Oxford University Computing Laboratory

Computer Manuals

ICL 1900 Civil Engineering and Building
General
Cut and Fill
2nd Ed 1967

CIVIL ENGINEERING & BUILDING

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ICL

1900 Series

Cut and Fill

Second Edition August 1967

Amendment list 4
incorporating User Notices 5 to 8

Each amendment list contains one or more numbered instructions to replace one or more existing pages or to add one or more new pages.

When a page is amended, significant technical changes on the re-issued page will be indicated by a vertical line in the margin against the changed passages. Any lines on the re-issued page which remain from a previous amendment, will be removed. New chapters or completely revised chapters will not be marked with amendment lines.

The date of issue appears at the foot of all new pages and re-issued pages in the form (month, year).

1	Front cover	Remove and destroy front cover. Replace by new front cover.
2	Title page	Remove and destroy title page and imprint page. Replace by new title page and imprint page.
3	Preface	Remove and destroy pages v and vi. Replace by new pages v and vi.
4	Contents list	Remove and destroy pages vii and viii. Replace by new pages vii and viii.
5	Introduction	Remove and destroy pages 1 and 2. Replace by new pages 1 and 2.
6	Chapter 1	Remove and destroy pages 13 to 16. Replace by new pages 13 to 16.1.
7	Chapter 1	Remove and destroy pages 23 and 24. Replace by new pages 23 and 24.
8	Chapter 1	Remove and destroy pages 27 to 30. Replace by new pages 27 to 30.
9	Chapter 1	Remove and destroy pages 42.1 and 42.2. Replace by new pages 42.1 and 42.2.
10	Chapter 3	Remove and destroy pages 51 and 52. Replace by new pages 51 and 52.
11	Chapter 3A	Insert new pages 54.5 to 54.7.
12	Chapter 4	Remove and destroy pages 75 and 76. Replace by new pages 75 and 76.
13	Chapter 4	Remove and destroy pages 79.2 to 108. Replace by new pages 79.2 to 108.
14	Chapter 4	Remove and destroy pages 111 and 112. Replace by new pages 111 and 112.
15	Index	Insert new pages 113 and 114.
16	Remove and destroy User Notices 5 to 8.	
17	Update the amendment record and file this list at the back of the manual.	

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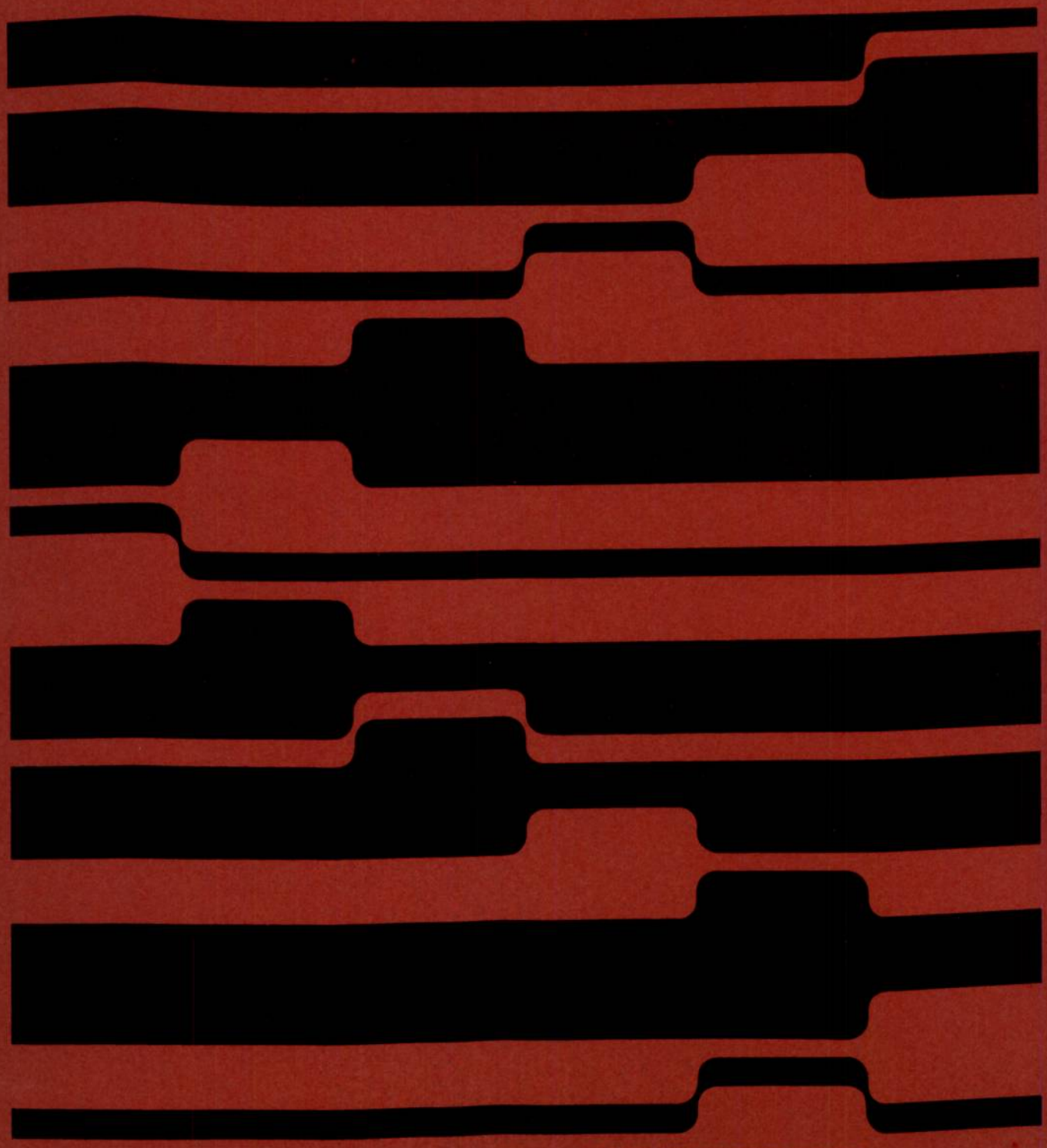
ICL House, Putney, London, S.W.15

ICL

Cut and Fill

1900 Series



Acknowledgement

International Computers and Tabulators Limited wish to thank Richard Costain Limited for their helpful advice throughout the preparation of this series of programs on both technical matters and user requirements.

ICL Cut and Fill 1900 Series

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PREFACE

The ICL 1900 Series Cut and Fill suite of programs is designed to calculate cut and fill volumes and associated values.

Some typical projects where the package may be used are harbour and estuary dredging, open-cast mining, site-clearance, quarrying and highways design.

The minimum computer configuration required for these programs is as follows:

1900 central processor with a floating-point Executive and 16K words of core store.

1 card reader or paper tape reader.

4 magnetic tape decks (including that used by the program tape)

1 line printer

The suite also includes programs for producing drawings on a graph plotter.

The drawings output by the graph plotter can also be produced off-line, so that a plotter at another installation may be used.

