes are made to an already analysed network, logic changes or adding resources to a particular operation then a TIME analysis is required to bring the new resource requirements into the cost and resource analyses.

3.8 The LIST command

The list command allows the user to list on the terminal the contents of the data files containing Resource Operation, or Network data, by using the sub-commands RES,OPS or NETS

3.8.1 The RES sub-command

This sub-command instructs SIM to read the resource files for the basic definitions, the actual resources required are shown by the only parameter under this command which is:-

Parameter 1 - Required Resource (Lab/Mat/PL/all).

Example:-

> LIST

Sub-command (RES/OPS/NETS) ? RES

Which resource(s) do you want (LAB/MAT/PL/ALL] ?ALL

Labour

Code	Description	Rate	Unit
L1	Labourer	2.00	Hour

Materials

NO MATERIALS HAVE BEEN DEFINED.

PLANT

Code	Description	Rate	Unit
E1	JCB 806	7.00	Hour
P1	3" pump	28.00	week

3.8.2. The OPS sub-command

The OPerations sub-command instructs SIM to read the operations file. After issuing this command SIM will display the number of operations in store and will ask for one of two options:-

(a) Will produce a summary of all, or some, of the operations currently in store showing operation code, description and duration. The operations are stored sequently that is they are written to the file in the order in which they are input to SIM. The listing will start at the ith operation and terminated at the Jth where I and J are supplied by the user.

(b) Will produce a detailed listing of one operation showing code description, duration and resource requirements.

Example:-

> LIST

What do you want listing (RES,OPS,NETS) ? OPS

20 operations are currently in store you can:-

(a) List all or some of the operations by code, description and duration or

(b) Get a detailed listing of one operation.

Enter option (A or B) ? A

(Note the operations are stored in the order of input)

Enter Start operation number and finish operation number ?, 1,3,

Count	Code	Description	Duration	Units
1	E1	Excavate	5.0	Hr.
2	S1	Shore	6.0	Hr.
3	S2	Shore MH2	12.0	Hr.

Or/

Enter option (A or B) ? B

Enter operation code ? 01

Operation Code E1

Description Excavate

Duration 5.0 Hours,

Quantity 150 M3

Resources CODE REQUIREMENTS

3.9 The SIM command

The SIMulate command instructs SIM to perform a Monte-Carlo simulation of a specified network, using distributions of four variables. The performance distributions which are required are for Site Performance Index, (SPI), operative Performance Index (OPI), Productive Unmeasured time (pu), and the degree of absenteeism or overloading (A/O). When issuing this command therefore the user is required to specify:-

(a) The network to be analysed and

(b) The distributions to be used.

3.9.1 Network

The network to be analysed is specified using two parameters of the SIM command these are:-

Parameter 1 - can be Snet or Mnet

Parameter 2 - Network code.

These parameters are those used under the NET, def command.

Example:-

SIM

Parameter 1 (Snet/Mnet) ?NI

When SIM has located the network data in the files then prompts will be made for the method of inputting the distribution.

3.9.2. Distribution Input

The user has three options available for distribution input:

3.9.2.1 Normal Distributions.

If the user wishes to use normal distributions in the simulation then SIM will require the mean and standard deviation of each distribution. SIM will then generate the required distribution data from this information.

Example:-

NORMAL DISTRIBUTIONS.

NEED HELP ? NO (brief notes are available)

S.P.I.	- MEAN	=	75.0
	- S.D	=	15.0
O.P.I	- MEAN	=	100.0
	- S.D	=	25.0
Pu(%)	- MEAN	=	15.0
	- S.D	=	5.0

3.9.2.2. Own Distributions

If required the user may specify non-normal distributions. This is done by the user entering the value of the variable and the percentage occurrance of that value. In this mode of input SIM will display the remaining percentage to be input in the left hand margin before a pair of values, (Variable, percentage) are entered. Input is automatically terminated when the cumulative percentage = 100. If the user tries to enter more than 100% then the input will be scrapped and will have to be started again. When the input is complete SIM will calculate and display the mean and standard deviation. The user should make a note of these figures as he may need them again.

Example:-

```
OWN DISTRIBUTION
Need Help?   NO
100       ?   50,10
 90       ?   60,30
 60       ?   70,35
 25       ?   80,10
 15       ?   90,10
  5       ?   100,5
MEAN = 69.50  STANDARD DEVIATION  =  12.90
(Remember these values you may need them again)
```

3.9.2.3. Re-using Own Distributions

The users own distributions can be re-accessed for further use order the third input option. Each specified distribution isstored on file and the user need merely specify the mean and standard deviation to re-use each distribution.

Example:-

SUPPLY THE FOLLOWING DATA FOR THE DISTRIBUTIONS YOU WISH TO USE

S.P.I - MEAN, S.D. = 73,0,10.0

O.P.I - MEAN, S.D. = 80,0,15.0

Pu. - MEAN, S.D. = 15.0,10.0

3.9.2.4. Selecting Input option

The users input option is selected from a check list supplied by SIM as follows

DISTRIBUTION INPUT

Need Help ? YES

SIM REQUIRES DISTRIBUTIONS OF THREE VARIABLES IN ORDER TO SIMULATE THE OPERATION TIMES IN THIS NETWORK. THESE DISTRIBUTIONS ARE SITE PERFORMANCE INDEX (S.P.I) OPERATIVE PERFORMANCE INDEX (O.P.I).

PRODUCTIVE UNMEASURED TIME (Pu) %

DEGREE OF ABSENTEEISM OR OVERLOADING (A/O)

YOU HAVE THREE OPTIONS FOR SPECIFYING THESE DISTRIBUTIONS

(1) USING STANDARD NORMAL DISTRIBUTIONS WHERE YOU SPECIFY THE MEAN AND STANDARD DEVIATION.

(2) SPECIFY YOUR OWN DISTRIBUTIONS, WHICH WILL BE RECORDED FOR RE-USE IF REQUIRED.

(3) USE DISTRIBUTIONS PREVIOUSLY INPUT UNDER (2)

OPTIONS

(1) STANDARD NORMAL DISTRIBUTIONS

(2) NEW DISTRIBUTIONS SPECIFIED BY YOU

(3) OWN DISTRIBUTION ALREADY SPECIFIED

YOUR REPLY ?

3.10 THE REP COMMAND.

The REPORT command produces a print of information stored by SIM. There are four basic types of report and these are produced with the following commands.

REP,DES	-	REPorts the basic resource DEScriptions,see fig.3.1.
REP,OPS	-	REPorts the data stored on all of the OPerationS. see Fig. 3.2.
REP,RES,ANA, Snet,NI	-	REPorts the RESults of the ANAlysis of Snet,NI, see fig. 3.3.
REP,RES,SIM,Snet, NI	-	REPorts the RESults of the SIMULATION of Snet,NI, see fig. 3.3

PROJECT ANALYSIS AND SIMULATION
****

ESTIMATE REFERENCE 19 : 2 : 80 NB/1

DESCRIPTION SANDRIDGE SEWER, ST ALBANS

RESOURCE DESCRIPTIONS
****

RESOURCE	CODE	DESCRIPTION	COST	UNIT
LABOUR	L1	GANGER	3.00	HOUR
	L2	LABOURER	2.65	HOUR
MATERIALS	M1	GRANULAR BEDDING	9.04	M3
	M2	500 DIA S. I. PIPE	37.90	M
	M3	525 DIA A/C PIPE	25.61	M
	M4	450 DIA A/C PIPE	20.39	M
PLANT	P1	JCB 806	12.01	HOUR
	P2	CAT 951	11.91	HOUR
	P3	JCB 5C	11.19	HOUR
	P4	2 IN PUMP	36.07	WEEK
	P5	2T DUMPER	1.65	HOUR
	P6	HY-MAC 580	12.01	HOUR
	P7	3T DUMPER	2.25	HOUR
	P8	4 IN PUMP	63.36	WEEK
	P9	3 IN PUMP	45.32	WEEK
	Q1	RAMMER	8.04	DAY
	Q2	22 RB	11.60	HOUR
	Q3	4T DUMPER	2.85	HOUR
	Q4	2T COMPRESSOR	1.69	HOUR

Fig. 3.1. Typical resource descriptions report.

PROJECT ANALYSIS AND SIMULATION
****

ESTIMATE REFERENCE 20 : 2 : 80
NB/1
DESCRIPTION SANDRIDGE SEWER, ST ALBANS

OPERATIONS
****

CODE	DESCRIPTION	STD DURATION	QUANTITY	LABOUR	MATERIALS	PLANT
01	C114 - LL1	8.13 DAY	104.50 M	L1 1 NO L2 3 NO	M1 38.67 M3 M2 104.50 M	P1 1 NO P2 1 NO P3 1 NO P4 1 NO P5 1 NO
02	LL1 - LL2	11.08 DAY	148.50 M	L1 1 NO L2 3 NO	M1 54.94 M3 M2 148.50 M	P6 2 NO P7 1 NO P8 1 NO P4 1 NO
03	LL2 - LL3	2.38 DAY	52.50 M	L1 1 NO L2 3 NO	M1 19.95 M3 M3 52.50 M	P6 2 NO P7 1 NO
04	LL3 - HEADING	2.91 DAY	55.00 M	L1 1 NO L2 3 NO	M1 20.90 M3 M3 55.00 M	P6 1 NO P7 1 NO
05	LL4 - LL5	5.03 DAY	95.00 M	L1 1 NO L2 3 NO	M1 36.10 M3 M3 95.00 M	P6 2 NO P7 1 NO P9 1 NO
06	LL5 - LL6	4.82 DAY	95.00 M	L1 1 NO L2 3 NO	M1 36.10 M3 M3 95.00 M	P6 2 NO P7 1 NO P8 1 NO
07	LL6 - LL7	4.80 DAY	92.50 M	L1 1 NO L2 3 NO	M1 35.15 M3 M3 92.50 M	P6 2 NO P7 1 NO
08	LL7 - LL8	5.44 DAY	105.00 M	L1 1 NO L2 3 NO	M1 39.90 M3 M3 105.00 M	P6 2 NO P7 1 NO P9 1 NO

Fig. 3.2 Typical operation description

NETWORK ANALYSIS

NETWORK CODE	S/N5
DESCRIPTION	RUN 05

TIME ANALYSIS

OPERATION	STD DURATION HOURS	TIME -> [HOURS] 0 10 20 30 40 50 60 70 80
*05	23.7725	!===========================

- * DENOTES CRITICAL OPERATIONS
- = OPERATIONS AT EARLY START POSITION
- : FLOAT

OPERATION	DURATION	EARLY START	LATE START	EARLY FINISH	LATE FINISH	FLOAT
05	23.77	0.00	23.77	0.00	23.77	0.00

COST ANALYSIS

OPERATION	LABOUR	MATERIALS	PLANT	SUB/CONT	PRELIMS	TOTAL
05	260.31	2184.10	692.73	0.00	0.00	3137.14

NETWORK SIMULATION

NETWORK S/N5 RUN 05

TIME SIMULATION

SAMPLING DATA	S.P.I.	O.P.I.	R	PU %	A/O %
MEAN	47.000	72.000	0.700	0.000	0.750
S.D.	17.000	21.000		0.000	3.440

SIMULATED OPERATION DURATIONS

OP	STND. DUR	MEAN	S.D.	MIN	MAX	UNIT	CRIT. INDEX
05	2.57	5.73	0.90	4.00	7.63	DAY	1.00

SIMULATED NETWORK DURATION

MEAN	S.D.	MIN	MAX	UNIT
53.03	8.29	37.03	70.58	HR

RESOURCE SIMULATION - GANG SIZES

OPERATION	MEAN	S.D.	MIN	MAX
05	4.03	0.05	3.91	4.09

SIMULATED COSTS

OPERATION 05	MIN	MAX	MEAN
LABOUR	408.11	777.78	584.40
MATERIALS	2184.10	2184.10	2184.10
PLANT	1120.67	2135.78	1604.74
TOTALS	3712.89	5097.66	4373.24

NETWORK COST SUMMARY

	MIN	MAX	MEAN
LABOUR	408.11	777.78	584.40
MATERIALS	2184.10	2184.10	2184.10
PLANT	1120.67	2135.78	1604.74
TOTALS	3712.89	5097.66	4373.24

Fig. 3.3. Typical network analysis and simulation report.

4.0 DATA PREPARATION

To assist the user in gathering together the data which is required for the analysis of a project, three standard forms have been produced.

See Fig 4.1 for Resources
Fig 4.2 for Operations
Fig 4.3 for Networks

RESOURCES	Estimate Reference. NB/2 AUDNAN DRAINAGE - STOURBRIDGE.	SIM/1

COMMAND : DES

SUB-COMMANDS : Lab.Mat.Pl.

RESOURCE	CODE	DESCRIPTION	RATE	UNIT
LABOUR	L1	GANGER.	3.00	hr.
	L2	LABOURER.	2.65	hr.
MATERIALS	M1	GRANULAR BEDDING.	9.04	M3
	M2	CONCRETE BEDDING.	19.95	M3
	M3	600 dia. CONC.PIPE.	24.90	M
	M4	1200 dia.CONC.PIPE.	104.62	M
	M5	300 dia.CONC.PIPE.	8.78	M
	M6	600 dia. A/C PIPE.	30.50	M
PLANT.	P1	JCB 808	14.75	hr.
	P2	JCB 806	12.01	hr.
	P3	2T COMPRESSOR.	1.69	hr.
	P4	3" PUMP	0.98	hr.
	P5	22 RB	11.60	hr.
	P6	3T DUMPER	1.30	hr.
	P7	BOMAG ROLLER	0.94	hr.
	P8	LASER	0.25	hr.

Fig. 4 .1 Typical 'SIM' data sheet - resources.

OPERATIONS	ESTIMATE REFERENCE NB/2	SIM/2
	SHEET 1 of 8	

COMMAND : OPS

SUB-COMMAND : DEF,LAB,MAT,PL

CODE	Ø 1		CODE	Ø 2	
DESCRIPTION	FMH2 - FMH3		DESCRIPTION	SMH2-SMH3	
STD DURATION.	1.484 WK.		STD DURATION.	1.508 WK.	
QUANTITY.	51.25M		QUANTITY.	40.0M	
RESOURCE.	CODE	REQUIRED	RESOURCE	CODE	REQUIRED.
LABOUR	L1	1 No.	LABOUR	L1	1 No.
	L2	2 No.		L2	2 No.
MATERIALS	M3	51.25M	MATERIALS.	MH	40.0M
	M2	53.81M3		M1	83.2M3
PLANT	P1	1 No.	PLANT	P1	1 No.
	P3	1 No.		P3	1 No.
	P4	1 No.		P4	1 No.
	P8	1 No.		P8	1 No.
	P6	1 No.		P6	1 No.

Fig. 4.2 Typical 'SIM' data sheet - Operations.

NETWORKS.	Estimate Reference :	SIM/
	Sheet of	

COMMAND :NET

SUB-COMMAND :DEF

TYPE (SNET/MNET)	CODE	DESCRIPTION.

SKETCH.

OP	PREDECESSORS.				OP	PREDECESSORS.			

Fig 4.3 Typical SIM Data Sheet - Networks

SECTION 6

PROJECT SIMULATION SUITE - PROGRAMME LISTINGS

6.1. Structure of 'Sim' data files

6.1.1. General Structure of data files

All the files used by 'SIM' are Basic formatted files, the total size (length) of a file is measured in records. Each record can contain 256 words of information. On the Hewlett-Packard access 2000 system which was used for development of SIM each number uses two words of storage, and each character uses one half of a word. Thus the maximum amount of data which can be stored on a record is as follows:-

1 record can contain 128 numbers, or

1 record can contain 512 characters.

In the following file descriptions a string of characters is denoted by a dollar ($) sign.

6.1.2. Master File - 'Mastrf'

File length = 20 records.

The master file contains the estimate references, and descriptions of all the current SIM projects.

Record Number	Variable	Description
1	N	The number of current projects
2	E1$(10),E0$(60)	Estimate reference and description of the first project

Record 2 repeats for each current project.

6.1.3. Resource description file - DESf

File length = 6 records.

Record No.	Variables	Description
1	L(10),B(10,2)	L contains the length of each labour description. B contains the cost/hr and the users cost unit.
2	M(20),T(20,2)	- ditto - materials data
3	P(20),A(20,2)	- ditto - plant
4	L$(20),L1$(250)	L$ is the string of labour codes L1$ is the string of labour descriptions.
5	M$(40),M1$(250)	- ditto - materials
6	P$(40),P1$(250)	- ditto - plant.

Labour cost data - Matrix B(10,2)

B(I,1) = Cost of plant type I, £/hr

B(I,2) = Unit of cost as input by the user, coded as follows.
1 hr, 2 = day, 3 = week.

Materials cost data - matrix T(20.2)

T(I,1) = Cost/unit of material type I

T(I,2) = Unit of cost, coded as follows:-
4 = M, 5 = m2, 6 = m3

Plant cost data - matrix A(20,2)

M(I,1) = Cost of plant type I, £/hr.

M(I,2) = Unit of cost as input by the user
1 = hr, 2 = day 3 = week

6.1.4. Operations data file - OPSf

File length = 111 records.

Record No's.	Variable	Description
1	Ø$(200)	Contains a maximum of 100 No. 2 character operation code
2,3,4,...9	01$(250)	Operation descriptions

OPSf file cont'd

Record No's.	Variable	Description
10	Ø(100),u(8)	Length of each operation description. Length of each description string, in each record.
11	D(4),L(5,3)M(5,3) P(10,3)	Durations, Labour, Materials and Plant requirements for 1st operation.

Record number 11 repeats for each operation.

Operations durations:- D(4)

D(1) = Operation duration (hours)

D(2) = duration units as input, 1 = hr. 2 = day 3 = week.

D(3) = Total operation quantity

D(4) = Units of quantity 4 = m, 5 = m2, 6 = m3

Resource requirements - L(5,3),M(5,3), P(10,3)

L(I,J), j=1, Labour code number, j=2 Number required, j=3 Labour cost £/hr

M(I,J), j=1 Material code number, j=2 total quantity j=3 Total material cost

P(I,J), j=1 Plant code number, j=2 Number required j=3 Plant cost £/hr

6.1.5. Network Descriptions File - 'NET f'

File length = 53 records

Record No.	Description	Variable
1	I,N$(30)	Number of networks in store. Maximum of 10 No. 3 charactrer network codes.
2	j(10)	Length of each network description
3	NO$(250)	Network descriptions
4,5,6	N(9,32)	Precedence relationship of 1st network as input by the user.
7	S(32)	Sorted list of operation code numbers
8	4$(64)	String of operation codes included in this network.

Record numbers 4,5,6,7,8 repeat for each network in store.

Precedence storage, matrix N(9,32), { I.J }

Each operation in the network is assigned to a column of the matrix,

i.e. the first row I=1, j=1 to 32 contains the code numbers of each operation, termed the object operation. The remainder of each column, I=2 to 9 contains the code numbers of the object operations immediately succeding operations.

Sorted operations list S(32)

This matrix contains the list of object operation code numbers sorted into chronological order.

The string H$ contains the operation codes corresponding to matrix S.