The introduction to the manual provides a general description of the facilities and their use. Chapter 1 describes input to the program and Chapter 2 describes the output. Chapter 3 describes the operating instructions. Chapter 3A describes running Cut and Fill under the GEORGE 1 and 2 operating system. This chapter does not provide full information for running programs under GEORGE, but is intended to be used in conjunction with the manual *GEORGE 1 and 2* (Edition 1, TP4114).

Chapter 4 gives an example of the use of Cut and Fill for a roadworks project. The input for the example shows examples of appropriate coding sheets for card input.

CUT AND FILL

CONTENTS

INTRODUCTION

This manual describes a suite of programs, written in 1900 FORTRAN, designed to calculate cut and fill volumes and associated values. The four main programs input, calculate, output and amend and are related to each other as shown in Figure 1.

Either British or metric units may be used for the measurements. The programs are intended for use in a variety of projects, such as quarrying, dredging, motorway and road design and construction, canals, dams, railways and airports.

If the programs are fully utilized, they will provide values at the following six stages of design and construction:

Stages of Design and Construction

Preliminary Design

The programs are arranged so that, at the preliminary design stage, various trial routes can be investigated in quick succession, using data derived from a survey of the terrain along the routes. At this stage, a minimum amount of data may be prepared and the accuracy of the results is proportional to the volume of data prepared.

Final Design

When one or more routes have been selected for detailed study, optimum centre-lines and grade profiles can be found. This is achieved by modifying the new construction data for successive runs, in the light of results already produced by the computer, until the most economic line has been established. The program arrangement is such that the minimum amount of work is necessary to make substantial alterations to data relating to the new construction.

Tender Preparation

The programs will compute the volumes and areas required for the Bill of Quantities which is sent out to tender.

Pre-construction Stage

The results of computation may be used at this stage for planning the method of construction and plant utilization.

During Construction

The programs may be used to obtain the volumes required to calculate interim payments.

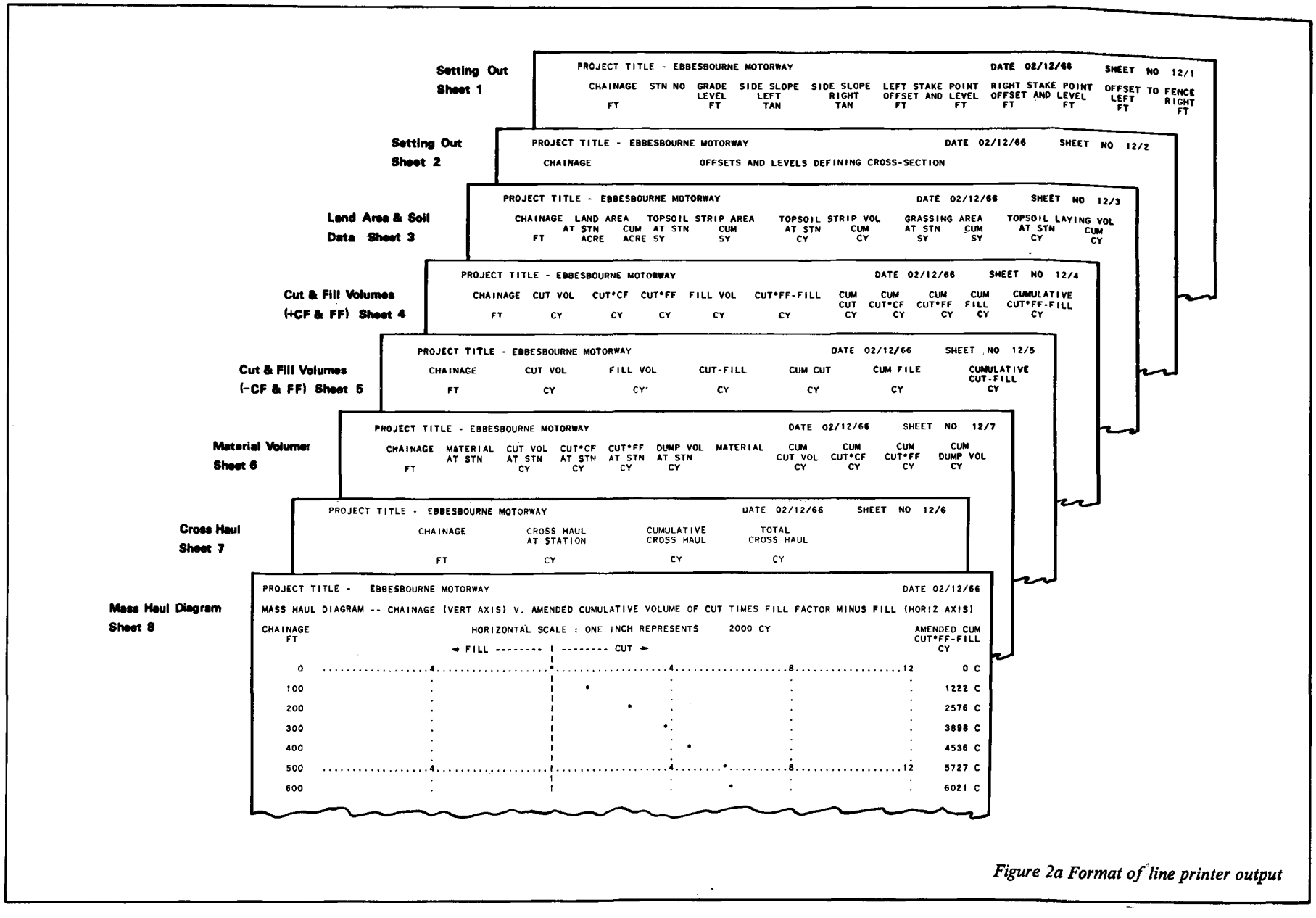

Figure 2a Format of line printer output

Final Measurement

The final volume of each material excavated can be calculated when the construction is complete. Data collected during construction giving agreed terrain and material interface information is used to amend the design data. These final volumes are an accurate measure of the work done during the construction and may be used for calculating final payments.

Method of the Program

The method employed by the calculations program compares the profile of the terrain with that of the intended earthworks at each station. The two profiles are then joined with appropriate side slopes for sections in cut, sections in fill, or sections in both cut and fill. The cross-sectional areas are then calculated, and since the chainage of each station is known, the volumes can be calculated. Other values, such as topsoil areas and volumes, and land acquisition, are readily found.

The principal formula used for the calculation of volumes is

$$\text{Volume} = \frac{L}{3}(A + B + \sqrt{AB})$$

where A and B are the areas of adjacent stations and L is the distance between them. This formula is more accurate than the 'average end area' formula, which can give up to 50% error for a cone, and more useful than Simpson's Rule since the latter demands equal spacing of stations. Alternatively, the user can choose to have the volume calculations performed by the 'average end area method'. If, however, the adjacent stations change from cut to fill or vice versa, the volumes are calculated using rectangular wedges and pyramids.

Surface areas are calculated using the trapezium rule.

All results and input data are held on magnetic tape so that the effects of changes on the data can be easily ascertained and the results can be printed out at any convenient time.

Computed Values

Prior to output, the calculations program will perform the following operations:

1 Calculate the grade level at specified stations.

2 Select only the suitable materials encountered in the cut length for use in fill.

3 Fix side slopes depending on whether the station is in cut or in fill, and either

   (a) height of embankment in cut or in fill, or

   (b) the material encountered in cut.

4 Insert berms at specified height intervals in cut or in fill.

5 Select the shape of the finished profile of earthworks from a table of possible profiles.

6 Add volumes at any point from side roads, spoil dumps or borrow pits.

7 Omit volumes at roundabouts, bridges, tunnels, viaducts, etc.

8 Produce profiles of strata interfaces below the ground at each station between bore holes or trial pits by applying a linear interpolation procedure to sets of information obtained from these holes or pits.

9 Adjust basic cut volume to give

   (a) bulked volume for transportation,

   (b) volume after consolidation.

10 Calculate the volume of each material excavated.

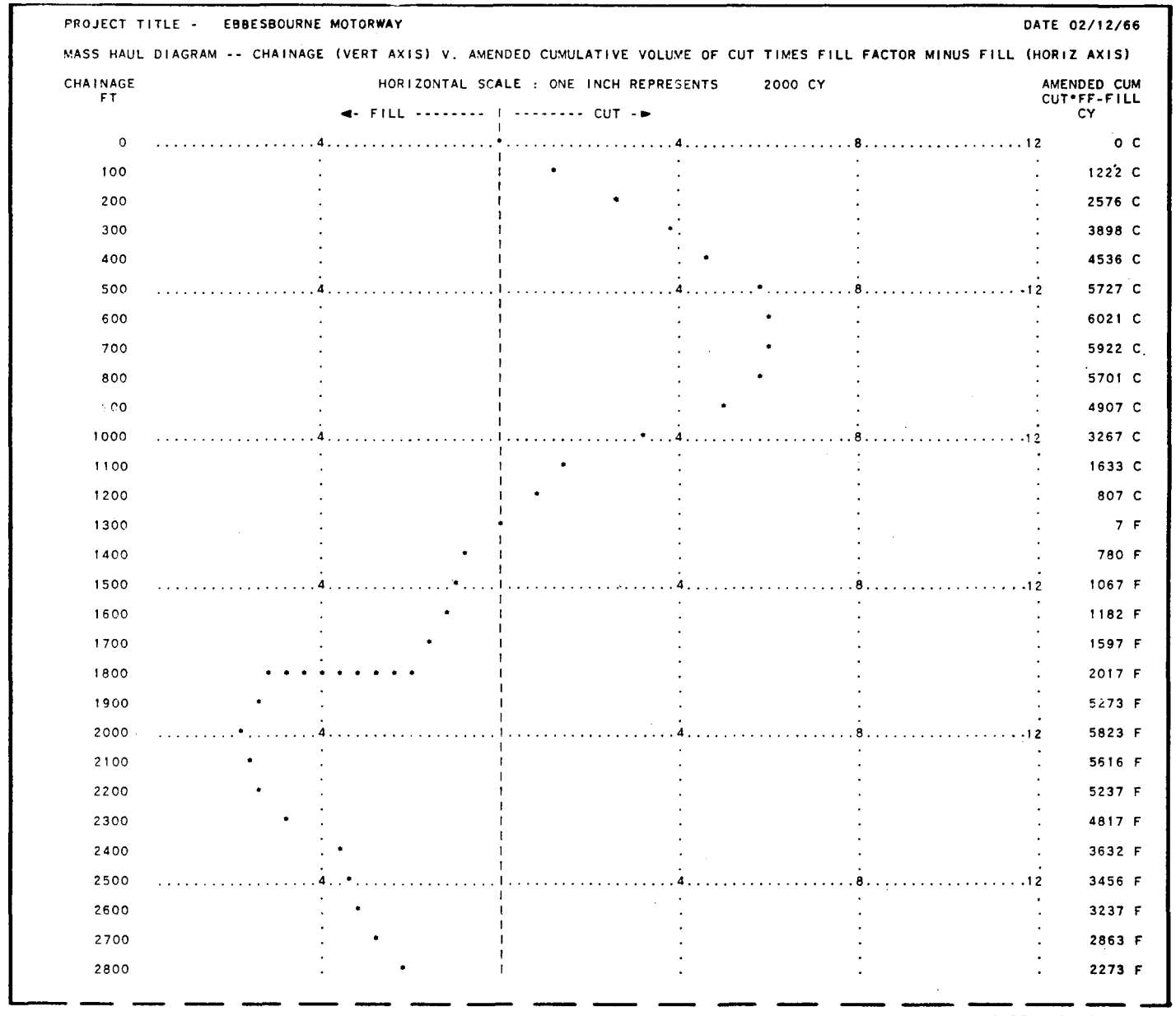

Figure 2b Mass haul diagram

Output

The output program will give results in *tabulated* and *diagrammatic* forms. The following results are output in *tabulated* form:

1 Setting-out data at each station:

chainage,

side slopes,

definition of slope stake points,

fence line positions,

definition of all points at each station.

The following values are given at each station and also as cumulative values:

2 **Land area enclosed by the two fence lines**

3 **Topsoil strip areas and volumes**

4 **Topsoil replacement volumes**

5 **Turfing or seeding areas**

6 **Cut volumes including modifications for transportation and after consolidation**

7 **Values of cut/fill**

8 **Cut volumes of all specified materials encountered**

9 **Volume of unsuitable or dump materials**

The following results are output in *diagrammatic* form:

10 **Mass-haul diagram (on the line printer and, optionally, on a graph plotter)**

11 **Plot of cross-section at each station (on a graph plotter)**

12 **Plot of longitudinal sections (on a graph plotter)**

Chapter 1

INPUT DATA

This chapter describes the data required for the input and amendment programs, how this data should be recorded on Data Sheets and the data punching conventions. As stated in the Introduction, there are punched card and paper tape input versions of these two programs. In this chapter, paper tape input to the programs is described first and then the differences for card input are dealt with. In particular, Sections 1.1 to 1.10 describe paper tape input for the input program, and Sections 1.11 to 1.19 describe paper tape input for the amendment program. The remaining sections - 1.20 and 1.21, and 1.22 and 1.23 - deal with card input for the input program and the amendment program respectively.

INPUT PROGRAM - DATA ON PAPER TAPE

General 1.1

Data will normally be prepared for the 1900 Cut and Fill program at various stages in the project, the most important being the Preliminary Design stage, the Final Design stage, the Contract Planning stage and the Final Measurement stage. At each stage, data must be presented to the program in the following sequence:

1 Job Heading

2 Unit Specification

3 Grade Data

4 Materials Data

5 Typicals Data

6 Station Data

7 Terrain Data

8 Strata Data

Each type of data must be preceded by its appropriate directive and followed by its appropriate terminator.

Probably the easiest way to record this data is to use a series of Data Sheets that will be self-explanatory both to the engineer who provides the data and to the operator who punches the data onto paper tape. Although it is impracticable to provide standard Data Sheets to cover the requirements of all projects, I.C.T. has designed a series of nine such Sheets to act as models for individual users.

Some of these Data Sheets can also be used to record data for the amendment program (see 1.11).