SIM

```
10  COM C$[70],X[6],Y[6],F1$[30]
15  REM              SIMULATION SUITE - CONTROL SEGMENT
20  REM              N. Bartram          FEB '79
30  FILES mastrf,*,*,*,*
40  DIM L[10],P[20],M[20],L$[10],M$[20],P$[20]
45  DIM B[10,2],A[20,2],T[20,2],L1$[250]
47  DIM P1$[250],M1$[250],C1$[10]
48  DIM E1$[10],E0$[60]
49  DIM D1$[60],R$[3]
60  GOSUB 2000
150  MAT X=ZER
155  MAT Y=ZER
200  PRINT
205  PRINT TAB(5);">    ";
210  LINPUT C$
215  C$=UPS$(C$)
220  N=LEN(C$)
221  IF C$[N,N] <> "," THEN 225
222  PRINT "Incorrect command input"
224  GOTO 150
225  N1=N2=0
230  N2=N2+1
235  X[N2]=N1+1
240  N1=N1+1
250  IF C$[N1,N1]="," THEN 265
255  IF N1=N THEN 275
260  GOTO 240
265  Y[N2]=N1-1
270  GOTO 230
275  Y[N2]=N
315  C1$=C$[X[1],Y[1]]
370  IF C1$="END" THEN 700
380  IF C1$="DES" THEN 520
390  IF C1$="OPS" THEN 530
395  IF C1$="NET" THEN 540
410  IF C1$="ANA" THEN 550
420  IF C1$="LIS" THEN 560
430  IF C1$="HELP" THEN 570
440  IF C1$="SIM" THEN 590
450  IF C1$="REP" THEN 600
500  PRINT "ERROR - COMMAND ";C1$;"  Not recognised"
510  GOTO 150
520  CHAIN "desc"
530  CHAIN "ops"
540  CHAIN "nets"
550  CHAIN "netal"
560  CHAIN "lstf"
570  GOSUB 4050
580  GOTO 150
590  CHAIN "simula"
600  CHAIN "repo"
700  STOP
```

```
1000  MAT B=ZER
1010  MAT A=ZER
1020  MAT T=ZER
1030  MAT L=ZER
1040  MAT P=ZER
1050  MAT M=ZER
1051  ASSIGN F1$[1,5],2,V1
1052  ASSIGN F1$[6,10],3,V1
1053  ASSIGN F1$[11,15],4,V1
1059  ASSIGN F1$[21,25],5,V1
1060  MAT  PRINT #2,1;L,B
1070  MAT  PRINT #2,2;M,T
1080  MAT  PRINT #2,3;P,A
1090  PRINT #2,4;L$,L1$
1100  PRINT #2,5;M$,M1$
1110  PRINT #2,6;P$,P1$
1120  DIM O[100],Z[8]
1130  MAT O=ZER
1140  MAT Z=ZER
1150  MAT  PRINT #3,10;O,Z
1153  DIM O$[250]
1155  O$[1,1]=","
1156  FOR I=1 TO 9
1157  PRINT #3,I;O$
1158  NEXT I
1160  I=0
1170  DIM J[31]
1180  MAT J=ZER
1190  DIM N$[35]
1192  FOR I9=1 TO 35
1193  N$[I9]="x"
1194  NEXT I9
1200  PRINT #4,1;I,N$
1205  MAT  PRINT #4,2;J
1210  I=0
1213  PRINT #5,1;I
1220  RETURN
2000  REM file handling segment
2005  DIM E$[10]
2010  PRINT TAB(25);"PROJECT SIMULATION"
2020  PRINT TAB(25);"******************"
2030  PRINT
2031  PRINT TAB(10);"DO YOU WANT THE GENERAL NOTES    ";
2032  INPUT R$
2033  R$=UPS$(R$)
2034  IF R$="NO" THEN 2040
2035  IF R$="YES" THEN 2037
2036  GOTO 2031
2037  GOSUB 4000
2040  PRINT TAB(10);"ESTIMATE REFERENCE";TAB(30);
2050  INPUT E$
2051  E$=UPS$(E$)
2060  READ #1,1;N
2070  PRINT TAB(10);"New Project";TAB(30);
```

```
2080  INPUT R$
2081  R$=UPS$(R$)
2090  IF R$="YES" THEN 2200
2091  IF R$="NO" THEN 2100
2093  GOTO 2070
2100  N1=1
2105  IF N=0 THEN 2160
2110  N1=N1+1
2120  READ #1,N1;E1$,E0$
2130  IF E$=E1$ THEN 2180
2140  IF N1=N+1 THEN 2160
2150  GOTO 2110
2160  PRINT "ERROR - This estimate referance is not in store"
2170  GOTO 2030
2180  GOSUB 3000
2190  RETURN
2200  PRINT TAB(10);"Description";TAB(30);
2210  INPUT D1$
2211  D1$=UPS$(D1$)
2215  N1=1
2220  IF N=0 THEN 2320
2240  N1=N1+1
2250  READ #1,N1;E1$,E0$
2260  IF E1$=E$ THEN 2290
2270  IF N1=N+1 THEN 2320
2280  GOTO 2240
2290  PRINT "ERROR - Duplicate Estimate referances"
2300  PRINT TAB(5);E$;" was assigned to ";E0$
2310  GOTO 2040
2320  N1=N1+1
2330  N=N+1
2340  PRINT #1,1;N
2350  GOSUB 3000
2360  PRINT #1,N1;E$,D1$
2370  CREATE V1,F1$[1,5],10
2380  CREATE V1,F1$[6,10],111
2390  CREATE V1,F1$[11,15],60
2400  CREATE V1,F1$[16,20],120
2410  CREATE V1,F1$[21,25],30
2420  CREATE V1,F1$[26,30],50
2450  GOSUB 1000
2460  RETURN
3000  REM File name generation
3100  CONVERT N1 TO X$
3120  I=LEN(X$)
3130  F1$[1,4]="desf"
3140  F1$[5,5]=X$
3150  F1$[6,9]="opsf"
3160  F1$[10,10]=X$
3180  F1$[11,14]="netf"
3190  F1$[15,15]=X$
3200  F1$[16,19]="ansf"
3210  F1$[20,20]=X$
3220  F1$[21,24]="DISF"
```

```
3225  F1$[25,25]=X$
3230  F1$[26,29]="simf"
3235  F1$[30,30]=X$
3250  RETURN
4000  REM   general notes
4010  PRINT TAB(5);"'SIM' is a command driven suite of progran
4020  PRINT TAB(10);"analysis and simulation. You control the
4030  PRINT TAB(10);"programmes by issuing commands. There are
4040  PRINT TAB(10);"available to enable you to do the followi
4050  PRINT TAB(5);"DES - Describe basic resources lab, mat ar
4060  PRINT TAB(5);"OPS - To combine these resources into oper
4070  PRINT TAB(5);"NET - To combine these operations into net
4080  PRINT TAB(5);"ANA - Analyse a network."
4090  PRINT TAB(5);"LIS - List the descriptions which have bee
4200  PRINT TAB(5);"'SIM' commands are prompted by a '>' in th
4210  PRINT TAB(10);"if you want the command list at any time
4220  RETURN
5000  END
```

OPS

```
10   COM C$[70],X[6],Y[6],F1$[30]
20   REM              SIMULATION SUITE - OPERATIONS INPUT
25   REM              N. Bartram             Feb '79
30   FILES *,*
35   ASSIGN F1$[6,10],1,V1
36   IF V1=3 THEN 240
40   ASSIGN F1$[1,5],2,V1
45   IF V1=3 THEN 240
50   DIM O[100],O1$[250],D[4],L[5,3],M[5,3],P[10,3],G[20]
60   DIM O$[200],R$[10],R1$[250],R[10,2],M$[40],Z[20,2]
65   DIM X$[4],C1$[20],C0$[20]
66   DIM U[8],K[10]
69   X$="DLMP"
70   IF X[2]=0 THEN 85
72   C1$=C$[X[2],Y[2]]
77   GOTO 100
85   PRINT TAB(10);"Sub-command (des/lab/mat/pl)    ";
90   INPUT C1$
95   C1$=UPS$(C1$)
100  N=POS(X$,C1$[1,1])
110  IF N>0 THEN 140
120  PRINT "ERROR - Sub command ";C1$;" not recognised"
130  GOTO 85
140  GOSUB N OF 1000,2000,3000,4000
220  CHAIN V1,"sim",150
230  STOP
240  PRINT TAB(5);"** FILE ERROR DETECTED - ATTEMPTING TO CORR
245  CHAIN V1,"sim",530
1000  REM   operations descriptions
1010  IF X[3]=0 THEN 1020
1015  C1$=C$[X[3],Y[3]]
1018  GOTO 1060
1020  PRINT TAB(10);"Operation Code";TAB(25);
1030  INPUT C1$
1031  C1$=UPS$(C1$)
1035  IF  END #1 THEN 1700
1060  MAT  READ #1,10;O,U
1066  READ #1,1;O$
1067  N=POS(O$,C1$)
1070  IF N=0 THEN 1230
1080  N=(N+1)/2
1090  N2=0
1100  FOR J=1 TO N
1110  N2=N2+O[J]
1120  NEXT J
1130  J=0
1140  J=J+1
1150  IF N2 <= U[J] THEN 1180
1160  N2=N2-U[J]
1170  GOTO 1140
1180  J=J+1
1185  READ #1,J;O1$
```

```
1190  N1=N2-O[N]+1
1210  PRINT "ERROR - ";C1$;" was assigned to operation · ";O1$
1220  RETURN
1230  J=0
1240  J=J+1
1250  IF O[J]>0 THEN 1240
1260  N=J
1270  J=LEN(O$)
1275  IF J>1 THEN 1280
1277  J=0
1280  O$[J+1,J+2]=C1$
1290  IF X[4]=0 THEN 1300
1295  C1$=C$[X[4],Y[4]]
1297  GOTO 1320
1300  PRINT TAB(10);"Description";TAB(30);
1310  INPUT C1$
1311  C1$=UPS$(C1$)
1320  GOSUB 1600
1330  PRINT #1,1;O$
1340  MAT  PRINT #1,10;O,U
1345  IF X[5]=0 THEN 1370
1350  CONVERT C$[X[5],Y[5]] TO X,1370
1360  GOTO 1390
1370  PRINT TAB(10);"Duration";TAB(30);
1380  INPUT X
1390  D[1]=X
1395  IF X[6]=0 THEN 1410
1400  C1$=C$[X[6],Y[6]]
1405  GOTO 1430
1410  PRINT TAB(10);"Units";TAB(30);
1420  INPUT C1$
1421  C1$=UPS$(C1$)
1430  IF C1$="HR" THEN 1480
1440  IF C1$="DAY" THEN 1500
1450  IF C1$="WK" THEN 1520
1460  PRINT "ERROR - Time units required for durations"
1470  GOTO 1410
1480  D[2]=1
1490  GOTO 1530
1500  D[2]=2
1505  D[1]=D[1]*9.25
1510  GOTO 1530
1520  D[2]=3
1525  D[1]=D[1]*9.25*5
1530  MAT L=ZER
1540  MAT M=ZER
1550  MAT P=ZER
1551  N9=N+10
1560  PRINT TAB(10);"Total,activity Quantity";TAB(30);
1562  INPUT D[3]
1564  PRINT TAB(10);"Units";TAB(30);
1566  INPUT R$
1568  R$=UPS$(R$)
1570  IF R$="M" THEN 1580
```

```
1572  IF R$="M2" THEN 1584
1574  IF R$="M3" THEN 1588
1576  PRINT TAB(5);"** ERROR - UNITS NOT RECOGNISED **"
1578  GOTO 1564
1580  D[4]=1
1582  GOTO 1590
1584  D[4]=2
1586  GOTO 1590
1588  D[4]=3
1590  MAT  PRINT #1,N9;D,L,M,P
1595  RETURN
1600  O[N]=LEN(C1$)
1610  J=0
1620  J=J+1
1630  IF U[J]>230 THEN 1620
1635  J1=J+1
1640  READ #1,J1;O1$
1650  O1$[U[J]+1,U[J]+O[N]]=C1$
1660  U[J]=LEN(O1$)
1670  PRINT #1,J1;O1$
1680  RETURN
1700  PRINT "ERROR - No data in file opsf"
1710  RETURN
2000  REM     labour
2005  IF X[3]=0 THEN 2020
2010  C1$=C$[X[3],Y[3]]
2015  GOTO 2040
2020  PRINT TAB(10);"Operation Code";TAB(30);
2030  INPUT C1$
2035  C1$=UPS$(C1$)
2040  READ #1,1;O$
2050  N=POS(O$,C1$)
2060  IF N>0 THEN 2090
2070  PRINT "ERROR - No such operation as ";C1$
2080  RETURN
2090  N=(N+1)/2
2095  IF X[4]=0 THEN 2200
2100  C1$=C$[X[4],Y[4]]
2105  GOTO 2220
2200  PRINT TAB(10);"labour Code";TAB(30);
2210  INPUT C1$
2215  C1$=UPS$(C1$)
2220  READ #2,4;R$,R1$
2230  I=POS(R$,C1$)
2240  IF I>0 THEN 2270
2250  PRINT "ERROR - No such labour as ";C1$
2260  RETURN
2270  I=(I+1)/2
2280  MAT  READ #1,N+10;D,L,M,P
2290  J=0
2300  J=J+1
2310  IF J<6 THEN 2340
2320  PRINT "ERROR - Only 5 Labour types allowed per Operation
2330  RETURN
```

```
2340  IF L[J,1]>0 THEN 2300
2350  L[J,1]=I
2360  MAT  READ #2,1;K,R
2370  IF X[5]=0 THEN 2390
2375  CONVERT C$[X[5],Y[5]] TO X1,2390
2380  GOTO 2410
2390  PRINT TAB(10);"Number Required";TAB(25);
2400  INPUT X1
2410  L[J,2]=X1
2420  R1=R[I,1]
2480  L[J,3]=X1*R1
2490  MAT  PRINT #1,N+10;D,L,M,P
2500  RETURN
3000  REM materials
3005  IF X[3]=0 THEN 3020
3010  C1$=C$[X[3],Y[3]]
3015  GOTO 3040
3020  PRINT TAB(10);"Operation code";TAB(30);
3030  INPUT C1$
3031  C1$=UPS$(C1$)
3040  READ #1,1;O$
3050  N=POS(O$,C1$)
3060  IF N>0 THEN 3090
3070  PRINT "ERROR - No such operation as ";C1$
3080  RETURN
3090  N=(N+1)/2
3100  IF X[4]=0 THEN 3110
3105  C1$=C$[X[4],Y[4]]
3108  GOTO 3130
3110  PRINT TAB(10);"Material code";TAB(30);
3120  INPUT C1$
3121  C1$=UPS$(C1$)
3130  READ #2,5;M$,R1$
3140  I=POS(M$,C1$)
3150  IF I>0 THEN 3180
3160  PRINT "ERROR - No such Material as ";C1$
3170  RETURN
3180  I=(I+1)/2
3185  N9=N+10
3190  MAT  READ #1,N9;D,L,M,P
3200  J=0
3210  J=J+1
3220  IF J<6 THEN 3250
3230  PRINT "The limit on the number of material types for thi
3240  RETURN
3250  IF M[J,1]>0 THEN 3210
3260  M[J,1]=I
3270  MAT  READ #2,2;G,Z
3275  IF X[5]=0 THEN 3300
3280  C1$=C$[X[5],Y[5]]
3285  CONVERT C1$ TO X1,3300
3290  GOTO 3320
3300  PRINT TAB(10);"Total Quantity";TAB(30);
3310  INPUT X1
```

```
3320  M[J,2]=X1
3330  R1=Z[I,1]
3340  U1=Z[I,2]
3345  IF X[6]=0 THEN 3370
3346  C1$=C$[X[6],Y[6]]
3350  GOTO 3382
3360  GOTO 3400
3370  PRINT TAB(10);"Units";TAB(30);
3380  INPUT C1$
3381  C1$=UPS$(C1$)
3382  X2=4
3383  IF C1$="M" THEN 3400
3384  IF C1$="M2" THEN 3395
3385  IF C1$="M3" THEN 3390
3390  X2=X2+1
3395  X2=X2+1
3400  IF U1=X2 THEN 3500
3410  PRINT "** ERROR  -  THESE UNITS ARE NOT THE SAME AS THOS
3490  RETURN
3500  M[J,3]=X1*R1
3505  N9=N+10
3510  MAT  PRINT #1,N9;D,L,M,P
3520  RETURN
4000  REM plant
4005  IF X[3]=0 THEN 4020
4010  C1$=C$[X[3],Y[3]]
4015  GOTO 4040
4020  PRINT TAB(10);"Operation Code";TAB(30);
4030  INPUT C1$
4031  C1$=UPS$(C1$)
4040  READ #1,1;O$
4050  N=POS(O$,C1$)
4060  IF N>0 THEN 4090
4070  PRINT "ERROR - No such Operation as ";C1$
4080  RETURN
4090  N=(N+1)/2
4095  IF X[4]=0 THEN 4110
4100  C1$=C$[X[4],Y[4]]
4105  GOTO 4130
4110  PRINT TAB(10);"plant code";TAB(30);
4120  INPUT C1$
4121  C1$=UPS$(C1$)
4130  READ #2,6;M$,R1$
4140  I=POS(M$,C1$)
4150  IF I>0 THEN 4180
4160  PRINT "ERROR - No such plant as ";C1$
4170  RETURN
4180  I=(I+1)/2
4185  N9=N+10
4190  MAT  READ #1,N9;D,L,M,P
4200  J=0
4210  J=J+1
4220  IF J=11 THEN 4250
4230  IF P[J,1]>0 THEN 4210
```

```
4240  GOTO 4270
4250  PRINT "The limit on the number of plant types for this o
4260  RETURN
4270  P[J,1]=I
4280  MAT  READ #2,3;G,Z
4285  IF X[5]=0 THEN 4310
4290  CONVERT C$[X[5],Y[5]] TO X1,4310
4300  GOTO 4330
4310  PRINT TAB(10);"Number Required";TAB(30);
4320  INPUT X1
4330  P[J,2]=X1
4340  R1=Z[I,1]
4400  P[J,3]=X1*R1
4410  MAT  PRINT #1,N9;D,L,M,P
4420  RETURN
6000  END
```