Subsequent sections of this chapter describe the different types of data in the sequence given above and indicate how the data should be recorded on the sample Data Sheets. Before this, however, the following general observations about these Data Sheets can be made:

1 Basically, the Sheets consist of a number of boxes accompanied by explanatory text.

The text is significant only to the engineer, who merely has to enter data and follow instructions in accordance with this text. All the standard program requirements, such as directives and terminators, are pre-printed.

By the same token, the punch operator need not be concerned with engineering aspects and merely has to punch everything enclosed in the boxes.

2 Where a particular type of data is not required, the relevant box should be crossed out leaving just the initial directive and the terminator. When only a portion of a box is used, the remainder should be crossed out.

3 As the position of the last entry for any type of data varies, terminators are printed on the Sheet just before the initial directive of the next type of data and not at the end of one type of data.

As stated above, there are nine types of sample Data Sheets.

Data Sheet 1 records *Job Heading, Unit Specification, Grade Data* and *Materials Data* (see page 10). This Data Sheet is probably best suited to final design work. For preliminary design, more room may be needed for grade data and the full number of materials will probably not be required.

Data Sheet 2 records *Typicals Data* (see page 12). On this Sheet, 23 of the 29 allowable pairs of offset/level values for each half-typical can be recorded. In general, fewer points will suffice at the preliminary design stage.

Data Sheets 3a,3b,3c record *Station Data* (see pages 14, 16 and 24). Values on Sheets 3a which are not required by a particular user may be omitted from his own standard Data Sheet. For preliminary design, it is likely that only one Sheet 3a will be used, followed by several Sheets 3b. For final design, Sheets 3a may be mingled with Sheets 3b. Sheet 3c may be inserted at any station. It is important that station data should refer to each chainage in ascending sequence.

Data Sheet 4 records *Terrain Data* (see page 26). The number of points required to specify the terrain profile in the required detail will depend upon the irregularity of the terrain at each station. For flat terrain, the number of points allowed on Data Sheet 4 may be too many. For very irregular terrain, however, the full 40 points allowable may be needed.

Data Sheets 5a,5b record *Strata Data* (see pages 32 to 34). Sheet 5a is used for final design and for tender and contract planning. From the data filled in on Sheet 5a, the computer produces an estimate of the volumes of each material. During excavation, actual points on material interfaces can be recorded on Sheet 5b.

Although only 11 points for 3 interfaces are shown for each station, in fact, up to 38 points for 6 interfaces may be defined.

Data Sheet 6 specifies *Output* (see page 46). Only those options which may be required need be included on this Sheet.

These Sheets do nothing more than suggest an approach to recording data, and individual users may wish to revise them, particularly in respect of the size of boxes. However, all Data Sheets must be designed so that data is presented in the form and sequence that the program requires, and it is recommended that the general lay-out and the principles outlined above be adopted in any revised Sheets.

At this point, it should be noted that offsets are measured from two datum lines. The first datum line is referred to as the TERRAIN DATUM and all terrain data is related to this datum. The second datum is referred to as the CONSTRUCTION CENTRE-LINE. This datum will normally be the true centre-line of the new construction but it can be any arbitrary datum line chosen by the engineer. All half-typicals are specified from this datum line and all output is referenced to it.

The reason for having two separate reference datum lines is that the new construction can be moved relative to the terrain by re-specifying the distance between the two datum lines (using the variable CLIN - see 1.7.2).

Data preparation will now be considered in detail. Particular attention should be paid to the use of tabulate, space and newline characters, which indicate to the program where one item of data finishes and another begins. If the instructions on data preparation are observed by both the engineer and the punch operator, there should be little need for data correction. Where necessary, corrections may be made at the time of punching by over-punching errors with 'delete' characters and re-punching correctly; or faulty tapes may subsequently be corrected by using the standard I.C.T. PROM program to re-punch a correct tape. Tape editing can also be carried out on some types of tape preparation equipment, e.g. a Flexowriter.

Job Heading 1.2

The job heading is the name and reference number of a particular job. Up to 72 characters are allowed, composed of any arrangement of alphabetic, numeric, space and punctuation characters. Any reference information required may be included in the job heading. For instance, if more than one computer run is required for a particular job, the run number may be incorporated.

The job heading must be preceded by the directive HEADING and terminated by a newline character as shown on Data Sheet 1 (page 10).

Unit Specification 1.3

The unit specification indicates which units of measurement are required, British units or Metric units. For alphabetic characters must be used: either BRIT for British units or METR for Metric units.

When BRIT is used, all input of offsets, levels, thicknesses, lengths, chainages, etc., must be in units of feet (but see 1.7.8). Similarly, if METR is used, all input must be in metres.

The unit specification must be preceded by the directive UNIT and terminated by a newline character (see Data Sheet 1).

Grade Data 1.4

If the program is required to calculate grade levels at some or all of the stations, it is necessary to supply grade data. The data must cover all points at which calculation is required, either as a continuous set of data or as a series of sections of data, each in itself continuous.

The calculated vertical curves are parabolic and join one straight-line gradient to the next. The parabolic curves meet the gradients on either side tangentially and the horizontally projected distance between the tangent points is the curve length supplied in the input data. Grade levels can be calculated by the program at any point within the range of given data, i.e. on the straight-line gradients and on the vertical curves.

Input Variables 1.4.1

The following variables are punched in tabular form:

Chainage

Grade level

Length of the curve.

The following points should be observed in the preparation of grade data.

1 Chainages must be in ascending order.

2 Care must be taken to ensure that the vertical curves specified do not overlap.

3 Grade data may be input as a series of sections (see Figure 3). Each section must contain continuous data and must begin with a zero curve length at the first chainage, and end with a zero curve length at the last chainage. Thus, the complete data will always have zero curve lengths at the first and last chainages and other zero values of curve length must appear in pairs. Such pairs of zeros indicate a break between sections of grade data and grade levels cannot be computed between such sections.

I.C.T. 1900 Series cut and fill program
tape input

Reference - Data Sheet 1
Sheet number ____________

ƀ = Tabulator Character
∇ = Space Character
N̶ = New Line

HEADING N̶

Maximum No. of characters shown

R SPALDING AND SONS DER
ESBURY ROAD SECTION A T
EST RUN NO N̶

UNIT N̶
BRIT N either BRIT or METR

GRADE DATA N̶

No computation from 1550 to 2370 and from 4540 to 5250

5250 to 5650 is an example of constant gradient data

Unlimited

	Chainage at intersection of tangents		Grade level of intersection of tangents		Curve length	
ƀ	200	∇	120·5	∇	0	N̶
ƀ	1 050·5	∇	190·2	∇	240	N̶
ƀ	1550	∇	152	∇	0	N̶
ƀ	2370	∇	148·68	∇	0	N̶
ƀ	2482·6	∇	152	∇	110	N̶
ƀ	3501·7	∇	107·8	∇	275·2	N̶
ƀ	4540	∇	180·3	∇	0	N̶
ƀ	5250	∇	122	∇	0	N̶
ƀ	5450	∇	132	∇	1	N̶
ƀ	5650	∇	142	∇	0	N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶
ƀ		∇		∇		N̶