DESC

```
10  COM C$[70],X[6],Y[6],F1$[30]
15  REM            SIMULATION SUITE - DESCRIPTION INPUT SEGMENT
20  REM            N. Bartram        FEB '79
30  FILES *
33  ASSIGN F1$[1,5],1,V1
34  IF V1=3 THEN 450
35  DIM L[10],P[20],M[20],L$[10],M$[40],P$[40]
40  DIM B[10,2],A[20,2],T[20,2],L1$[250],P1$[250],M1$[250]
45  DIM C1$[20],Y$[10]
46  IF X[2]=0 THEN 110
47  Y$="          "
49  C1$=C$[X[2],Y[2]]
50  IF C1$=Y$ THEN 110
60  IF C1$="LAB" THEN 140
70  IF C1$="PL" THEN 200
80  IF C1$="MAT" THEN 260
100  PRINT "ERROR - sub command ";C1$;" Not recognised"
110  PRINT TAB(5);"S/Command (lab/mat/pl)";TAB(20);
120  INPUT C1$
125  C1$=UPS$(C1$)
130  GOTO 60
140  MAT  READ #1,1;L,B
150  READ #1,4;L$,L1$
160  GOSUB 1000
170  MAT  PRINT #1,1;L,B
180  PRINT #1,4;L$,L1$
190  GOTO 310
200  MAT  READ #1,3;P,A
210  READ #1,6;P$,P1$
220  GOSUB 2000
230  MAT  PRINT #1,3;P,A
240  PRINT #1,6;P$,P1$
250  GOTO 310
260  MAT  READ #1,2;M,T
270  READ #1,5;M$,M1$
280  GOSUB 3000
290  MAT  PRINT #1,2;M,T
300  PRINT #1,5;M$,M1$
310  CHAIN V1,"sim",150
440  STOP
450  PRINT TAB(5);"** FILE ERROR DETECTED - ATTEMPTING TO CORR
460  CHAIN V1,"SIM",380
1000  REM labour descriptions input
1010  IF X[3]>0 THEN 1037
1020  PRINT TAB(10);"Labour Code";TAB(30);
1030  INPUT C1$
1031  C1$=UPS$(C1$)
1035  GOTO 1040
1037  C1$=C$[X[3],Y[3]]
1040  N=POS(L$,C1$)
1050  IF N=0 THEN 1140
1060  N=(N+1)/2
```

```
1070  N1=0
1080  FOR I=1 TO N-1
1090  N1=N1+L[I]
1100  NEXT I
1110  PRINT "ERROR - labour code ";C1$;" was assigned to ";L1$[N1+
1130  GOTO 1020
1140  N=LEN(L$)                                                  ,N1+1+L[N]]
1150  N=N+1
1160  L$[N,N+1]=C1$
1170  N=(N+1)/2
1180  IF X[4]>0 THEN 1208
1190  PRINT TAB(10);"Dscription";TAB(30);
1200  INPUT C1$
1201  C1$=UPS$(C1$)
1205  GOTO 1210
1208  C1$=C$[X[4],Y[4]]
1210  N1=LEN(C1$)
1220  N2=LEN(L1$)
1225  IF N2>0 THEN 1230
1226  N2=1
1230  L1$[N2,N2+N1]=C1$
1240  L[N]=N1
1250  IF X[5]=0 THEN 1270
1255  CONVERT C$[X[5],Y[5]] TO X,1270
1260  GOTO 1290
1270  PRINT TAB(10);"Rate ";TAB(25);
1280  INPUT X
1290  B[N,1]=X
1300  IF X[6]>0 THEN 1328
1310  PRINT TAB(10);"Units";TAB(25);
1320  INPUT C1$
1321  C1$=UPS$(C1$)
1325  GOTO 1330
1328  C1$=C$[X[6],Y[6]]
1330  IF C1$="HR" THEN 1380
1340  IF C1$="DAY" THEN 1400
1350  IF C1$="WK" THEN 1420
1360  PRINT "ERROR - time units required for labour"
1370  GOTO 1310
1380  B[N,2]=1
1390  RETURN
1400  B[N,2]=2
1405  B[N,1]=B[N,1]/9.25
1410  RETURN
1420  B[N,2]=3
1425  B[N,1]=B[N,1]/(9.25*5)
1430  RETURN
2000  REM Plant descriptions
2010  IF X[3]>0 THEN 2035
2020  PRINT TAB(10);"Plant code";TAB(25);
2030  INPUT C1$
2031  C1$=UPS$(C1$)
2032  GOTO 2040
2035  C1$=C$[X[3],Y[3]]
```

```
2040  N=POS(P$,C1$)
2050  IF N=0 THEN 2140
2060  N=(N+1)/2
2070  N1=0
2080  FOR I=1 TO N-1
2090  N1=N1+P[I]
2100  NEXT I
2110  PRINT "ERROR - Plant code ";C1$;" was assigned to ";P1$[N1+
                                                  N1+1+P[N]]
2130  GOTO 2020
2140  N=LEN(P$)
2150  N=N+1
2160  P$[N,N+1]=C1$
2170  N=(N+1)/2
2180  IF X[4]>0 THEN 2208
2190  PRINT TAB(10);"Description";TAB(25);
2200  INPUT C1$
2201  C1$=UPS$(C1$)
2205  GOTO 2210
2208  C1$=C$[X[4],Y[4]]
2210  N1=LEN(C1$)
2220  N2=LEN(P1$)
2225  IF N2>0 THEN 2230
2226  N2=1
2230  P1$[N2,N2+N1]=C1$
2240  P[N]=N1
2250  IF X[5]=0 THEN 2270
2255  CONVERT C$[X[5],Y[5]] TO X,2270
2260  GOTO 2290
2270  PRINT TAB(10);"Rate";TAB(25);
2280  INPUT X
2290  A[N,1]=X
2300  IF X[6]>0 THEN 2325
2310  PRINT TAB(10);"Units";TAB(25);
2320  INPUT C1$
2321  C1$=UPS$(C1$)
2322  GOTO 2330
2325  C1$=C$[X[6],Y[6]]
2330  IF C1$="HR" THEN 2380
2340  IF C1$="DAY" THEN 2400
2350  IF C1$="WK" THEN 2420
2360  PRINT "ERROR - Time uniits required for plant"
2370  GOTO 2310
2380  A[N,2]=1
2390  RETURN
2400  A[N,2]=2
2405  A[N,1]=A[N,1]/9.25
2410  RETURN
2420  A[N,2]=3
2425  A[N,1]=A[N,1]/(9.25*5)
2430  RETURN
3000  REM materials
3005  IF X[3]=0 THEN 3020
3010  C1$=C$[X[3],Y[3]]
3015  GOTO 3040
```

```
3020  PRINT TAB(10);"Material Code";TAB(25);
3030  INPUT C1$
3031  C1$=UPS$(C1$)
3040  N=POS(M$,C1$)
3050  IF N=0 THEN 3140
3060  N=(N+1)/2
3070  N1=0
3080  FOR I=1 TO N-1
3090  N1=N1+M[I]
3100  NEXT I
3110  PRINT "ERROR - Material code ";C1$;" was assigned to ";M1$[
                                                   +1,N1+1+M[N]]
3120  GOTO 3020
3140  N=LEN(M$)
3150  N=N+1
3160  M$[N,N+1]=C1$
3170  N=(N+1)/2
3175  IF X[4]=0 THEN 3190
3180  C1$=C$[X[4],Y[4]]
3185  GOTO 3210
3190  PRINT TAB(10);"Description";TAB(25);
3200  INPUT C1$
3201  C1$=UPS$(C1$)
3210  N1=LEN(C1$)
3220  N2=LEN(M1$)
3222  IF N2>0 THEN 3230
3225  N2=1
3230  M1$[N2,N2+N1]=C1$
3240  M[N]=N1
3245  IF X[5]=0 THEN 3270
3250  CONVERT C$[X[5],Y[5]] TO X,3270
3260  GOTO 3290
3270  PRINT TAB(10);"Rate";TAB(25);
3280  INPUT X
3290  T[N,1]=X
3295  IF X[6]=0 THEN 3310
3300  C1$=C$[X[6],Y[6]]
3305  GOTO 3330
3310  PRINT TAB(10);"Units";TAB(25);
3320  INPUT C1$
3321  C1$=UPS$(C1$)
3330  IF C1$="M" THEN 3380
3340  IF C1$="M2" THEN 3400
3350  IF C1$="M3" THEN 3420
3360  PRINT "ERROR - m, m2 or m3 units required for materials"
3370  GOTO 3310
3380  T[N,2]=4
3390  RETURN
3400  T[N,2]=5
3410  RETURN
3420  T[N,2]=6
3430  RETURN
6000  END
```

NETS

```
10   COM C$[70],X[6],Y[6],F$[30]
15   REM                            SIMULATION SUITE - NETWORK INPUT &
20   REM                            N. Bartram          FEB '79
30   FILES *,*,*,*,*,*
40   ASSIGN F$[1,5],1,V1
50   ASSIGN F$[6,10],2,V1
60   ASSIGN F$[11,15],3,V1
65   ASSIGN F$[16,20],4,V1
70   DIM N[9,32],N$[35],J[31],X$[4],NO$[250],N1$[3]
75   DIM C1$[15],O$[200],R$[3],F1$[2],A$[5],S[32]
90   X$="DE"
100  IF X[2]>0 THEN 140
110  PRINT TAB(10);"Sub-Command (def/edit)      ";
120  INPUT C1$
125  C1$=UPS$(C1$)
130  GOTO 150
140  C1$=C$[X[2],Y[2]]
150  X1=POS(X$,C1$[1,1])
160  IF X1=0 THEN 190
170  GOSUB X1 OF 500,2000
180  CHAIN V1,"sim",150
190  PRINT TAB(5);"** ERROR - SUB-COMMAND ";C1$;" NOT RECOGNISED
200  GOTO 110
210  STOP
490  REM   DEF-----------------------------------------------------------
500  GOSUB 9000
501  IF I=0 THEN 605
505  READ #3,3;NO$
510  IF A=0 THEN 610
520  T1=1
525  I1=(A+2)/3
530  FOR J1=1 TO I1
540  T1=T1+J[J1]
550  NEXT J1
560  T2=T1-J[I1]
561  T1=T1-1
580  PRINT TAB(5);"** ERROR - NETWORK CODE ";C1$;" WAS ASSIGNED T
585  PRINT "**"                                          ";NO$[T2,T1
590  GOSUB 9620
600  GOTO 510
605  N$=N1$
606  I=1
607  GOTO 650
610  J1=LEN(N$)+1
620  J2=J1+2
630  I=I+1
640  N$[J1,J2]=N1$
650  IF X[5]>0 THEN 700
670  PRINT TAB(10);"Description       ";
680  INPUT C1$
685  C1$=UPS$(C1$)
690  GOTO 710
```

```
700   C1$=C$[X[5],Y[5]]
710   J2=0
720   FOR J1=1 TO (I-1)
730   J2=J2+J[J1]
740   NEXT J1
750   J[I]=LEN(C1$)
760   NO$[J2+1,J2+1+J[I]]=C1$
770   PRINT #3,1;I,N$
780   MAT  PRINT #3,2;J
790   PRINT #3,3;NO$
800   GOSUB 1000
806   A1=(15*(I-1))+1
810   A=(4*I)+(I-1)
820   GOSUB 4300
830   GOSUB 3500
840   A=A+3
850   MAT  PRINT #3,A;S
860   A=A+1
870   PRINT #3,A;H$
875   C1=C2=C3=0
877   PRINT #4,A1;C1,C2,C3
880   RETURN
1000  REM   PRECEDENCE INPUT ************************************
1005  MAT N=ZER
1010  READ #2,1;O$
1015  READ #3,1;I,N$
1020  N1=0
1030  PRINT TAB(10);"NETWORK INPUT"
1040  PRINT TAB(10);"*************"
1050  PRINT TAB(15);"Need Help         ";
1060  INPUT N1$
1065  N1$=UPS$(N1$)
1070  IF N1$="NO" THEN 1090
1080  IF N1$="YES" THEN 1088
1085  GOTO 1050
1088  GOSUB 8500
1090  N1=N1+1
1100  PRINT TAB(5);"*";
1120  LINPUT C$
1121  C$=UPS$(C$)
1130  GOSUB 8600
1135  IF X[1]=0 THEN 1100
1140  IF C$[X[1],Y[1]]="END" THEN 1330
1141  IF X1=2 THEN 1150
1143  I1=POS(N$,C$[X[1],Y[1]])
1145  IF I1=0 THEN 1192
1147  I1=(I1+1)/3
1149  GOTO 1210
1150  I1=POS(O$,C$[X[1],Y[1]])
1160  IF I1>0 THEN 1200
1170  J1=1
1180  PRINT TAB(5);"** ERROR - NO SUCH OPERATION AS ";C$[X[J1],Y[
1190  RETURN                                                      .]]; " **
1192  J1=1
```

```
1194  PRINT TAB(5);"** ERROR - NO SUCH NETWORK AS ";C$[X[J1],Y[J1
1196  RETURN
1200  I1=(I1+1)/2
1210  N[1,N1]=I1
1220  J1=0
1230  J1=J1+1
1240  IF X[J1]=0 THEN 1090
1250  IF C$[X[J1],Y[J1]]="START" THEN 1300
1251  IF X1=2 THEN 1260
1253  I2=POS(N$,C$[X[J1],Y[J1]])
1255  IF I2=0 THEN 1194
1257  I2=(I2+1)/3
1259  GOTO 1310
1260  I2=POS(O$,C$[X[J1],Y[J1]])
1270  IF I2=0 THEN 1180
1280  I2=(I2+1)/2
1290  GOTO 1310
1300  I2=101
1310  N[J1,N1]=I2
1320  GOTO 1230
1330  PRINT
1340  N2=N1
1345  N[1,N2]=102
1350  PRINT TAB(5);"INPUT SUMMARY"
1360  FOR J1=1 TO N2
1385  PRINT
1390  I1=0
1400  I1=I1+1
1410  P=N[I1,J1]
1415  IF P=0 THEN 1580
1416  IF X1=2 THEN 1420
1417  PRINT TAB(5);N$[3*P-1,3*P];
1418  GOTO 1430
1420  PRINT TAB(5);O$[2*P-1,2*P];
1430  I1=I1+1
1440  P=N[I1,J1]
1450  IF P=0 THEN 1580
1455  IF P=101 THEN 1560
1456  IF X1=2 THEN 1460
1457  PRINT ",";N$[3*P-1,3*P];
1459  GOTO 1580
1460  PRINT ",";O$[2*P-1,2*P];
1470  GOTO 1430
1560  PRINT ",";"START";
1570  GOTO 1430
1580  NEXT J1
1590  RETURN
2000  REM editor^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
2002  PRINT TAB(5);"Do you want a print of the network before yo
2003  INPUT R$
2004  R$=UPS$(R$)
2005  IF R$="NO" THEN 2020
2006  IF R$="YES" THEN 2010
2007  GOTO 2002
```

```
2010  PRINT TAB(5);"Issue the LIS,NETS Instruction"
2015  RETURN
2020  GOSUB 9500
2030  IF A>0 THEN 2060
2040  PRINT TAB(5);"** ERROR - NO SUCH NETWORK **"
2050  RETURN
2060  A=(A+2)/3
2064  A2=A
2065  A=(4*A)+(A-1)
2070  GOSUB 4500
2080  PRINT TAB(10);"EDITOR IS READY"
2085  READ #2,1;O$
2090  PRINT TAB(15);"Need Help    ";
2100  INPUT R$
2101  R$=UPS$(R$)
2110  IF R$="YES" THEN 2140
2120  IF R$="NO" THEN 2150
2130  GOTO 2090
2140  GOSUB 8000
2150  PRINT TAB(5);"*";
2160  LINPUT C$
2165  C$=UPS$(C$)
2170  GOSUB 8600
2180  IF C$[X[1],Y[1]]="ADD" THEN 2230
2190  IF C$[X[1],Y[1]]="DEL" THEN 2250
2200  IF C$[X[1],Y[1]]="END" THEN 2355
2205  I=1
2210  PRINT TAB(5);"ERROR - EDIT COMMAND ";C$[X[I],Y[I]];" NOT RE
                                                          COGNISED **
2220  GOTO 2090
2230  B=1
2240  GOTO 2260
2250  B=2
2260  IF C$[X[2],Y[2]]="NODE" THEN 2300
2270  IF C$[X[2],Y[2]]="ARROW" THEN 2320
2280  I=2
2290  GOTO 2210
2300  D=3
2310  GOTO 2330
2320  D=5
2330  C=B+D-3
2340  GOSUB C OF 2400,2700,3000,3000
2350  GOTO 2150
2355  A1=(15*(A2-1))+1
2360  GOSUB 3500
2365  GOSUB 5000
2370  GOSUB 4300
2372  GOSUB 6000
2375  C1=C2=C3=0
2377  PRINT #4,A1;C1,C2,C3
2380  A=A+3
2390  MAT  PRINT #3,A;S
2392  A=A+1
2394  PRINT #3,A;H$
2396  RETURN
```

```
2400  REM          ADDING NODE     ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
2410  GOSUB 7000
2412  MAT  PRINT P
2414  MAT  PRINT S
2420  FOR I=1 TO 32
2430  IF N[1,I]=102 THEN 2450
2440  NEXT I
2450  N[1,I]=Z
2455  N[1,I+1]=102
2460  J1=0
2470  J1=J1+1
2480  IF P[J1]=0 THEN 2510
2490  N[J1+1,I]=P[J1]
2500  GOTO 2470
2510  J1=0
2520  J1=J1+1
2530  IF S[J1]=0 THEN 2620
2540  FOR I=1 TO 32
2550  IF N[1,I]=S[J1] THEN 2570
2560  NEXT I
2570  FOR J=2 TO 9
2580  IF N[J,I]=0 THEN 2600
2590  NEXT J
2600  N[J,I]=Z
2610  GOTO 2520
2620  RETURN
2690  J1=N[1,J]
2700  REM            DELETE NODE        ?????????????????????????
2710  GOSUB 7000
2720  FOR I=1 TO 32
2730  IF N[1,I]=Z THEN 2770
2740  NEXT I
2750  PRINT TAB(5);"** ERROR - OPERATION ";O$[2*Z-1,2*Z];" NOT IN
2760  GOTO 2150                                   IETWORK **
2770  FOR J=1 TO 9
2780  N[J,I]=0
2790  NEXT J
2800  J1=0
2810  J1=J1+1
2820  IF S[J1]=0 THEN 2910
2830  FOR I=1 TO 32
2840  IF N[1,I]=S[J1] THEN 2860
2850  NEXT I
2860  FOR J=2 TO 9
2870  IF N[J,I] <> Z THEN 2890
2880  N[J,I]=0
2890  NEXT J
2900  GOTO 2810
2910  RETURN
3000  REM          ADD & DEL ARROW     ///////////////////////////////
3010  READ #2,1;O$
3020  PRINT TAB(10);"START NODE";TAB(25);
3030  INPUT A$
3031  A$=UPS$(A$)
```

```
3040  I=POS(O$,A$)
3050  IF I>0 THEN 3080
3060  PRINT TAB(5);"** ERROR - NO SUCH OPERATION AS ";A$;" **"
3070  RETURN
3080  Z=(I+1)/2
3090  PRINT TAB(10);"FINISH NODE";TAB(25);
3100  INPUT A$
3101  A$=UPS$(A$)
3110  I=POS(O$,A$)
3120  IF I=0 THEN 3060
3130  Y=(I+1)/2
3140  FOR J=1 TO 32
3150  IF N[1,J]=Y THEN 3200
3160  NEXT J
3170  A$=O$[2*Y-1,2*Y]
3180  PRINT TAB(5);"** ERROR - OPERATION ";A$;" IS NOT IN THE NETW
3190  RETURN
3200  IF C=3 THEN 3280
3210  FOR I=2 TO 9
3220  IF N[I,J]=Z THEN 3260
3230  NEXT I
3240  A$=O$[2*Z-1,2*Z]
3250  GOTO 3180
3260  N[I,J]=0
3270  RETURN
3280  FOR I=2 TO 9
3290  IF N[I,J]=0 THEN 3310
3300  NEXT I
3310  N[I,J]=Z
3320  RETURN
3500  REM     SORTING "N"      /?????????????????????????????/
3510  DIM H$[64],M[50,12]
3511  H$=""
3515  MAT M=ZER
3520  H$[1,2]="SS"
3530  I=1
3540  FOR J=1 TO 32
3550  IF N[1,J]=0 OR N[1,J]=101 THEN 3590
3555  IF N[1,J]=102 THEN 3590
3560  I=I+1
3570  J1=(2*N[1,J])-1
3580  H$[2*I-1,2*I]=O$[J1,J1+1]
3590  NEXT J
3600  I=LEN(H$)
3610  H$[I+1,I+2]="FF"
3620  MAT S=ZER[32]
3630  FOR J=1 TO 32
3640  S[J]=J
3650  NEXT J
3660  I1=0
3670  FOR J=1 TO 32
3680  IF N[1,J]=0 THEN 3790
3690  J1=N[1,J]
3700  I=1
```

```
3710  I=I+1
3720  IF I=10 THEN 3790
3730  IF N[I,J]=0 THEN 3710
3740  I1=I1+1
3750  M[I1,1]=J1
3760  M[I1,2]=N[I,J]
3780  GOTO 3710
3790  NEXT J
3800  K=2
3810  K=K+1
3820  I=0
3830  I=I+1
3840  P=M[I,1]
3841  IF P<101 THEN 3850
3842  F1$="SS"
3843  GOTO 3870
3850  P=2*P-1
3860  F1$=O$[P,P+1]
3870  J=POS(H$,F1$)
3880  P=M[I,2]
3881  IF P<101 THEN 3890
3882  F1$="SS"
3883  GOTO 3910
3890  P=P*2-1
3900  F1$=O$[P,P+1]
3910  J1=POS(H$,F1$)
3920  J=(J+1)/2
3930  J1=(J1+1)/2
3940  IF S[J]>S[J1] THEN 3990
3950  P=S[J]
3960  S[J]=S[J1]
3970  S[J1]=P
3980  M[I,K]=1
3990  IF I=I1 THEN 4010
4000  GOTO 3830
4010  T=0
4020  FOR J=1 TO I1
4030  T=T+M[J,K]
4040  NEXT J
4050  IF T=0 THEN 4080
4060  IF K=12 THEN 4100
4070  GOTO 3810
4080  PRINT TAB(5);"** NETWORK LOGIC CHECK - NO LOOPS FOUND **"
4090  RETURN
4100  PRINT TAB(5);"** NETWORK LOGIC CHECK - LOOP DETECTED **"
4105  FOR J=1 TO I1
4120  IF M[J,K]=0 THEN 4190
4130  F1$=O$[2*M[J,2]-1,2*M[J,2]]
4140  PRINT TAB(15);"[";F1$;"] --> [";
4150  F1$=O$[2*M[J,1]-1,2*M[J,1]]
4160  PRINT F1$;"]"
4190  NEXT J
4200  RETURN
4300  REM          PRINTING "N" to FILE
```

```
4310  PRINT #3,A;A
4320  FOR I=1 TO 9
4330  FOR J=1 TO 32
4340  PRINT #3;N[I,J]
4350  NEXT J
4360  NEXT I
4370  RETURN
4500  REM          READING N FROM FILE
4510  READ #3,A;A
4520  FOR I=1 TO 9
4540  FOR J=1 TO 32
4550  READ #3;N[I,J]
4560  NEXT J
4570  NEXT I
4580  RETURN
5000  REM sorting n
5005  N2=(LEN(H$)/2)-1
5010  J=K=0
5020  J=J+1
5030  IF N[1,J]>0 THEN 5090
5035  K=K+1
5040  FOR I=1 TO 9
5050  N[I,J]=N[I,J+1]
5060  N[I,J+1]=0
5070  NEXT I
5090  IF J<N2 THEN 5020
5095  IF K>0 THEN 5010
5100  RETURN
6000  REM additional sorting of 'n'
6010  N2=LEN(H$)/2
6020  J=0
6030  J=J+1
6040  IF T[1,J]>0 THEN 6100
6050  FOR I=1 TO 9
6060  T[I,J]=T[I,J+1]
6070  T[I,J+1]=0
6080  NEXT I
6090  GOTO 6020
6100  IF J<N2 THEN 6030
6110  RETURN
7000  REM :::::::::::::::::::::::::::::::::::::::::::::::::::
7006  MAT P=ZER[6]
7007  MAT S=ZER[6]
7010  PRINT TAB(10);"OPERATION CODE";TAB(30);
7020  INPUT A$
7021  A$=UPS$(A$)
7030  Z=POS(O$,A$)
7035  Z=(Z+1)/2
7040  IF Z>0 THEN 7070
7050  PRINT TAB(5);"** ERROR - NO SUCH OPERATION AS ";A$;" **"
7060  GOTO 2150
7070  PRINT TAB(10);"PREDECESSORS";TAB(30);
7080  INPUT C$
7081  C$=UPS$(C$)
```

```
7090  GOSUB 8600
7100  J1=0
7110  J1=J1+1
7120  IF X[J1]=0 THEN 7170
7125  IF C$[X[J1],Y[J1]]="END" THEN 7161
7126  IF C$[X[J1],Y[J1]]="START" THEN 7165
7130  P[J1]=POS(O$,C$[X[J1],Y[J1]])
7135  P[J1]=(P[J1]+1)/2
7140  IF P[J1]>0 THEN 7110
7150  A$=C$[X[J1],Y[J1]]
7160  GOTO 7050
7161  P[J1]=102
7162  GOTO 7110
7165  P[J1]=101
7166  GOTO 7110
7170  PRINT TAB(10);"SUCCESSORS";TAB(30);
7180  INPUT C$
7185  C$=UPS$(C$)
7190  GOSUB 8600
7200  J1=0
7210  J1=J1+1
7220  IF X[J1]=0 THEN 7270
7221  IF C$[X[J1],Y[J1]]="END" THEN 7261
7222  IF C$[X[J1],Y[J1]]="START" THEN 7265
7230  S[J1]=POS(O$,C$[X[J1],Y[J1]])
7235  S[J1]=(S[J1]+1)/2
7240  IF S[J1]>0 THEN 7210
7250  A$=C$[X[J1],Y[J1]]
7260  GOTO 7050
7261  S[J1]=102
7262  GOTO 7210
7265  S[J1]=101
7266  GOTO 7210
7270  RETURN
8000  PRINT TAB(20);"Editor commands are prompted by '*'."
8010  PRINT TAB(10);"Possible commands are - ADD or DEL , NODE o
8020  PRINT TAB(10);"a command any further information required
8030  PRINT TAB(10);"for. To terminate the edit enter 'END'."
8040  RETURN
8500  PRINT TAB(20);"The network is defined by specifying each o
8510  PRINT TAB(10);"its code, followed by its immediate predece
8520  PRINT TAB(10);"E.G. The line of input  01,02,03 means that
8530  PRINT TAB(10);"01 cannot start before both 02 and 03 are c
8540  PRINT TAB(10);"start operation is defined by <Op Code>,'ST
8560  PRINT TAB(10);"prompted by '*', to terminate type 'END'."
8570  RETURN
8600  REM  decoding c$
8610  MAT X=ZER
8620  MAT Y=ZER
8630  L=LEN(C$)
8640  IF C$[L,L] <> "," THEN 8670
8650  PRINT TAB(5);"** ERROR - INCORRECT COMMAND INPUT **"
8660  RETURN
8670  L1=L2=0
```

```
8680  L2=L2+1
8690  X[L2]=L1+1
8700  L1=L1+1
8710  IF C$[L1,L1] <> "," THEN 8740
8720  Y[L2]=L1-1
8730  GOTO 8680
8740  IF L1<L THEN 8700
8750  Y[L2]=L
8760  RETURN
9000  REM       lis
9361  C1$=UPS$(C1$)
9500  IF X[3]>0 THEN 9530
9510  PRINT TAB(10);"PARAMETER 1 (SNET/MNET)";TAB(40);
9520  INPUT C1$
9521  C1$=UPS$(C1$)
9525  GOTO 9540
9530  C1$=C$[X[3],Y[3]]
9540  IF C1$="MNET" THEN 9580
9550  IF C1$="SNET" THEN 9600
9560  PRINT TAB(5);"** ERROR - MNET OR SNET IS REQUIRED **"
9565  MAT X=ZER
9570  GOTO 9510
9580  X1=1
9590  GOTO 9610
9600  X1=2
9610  IF X[4]>0 THEN 9650
9620  PRINT TAB(10);"NETWORK CODE";TAB(25);
9630  INPUT C1$
9635  C1$=UPS$(C1$)
9640  GOTO 9660
9650  C1$=C$[X[4],Y[4]]
9660  IF X1=1 THEN 9690
9670  N1$[1,1]="S"
9680  GOTO 9700
9690  N1$[1,1]="M"
9700  N1$[2,3]=C1$
9710  READ #3,1;I,N$
9720  MAT  READ #3,2;J
9730  A=POS(N$,N1$)
9740  RETURN
9750  END
```

NETAL

```
10   COM C$[70],X[6],Y[6],F$[30]
15   REM          SIMULATION SUITE   - NETWORK ANALYSIS
20   REM          N. Bartram             Mar '79
25   FILES *,*,*,*,*,*,*
30   FOR I=1 TO 4
40   ASSIGN F$[5*I-4,5*I],I,V1
45   NEXT I
47   ASSIGN "tfile",5,V1
50   DIM N[9,32],S[32],N1$[35],Y$[3],T[32,8],H$[64]
55   DIM O$[200],D[4],L[5,3],M[5,3],P[10,3]
56   DIM C1$[5],A$[2],N$[3],FO$[32]
57   DIM E[32],C[30,7]
60   A$="SM"
70   Y$="TRC"
75   IF X[2]>0 THEN 95
80   PRINT TAB(10);"Parameter 1 (mnet/snet)";TAB(35);
85   INPUT C1$
86   C1$=UPS$(C1$)
90   GOTO 100
95   C1$=C$[X[2],Y[2]]
100   X1=POS(A$,C1$[1,1])
110   IF X1>0 THEN 135
120   PRINT "ERROR - Parameter 1 not recognised"
130   GOTO 80
135   IF X[3]>0 THEN 170
140   PRINT TAB(10);"Parameter 2 (network code)";TAB(35);
150   INPUT C1$
155   C1$=UPS$(C1$)
160   GOTO 175
170   C1$=C$[X[3],Y[3]]
175   READ #3,1;Z,N1$
180   N$[1,1]=A$[X1,X1]
185   N$[2,3]=C1$
190   X1=POS(N1$,N$)
192   X1=(X1+2)/3
195   IF X1>0 THEN 217
200   PRINT "ERROR - network ";C1$;" is not in store"
210   X[4]=0
215   GOTO 80
217   IF X[4]>0 THEN 250
220   PRINT TAB(10);"Required analysis (time/res/cost)";TAB(35);
230   INPUT C1$
235   C1$=UPS$(C1$)
240   GOTO 260
250   C1$=C$[X[4],Y[4]]
260   X2=POS(Y$,C1$[1,1])
270   IF X2>0 THEN 300
280   PRINT "ERROR - Analysis type ";C1$;" not recognised"
290   GOTO 220
300   A=(4*X1)+(X1-1)
310   GOSUB 3200
315   A=A+3
```

```
320  MAT  READ #3, A; S
325  A=A+1
330  READ #3, A; H$
340  READ #2, 1; O$
400  GOSUB X2 OF 500, 4000, 4000
410  CHAIN V1, "SIM", 150
420  STOP
500  REM
505  PRINT TAB(10); "ANALYSING ....  ";
506  Z9=(15*(X1-1))+1
510  READ #4, Z9; C1, C2, C3
530  C1=1
540  PRINT #4, Z9; C1, C2, C3
550  MAT T=ZER
554  MAT C=ZER
560  N2=LEN(H$)/2
570  I=0
580  I=I+1
590  FOR J=1 TO N2
600  IF S[J]=I THEN 620
610  NEXT J
620  I1=(2*J)-1
630  A$=H$[I1, I1+1]
640  IF A$="ss" THEN 690
650  IF A$="ff" THEN 710
660  I1=POS(O$, A$)
670  I1=(I1+1)/2
680  GOTO 720
690  I1=101
700  GOTO 720
710  I1=102
720  T[I, 1]=I1
730  IF I<N2 THEN 580
740  FOR I=2 TO N2-1
750  I1=T[I, 1]
752  C[I-1, 1]=I1
756  I1=I1+10
758  MAT  READ #2, I1; D, L, M, P
760  T[I, 2]=D[1]
762  J3=0
764  FOR J2=1 TO 9 STEP 2
766  J3=J3+1
772  C[I-1, 2]=C[I-1, 2]+L[J3, 3]
778  C[I-1, 3]=C[I-1, 3]+M[J3, 3]
784  C[I-1, 4]=C[I-1, 4]+P[J3, 3]
786  NEXT J2
802  NEXT I
804  GOSUB 1250
810  GOSUB 1000
820  GOSUB 1550
830  GOSUB 1950
850  GOSUB 3400
854  GOSUB 7300
855  PRINT TAB(10)"Bar Chart"; TAB(35);
```

```
856  GOSUB 9600
860  IF Y$="YES" THEN 890
865  IF Y$="NO" THEN 870
866  GOTO 855
870  RETURN
890  GOSUB 7000
1000  REM FORWARD PASS
1005  PRINT "FORWARD PASS ....  ";
1010  J=1
1020  J=J+1
1040  I2=(2*(T[J,1]))-1
1050  A$=O$[I2,I2+1]
1060  J1=POS(H$,A$)
1070  J1=((J1+1)/2)-1
1080  FOR I=2 TO 9
1090  IF N[I,J1]=0 THEN 1170
1110  FOR I1=1 TO N2
1120  IF T[I1,1]=N[I,J1] THEN 1140
1130  NEXT I1
1140  IF T[I1,4]<T[J,3] THEN 1170
1150  T[J,3]=T[I1,4]
1160  T[J,4]=T[J,3]+T[J,2]
1170  NEXT I
1180  IF J<N2-1 THEN 1020
1185  FOR J=1 TO 32
1190  IF E[J]=0 THEN 1210
1195  IF T[N2,3]>T[J,4] THEN 1210
1200  T[N2,3]=T[J,4]
1205  T[N2,4]=T[N2,3]+T[N2,2]
1210  NEXT J
1215  T[N2,5]=T[N2,6]=T[N2,4]
1220  RETURN
1250  REM
1260  MAT E=CON
1265  E[1]=0
1270  I1=1
1280  I1=I1+1
1290  FOR J=1 TO N2
1300  IF N[I1,J]=0 THEN 1365
1310  J1=(2*N[I1,J])-1
1320  A$=O$[J1,J1+1]
1330  K=POS(H$,A$)
1340  K=(K+1)/2
1350  K=S[K]
1360  E[K]=0
1365  NEXT J
1370  IF I1<9 THEN 1280
1480  RETURN
1550  REM      BACKWARD PASS
1555  PRINT "BACKWARD PASS "
1560  FOR J=1 TO N2
1570  IF E[J]=0 THEN 1600
1580  T[J,6]=T[N2,5]
1590  T[J,5]=T[J,6]-T[J,2]
```

```
1600  NEXT J
1610  J=N2
1620  J=J-1
1630  IF J=1 THEN 1820
1640  I1=T[J,1]
1650  I1=(2*I1)-1
1660  A$=O$[I1,I1+1]
1670  I1=POS(H$,A$)
1680  J1=((I1+1)/2)-1
1690  FOR I=2 TO 9
1700  IF N[I,J1]=0 THEN 1790
1710  K=N[I,J1]
1720  FOR I1=1 TO N2
1730  IF T[I1,1]=K THEN 1750
1740  NEXT I1
1750  IF T[I1,6]=0 THEN 1770
1760  IF T[I1,6]<T[J,5] THEN 1790
1770  T[I1,6]=T[J,5]
1780  T[I1,5]=T[I1,6]-T[I1,2]
1790  NEXT I
1800  GOTO 1620
1820  FOR J=2 TO N2-1
1830  T[J,7]=T[J,6]-T[J,4]
1840  IF T[J,7]>.001 THEN 1860
1850  T[J,8]=1
1860  NEXT J
1890  RETURN
1950  PRINT
1970  PRINT TAB(10);"TIME ANALYSIS"
1980  PRINT TAB(10);"*************"
1990  PRINT
2000  PRINT TAB(5);"OP";TAB(10);"DUR";TAB(20);"ES";TAB(30);"EF";
2010  PRINT TAB(50);"LF";TAB(60);"FL"
2020  PRINT TAB(5);"------------------------------------------------
2030  PRINT                                                   (40);"LS";
2040  FOR J=2 TO N2-1                                         --------------
2041  IF T[J,8]=1 THEN 2045
2042  PRINT TAB(5);
2043  GOTO 2050
2045  PRINT "*";TAB(5);
2050  I1=T[J,1]
2060  I1=(2*I1)-1
2070  PRINT O$[I1,I1+1];TAB(8);
2080  PRINT  USING 2090;T[J,2],T[J,3],T[J,4],T[J,5],T[J,6],T[J,7
2090  IMAGE ddd.dxxxxx
2140  PRINT
2150  NEXT J
2160  PRINT
2165  PRINT TAB(20);"( * DENOTES CRITICAL OPERATIONS )"
2170  PRINT TAB(10);"Total Duration = ";T[N2,3];"Hours"
2180  PRINT TAB(10);"               = ";T[N2,3]/9.25;"Days"
2195  PRINT
2200  RETURN
2300  REM reading matrix r
```

```
2310  READ #4,R1;R1
2330  FOR J=1 TO 30
2340  FOR I=1 TO 41
2350  READ #4;R[J,I]
2360  NEXT I
2370  NEXT J
2380  RETURN
3200  REM   reading mat n
3210  READ #3,A;I1
3220  FOR I1=1 TO 9
3230  FOR J1=1 TO 32
3240  READ #3;N[I1,J1]
3250  NEXT J1
3260  NEXT I1
3270  RETURN
3400  REM      print matrix "T" to file
3405  A=(15*(X1-1))+2
3410  PRINT #4,A;A
3420  FOR I1=1 TO 32
3430  FOR J1=1 TO 8
3440  PRINT #4;T[I1,J1]
3450  NEXT J1
3460  NEXT I1
3470  RETURN
3800  REM reading matrix t (32,8)
3810  READ #4,R1;I1
3820  FOR I1=1 TO 32
3825  FOR J1=1 TO 8
3830  READ #4;T[I1,J1]
3840  NEXT J1
3850  NEXT I1
3860  RETURN
4000  REM prepare to chain to rescos
4010  X[1]=X2
4015  X[2]=X1
4020  CHAIN "rescos"
5000  REM  chain from simula joins here
5010  I1=X[6]
5015  T1=0
5016  T2=10000
5020  FOR I=1 TO 6
5030  ASSIGN F$[5*I-4,5*I],I,V1
5040  NEXT I
5060  ASSIGN "tfile",7,V1
5070  READ #2,1;O$
5080  A=(4*I1)+(I1-1)
5087  DIM I[32]
5088  MAT I=ZER
5090  GOSUB 3200
5095  PRINT TAB(10);"NETWORK SIMULATION"
5100  A=A+3
5110  MAT D=ZER[4]
5115  D[3]=10000
5120  MAT  READ #3,A;S
```

```
5125  MAT T=ZER
5130  A=A+1
5140  READ #3,A;H$
5145  N2=(LEN(H$))/2
5150  GOSUB 5600
5160  GOSUB 1250
5170  READ #7,1;X2
5180  X1=0
5190  X1=X1+1
5195  GOSUB 6100
5200  GOSUB 5800
5210  GOSUB 1010
5220  GOSUB 1560
5230  D[1]=D[1]+T[N2,6]
5240  D[2]=D[2]+(T[N2,6]*T[N2,6])
5242  IF D[3]<T[N2,6] THEN 5246
5244  D[3]=T[N2,6]
5246  IF D[4]>T[N2,6] THEN 5250
5248  D[4]=T[N2,6]
5250  FOR J=1 TO N2
5255  IF T[J,8]=0 THEN 5270
5260  I[J]=I[J]+1
5270  NEXT J
5280  X2=X1/10
5290  X3=INT(X2)
5300  IF X2-X3>0 THEN 5320
5310  PRINT TAB(10);"** ";X1;" SIMULATIONS OF NETWORK COMPLETED
5320  IF X1<30 THEN 5190
5330  PRINT TAB(10);"** SIMULATION OF NETWORK COMPLETE **"
5340  D[1]=D[1]/30
5350  D[2]=D[2]/30
5360  D[2]=D[2]-(D[1]*D[1])
5365  IF D[2]>0 THEN 5370
5366  D[2]=0
5370  D[2]=SQR(D[2])
5380  FOR J=1 TO N2
5390  I[J]=I[J]/30
5395  NEXT J
5400  GOSUB 5900
5410  I1=X[6]
5420  I2=5*I1-2
5430  MAT  PRINT #6,I2;D,I
5500  GOSUB 8150
5600  I=0
5610  I=I+1
5620  FOR J=1 TO N2
5630  IF S[J]=I THEN 5650
5640  NEXT J
5650  I1=(2*J)-1
5660  A$=H$[I1,I1+1]
5670  IF A$="SS" THEN 5720
5680  IF A$="FF" THEN 5740
5690  I1=POS(O$,A$)
5700  I1=(I1+1)/2
```

```
5710  GOTO 5750
5720  I1=101
5730  GOTO 5750
5740  I1=102
5750  T[I,1]=I1
5760  IF I<N2 THEN 5610
5770  RETURN
5800  REM reading time estimates
5810  FOR J=2 TO 31
5820  READ #7;T[J,2],X
5830  NEXT J
5855  RETURN
5900  REM
5910  PRINT TAB(10);" NETWORK SIMULATION - RESULTS"
5920  PRINT TAB(10);" DURATION    -  MEAN          = ";D[1];" HOURS
5930  PRINT TAB(10);"             -  STANDARD DEV  = ";D[2];" HOURS
5935  PRINT TAB(10);"             -  MIN           = ";D[3];" HOURS
5940  PRINT TAB(10);"             -  MAX           = ";D[4];" HOURS
5960  PRINT TAB(10);" PROBABILITIES OF OPERATIONS BEING CRITICAL"
5970  FOR J=2 TO N2-1
5980  I1=(2*T[J,1])-1
5990  A$=O$[I1,I1+1]
6000  PRINT TAB(20);A$;TAB(40);I[J]
6010  NEXT J
6020  RETURN
6100  REM       zero ing "T"
6110  FOR J=1 TO 32
6120  FOR I=2 TO 8
6130  T[J,I]=0
6140  NEXT I
6150  NEXT J
6160  RETURN
6500  REM cost results
6510  PRINT TAB(5);"OPERATION";TAB(15);"LABOUR";TAB(30);"MATERIAL
6520  PRINT TAB(45);"PLANT";TAB(60);"TOTAL"
6530  PRINT
6540  FOR J=1 TO N2
6550  PRINT TAB(9);O$[2*T[J,1]-1,2*T[J,1]];TAB(15);
6560  T1=T[J,J1]+T[J,J2]+T[J,2]
6570  PRINT  USING 6580;T[J,J1],T[J,2],T[J,J2],T1
6580  IMAGE dddd.dd,8x,dddd.dd,8x,dddd.dd,8x,ddddd.dd
6590  NEXT J
6600  PRINT "PRESS 'RETURN' TO CONTINUE";
6610  LINPUT C$
6620  RETURN
7000  PRINT #5;N2,A,H$
7100  CHAIN "barch"
7110  RETURN
7300  REM   printing matrix c to file
7305  A=(15*X1)-1
7310  PRINT #4,A;A
7320  FOR I=1 TO 30
7330  FOR J=1 TO 7
7340  PRINT #4;C[I,J]
```

```
7350  NEXT J
7360  NEXT I
7370  RETURN
8150  REM cost simulation
8152  MAT I=ZER
8155  MAT D=ZER[4]
8160  MAT R=ZER[30,2]
8170  MAT T=ZER[30,8]
8185  MAT S=ZER[32]
8240  I1=X[6]
8250  I2=(4*I1)+(I1-1)+3
8260  MAT  READ #3,I2;S
8265  READ #3,I2+1;H$
8270  I=1
8280  I=I+1
8290  FOR J=2 TO 32
8300  IF S[J]=I THEN 8320
8310  NEXT J
8320  F0$=H$[2*J-1,2*J]
8330  IF F0$="FF" THEN 8500
8340  I1=POS(O$,F0$)
8350  I1=(I1+1)/2
8360  J1=I1+10
8370  MAT  READ #2,J1;D,L,M,P
8375  GOSUB 9300
8380  L1=0
8390  T[I-1,1]=I1
8400  FOR P=1 TO 5
8410  T[I-1,2]=T[I-1,2]+M[P,3]
8420  R[I-1,1]=R[I-1,1]+L[P,3]
8430  L1=L1+L[P,2]
8440  NEXT P
8445  IF L1=0 THEN 8460
8450  R[I-1,1]=R[I-1,1]/L1
8460  FOR P=1 TO 10
8470  R[I-1,2]=R[I-1,2]+P[P,3]
8480  NEXT P
8490  GOTO 8280
8500  MAT C=ZER[30,4]
8501  N2=I-2
8505  I1=X[6]
8510  I2=5*I1-4
8515  MAT  READ #6,I2;C
8520  FOR I=1 TO 30
8530  T[I,3]=R[I,1]*C[I,3]*I[I]
8540  T[I,4]=R[I,1]*C[I,4]*I[I]
8550  T[I,5]=R[I,1]*C[I,1]*I[I]
8560  T[I,6]=R[I,2]*C[I,3]*I[I]
8570  T[I,7]=R[I,2]*C[I,4]*I[I]
8580  T[I,8]=R[I,2]*C[I,1]*I[I]
8590  NEXT I
8600  I2=I2+1
8605  MAT  READ #6,I2;C
8610  FOR I=1 TO 30
```

```
8620  T[I,3]=T[I,3]*C[I,1]
8630  T[I,4]=T[I,4]*C[I,1]
8640  T[I,5]=T[I,5]*C[I,1]
8650  NEXT I
8740  PRINT TAB(10);"SIMULATED COSTS"
8745  PRINT TAB(10);"***************"
8750  PRINT
8760  PRINT TAB(5);"MINIMUM COSTS"
8770  J1=3
8780  J2=6
8790  GOSUB 6500
8800  PRINT TAB(5);"MAXIMUM COSTS"
8810  J1=4
8820  J2=7
8830  GOSUB 6500
8840  PRINT TAB(5);"MEAN COSTS"
8850  J1=5
8860  J2=8
8870  GOSUB 6500
8880  PRINT TAB(5);"COST SUMMARY"
8890  MAT P=ZER[4,3]
8900  PRINT TAB(30);"MIN";TAB(40);"MAX";TAB(50);"MEAN"
8910  FOR J=1 TO N2
8920  P[1,1]=P[1,1]+T[J,3]
8930  P[1,2]=P[1,2]+T[J,4]
8940  P[1,3]=P[1,3]+T[J,5]
8950  P[2,1]=P[2,1]+T[J,2]
8960  P[2,2]=P[2,3]=P[2,1]
8970  P[3,1]=P[3,1]+T[J,6]
8980  P[3,2]=P[3,2]+T[J,7]
8990  P[3,3]=P[3,3]+T[J,8]
9000  NEXT J
9010  P[4,1]=P[1,1]+P[2,1]+P[3,1]
9020  P[4,2]=P[1,2]+P[2,2]+P[3,2]
9030  P[4,3]=P[1,3]+P[2,3]+P[3,3]
9040  PRINT TAB(15);"LABOUR";TAB(30);
9050  PRINT  USING 9060;P[1,1],P[1,2],P[1,3]
9060  IMAGE ddddd.dd,11x,ddddd.dd,11x,ddddd.dd
9070  PRINT TAB(15);"MATERIALS";TAB(30);
9080  PRINT  USING 9060;P[2,1],P[2,2],P[2,3]
9090  PRINT TAB(15);"PLANT";TAB(30);
9100  PRINT  USING 9060;P[3,1],P[3,2],P[3,3]
9110  PRINT TAB(15);"TOTALS";TAB(30);
9120  PRINT  USING 9060;P[4,1],P[4,2],P[4,3]
9130  I1=X[6]
9140  MAT S=ZER[30]
9150  I2=(5*I1)-2
9155  MAT E=ZER[4]
9160  MAT  READ #6,I2;E,S
9165  MAT  PRINT #6,I2;E,S
9170  MAT E=ZER[9]
9180  MAT  READ #5,2;E
9190  MAT  PRINT #6;E,P
9200  I2=I2+1
```

```
9210  PRINT #6, I2; I2
9220  FOR J=1 TO 30
9230  FOR I=1 TO 8
9240  PRINT #6; T[J, I]
9250  NEXT I
9260  NEXT J
9270  CHAIN V1, "sim", 150
9300  REM units
9310  GOTO D[2] OF 9320, 9340, 9360
9320  I[I-1]=1
9330  RETURN
9340  I[I-1]=9.25
9350  RETURN
9360  I[I-1]=46.25
9370  RETURN
9600  INPUT Y$
9610  Y$=UPS$(Y$)
9620  RETURN
9998  END
```