EODA N̶
MATERIALS DATA N̶

Clay unsuitable for fill

Example of minimum input data

Maximum No. of Materials shown

	Material name		Cut factor		Fill factor (0 if unsuitable)		Cut slope (Nat. Tan.)	
ƀ	TOPS	∇	1	∇	1	∇	0·33	N̶
ƀ	CLAY	∇	0·9	∇	0	∇	0·33	N̶
ƀ	SAND	∇	1·1	∇	0·97	∇	0·33	N̶
ƀ	CHLK	∇	1·2	∇	0·95	∇	0·577	N̶
ƀ	GRAV	∇	1·2	∇	1·05	∇	0·33	N̶
ƀ		∇		∇		∇		N̶
ƀ		∇		∇		∇		N̶
ƀ		∇		∇		∇		N̶
ƀ		∇		∇		∇		N̶
ƀ		∇		∇		∇		N̶
ƀ		∇		∇		∇		N̶
ƀ	TOPS	∇	1	∇	1	∇	0·33	N̶
ƀ	MUCK	∇	1	∇	1	∇	0·33	N̶
ƀ		∇		∇		∇		N̶
ƀ		∇		∇		∇		N̶
ƀ		∇		∇		∇		N̶
ƀ		∇		∇		∇		N̶
ƀ		∇		∇		∇		N̶
ƀ		∇		∇		∇		N̶
ƀ		∇		∇		∇		N̶

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4 If it is required to input grade data as a single straight-line gradient, this can be achieved by specifying chainages and levels at the beginning, middle and end points, and giving curve lengths of zero, 1.0 and zero, respectively, as shown on Data Sheet 1.

The grade data must be preceded by the directive GRADE DATA and terminated with the characters EODA.

The variables must be punched in the order given above, and must be separated by single space characters. Before any line of numeric data is punched, it must be preceded by a tabulate character. The example of Data Sheet 1 shows the grade data for the conditions depicted in Figure 3. If grade levels are not required to be computed (see 1.7.1) and therefore there is no input of grade data, the program must be informed by deleting the table and having nothing punched but the directive GRADE DATA and the terminator EODA on consecutive lines.

Materials Data 1.5

The materials data summarizes all the materials that are considered in the calculations; the materials data must include information about all the materials that are input under Strata Data (see 1.9). In this summary of materials, the constants for each material are defined together with an indication of the suitability of any cut materials to be re-used for fill.

Input Variables 1.5.1

The following variables are punched in tabular form:

1 Material name. Four alpha characters must be used for this name. Topsoil must always be specified first and is represented by TOPS.

2 Cut factor for the material. This is the required modification factor to convert undisturbed cut volume to excavated, ready-for-transport volume (i.e. no consolidation).

3 Fill factor for the material. This is the required modification factor to convert undisturbed cut volume to that fill volume following excavation, transport, laying and consolidation.

4 Cut slope for the material. This is expressed as the tangent of the angle.

A maximum of 20 materials may be specified but at least two must be presented including topsoil which must always be input even if not required. The program recognizes the material name 'TOPS', pre-printed on Data Sheet 1, as representing topsoil. A fill factor of zero indicates that the material is unsuitable for re-use as fill. Its calculated volume will be added to the DUMP volume (see Chapter 2 on Output).

The materials data must be preceded by the directive MATERIALS DATA and terminated with the characters EODA.

The variables must be punched in the order given above and must be separated by single space characters. Before each line of data, a tabulate character must be punched. Two examples of materials data are shown on Data Sheet 1.

The minimum amount of materials data which may be input is shown in the second example.

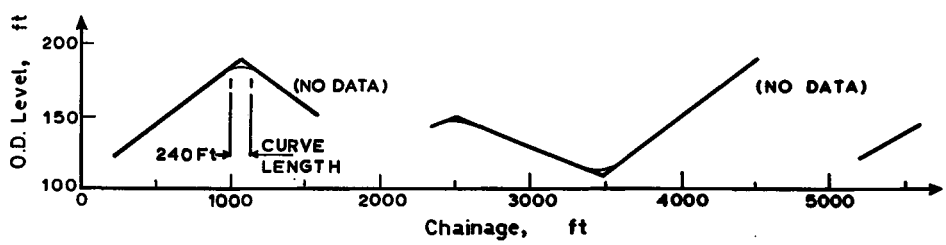


Figure 3 Grade computing data (see Data Sheet 1)