RESCOS

```
10   COM C$[70],X[6],Y[6],F$[30]
15   REM        SIMULATION SUITE - RESOURCE AND COST ANALYSIS
20   REM        N. Bartram            APRIL '79
25   FILES *,*,*,*,tfile
30   FOR P=1 TO 4
40   ASSIGN F$[5*P-4,5*P],P,V1
50   NEXT P
70   DIM R[30,40],C[30,7],R$[3],O$[200],FO$[2],T[32,8]
80   DIM S[20],D[4],L[5,3],M[5,3],P[10,3]
100  X2=X[1]
110  X1=X[2]
120  GOSUB X2 OF 130,4000,6000
130  CHAIN V1,"sim",150
2300  REM retrieve resources
2305  MAT R=ZER
2310  FOR I=2 TO 32
2315  IF T[I,1]=0 OR T[I,1]=102 THEN 2375
2320  I1=T[I,1]+10
2325  MAT  READ #2,I1;D,L,M,P
2330  J3=0
2335  FOR J2=1 TO 9 STEP 2
2336  J3=J3+1
2340  R[I-1,J2]=L[J3,1]
2345  R[I-1,J2+1]=L[J3,2]
2350  R[I-1,J2+10]=M[J3,1]
2355  R[I-1,J2+11]=M[J3,2]
2360  R[I-1,J2+20]=P[J3,1]
2365  R[I-1,J2+21]=P[J3,2]
2370  NEXT J2
2375  NEXT I
2380  RETURN
3800  REM reading matrix t
3805  R1=(15*X1)-13
3810  READ #4,R1;R1
3820  FOR I1=1 TO 32
3825  FOR J1=1 TO 8
3830  READ #4;T[I1,J1]
3840  NEXT J1
3850  NEXT I1
3860  RETURN
4000  REM resource analysis
4005  DIM Z[20,50]
4010  A=(15*X1)-14
4020  READ #4,A;C1,C2,C3
4030  IF C1>0 THEN 4070
4040  PRINT TAB(5);"ERROR - TIME ANALYSIS BEFORE RESOURCE ANALYSI
4050  RETURN
4070  GOSUB 3800
4080  GOSUB 2300
4090  T2=0
4100  FOR J=1 TO 30
4110  IF T2>T[J,6] THEN 4120
```

```
4115  T2=T[J,6]
4120  NEXT J
4135  F2=1
4140  IF T2 <= 50 THEN 4260
4150  IF T2 <= 426.5 THEN 4180
4160  F2=46.25
4170  GOTO 4190
4180  F2=9.25
4190  FOR J=1 TO 30
4200  FOR I=3 TO 6
4210  T[J,I]=T[J,I]/F2
4220  NEXT I
4240  NEXT J
4250  T2=T2/F2
4260  MAT Z=ZER
4270  Z1=3
4290  Z3=1
4300  Z4=9
4310  GOSUB 9000
4320  PRINT TAB(10);"RESOURCE - REQUIREMENTS"
4330  PRINT TAB(10);"LABOUR - EARLY START POSITIONS"
4340  GOSUB 9200
4345  GOSUB 5000
4350  PRINT TAB(5);"Do you want the labour requirements at late s
4360  GOSUB 9600
4380  IF R$="NO" THEN 4490
4390  IF R$="YES" THEN 4410
4400  GOTO 4350
4410  MAT Z=ZER
4420  Z1=5
4460  GOSUB 9000
4470  PRINT TAB(10);"LABOUR - LATE START POSITIONS"
4480  GOSUB 9200
4485  GOSUB 5000
4490  PRINT TAB(10);"Do you want the plant analysis   ";
4500  GOSUB 9600
4520  IF R$="NO" THEN 4640
4530  IF R$="YES" THEN 4560
4540  GOTO 4490
4560  Z1=3
4580  Z3=21
4590  Z4=39
4595  MAT Z=ZER
4600  GOSUB 9000
4610  PRINT TAB(10);"RESOURCE REQUIREMENTS"
4620  PRINT TAB(10);"PLANT - EARLY STARTS"
4630  GOSUB 9200
4635  GOSUB 5100
4640  PRINT TAB(10);"Do you want plant at late start   ";
4650  GOSUB 9600
4670  IF R$="NO" THEN 4750
4680  IF R$="YES" THEN 4700
4690  GOTO 4640
4700  Z1=5
```

```
4710  MAT Z=ZER
4720  GOSUB 9000
4730  PRINT TAB(10);"PLANT - LATE STARTS"
4740  GOSUB 9200
4745  GOSUB 5100
4750  RETURN
5000  REM labour codes
5005  DIM L$[20]
5010  READ #1,4;L$
5020  FOR P=1 TO LEN(L$)/2
5030  PRINT TAB(10);P;TAB(20);L$[2*P-1,2*P]
5040  NEXT P
5050  PRINT "PRESS 'RETURN' TO CONTINUE  ";
5060  LINPUT L$
5070  RETURN
5100  REM plant codes
5110  DIM P$[40]
5115  READ #1,6;P$
5120  FOR P=1 TO LEN(P$)/2
5130  PRINT TAB(10);P;TAB(20);P$[2*P-1,2*P]
5140  NEXT P
5150  PRINT "PRESS 'RETURN' TO CONTINUE   ";
5155  LINPUT P$
5160  RETURN
6000  REM   cost analysis
6002  GOSUB 3800
6005  READ #2,1;O$
6010  A=(15*X1)-14
6020  READ #4,A;C1,C2,C3
6030  IF C1>0 THEN 6060
6040  PRINT TAB(10);"** ERROR - TIME ANALYSIS BEFORE COST ANALYSI
6050  RETURN
6060  A=(15*X1)-1
6070  READ #4,A;A
6080  FOR I=1 TO 30
6090  FOR J=1 TO 7
6100  READ #4;C[I,J]
6110  NEXT J
6120  NEXT I
6122  FOR I=1 TO 30
6123  C[I,2]=C[I,2]*T[I+1,2]
6124  C[I,4]=C[I,4]*T[I+1,2]
6126  NEXT I
6130  T=0
6140  FOR I=1 TO 30
6150  C[I,7]=0
6160  FOR J=2 TO 6
6170  C[I,7]=C[I,7]+C[I,J]
6180  NEXT J
6190  T=T+C[I,7]
6200  NEXT I
6210  PRINT TAB(10);"COST TABLE"
6220  PRINT TAB(5);"OP";TAB(15);"LAB";TAB(25);"MAT";TAB(35);"PL"
6230  PRINT TAB(55);"PLIM";TAB(65);"TOT"                   3(45);"S/(
```

```
6240  PRINT TAB(5);"------------------------------------------------
6245  PRINT "----------"
6250  FOR I=1 TO 30
6260  I1=C[I,1]
6265  IF I1=0 THEN 6370
6270  I1=(2*I1)-1
6280  FO$=O$[I1,I1+1]
6290  PRINT TAB(5);FO$;TAB(10);
6320  PRINT  USING 6330;C[I,2],C[I,3],C[I,4],C[I,5],C[I,6],C[I,7]
6330  IMAGE dddd.ddxxx
6350  PRINT
6360  NEXT I
6370  PRINT TAB(65);"-------"
6380  PRINT TAB(50);"TOTAL";TAB(58);"#";TAB(60);T
6390  PRINT TAB(65);"-------"
6400  GOSUB 7300
6410  C2=1
6420  A=(15*X1)-14
6430  PRINT #4,A;C1,C2,C3
6440  RETURN
7200  REM printing R
7205  A=(15*(X1-1))+4
7210  PRINT #4,A;A
7220  FOR J=1 TO 30
7230  FOR I=1 TO 41
7240  PRINT #4;R[J,I]
7250  NEXT I
7260  NEXT J
7270  RETURN
7300  REM   printing matrix c to file
7305  A=(15*X1)-1
7310  PRINT #4,A;A
7320  FOR I=1 TO 30
7330  FOR J=1 TO 7
7340  PRINT #4;C[I,J]
7350  NEXT J
7360  NEXT I
7370  RETURN
9000  REM   resource allocations
9005  Z2=Z1+1
9010  T1=0
9020  T1=T1+1
9030  I=0
9040  IF T1>T2 THEN 9160
9050  FOR J=1 TO 30
9060  IF T[J+1,1]=0 THEN 9150
9070  IF T1 <= T[J+1,Z1] THEN 9150
9075  IF T1>T[J+1,Z2] THEN 9150
9080  FOR J1=Z3 TO Z4 STEP 2
9090  IF R[J,J1]=0 THEN 9140
9100  FOR J2=1 TO R[J,J1+1]
9110  I=I+1
9120  Z[I,T1]=R[J,J1]
9130  NEXT J2
```

```
9140  NEXT J1
9150  NEXT J
9155  GOTO 9020
9160  RETURN
9200  REM printing resource histogram
9215  MAT S=ZER
9220  FOR J=1 TO 20
9230  FOR I=1 TO 50
9240  S[J]=S[J]+Z[J,I]
9250  NEXT I
9260  NEXT J
9270  I=21
9280  I=I-1
9290  IF I=0 THEN 9400
9300  IF S[I]=0 THEN 9280
9305  PRINT TAB(5);
9310  FOR J=1 TO 50
9320  IF Z[I,J]=0 THEN 9360
9330  PRINT  USING 9340;Z[I,J]
9340  IMAGE #,d
9350  GOTO 9370
9360  PRINT " ";
9370  NEXT J
9380  PRINT
9390  GOTO 9280
9400  PRINT TAB(5);"|----|----|----|----|----|----|----|----|----
9410  PRINT TAB(5);"0";TAB(15);"10";TAB(25);"20";TAB(35);"30";TAB
9420  PRINT TAB(55);"50"
                                                         ---|"
                                                         5);"40
9430  IF F2=1 THEN 9470
9440  IF F2=9.25 THEN 9490
9450  PRINT TAB(20);"TIME -->  WEEKS"
9460  GOTO 9500
9470  PRINT TAB(20);"TIME -->  HOURS"
9480  GOTO 9500
9490  PRINT TAB(20);"TIME -->  DAYS"
9500  PRINT TAB(25);"TABLE OF RESOURCE CODES"
9510  RETURN
9600  INPUT R$
9610  R$=UPS$(R$)
9620  RETURN
9998  END
```

SIMULA

```
5  COM C$[70],X[6],Y[6],F$[30]
6  PRINT F$
10  REM      SIMULATION SUITE - SIMULATION OF OPERATION TIMES
15  REM      N. Bartram           APRIL 79
20  FILES *,*,*,*,*,*,*
30  ASSIGN F$[1,5],1,V1
40  ASSIGN F$[6,10],2,V1
50  ASSIGN F$[11,15],3,V1
60  ASSIGN F$[16,20],4,V1
70  ASSIGN F$[21,25],5,V1
90  DIM C1$[5]
100  DIM T[30,2],H$[64],D[4],L[5,3],M[5,3],P[10,3],O$[200]
110  DIM G[30],S[30],Q[30],N$[3],N1$[35],F1$[2]
120  DIM E[9],U[30,2],A[30,2],O[32]
130  DIM B[32],C[30]
150  PRINT TAB(10);"OPERATION SIMULATION"
165  PRINT
190  READ #2,1;O$
200  IF X[2]>0 THEN 250
210  PRINT TAB(10);"Parameter 2 (snet/mnet)    ";
220  INPUT C1$
230  C1$=UPS$(C1$)
240  GOTO 255
250  C1$=C$[X[2],Y[2]]
255  IF C1$[1,1]="M" THEN 270
258  IF C1$[1,1]="S" THEN 270
260  PRINT TAB(5);"** ERROR - PARAMETER 2SHOULD BE SNET OR MNET
265  MAT X=ZER
266  GOTO 210
270  N$[1,1]=C1$[1,1]
275  IF X[3]>0 THEN 300
280  PRINT TAB(10);"Network Code                ";
290  INPUT N$[2,3]
292  N$=UPS$(N$)
295  GOTO 310
300  N$[2,3]=C$[X[3],Y[3]]
310  GOSUB 1000
320  IF I1=0 THEN 900
325  GOSUB 8000
330  GOSUB 1067
335  REM   1200 reads basic network data
340  GOSUB 1500
345  REM    1500 time simulation
350  GOSUB 2000
355  REM 2000 = compute means & s.d. of op durations
360  GOSUB 4000
400  CHAIN V1,"netal",5000
900  CHAIN V1,"sim",150
1000  REM    network code number
1010  READ #3,1;I1,N1$
1020  I1=POS(N1$,N$)
1030  IF I1>0 THEN 1060
```

```
1040  PRINT TAB(5);"** ERROR - NETWORK ";N$;" IS NOT IN STORE **"
1050  RETURN
1060  I1=(I1+2)/3
1065  X[6]=I1
1066  RETURN
1067  REM    network basic data
1068  I1=X[6]
1070  I2=(4*I1)+(I1-1)
1076  I2=I2+4
1080  READ #3, I2; H$
1090  READ #2, 1; O$
1100  I2=I2-1
1110  MAT  READ #3, I2; O
1210  MAT S=ZER
1220  MAT G=ZER
1230  MAT Q=ZER
1240  MAT C=ZER
1250  I=1
1255  MAT B=ZER
1260  I=I+1
1262  FOR J=1 TO 32
1264  IF O[J]=I THEN 1270
1266  NEXT J
1270  B[I]=J
1275  F1$=H$[2*J-1, 2*J]
1280  IF F1$="FF" THEN 1390
1290  I2=POS(O$, F1$)
1295  I2=((I2+1)/2)+10
1300  MAT  READ #2, I2; D, L, M, P
1310  Q[I-1]=D[3]
1320  FOR J=1 TO 5
1330  G[I-1]=G[I-1]+L[J, 2]
1340  NEXT J
1342  IF G[I-1]>0 THEN 1350
1344  G[I-1]=1
1346  IF D[3]=0 THEN 1356
1350  GOTO D[2] OF 1355, 1365, 1375
1355  S[I-1]=(D[1]*G[I-1])/D[3]
1356  C[I-1]=1
1360  GOTO 1260
1365  S[I-1]=(D[1]*G[I-1])/(D[3]*9.25)
1366  C[I-1]=9.25
1370  GOTO 1260
1375  S[I-1]=(D[1]*G[I-1])/(D[3]*9.25*5)
1376  C[I-1]=46.25
1380  GOTO 1260
1390  RETURN
1500  REM        time simulations
1501  J=TIM(1)
1502  J1=TIM(0)
1503  J2=TIM(4)
1504  PRINT  USING 1506; J, J1, J2
1505  ASSIGN "tfile", 7, V1
1506  IMAGE dd, ":", dd, ":", dd
```

```
1508  N2=LEN(H$)/2
1509  N2=N2-2
1510  J=0
1515  PRINT #7,1;J
1520  J=J+1
1525  MAT T=ZER
1530  I1=1
1540  I1=I1+1
1545  J1=B[I1]
1550  F1$=H$[2*J1-1,2*J1]
1560  IF F1$="FF" THEN 1820
1570  Q2=Q[I1-1]
1575  IF Q2=0 THEN 1540
1580  T1=0
1585  T2=0
1590  T1=T1+1
1600  GOSUB 3000
1610  G1=(A1*G[I1-1])/100
1620  G1=G1+G[I1-1]
1625  T2=T2+G1
1630  P1=(P1*G1)/100
1640  W1=(G1*(O1-S4))/O1
1650  P2=G1-P1-W1
1660  P3=P2*O1/100
1670  Q1=P3/S[I1-1]
1680  Q2=Q2-Q1
1690  IF Q2>0 THEN 1590
1700  IF Q2=0 THEN 1790
1710  Q3=Q2+Q1
1720  Q2=-1*Q2
1730  T3=1+(Q2/Q3)
1740  T3=1/T3
1750  T[I1-1,1]=T1+T3-1
1760  T4=T3*G1
1770  T[I1-1,2]=T2-G1+T4
1775  T[I1-1,2]=T[I1-1,2]/T[I1-1,1]
1777  T[I1-1,1]=T[I1-1,1]*C[I1-1]
1780  GOTO 1540
1790  T[I1-1,1]=T1
1800  T[I1-1,2]=T2
1805  T[I1-1,2]=T[I1-1,2]/T[I1-1,1]
1807  T[I1-1,1]=T[I1-1,1]*C[I1-1]
1810  GOTO 1540
1820  MAT  PRINT #7;T
1825  PRINT J
1830  J1=J/10
1840  J2=INT(J1)
1850  IF J1-J2>0 THEN 1870
1860  PRINT TAB(5);"** ";J;" SIMULATIONS OF OPERATION TIMES COMP
1870  IF J<30 THEN 1520
1880  PRINT TAB(10);"** OPERATION SIMULATION COMPLETED **"
1890  J=TIM(1)
1900  J1=TIM(0)
1910  J2=TIM(4)
```

```
1920  PRINT  USING 1506; J, J1, J2
1970  RETURN
2000  REM      means & standard deviations
2005  DIM Z[30,4]
2006  FOR J1=1 TO 2
2009  READ #7,1;J
2010  MAT Z=ZER
2011  FOR J=1 TO 30
2012  Z[J,3]=10000
2013  NEXT J
2030  FOR J=1 TO 30
2040  MAT  READ #7;T
2050  FOR I=1 TO N2
2060  Z[I,1]=Z[I,1]+T[I,J1]
2070  Z[I,2]=Z[I,2]+(T[I,J1]*T[I,J1])
2072  IF Z[I,3]<T[I,J1] THEN 2076
2074  Z[I,3]=T[I,J1]
2076  IF Z[I,4]>T[I,J1] THEN 2080
2078  Z[I,4]=T[I,J1]
2080  NEXT I
2090  NEXT J
2100  FOR J=1 TO N2
2110  Z[J,1]=Z[J,1]/30
2120  Z[J,2]=Z[J,2]/30
2130  Z[J,2]=Z[J,2]-(Z[J,1]*Z[J,1])
2132  IF Z[J,2]>0 THEN 2140
2134  Z[J,2]=0
2140  Z[J,2]=SQR(Z[J,2])
2150  NEXT J
2151  GOSUB 2500
2152  P=J1+14
2155  MAT  PRINT #7,P;Z
2157  NEXT J1
2158  MAT  READ #7,15;Z
2160  PRINT TAB(10);"OPERATION TIMES"
2170  PRINT TAB(10);"***************"
2172  J=1
2175  PRINT TAB(5);"OPERATION";TAB(25);"MEAN";TAB(35);"S.D.";TAB
2180  I=1                                          5);"MIN";TAB(55);"MAX
2190  I=I+1
2195  J1=B[I]
2200  F1$=H$[2*J1-1,2*J1]
2210  IF F1$="FF" THEN 2240
2220  PRINT TAB(10);F1$;TAB(25);
2222  PRINT  USING 2225;Z[I-1,1],Z[I-1,2],Z[I-1,3],Z[I-1,4]
2225  IMAGE #,ddd.dd,4x,ddd.dd,4x,ddd.dd,4x,ddd.dd,4x
2227  GOSUB 2700
2230  GOTO 2190
2240  IF J=2 THEN 2290
2245  J=J+1
2250  MAT  READ #7,16;Z
2255  PRINT "PRESS 'RETURN' TO CONTINUE";
2256  LINPUT C$
2260  PRINT TAB(10);"ACTUAL LABOUR REQUIREMENTS"
```

```
2270  PRINT TAB(10);"***************************"
2280  GOTO 2175
2290  RETURN
2500  REM correcting units
2510  IF J1=2 THEN 2580
2520  FOR J=1 TO N2
2530  Z[J,1]=Z[J,1]/C[J]
2540  Z[J,2]=Z[J,2]/C[J]
2550  Z[J,3]=Z[J,3]/C[J]
2560  Z[J,4]=Z[J,4]/C[J]
2570  NEXT J
2580  RETURN
2700  REM print units
2710  IF J=2 THEN 2755
2715  IF C[I-1]=1 THEN 2740
2720  IF C[I-1]=9.25 THEN 2750
2730  PRINT "[weeks]"
2735  RETURN
2740  PRINT "[hours]"
2745  RETURN
2750  PRINT "[days]";
2755  PRINT
2760  RETURN
3000  REM randomness generation
3010  A3=1
3020  A2=E[5]
3030  A1=SQR(1-(A2*A2))
3040  G=TIM(4)
3050  A=RND(G)
3060  B=RND(G)
3070  M1=SQR(-2*LOG(A))*COS(2*3.14159*B)
3080  M2=SQR(-2*LOG(A))*SIN(2*3.14159*B)
3090  S4=(A1*M1)+(A2*M2)
3100  S4=(S4*E[2])+E[1]
3120  O1=A3*M2
3130  O1=(O1*E[4])+E[3]
3140  IF O1>S4 THEN 3160
3150  O1=S4
3160  REM a/o
3170  F1=RND(G)
3180  IF F1<A[1,2] THEN 3300
3190  FOR I=1 TO 30
3200  IF A[I,2]=0 THEN 3280
3210  IF F1 <= A[I,2] THEN 3230
3220  NEXT I
3230  X1=F1-A[I-1,2]
3240  Y2=A[I,1]-A[I-1,1]
3250  X2=A[I,2]-A[I-1,2]
3260  A1=A[I-1,1]+((X1*Y2)/X2)
3270  GOTO 3310
3280  A1=(5*E[9])+E[8]
3290  GOTO 3310
3300  A1=(-3.5*E[9])+E[8]
3310  REM pu
```

```
3400  F1=RND(1)
3410  IF F1 <= U[1,2] THEN 3530
3420  FOR I=1 TO 30
3430  IF U[I,2]=0 THEN 3510
3440  IF F1 <= U[I,2] THEN 3460
3450  NEXT I
3460  X1=F1-U[I-1,2]
3470  Y2=U[I,1]-U[I-1,1]
3480  X2=U[I,2]-U[I-1,2]
3490  P1=U[I-1,1]+((X1*Y2)/X2)
3500  GOTO 3540
3510  P1=(3.5*E[7])+E[6]
3520  GOTO 3540
3530  P1=(-3.5*E[7])+E[6]
3540  REM
3542  IF P1 >= 0 THEN 3550
3544  P1=0
3550  RETURN
4000  REM data to file
4010  I1=X[6]
4020  MAT  READ #7,15;Z
4030  I2=5*I1-4
4040  MAT  PRINT #6,I2;Z
4050  MAT  READ #7,16;Z
4060  I2=I2+1
4070  MAT  PRINT #6,I2;Z
4080  RETURN
8000  CHAIN "disinp"
8100  ASSIGN F$[1,5],1,V1
8120  ASSIGN F$[6,10],2,V1
8130  ASSIGN F$[11,15],3,V1
8140  ASSIGN F$[16,20],4,V1
8150  ASSIGN F$[21,25],5,V1
8155  ASSIGN F$[26,30],6,V1
8160  MAT  READ #5,2;E
8170  MAT  READ #5,3;U,A
8180  GOTO 330
9999  END
```

DISINP

```
10   COM C$[70],X[6],Y[6],F$[30]
15   REM            simulation suite -  distributions input
20   REM            N. Bartram            May '79
30   FILES *,*,*,*,*,*
40   ASSIGN F$[21,25],5,V1
50   DIM R$[3],M[9],D[30,2],N[2,29],P[30,2]
90   MAT  READ N
100  PRINT TAB(10);"SAMPLING DATA INPUT"
110  PRINT TAB(10);"*******************"
120  PRINT
130  PRINT TAB(15);"Need help   ";
140  INPUT R$
150  R$=UPS$(R$)
160  IF R$="NO" THEN 200
170  IF R$="YES" THEN 190
180  GOTO 130
190  GOSUB 1000
200  PRINT TAB(10);"S.P.I.  ";
210  GOSUB 1200
220  GOSUB P OF 6000,2000,6400
230  M[1]=M1
240  M[2]=S1
250  PRINT TAB(10);"O.P.I.  ";
260  GOSUB 1200
270  GOSUB P OF 6000,2000,6400
280  M[3]=M1
290  M[4]=S1
300  GOSUB 5100
310  M[5]=R
320  PRINT TAB(10);"Pu    ";
330  GOSUB 1200
340  GOSUB P OF 6000,2000,6400
350  M[6]=M1
360  M[7]=S1
370  GOSUB 7000
380  MAT  PRINT #5,3;P
390  GOSUB 5500
400  CHAIN V1,"simula",8100
1000  REM general notes
1010  PRINT TAB(10);"To simulate this network 'SIM' requires dis
1020  PRINT TAB(10);"four variables - S.P.I., O.P.I., Pu, A/O. T
1030  PRINT TAB(10);"input of these data is decided by you. In s
1040  PRINT TAB(10);"specify either normal or 'special' and in c
1050  PRINT TAB(10);"specify mean and s.d. or allow 'SIM' to sel
1060  PRINT TAB(10);"from standard figures"
1080  RETURN
1100  REM input distribution
1110  PRINT TAB(10);"The required data for this distribution are
1120  PRINT TAB(10);"[a]   The value of the variable, and"
1130  PRINT TAB(10);"[b]   The percentage occurance of that valu
1140  PRINT TAB(10);"Enter each pair of values a, b on one line,
1145  PRINT TAB(10);"of the variable. 'SIM' will display the rem

butions of"
method of"
 cases you"
ers you"
 these parameter

 ascending orde
ning %age in the
```

```
1150  PRINT TAB(10);"left hand margin before each pair of values    re input."
1155  PRINT TAB(10);"Input will be terminated when the cumulative    tage = 100
1160  RETURN
1200  REM input option
1205  PRINT "Input option";
1210  PRINT " (NOR/OWN/REU/?)    ";
1220  INPUT R$
1230  R$=UPS$(R$)
1240  P=0
1250  IF R$="NOR" THEN 1380
1260  IF R$="OWN" THEN 1370
1270  IF R$="REU" THEN 1360
1280  PRINT TAB(10);"Three options are available for this distrib    tion"
1290  PRINT TAB(10);"NOR - NORMAL distribution - you specify mean    and standard"
1300  PRINT TAB(10);"        deviation only."
1310  PRINT TAB(10);"OWN - OWN distribution - you input a 'specia    ' distribution
1320  PRINT TAB(10);"        which will be saved for re-use if requ    red"
1330  PRINT TAB(10);"REU - RE-USE a distribution previously input    under 'OWN'"
1350  GOTO 1210
1360  P=P+1
1370  P=P+1
1380  P=P+1
1390  RETURN
2000  REM    input distbn.   ------------
2010  PRINT TAB(10);"OWN DISTRIBUTION INPUT"
2020  PRINT TAB(15);"Need help   ";
2030  INPUT R$
2040  R$=UPS$(R$)
2050  IF R$="NO" THEN 2160
2060  GOSUB 1100
2160  T=100
2165  I=0
2170  MAT D=ZER
2175  I=I+1
2180  PRINT TAB(5);T;TAB(20);
2185  INPUT D[I,1],D[I,2]
2190  T=T-D[I,2]
2200  IF T>0 THEN 2175
2210  IF T=0 THEN 2235
2220  PRINT TAB(5);"** ERROR - CUMULATIVE PERCENTAGE GREATER THA    100 **
2225  PRINT TAB(5);"** THIS INPUT IS SCRAPPED - START AGAIN    **"
2230  GOTO 2160
2235  T1=T=T2=0
2240  FOR J=1 TO I
2245  T=T+D[J,2]
2250  T1=T1+(D[J,1]*D[J,2])
2255  T2=T2+(D[J,1]*D[J,2]*D[J,2])
2260  NEXT J
2270  M1=T1/T
2275  S1=(T2/T)-(M1*M1)
2276  IF S1 <= 0 THEN 2284
2280  S1=SQR(S1)
2281  GOTO 2285
2284  S1=0
```

```
2285  PRINT TAB(10);"MEAN = ";M1;TAB(30);"STANDARD DEVIATION = ";S
2290  PRINT TAB(10);"[ Remember these values you may need them aga
2295  GOSUB 4000
2300  RETURN
2400  REM Histogram
2405  PRINT TAB(10);"Histogram Plot  ";
2406  INPUT R$
2410  R$=UPS$(R$)
2415  IF R$="NO" THEN 2540
2420  IF R$="YES" THEN 2430
2425  GOTO 2410
2430  PRINT TAB(10);"HISTOGRAM"
2440  PRINT TAB(30);"% age occurance"
2445  IMAGE 14x,"0",9x,"20",8x,"40",8x,"60",8x,"80",8x,"100"
2450  IMAGE 14x,"+---------+---------+---------+---------+-------
2455  PRINT  USING 2445
2460  PRINT  USING 2450
2470  FOR J=1 TO I
2480  PRINT TAB(2);D[J,1];TAB(14);"I";
2490  J1=D[J,2]/2
2500  FOR I1=1 TO J1
2510  PRINT "*";
2520  NEXT I1
2525  PRINT
2530  NEXT J
2540  RETURN
3290  PRINT TAB(10);"Pu    ";
3500  REM cusum plot
3510  MAT P=ZER
3520  P[1,1]=D[1,1]
3530  P[1,2]=D[1,2]
3540  FOR J=2 TO I
3550  P[J,1]=D[J,1]
3555  P[J,2]=P[J-1,2]+D[J,2]
3560  NEXT J
3570  PRINT TAB(10);"Cumulative Probability Plot   ";
3580  INPUT R$
3585  R$=UPS$(R$)
3590  IF R$="NO" THEN 3710
3595  IF R$="YES" THEN 3600
3596  GOTO 3570
3600  PRINT TAB(10);"Cumulative Probability (%)"
3610  PRINT  USING 2445
3620  PRINT  USING 2450
3630  FOR J=1 TO I
3640  PRINT TAB(2);P[J,1];TAB(14);"I";
3650  I1=P[J,2]/2
3660  FOR J1=1 TO I1
3670  PRINT " ";
3680  NEXT J1
3690  PRINT "*"
3700  NEXT J
3710  RETURN
4000  READ #5,1;R
```

```
4010  GOSUB 2400
4020  GOSUB 3500
4030  R=R+1
4040  PRINT #5,1;R
4050  R=R+3
4060  GOSUB 5000
4080  RETURN
5000  REM printing to file
5010  IMAGE ddd.dd
5020  PRINT #5,R;M1,S1
5030  MAT  PRINT #5;P
5040  RETURN
5100  REM "R"
5110  PRINT TAB(10);"S.P.I. and O.P.I. have been shown to be corr
5120  PRINT TAB(10);"want to input this value of 'R' or allow 'SI
5130  PRINT TAB(10);"a typical value "
5140  PRINT TAB(10);"(INP/GEN)    ";                        lated. Do you
5150  INPUT R$                                              ' to generate
5160  R$=UPS$(R$)
5170  IF R$="INP" THEN 5220
5180  IF R$="GEN" THEN 5250
5190  PRINT TAB(5);"INP - you will input 'R'"
5200  PRINT TAB(5);"GEN - 'SIM' will generate 'R'"
5210  GOTO 5140
5220  PRINT TAB(10);"CORRELATION COEFFICIENT 'R'  = ";
5230  INPUT R
5240  IF R <= 1 THEN 5300
5242  PRINT TAB(5);"** ERROR - 'R' MUST BE LESS THAN OR EQUAL TO
5245  GOTO 5220
5250  M1=.706
5255  S1=.136
5260  GOSUB 7000
5265  GOSUB 7100
5270  IF R <= 1 THEN 5290
5280  R=1
5290  PRINT TAB(5);"CORRELATION COEFFICIENT 'R' = ";R
5300  RETURN
5500  REM  A/O
5510  PRINT TAB(10);"ABSENTEEISM/OVERLOADING"
5515  PRINT
5520  PRINT TAB(5);"Distributions of this variable are assumed t
5530  PRINT TAB(5);"the parameters required for this variable ar
5540  PRINT TAB(5);"deviation. Do you want to INPut these values
5550  PRINT TAB(5);"'SIM' to GENerate typical values."
5570  PRINT TAB(10);"(INP/GEN)    ";               ne normal. Therefor
5580  INPUT R$                                     nean and standard"
5590  R$=UPS$(R$)                                  r allow"
5600  IF R$="INP" THEN 5650
5610  IF R$="GEN" THEN 5680
5640  GOTO 5570
5650  GOSUB 6080
5652  M[8]=M1
5654  M[9]=S1
5660  GOSUB 7000
```

```
5670  GOTO 5890
5680  M1=.98
5690  S1=2.95
5700  GOSUB 7000
5710  GOSUB 7100
5720  M[8]=R
5730  M1=6.37
5740  S1=3.44
5750  GOSUB 7000
5760  GOSUB 7100
5770  M[9]=R
5780  M1=M[8]
5790  S1=M[9]
5800  GOSUB 7000
5890  MAT  PRINT #5;P
5900  MAT  PRINT #5,2;M
5905  PRINT TAB(5);"A/O DISTRIBUTION - MEAN = ";M1
5906  PRINT TAB(5);"                  - S.D.  = ";S1
5910  RETURN
6000  REM  normal distributions
6020  PRINT TAB(10);"NORMAL DISTRIBUTION "
6080  PRINT TAB(10);"MEAN   = ";                                      -.1,0,.1,.
6090  INPUT M1
6100  PRINT TAB(10);"S.D.   = ";                                      3085,.3446
6120  INPUT S1                                                         7,.758
6130  RETURN
6290  DATA -3,-2.25,-1.5,-1.25,-1,-.9,-.8,-.7,-.6,-.5,-.4,-.3,-.2
6300  DATA .3,.4,.5,.6,.7,.8,.9,1,1.25,1.5,2.25,3
6310  DATA .00135,.0122,.0668,.1056,.1587,.1841,.2119,.242,.2743,
6320  DATA .3821,.4207,.4602,.5,.5398,.5793,.6179,.6554,.6915,.72
6330  DATA .7881,.8159,.8413,.8944,.9332,.9878,.99865
6400  REM re-using distribution
6410  PRINT TAB(10);"RE-USING A DISTRIBUTION"
6420  PRINT TAB(5);"Input the following parameters for the distr
6440  GOSUB 6080                                  ption you wish to use
6480  READ #5,1;R
6490  IF R>0 THEN 6530
6500  PRINT TAB(5);"** ERROR - YOU HAVE NOT SPECIFIED ANY DISTRI
6510  PRINT TAB(5);"** WE WILL ASSUME A NORMAL DISTRIBUTION FOR
6515  GOSUB 7000                                          TIONS **"
6520  RETURN                                              IS VARIABLE *
6530  R1=R+3
6540  FOR R=4 TO R1
6550  READ #5,R;M2,S2
6560  IF M1=M2 AND S1=S2 THEN 6660
6570  NEXT R
6580  PRINT TAB(5);"** ERROR - A DISTRIBUTION WITH THESE PARAMET
6590  GOTO 6510                                   S IS NOT IN STORE *
6660  MAT READ #5;P
6670  RETURN
7000  REM
7010  MAT P=ZER
7020  FOR J=1 TO 29
7030  P[J,2]=N[2,J]
```

```
7040  P[J,1]=(N[1,J]*S1)+M1
7050  NEXT J
7060  RETURN
7100  P=TIM(0)
7110  X=RND(P)
7120  FOR J=1 TO 29
7130  IF X <= P[J,2] THEN 7170
7140  NEXT J
7150  R=(3*S1)+M1
7160  GOTO 7220
7170  X1=X-P[J-1,2]
7180  X2=P[J,2]-P[J-1,2]
7190  Y2=P[J,1]-P[J-1,1]
7200  Y1=(X1*Y2)/X2
7210  R=Y1+P[J-1,1]
7220  RETURN
9999  END
```