I.C.T. 1900 Series cut and fill program
tape input/amendment

Reference - Data Sheet 2

Sheet number _____

b = Tabulator Character
∇ = Space Character
N = New Line

delete if 'AMENDMENT' was last directive given

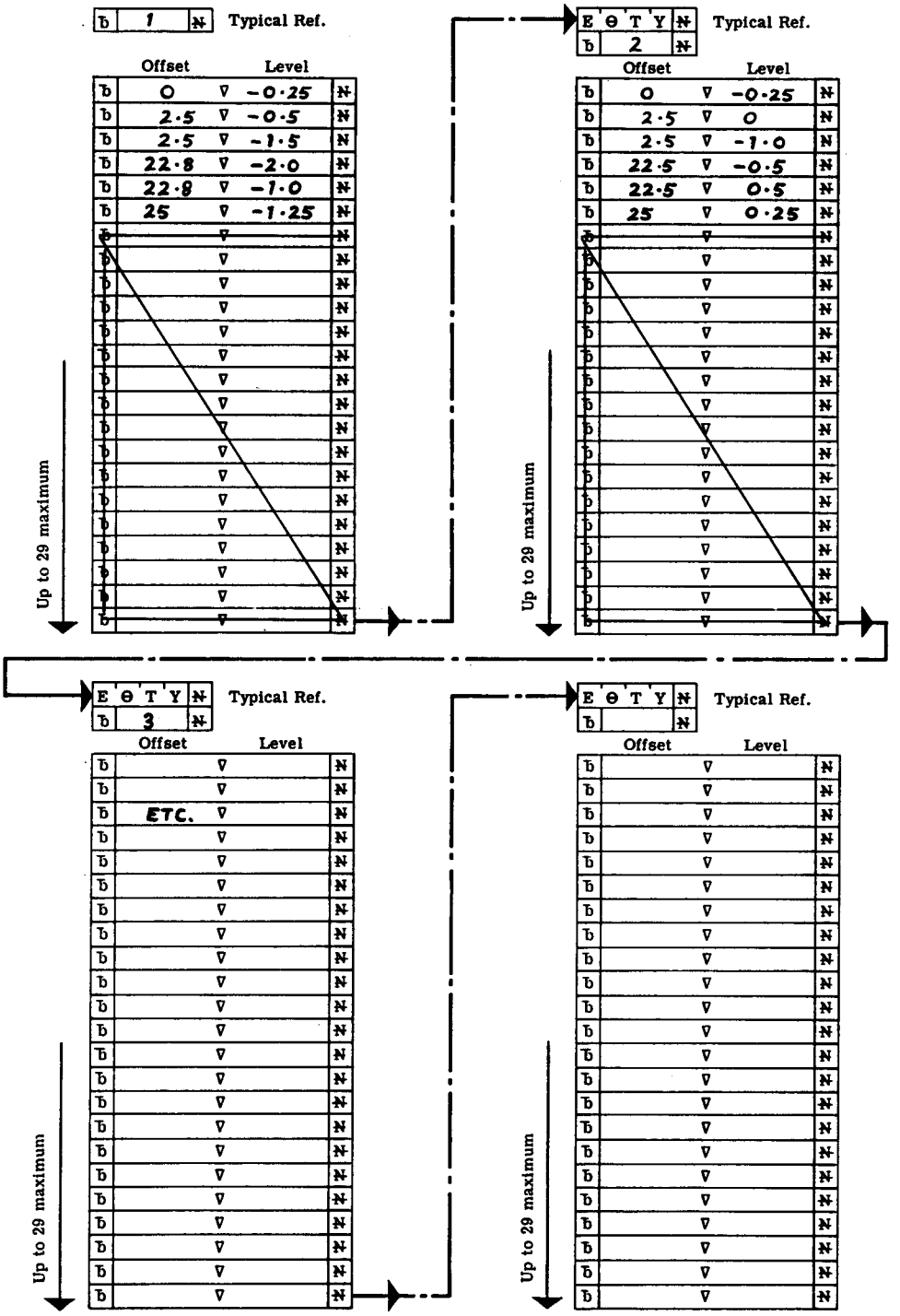
E ⊖ D A N
T Y P I C A L S D A T A N

} Delete these 2 boxes for all but first sheet of Typicals Data

OR

E ⊖ T Y N

Delete this box on first sheet



Typicals Data 1.6

Typicals are used to define the profiles of the proposed earthwork formation. Typicals data consists of a series of right-hand half-typicals each specified by a reference number and up to 29 pairs of offsets and levels.

Station data (see 1.7.2) contains the typical reference numbers of the half-typicals which are to be used to generate the full typical at a station. Left-hand half-typicals are generated as the mirror image of right-hand half-typicals as shown in Figure 4.

At a particular station it is not necessary to use the same half-typical for the left-hand and right-hand sides of the profile. Both cut and fill half-typicals are specified for each side and the calculations program selects the required typicals at each station depending on whether the outermost point is in cut or in fill. The outermost point is also the point at which the side slope commences.

For each side of the roadway, the program first selects the relevant cut half-typical and calculates the offset and level of the shoulder (that is, outer extremity) of the typical. If this point lies exactly on or below the terrain, then the cut half-typical is used. If the point lies above the terrain, the fill half-typical is selected, and the offset and level of the new shoulder are calculated. If this new point lies above the terrain, then the fill half-typical is used; however if the new point lies exactly on or below the terrain, then the cut half-typical is re-selected and used regardless of earlier circumstances. The full typical (either supplied or built up from standard half-typicals) at a station should not extend beyond the extreme terrain point on each side. The description of the calculations program (page 52) details the effect of disobeying this rule.

There is also a facility for specifying full typicals at the particular stations if the required profiles cannot be generated from the stored typicals data (see 1.7.6).

Input Variables 1.6.1

The following variables are punched in tabular form:

Typical reference number.

Offset of a point on the typical from the construction centre-line. (All offsets are positive or zero.)

Level of the point on the typical, relative to the grade level.

The latter two variables are repeated, building up points that, when joined by straight lines, give the shape of the half-typical. The order of the points must be such that when joined by straight lines in that sequence, the correct shape results. Overhangs are not permitted in typicals or half-typicals.

The typicals data must be preceded by the directive TYPICALS DATA and terminated with the characters EODA. After the completion of the data for each half-typical except the last, the terminator EOTY must be punched.

The first typical quoted must be number 1, and the subsequent typicals should be in ascending order.

The offset must precede the level and be separated from it by a space character. Each line of numeric data must be preceded by a tabulate character as shown on Data Sheet 2, page 12.

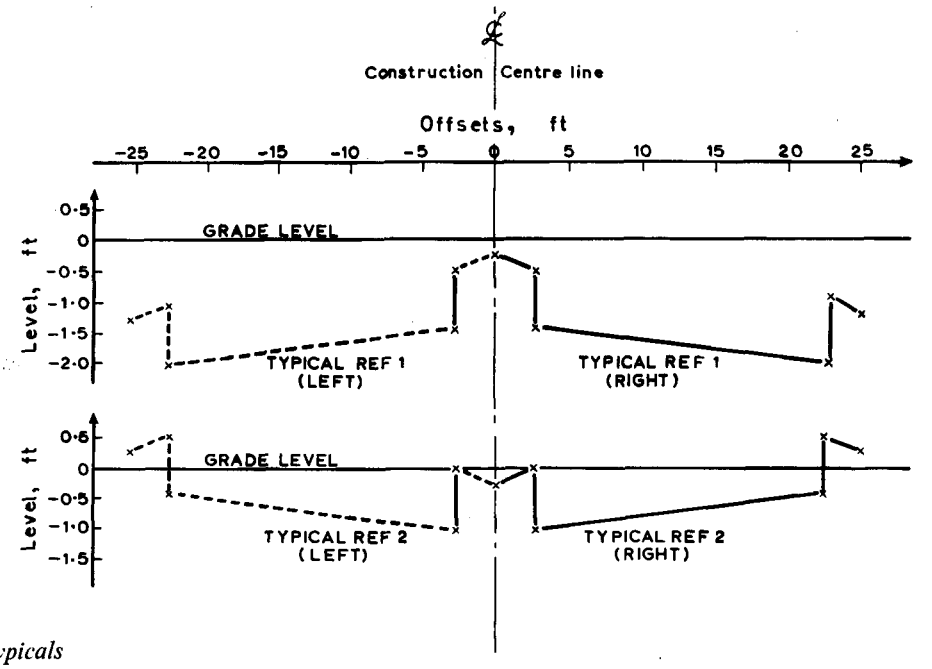


Figure 4 Typicals

If no standard typicals are required, the tables must be deleted, leaving the directive TYPICALS DATA and the terminator EODA to be punched on consecutive lines.

Station Data **1.7**

The station data is necessary to complete the standard information for each station, and once specified, applies to subsequent stations until a change is made.

Compulsory Variables Input for Each Station **1.7.1**

The following variables are punched for each station:

1 Station number. From two to eight alphanumeric characters are permitted. The station number is used only for station recognition purposes and never for cross-referencing.

2 Chainage at the station. This is used for cross-referencing.

3 Grade level. If the grade level is to be calculated using grade data (see 1.4), this variable is punched as zero. Negative values of the grade level are not accepted.

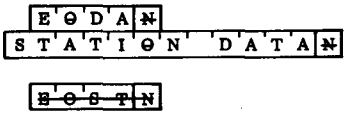
This data is punched on separate lines in the order given above (see Data Sheet 3a, page 14). Where none of the optional variables (see 1.7.2) shown on Data Sheet 3a is to be altered, Data Sheet 3b can be used for subsequent stations. The examples shown on pages 14, 16 and 17 form a set of information for stations S1 to S8 on Data Sheets 3a (Example 1), 3b and 3a (Example 2).