LSTF

```
10   COM C$[70],X[6],Y[6],F$[30]
15   REM          SIMULATION SUITE - LISTING FILES
20   REM          N. Bartram          Mar '79
25   FILES *,*,*,*,*
30   ASSIGN F$[1,5],1,V1
40   ASSIGN F$[6,10],2,V1
50   ASSIGN F$[11,15],3,V1
60   ASSIGN F$[16,20],4,V1                                   250
70   DIM R1$[250],R$[3],L$[20],M$[40],X$[4],O$[200],O[100],U[8],O1
80   DIM L[10],B[10,2],P[20,2],M[20],D[4],A[5,3],R[5,3],Z[10,3]
85   DIM C1$[5],N$[35],F1$[2],F0$[2]
86   DIM N[9,32],H$[64],S[32],NO$[250],J[31]
87   DIM U$[6]
90   IF X[2]=0 THEN 120
100  C1$=C$[X[2],Y[2]]
110  GOTO 140
120  PRINT TAB(10);"SUB-COMMAND   (RES/OPS/NET)     ";
130  INPUT C1$
135  C1$=UPS$(C1$)
140  X$="RON"
145  U$="M M2M3"
150  X1=POS(X$,C1$[1,1])
160  IF X1=0 THEN 190
170  GOSUB X1 OF 300,1300,4000
180  CHAIN V1,"sim",150
190  PRINT TAB(5);"ERROR - SUB-COMMAND ";C1$;" NOT RECOGNISED **"
200  MAT X=ZER
210  GOTO 120
240  STOP
300  REM resources
310  IF X[3]=0 THEN 340
320  C1$=C$[X[3],Y[3]]
330  GOTO 360
340  PRINT TAB(10);"WHICH RESOURCE(S) DO YOU WANT (LAB/MAT/PL/ALL
350  INPUT C1$
355  C1$=UPS$(C1$)
360  X$="LMPA"
370  X1=POS(X$,C1$[1,1])
380  IF X1=0 THEN 420
390  IF X1=4 THEN 450
400  GOSUB X1 OF 500,700,950
410  RETURN
420  PRINT TAB(5);"** ERROR - RESOURCE COMMAND ";C1$;" NOT RECOG
430  MAT X=ZER
440  GOTO 340
450  GOSUB 500
460  GOSUB 700
470  GOSUB 950
480  RETURN
500  REM labour listing
510  MAT  READ #1,1;L,B
515  READ #1,4;L$,R1$
```

```
520  PRINT
530  PRINT TAB(15);"LABOUR"
535  PRINT TAB(15);"******"
540  PRINT
550  IF L[1]=0 THEN 680
555  PRINT TAB(10);"CODE";TAB(20);"DESCRIPTION";TAB(40);"RATE #";T
556  T=1                                                   B(60);"UNIT"
560  J=0
570  J=J+1
580  IF J=11 THEN 690
585  IF L[J]=0 THEN 570
590  T=T+L[J]
600  PRINT TAB(10);L$[2*J-1,2*J];TAB(20);R1$[T-L[J],T-1];TAB(40);
610  GOTO B[J,2] OF 620,640,660
620  PRINT B[J,1];TAB(60);"hour"
630  GOTO 570
640  PRINT B[J,1]*9.25;TAB(60);"day"
650  GOTO 570
660  PRINT B[J,1]*9.25*5;TAB(60);"week"
670  GOTO 570
680  PRINT TAB(10);"NO LABOUR HAS BEEN DEFINED"
690  RETURN
700  REM materials
710  MAT  READ #1,2;M,P
720  READ #1,5;M$,R1$
730  PRINT
740  PRINT TAB(15);"MATERIALS"
750  PRINT TAB(15);"*********"
760  PRINT
770  IF M[1]=0 THEN 930
780  PRINT TAB(10);"CODE";TAB(20);"DESCRIPTION";TAB(40);"RATE #";T
790  T=1                                                   B(60);"UNIT"
800  J=0
810  J=J+1
820  IF J=21 THEN 940
830  IF M[J]=0 THEN 810
840  T=T+M[J]
850  PRINT TAB(10);M$[2*J-1,2*J];TAB(20);R1$[T-M[J],T-1];TAB(40);FA
860  GOTO P[J,2] OF 810,810,810,870,890,910                 J,1];
870  PRINT TAB(60);"m"
880  GOTO 810
890  PRINT TAB(60);"m2"
900  GOTO 810
910  PRINT TAB(60);"m3"
920  GOTO 810
930  PRINT TAB(10);"NO MATERIALS HAVE BEEN DEFINED "
940  RETURN
950  REM plant
960  READ #1,6;M$,R1$
970  MAT  READ #1,3;M,P
980  PRINT
990  PRINT TAB(15);"PLANT"
1000  PRINT TAB(15);"*****"
1010  PRINT
```

```
1020  IF M[1]=0 THEN 1270
1030  PRINT TAB(10);"CODE";TAB(20);"DESCRIPTION";TAB(40);"RATE #";
1040  T=1
                                                           'AB(60);"UNIT"
1050  J=0
1060  J=J+1
1070  IF J=21 THEN 1280
1080  IF M[J]=0 THEN 1060
1090  T=T+M[J]
1100  PRINT TAB(10);M$[2*J-1,2*J];TAB(20);R1$[T-M[J],T-1];
1200  GOTO P[J,2] OF 1210,1230,1250
1210  PRINT TAB(40);P[J,1];TAB(60);"hour"
1220  GOTO 1060
1230  PRINT TAB(40);P[J,1]*9.25;TAB(60);"day"
1240  GOTO 1060
1250  PRINT TAB(40);P[J,1]*9.25*5;TAB(60);"week"
1260  GOTO 1060
1270  PRINT TAB(10);"NO PLANT HAS BEEN DEFINED"
1280  RETURN
1300  REM operations listing
1310  READ #2,1;O$
1320  N1=LEN(O$)/2
1325  IF N1=.5 THEN 1450
1330  PRINT
1340  PRINT TAB(15);"OPERATIONS"
1350  PRINT TAB(15);"**********"
1360  PRINT
1380  GOSUB 9000
1390  IF A$="A" THEN 1410
1400  IF A$="B" THEN 1430
1410  GOSUB 2000
1420  GOTO 1440
1430  GOSUB 2500
1440  RETURN
1450  PRINT TAB(10);"NO OPERATIONS HAVE BEEN DEFINED"
1460  RETURN
2000  REM listing ops between n2 & n3
2010  MAT  READ #2,10;O,U
2020  PRINT TAB(5);"COUNT";TAB(15);"CODE";TAB(25);"DESCRIPTION";TA
2022  PRINT TAB(60);"QUANTITY"
                                                           (45);"DURATION"
2025  PRINT
2030  J=N2-1
2040  J=J+1
2050  PRINT TAB(7);J;TAB(16);O$[2*J-1,2*J];TAB(25);
2060  T=0
2070  FOR I=1 TO J
2080  T=T+O[I]
2090  NEXT I
2100  FOR I=1 TO 8
2110  IF T <= U[I] THEN 2140
2120  T=T-U[I]
2130  NEXT I
2140  I1=I+1
2150  READ #2,I1;O1$
2160  PRINT O1$[T-O[J]+1,T];
```

```
2170  I1=J+10
2180  MAT  READ #2,I1;D,A,R,Z
2190  GOTO D[2] OF 2200,2220,2240
2200  PRINT TAB(45);D[1];"hours";
2210  GOTO 2250
2220  PRINT TAB(45);D[1]/9.25;"days";
2230  GOTO 2250
2240  PRINT TAB(45);D[1]/(9.25*5);"weeks";
2250  R$=U$[2*D[4]-1,2*D[4]]
2255  PRINT TAB(60);D[3];R$
2257  IF J<N3 THEN 2040
2260  RETURN
2500  REM listing of one operation
2510  N2=POS(O$,C1$)
2520  IF N2>0 THEN 2560
2530  PRINT TAB(5);"ERROR - OPERATION ";C1$;" IS NOT IN STORE ** '
2540  RETURN
2560  MAT  READ #2,10;O,U
2565  T=0
2570  J=(N2+1)/2
2580  FOR I=1 TO J
2590  T=T+O[I]
2600  NEXT I
2610  FOR I=1 TO 8
2620  IF T <= U[I] THEN 2650
2630  T=T-U[I]
2640  NEXT I
2650  I1=I+1
2660  READ #2,I1;O1$
2670  I1=J+10
2680  MAT  READ #2,I1;D,A,R,Z
2690  PRINT TAB(10);"OPERATION CODE";TAB(30);C1$
2700  PRINT TAB(10);"DESCRIPTION";TAB(30);O1$[T-O[J]+1,T]
2710  PRINT TAB(10);"DURATION";TAB(30);
2730  GOTO D[2] OF 2740,2760,2780
2740  PRINT D[1],"hours"
2750  GOTO 2790
2760  PRINT D[1]/9.25,"days"
2770  GOTO 2790
2780  PRINT D[1]/(9.25*5),"weeks"
2790  R$=U$[2*D[4]-1,2*D[4]]
2793  PRINT TAB(10);"QUANTITY";TAB(30);D[3];R$
2794  PRINT
2795  PRINT TAB(15);"RESOURCES";TAB(30);"CODE";TAB(50);"REQUIREMEN
2800  PRINT TAB(15);"LABOUR";TAB(30);
2810  IF A[1,1]>0 THEN 2840
2820  PRINT "NONE SPECIFIED"
2830  GOTO 2900
2840  READ #1,4;L$,R1$
2850  FOR I=1 TO 5
2860  IF A[I,1]=0 THEN 2890
2870  I1=2*A[I,1]-1
2880  PRINT TAB(30);L$[I1,I1+1];TAB(50);A[I,2],"no."
2890  NEXT I
```

```
2900  PRINT
2910  PRINT TAB(15);"MATERIALS";TAB(30);
2920  IF R[1,1]>0 THEN 2950
2930  PRINT "NONE SPECIFIED"
2940  GOTO 3000
2950  READ #1,5;M$,R1$
2960  FOR I=1 TO 5
2965  IF R[I,1]=0 THEN 2990
2970  I1=2*R[I,1]-1
2980  PRINT TAB(30);M$[I1,I1+1];TAB(50);R[I,2]
2990  NEXT I
3000  PRINT
3010  PRINT TAB(15);"PLANT";TAB(30);
3020  IF Z[1,1]>0 THEN 3050
3030  PRINT "NONE SPECIFIED"
3040  RETURN
3050  READ #1,6;M$,R1$
3060  FOR I=1 TO 10
3070  IF Z[I,1]=0 THEN 3100
3080  I1=2*Z[I,1]-1
3090  PRINT TAB(30);M$[I1,I1+1];TAB(50);Z[I,2],"no"
3100  NEXT I
3110  RETURN
4000  REM networks
4005  READ #3,1;X1,N$
4010  PRINT TAB(15);"NETWORKS ";X1;" NETWORKS ARE CURRENTLY IN STO
4030  PRINT TAB(10);"[1]   LIST ALL THESE NETWORKS SHOWING CODE AN
4035  PRINT TAB(10);"[2]   GET A PRINT OF ONE NETWORK"
4040  PRINT TAB(10);"ENTER OPTION (1 or 2)   ";          E YOU CAN"
4050  INPUT X2                                            TITLE, OR"
4055  IF X2=1 THEN 4090
4060  IF X2=2 THEN 4096
4075  GOTO 4040
4090  GOSUB 5000
4095  RETURN
4096  GOSUB 5200
4097  RETURN
5000  REM listing all networks
5010  PRINT
5020  PRINT TAB(10);"NETWORK CODE";TAB(30);"DESCRIPTION"
5040  MAT  READ #3,2;J
5060  READ #3,3;NO$
5070  T=1
5080  FOR I=1 TO X1
5090  PRINT TAB(12);N$[3*I-1,3*I];
5100  T=T+J[I]
5105  PRINT TAB(30);NO$[T-J[I],T-1]
5111  NEXT I
5120  PRINT
5130  RETURN
5200  REM printing one network
5205  PRINT TAB(5);"NETWORK CODE (PREFIXED M OR S)   ";
5210  READ #3,1;I,N$
5215  INPUT C1$
```

```
5216  C1$=UPS$(C1$)
5220  J1=POS(N$,C1$)
5225  IF J1>0 THEN 5240
5230  PRINT TAB(5);"** ERROR - NETWORK ";C1$;" IS NOT IN STORE **"
5235  RETURN
5240  MAT  READ #3,2;J
5250  I1=0
5255  PRINT TAB(10);"NETWORK   ";
5260  T=1
5265  J1=(J1+2)/3
5270  FOR I1=1 TO J1
5280  T=T+J[I1]
5290  NEXT I1
5320  I1=(4*J1)+(J1-1)
5330  GOSUB 6000
5340  DIM W[2,50]
5345  MAT W=ZER
5350  I1=0
5360  FOR I=1 TO 32
5365  FOR J=2 TO 9
5370  IF N[J,I]=0 THEN 5400
5375  I1=I1+1
5380  W[1,I1]=N[1,I]
5390  W[2,I1]=N[J,I]
5400  NEXT J
5405  NEXT I
5415  PRINT C1$[2,3];TAB(30);NO$[T-J[J1],T]
5416  PRINT
5420  I=0
5425  I=I+1
5430  FOR J=1 TO 32
5440  IF S[J] <> I THEN 5760
5450  FO$=H$[2*J-1,2*J]
5460  IF FO$="FF" THEN 5770
5470  IF FO$="SS" THEN 5510
5480  X1=POS(O$,FO$)
5490  X1=(X1+1)/2
5500  GOTO 5520
5510  X1=101
5520  Z9=0
5530  FOR J1=1 TO 50
5540  IF X1=W[2,J1] THEN 5610
5550  NEXT J1
5560  IF Z9>0 THEN 5590
5570  IF I<32 THEN 5425
5580  GOTO 5770
5590  PRINT
5600  GOTO 5430
5610  X2=W[1,J1]
5620  W[2,J1]=W[1,J1]=0
5630  F1$=O$[2*X2-1,2*X2]
5640  T1=(POS(H$,FO$)+1)/2
5645  T1=S[T1]*4-3
5650  T2=(POS(H$,F1$)+1)/2
```

```
5655  T2=S[T2]*4-3
5660  IF Z9>0 THEN 5680
5670  PRINT TAB(T1);F0$;
5680  FOR P=T1+2 TO T2-1
5690  PRINT "-";
5700  NEXT P
5710  PRINT F1$;
5720  Z9=Z9+1
5730  F0$=F1$
5740  X1=X2
5750  GOTO 5530
5760  NEXT J
5770  RETURN
6000  REM network basic data
6005  READ #3,I1;J
6010  FOR J=1 TO 9
6020  FOR I=1 TO 32
6030  READ #3;N[J,I]
6040  NEXT I
6050  NEXT J
6060  I1=I1+3
6070  MAT  READ #3,I1;S
6080  I1=I1+1
6090  READ #3,I1;H$
6095  H$=UPS$(H$)
6100  READ #2,1;O$
6110  RETURN
9000  REM
9015  R$=UPS$(R$)
9060  PRINT TAB(10);N1;" OPERATIONS ARE CURRENTLY IN STORE, YOU C
9070  PRINT TAB(10);"[a]  LIST ALL (OR SOME) OF THESE OPERATIONS I
9080  PRINT TAB(10);"     DESCRIPTION & DURATION, OR"
9090  PRINT TAB(10);"[b]  GET A DETAILED DESCRIPTION OF ONE OPERA
9100  PRINT TAB(5);"ENTER OPTION (a OR b)    ";
9110  INPUT A$
9115  A$=UPS$(A$)
9120  IF A$="A" THEN 9150
9130  IF A$="B" THEN 9270          HE ORDER IN WHICH THEY WERE INPUT]"
9140  GOTO 9100
9150  PRINT "[NOTE THAT THE OPERATIONS ARE STORED AND NUMBERED IN
9160  PRINT TAB(10);"ENTER START OPERATION NUMBER & FINISH OPERAT
                                                          ON NUMBER'
9170  INPUT N2,N3
9180  IF N3 >= N2 THEN 9210
9190  PRINT "** ERROR - START NUMBER SHOULD BE LESS THAN FINISH N
9200  GOTO 9160
9210  IF N2 <= N1 THEN 9240
9220  PRINT "** ERROR - WE HAVE ONLY GOT ";N1;" OPERATIONS IN STO
9230  GOTO 9160
9240  IF N3 <= N1 THEN 9260
9250  GOTO 9220
9260  RETURN
9270  PRINT TAB(10);"ENTER OPERATION CODE    ";
9280  INPUT C1$
9285  C1$=UPS$(C1$)
9290  RETURN
9999  END
```

REPO

```
5   COM C$[70],X[6],Y[6],F$[30]
10  REM          SIMULATION SUITE - REPORT GENERATOR
15  REM          N. Bartram                      May '79
20  FILES *,*,*,*,*,*,mastrf,report
25  FOR J=1 TO 6
30  ASSIGN F$[5*J-4,5*J],J,V1
35  NEXT J
70  DIM O$[200],R$[3],C1$[10],A[12],B[20,2],L1$[250],L$[20],M$[40]
80  DIM Z$[24],O[100],D[4],L[5,3],M[5,3],N$[35],J[31],T[32,10]
85  DIM P$[40],P[10,3],S[30],H$[64],A$[120],G[6]
86  N=8
90  GOSUB 1400
92  MAT  READ G
95  Z$="HOURDAY WEEKM   M2  M3  "
97  A$="EDOR"
100  PRINT TAB(10);"REPORT GENERATION"
110  PRINT TAB(10);"Need Help   ";
112  INPUT R$
114  R$=UPS$(R$)
115  IF R$="NO" THEN 140
120  IF R$="YES" THEN 130
125  GOTO 110
130  GOSUB 1000
140  PRINT TAB(5);"*";
150  LINPUT C$
155  C$=UPS$(C$)
160  GOSUB 1200
170  IF X[1]=0 THEN 140
180  C1$=C$[X[1],Y[1]]
190  P1=POS(A$,C1$[1,1])
200  IF P1=0 THEN 225
210  GOSUB P1 OF 300,2000,3000,5000
220  GOTO 140
225  PRINT TAB(5);"** ERROR - SUB-COMMAND ";C1$;" NOT RECOGNISED *
230  GOTO 110
300  PRINT TAB(5);"** REPORT GENERATION FINISHED - REMEMBER ANOTHE
310  PRINT TAB(5);"** 'REP' COMMAND WILL OVER-WRITE  THE REPORTS A
320  PRINT TAB(5);"** ERATED, YOU MUST WAIT UNTILL YOU HAVE OBTAIN
330  PRINT TAB(5);"** REPORTS BEFORE REPEATING THIS COMMAND
350  CHAIN V1,"sim",150
360  END
1000  PRINT TAB(25);"The following commands are available"
1010  PRINT TAB(10);"for generating standard reports ;"
1020  PRINT TAB(10);"DES - To list the basic resource descriptions
1030  PRINT TAB(10);"OPS - To list the operations"
1040  PRINT TAB(10);"RES - To obtain results of a standard analysi
1050  PRINT TAB(10);"        OR a simulation"
1060  PRINT TAB(5);"With the 'RES' sub-command three parameters ar
1070  PRINT TAB(5);"No. 1 - 'ANA' - To obtain results of standard
1080  PRINT TAB(5);"        'SIM' - To obtain results of the simula
1090  PRINT TAB(5);"No. 2 - 'Snet/Mnet'"
1100  PRINT TAB(5);"No. 3 - Network code letters"

 USE OF THE **"
LREADY GEN **"
D YOUR     **"
           ** "

 required"
etwork analyses"
ions  "
```

```
1120  PRINT TAB(15);"To finish generating reports use the sub-comm
1130  PRINT TAB(10);"END. Report sub-commands are prompted by an a
1140  RETURN
1200  MAT X=ZER
1210  MAT Y=ZER
1220  M=LEN(C$)
1230  IF C$[M,M] <> "," THEN 1260
1240  PRINT TAB(5);"** ERROR - incorrect command input **"
1245  MAT X=ZER
1250  RETURN
1260  N3=N2=0
1270  N2=N2+1
1280  X[N2]=N3+1
1285  N3=N3+1
1290  IF C$[N3,N3]="," THEN 1320
1300  IF N3=M THEN 1340
1310  GOTO 1285
1320  Y[N2]=N3-1
1330  GOTO 1270
1340  Y[N2]=M
1350  RETURN
1400  REM     report heading
1405  PRINT #N;TAB(40);"PROJECT ANALYSIS AND SIMULATION"
1406  PRINT #N;TAB(40);"*******************************"
1410  PRINT #N
1430  CONVERT F$[5,5] TO M,1440
1435  GOTO 1460
1440  PRINT TAB(5);"** ERROR - IN ESTIMATE REFERANCE **"
1450  RETURN
1460  READ #7,M;C1$,C$
1500  N1=TIM(2)
1510  N2=TIM(3)
1520  N3=(N2+1900)/4
1540  MAT  READ A
1550  DATA 31,28,31,30,31,30,31,31,30,31,30,31
1560  N4=INT(N3)
1570  IF N3-N4>0 THEN 1590
1580  A[2]=29
1590  FOR I=1 TO 12
1600  IF N1 <= A[I] THEN 1630
1610  N1=N1-A[I]
1620  NEXT I
1630  PRINT #N;TAB(50);N1;":";I;":";N2
1660  PRINT #N;TAB(25);"ESTIMATE REFERENCE";TAB(50);C1$
1670  PRINT #N;TAB(25);"DESCRIPTION";TAB(50);C$
1690  RETURN
2000  REM descriptions
2010  MAT J=ZER[10]
2020  MAT B=ZER[10,2]
2030  MAT  READ #1,1;J,B
2040  READ #1,4;L$,L1$
2060  PRINT #N;'1;TAB(40);"RESOURCE DESCRIPTIONS"
2065  PRINT #N;TAB(40);"*********************"
2070  PRINT #N
```

```
2075  GOSUB 9800
2080  PRINT #N;TAB(4);"!";TAB(13);"RESOURCE";TAB(29);"!";TAB(37);"
2085  PRINT #N;TAB(49);"!";TAB(59);"DESCRIPTION";TAB(79);"!";TAB(8
2090  PRINT #N;TAB(96);"!";TAB(103);"UNIT";TAB(114);"!"
2095  GOSUB 9800                                          ODE";
2100  PRINT #N;TAB(4);"!";TAB(13);"LABOUR";TAB(29);"!";   );"COST";
2105  IF J[1]>0 THEN 2130
2110  GOSUB 9870
2120  GOTO 2220
2130  J=LEN(L$)/2
2140  T=0
2150  FOR I=1 TO J
2160  PRINT #N;TAB(37);L$[2*I-1,2*I];TAB(49);"!";TAB(55);L1$[T+1,T
2175  N1=4*B[I,2]-3
2176  T=T+J[I]                                     J[I]];TAB(79);"!";
2180  PRINT #N; USING 2190;B[I,1],Z$[N1,N1+3]
2190  IMAGE 5x,ddd.dd,5x,"!",6x,4a,7x,"!"
2195  PRINT #N;TAB(4);"!";TAB(29);"!";
2200  NEXT I
2210  PRINT #N;TAB(49);"!";TAB(79);"!";TAB(96);"!";TAB(114);"!"
2220  MAT J=ZER[20]
2225  MAT B=ZER[20,2]
2230  MAT  READ #1,2;J,B
2240  READ #1,5;M$,L1$
2250  PRINT #N;TAB(4);"!";TAB(13);"MATERIALS";TAB(29);"!";
2260  IF J[1]>0 THEN 2290
2270  GOSUB 9870
2280  GOTO 2300
2290  GOSUB 2500
2300  MAT  READ #1,3;J,B
2310  READ #1,6;M$,L1$
2320  PRINT #N;TAB(4);"!";TAB(13);"PLANT";TAB(29);"!";
2330  IF J[1]>0 THEN 2360
2340  GOSUB 9870
2350  GOTO 2370
2360  GOSUB 2500
2370  GOSUB 9800
2380  RETURN
2500  J=LEN(M$)/2
2510  T=0
2520  FOR I=1 TO J
2530  PRINT #N;TAB(37);M$[2*I-1,2*I];TAB(49);"!";
2540  PRINT #N;TAB(55);L1$[T+1,T+J[I]];TAB(79);"!";
2550  N1=4*B[I,2]-3
2560  T=T+J[I]
2570  PRINT #N; USING 2190;B[I,1]*G[B[I,2]],Z$[N1,N1+3]
2575  PRINT #N;TAB(4);"!";TAB(29);"!";
2580  NEXT I
2590  PRINT #N;TAB(49);"!";TAB(79);"!";TAB(96);"!";TAB(114);"!"
2595  GOSUB 9800
2600  RETURN
3000  REM   operations
3010  MAT A=ZER[8]
3015  MAT T=ZER[10,3]
```

```
3017  MAT J=ZER[20]
3020  READ #2,1;O$
3030  READ #2,2;L1$
3035  MAT  READ #2,10;O,A
3040  MAT  READ #1,2;J,B
3045  READ #1,4;L$
3050  READ #1,5;M$
3055  READ #1,6;P$
3062  PRINT #N;CTL(1)
3065  PRINT #N;TAB(40);"OPERATIONS"
3066  PRINT #N;TAB(40);"**********"
3070  PRINT #N
3080  IF O[1]>0 THEN 3110
3085  PRINT #N;TAB(40);"NONE SPECIFIED"
3090  PRINT #N;TAB(40);"**************"
3100  GOTO 3370
3110  GOSUB 9800
3120  PRINT #N;TAB(4);"! CODE !";TAB(20);"DESCRIPTION";TAB(38);"!"
3125  PRINT #N;"  STD DURATION !   QUANTITY   !   LABOUR    !";
3130  PRINT #N;"     MATERIALS   !    PLANT      !"
3135  GOSUB 9800
3140  T=I=I1=0
3150  T1=1
3160  I=I+1
3162  I1=0
3165  IF O[I]=0 THEN 3370
3166  MAT  READ #2,I+10;D,L,M,T
3170  PRINT #N;TAB(4);"!   ";O$[2*I-1,2*I];"  !    ";
3175  T=T+O[I]
3180  IF T <= A[T1] THEN 3200
3185  T1=T1+1
3190  T=O[I]
3195  READ #2,T1+1;L1$
3200  PRINT #N;L1$[T-O[I]+1,T];TAB(38);"!";
3205  Z=D[4]+3
3206  GOSUB 4000
3210  PRINT #N; USING 3215;D[1],Z$[4*D[2]-3,4*D[2]],D[3],Z$[4*Z-3,
                                                                 *Z]
3215  IMAGE #,X,DDDD.DD,2X,4A,X,"!",X,DDD.DD,2X,4A,X,"!"
3220  I1=I1+1
3225  Z=0
3230  IF L[I1,1]=0 THEN 3260
3240  Z=1
3245  PRINT #N; USING 3250;L$[2*L[I1,1]-1,2*L[I1,1]],L[I1,2]
3250  IMAGE #,2x,2a,2x,2d,x,"no"
3260  PRINT #N;TAB(82);"!";
3265  IF M[I1,1]=0 THEN 3290
3270  J=4*B[M[I1,1],2]-3
3275  PRINT #N; USING 3280;M$[2*M[I1,1]-1,2*M[I1,1]],M[I1,2],Z$[J,
                                                                 +1]
3280  IMAGE #,x,aa,dddd.dd,2x,2a,x
3285  Z=1
3290  PRINT #N;TAB(99);"!";
3295  IF T[I1,1]=0 THEN 3310
3300  Z=1
3305  PRINT #N; USING 3250;P$[2*T[I1,1]-1,2*T[I1,1]],T[I1,2]
```

```
3310  PRINT #N;TAB(114);"!"
3315  IF Z=0 THEN 3360
3320  IF I1=10 THEN 3360
3325  IF I1 >= 5 THEN 3330
3326  PRINT #N; USING 3345
3327  GOTO 3220
3330  I1=I1+1
3335  Z=0
3340  PRINT #N; USING 3345
3345  IMAGE #,4x,"!",6x,"!",26x,"!",15x,"!",14x,"!"
3350  PRINT #N;TAB(82);"!";TAB(99);"!";
3355  GOTO 3295
3360  GOSUB 9800
3365  GOTO 3160
3370  RETURN
3900  REM
3910  INPUT C1$
3920  C1$=UPS$(C1$)
3930  RETURN
4000  REM units
4010  GOTO D[2] OF 4050,4020,4040
4020  D[1]=D[1]/9.25
4030  GOTO 4050
4040  D[1]=D[1]/(9.25*5)
4050  RETURN
5000  REM      results
5010  IF X[2]>0 THEN 5060
5020  PRINT TAB(10);"Parameter 1 (ANA/SIM)   ";
5030  GOSUB 3900
5050  GOTO 5070
5060  C1$=C$[X[2],Y[2]]
5070  IF C1$="SIM" THEN 5120
5080  IF C1$="ANA" THEN 5140
5090  MAT X=ZER
5100  PRINT TAB(5);"** ERROR - PARAMETER 1 ";C1$;" NOT RECOGNISED
5110  GOTO 5020
5120  T3=1
5130  GOTO 5150
5140  T3=2
5150  IF X[3]>0 THEN 5200
5160  PRINT TAB(10);"Prameter 2 (SNET/MNET)   ";
5170  GOSUB 3900
5190  GOTO 5210
5200  C1$=C$[X[3],Y[3]]
5210  IF C1$[1,1]="S" THEN 5260
5220  IF C1$[1,1]="M" THEN 5260
5230  PRINT TAB(5);"** ERROR - PARMETER 2 ";C1$;" NOT RECOGNISED *
5240  MAT X=ZER
5250  GOTO 5160
5260  R$[1,1]=C1$[1,1]
5270  IF X[4]>0 THEN 5305
5280  PRINT TAB(5);"Parameter 3 (NET CODE)   ";
5290  GOSUB 3900
5302  GOTO 5310
```

```
5305  C1$=C$[X[4],Y[4]]
5310  R$[2,3]=C1$
5320  READ #3,1;I,N$
5330  N1=POS(N$,R$)
5340  IF N1>0 THEN 5370
5350  PRINT TAB(5);"** ERROR - THIS NETWORK IS NOT IN STORE **"
5360  GOTO 5160
5370  N1=(N1+2)/3
5500  REM network analysis
5510  MAT  READ #3,2;J
5520  READ #3,3;L1$
5525  T1=0
5530  FOR I=1 TO N1
5540  T1=T1+J[I]
5550  NEXT I
5560  GOSUB T3 OF 8000,5570
5565  RETURN
5570  PRINT #N
5580  PRINT #N;TAB(50);"NETWORK ANALYSIS"
5585  PRINT #N;TAB(50);"****************"
5590  PRINT #N
5600  PRINT #N;TAB(30);"NETWORK CODE";TAB(50);R$[1,1];"/";R$[2,3]
5610  PRINT #N;TAB(30);"DESCRIPTION";TAB(50);L1$[T1-J[N1]+1,T1]
5620  PRINT #N
5630  PRINT #N;TAB(30);"TIME ANALYSIS"
5640  PRINT #N;TAB(30);"-------------"
5645  MAT T=ZER[32,8]
5650  PRINT #N
5660  GOSUB 9800
5665  READ #2,1;O$
5670  J=15*N1-13
5675  READ #4,J;I
5680  FOR I=1 TO 32
5685  FOR I1=1 TO 8
5700  READ #4;T[I,I1]
5710  NEXT I1
5720  NEXT I
5730  T1=0
5735  N2=1
5740  N2=N2+1
5750  IF N2=33 THEN 5775
5755  IF T[N2,6]=0 THEN 5775
5760  T1=T[N2,6]
5770  GOTO 5740
5775  GOSUB 9800
5780  PRINT #N;TAB(4);"! OPERATION ! STD DURATION !      TIME ->";
5785  N2=N2-1
5790  F1=1
5800  IF T1 <= 80 THEN 5860
5810  F1=9.25
5820  T1=T1/F1
5830  IF T1 <= 80 THEN 5880
5835  F1=5*9.25
5840  PRINT #N;"[WEEKS]";TAB(114);"!"
```

```
5850  GOTO 5890
5860  PRINT #N;"   [HOURS]";TAB(114);"!"
5870  GOTO 5890
5880  PRINT #N;"    [DAYS]";TAB(114);"!"
5890  PRINT #N;TAB(4);"!";TAB(16);"!      HOURS     !0";
5895  FOR I=1 TO 8
5900  PRINT #N; USING 5905;10*I
5905  IMAGE #,8x,dd
5910  NEXT I
5920  PRINT #N;TAB(114);"!"
5930  GOSUB 9800
5940  FOR J=2 TO N2-1
5950  PRINT #N;TAB(4);"!";
5960  IF T[J,8]=0 THEN 5970
5965  PRINT #N;"  *";
5970  PRINT #N;TAB(8);O$[2*T[J,1]-1,2*T[J,1]];TAB(16);"!";
5975  PRINT #N;TAB(20);T[J,2];TAB(30);"!";
5980  FOR I1=1 TO T[J,3]/F1
5985  PRINT #N;" ";
5990  NEXT I1
5995  FOR I1=1 TO T[J,2]/F1
6000  PRINT #N;"=";
6010  NEXT I1
6020  FOR I1=1 TO T[J,7]/F1
6030  PRINT #N;":";
6040  NEXT I1
6045  PRINT #N;TAB(114);"!"
6050  NEXT J
6060  GOSUB 9800
6070  PRINT #N
6075  PRINT #N;TAB(25);"*    DENOTES CRITICAL OPERATIONS"
6080  PRINT #N;TAB(25);"=    OPERATIONS AT EARLY START POSITION"
6090  PRINT #N;TAB(25);":    FLOAT "
6095  PRINT #N
6100  REM time
6110  GOSUB 9800                                  DURATION    !  EARLY STAR
6120  PRINT #N;TAB(4);"! OPERATION    !    EARLY FINISH  !  LATE FINISH   !  F
6130  PRINT #N;"  LATE START   !
6150  GOSUB 9800
6160  FOR J=2 TO N2-1                                                TAB(18);
6170  PRINT #N;TAB(4);"!";TAB(10);O$[2*T[J,1]-1,2*T[J,1]];T[J,6],T[J,
6180  PRINT #N; USING 6190;T[J,2],T[J,3],T[J,4],T[J,5],
6190  IMAGE 5(xx,ddddd.dd,5x,"!")
6200  NEXT J
6205  GOSUB 9800
6210  REM cost table
6220  PRINT #N
6230  PRINT #N;TAB(30);"COST ANALYSIS"
6240  PRINT #N;TAB(30);"-------------"                !   MATERIALS
6245  GOSUB 9800                          LABOUR              !
6250  PRINT #N;TAB(4);"! OPERATION   !          !      PRELIMS
6260  PRINT #N;"!        PLANT     !   SUB/CONT      TOTAL";TAB(114);"!"
6280  MAT T=ZER[30,7]
6282  N3=(15*N1)-1
```

```
6285  READ #4,N3;I
6290  FOR I=1 TO 30
6300  FOR J=1 TO 7
6310  READ #4;T[I,J]
6320  NEXT J
6330  NEXT I
6340  GOSUB 9800
6350  FOR J=1 TO N2-2
6360  PRINT #N;TAB(4);"!";TAB(10);O$[2*T[J,1]-1,2*T[J,1]];TAB(
6370  PRINT #N; USING 6190;T[J,2],T[J,3],T[J,4],T[J,5],T[J,6],
6380  NEXT J
6390  GOSUB 9800
6400  RETURN
8000  REM simulation results
8010  PRINT #N;TAB(40);"NETWORK SIMULATION"
8020  PRINT #N;TAB(40);"******************"
8030  PRINT #N
8040  PRINT #N;TAB(30);"NETWORK      ";R$[1,1];"/";R$[2,3];"
8050  PRINT #N                                  1$[T1-J[N1]+1
8060  GOSUB 9800
8070  X[6]=N1
8080  CHAIN "rep1"
8090  REM return fro m rep1
8095  MAT  READ G
8100  N1=(6)
8105  N=8
8110  FOR J=1 TO 6
8120  ASSIGN F$[5*J-4,5*J],J,V1
8130  NEXT J
8140  ASSIGN "report",8,V1
8150  ASSIGN "mastrf",7,V1
8160  IF  END #8 THEN 8190
8170  LINPUT #8;A$
8180  GOTO 8160
8190  A$="EDOR"
8200  GOTO 140
9800  PRINT #N;TAB(4);
9810  FOR I1=1 TO 110
9820  PRINT #N;"-";
9830  NEXT I1
9840  PRINT #N
9850  RETURN
9860  RETURN
9870  PRINT #N;TAB(49);"!";TAB(59);"NONE SPECIFIED";TAB(79);"!
9880  PRINT #N;"!";TAB(114);"!"
9890  RETURN
9895  DATA 1,9.25,46.25,1,1,1
9999  END
```