I.C.T. 1900 Series cut and fill program
tape input

Reference - Data Sheet 3a

Sheet number Ex. 1

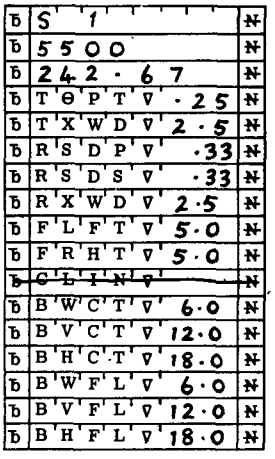
b = Tabulator Character
∇ = Space Character
N = New Line



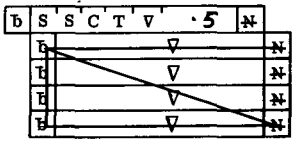
Delete these 2 boxes on all but the first Station Data Sheet

OR

Delete on first Station Data Sheet.

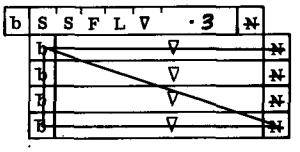


Station Name and/or Number
Chainage
Grade level
Topsoil Thickness
Topsoil Extra Width
Resoil Depth - horizontal - verges, central res.
Resoil Depth - Normal - on Slopes
Resoil Extra Width
Distance to Fence line Left
Distance to Fence line Right
Distance from ℄ Terrain to Datum of Typicals
Berm in Cut - Width
Berm in Cut - Vertical Separation
Berm in Cut - Max. Top Vert. Separation
Berm in Fill - Width
Berm in Fill - Vertical Separation
Berm in Fill - Max. Btm. Vert. Separation



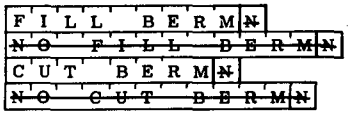
Side slope in cut - Natural Tan. if simple.

If slope to be automatically selected from height of cut - Give SSCT a value of 0 & fill in pairs of slopes (Nat. Tan.) & heights of Cut - Max. No. of 10



Side slope in Fill - Natural Tan. if Simple.

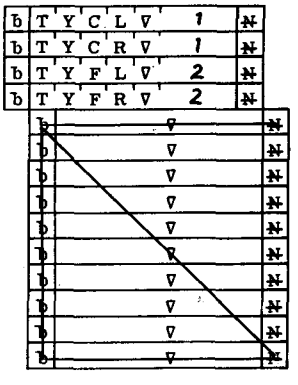
If slope to be automatically selected from height of Fill - Give SSFL a value of 0 & fill in pairs of slopes (Nat. Tan.) & heights of Fill - Max. No. of 10



If Fill berm data set (BWFL, BVFL, BHFL) delete as applicable - if not, delete both.

If Cut berm data set (BWCT, BVCT, BHCT) delete as applicable - if not, delete both.

If material slopes vary (see material data) delete as applicable - if not, delete both.



Typical Reference No. in Cut - Left
Typical Reference No. in Cut - Right
Typical Reference No. in Fill - Left
Typical Reference No. in Fill - Right

If Typical is not standard TYCL, TYCR TYFL & TYFR are set to 0 and Typical is defined by pairs of Off sets and Levels - up to 58 No. pairs

Note: This forms first sheet of Station Data or can be used for subsequent Stations where variables alter.

Some or all of the following variables may be punched for each station and apply to all the following stations until any of them is changed by giving a new value to the variable. If the variable is omitted for the first station, the variable in question is set to zero.

TOPT Topsoil thickness. This variable specifies the depth of topsoil to be removed at the station in question. If the topsoil depth to be removed varies across the terrain at the station, it is necessary to define topsoil as a stratum under STRATA DATA (see 1.9). If this strata facility is employed using the material name TOPS, then TOPT is ignored by the calculations program.

TXWD Topsoil extra width. It is sometimes necessary to remove topsoil over an area beyond that bounded by the slope stake line. TXWD is the extra width beyond each stake point over which topsoil is to be removed.

RSDP Resoil depth. The thickness of topsoil which is to be replaced on verges, central reservation and berms.

RSDS Resoil depth on side slopes. The thickness is normal to the slope. RSDS is used only to calculate volumes and not to cut back sideslopes. It is taken over the whole sideslope, including berms. In order to be consistent with RSDP, the sideslopes that are drawn from the end of the full typical are taken to represent the underside of the resoil, not the finished levels.

RXWD Resoil extra width. The extra width over which topsoil has to be replaced other than on side slopes and topsoil strippage extra width (TXWD). It is the sum of the widths of resoil in the verges and central reservation.

FLFT Distance from the left slope stake point to the left fence line. The left slope stake point and fence line are those to the left of the construction centre-line when viewing the station in the direction of increasing chainage. The slope stake point is the intersection of the existing ground level and the side slope.

FRHT Distance from the right slope stake point to the right fence line.

CLIN Distance of the terrain datum from the construction centre-line of the proposed earthworks. This variable is negative if the offset of the construction centre-line from the terrain datum is to the left when viewing the station in the direction of increasing chainage, and positive if the offset is to the right.

I.C.T. 1900 Series cut and fill program
tape input/amendment

Reference - Data Sheet 3b
Sheet number ____________

ƀ = Tabulator Character
N̶ = New Line

STATION DATA - Continued

This sheet to be used for sucessive stations where variables remain constant

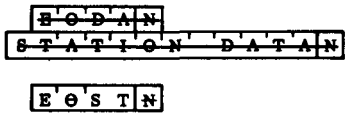
			Station name and/or number (Min. 2 ch. max. 8)			Chainage			Grade level (set to 0 if it is to be calculated)	
E θ S T	N̶	ƀ	S 2	N̶	ƀ	5600	N̶	ƀ	243.16	N̶
E θ S T	N̶	ƀ	S 3	N̶	ƀ	5700	N̶	ƀ	243.50	N̶
E θ S T	N̶	ƀ	S 4	N̶	ƀ	5800	N̶	ƀ	243.84	N̶
E θ S T	N̶	ƀ	S 5	N̶	ƀ	5898	N̶	ƀ	244.18	N̶
E θ S T	N̶	ƀ	S 6	N̶	ƀ	5998	N̶	ƀ	0	N̶
E θ S T	N̶	ƀ	S 7	N̶	ƀ	6098	N̶	ƀ	0	N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶
E θ S T	N̶	ƀ		N̶	ƀ		N̶	ƀ		N̶

I.C.T. 1900 Series cut and fill program
tape input

Reference - Data Sheet 3a

Sheet number Ex. 2

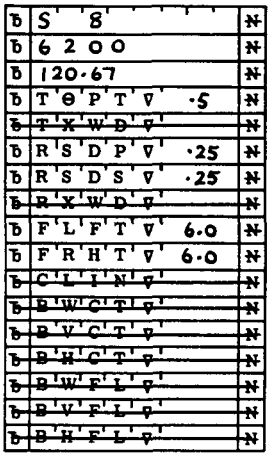
b = Tabulator Character
V = Space Character
N = New Line



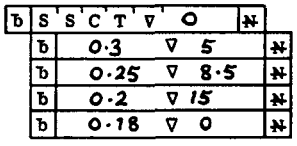
Delete these 2 boxes on all but the first Station Data Sheet

OR

Delete on first Station Data Sheet.

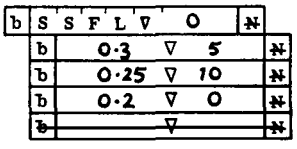


Station Name and/or Number
Chainage
Grade level
Topsoil Thickness
Topsoil Extra Width
Resoil Depth - horizontal - verges, central res.
Resoil Depth - Normal - on Slopes
Resoil Extra Width
Distance to Fence line Left
Distance to Fence line Right
Distance from ℄ Terrain to Datum of Typicals
Berm in Cut - Width
Berm in Cut - Vertical Separation
Berm in Cut - Max. Top Vert. Separation
Berm in Fill - Width
Berm in Fill - Vertical Separation
Berm in Fill - Max. Btm. Vert. Separation



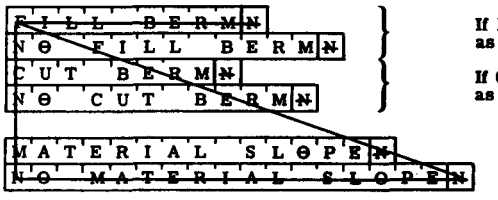
Side slope in cut - Natural Tan. if simple.

If slope to be automatically selected from height of cut - Give SSCT a value of 0 & fill in pairs of slopes (Nat. Tan.) & heights of Cut - Max. No. of 10



Side slope in Fill - Natural Tan. if Simple.

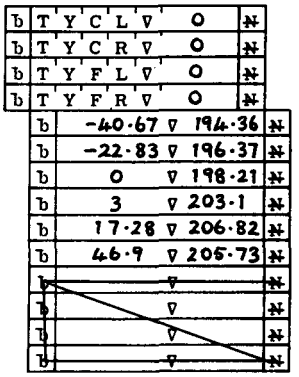
If slope to be automatically selected from height of Fill - Give SSFL a value of 0 & fill in pairs of slopes (Nat. Tan.) & heights of Fill - Max. No. of 10



If Fill berm data set (BWFL, BVFL, BHFL) delete as applicable - if not, delete both.

If Cut berm data set (BWCT, BVCT, BHCT) delete as applicable - if not, delete both.

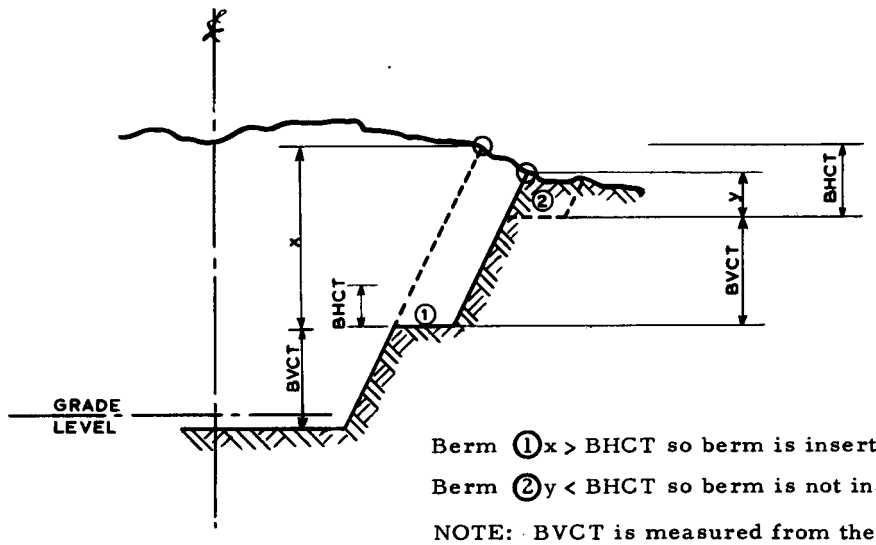
If material slopes vary (see material data) delete as applicable - if not, delete both.



Typical Reference No. in Cut - Left
Typical Reference No. in Cut - Right
Typical Reference No. in Fill - Left
Typical Reference No. in Fill - Right

If Typical is not standard TYCL, TYCR TYFL & TYFR are set to 0 and Typical is defined by pairs of Off sets and Levels - up to 58 No. pairs

Note: This forms first sheet of Station Data or can be used for subsequent Stations where variables alter.



Berm ①x > BHCT so berm is inserted

Berm ②y < BHCT so berm is not inserted

NOTE: BVCT is measured from the shoulder (i.e. the level of the outermost point on the typical), not from the grade level.

Figure 5

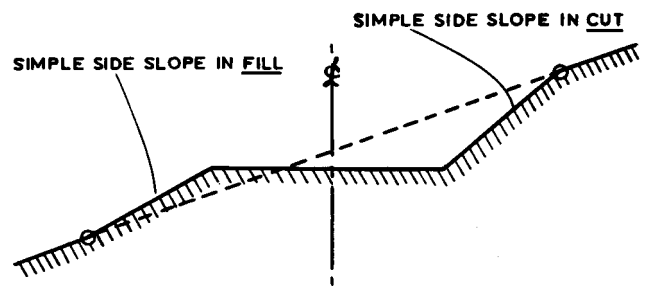


Figure 6 Simple side slopes

If the facility for the automatic positioning of berms is to be used, the following data is punched (see also 1.7.4):

BWCT Width of berm in cut.

BVCT Vertical separation one from another of berms in cut.

BHCT (for cut slopes). The maximum by which the vertical separation of the top berm and slope stake level can exceed BVCT. BHCT is also the minimum vertical separation of the top berm and slope stake level as shown in Figure 5.

BWFL Width of berm in fill.

BVFL Vertical separation one from another of berms in fill.

BHFL (for fill slopes). The maximum by which the vertical separation of the bottom berm and slope stake level can exceed BVFL. BHFL is also the minimum vertical separation of the bottom berm and slope stake level.

The following data is punched to set side slopes (see 1.7.3):

SSCT Tangent of the angle of the side slope in cut.

SSFL Tangent of the angle of the side slope in fill.

The following data is punched to select the required typicals (see 1.7.6):

TYCL Reference number of left half-typical in cut.

TYCR Reference number of right half-typical in cut.

TYFL Reference number of left half-typical in fill.

TYFR Reference number of right half-typical in fill.

The reference numbers punched here are the reference numbers of the required half-typicals which are specified in the typicals data (see 1.6.1).

The value of each variable must be preceded by its four-letter code reference and separated from it by a space character. Each four-letter code must be preceded by a tabulate character. All those variables not punched for the first station are given a value of zero. For subsequent stations, only variables which have different values to those of the preceding station are punched, together with their code reference. Those not re-specified are assumed to be as for the previous station.

The values described in this section are shown diagrammatically in Figure 7 (for fill) and Figure 8 (for cut).

Side Slopes 1.7.3

If simple side slopes are required, the variables SSCT and SSFL are punched as shown on Data Sheet 3a, where the numeric value is the tangent of the angle between the slope and the horizontal.

The selection of height-dependent slopes is possible if the slopes and height intervals are punched as shown on Data Sheet 3a, Example 2. The automatic cut slope selection data (under SSCT) mean the following, where H is the vertical height between the slope stake point and the shoulder:

$H \leqslant 5ft$	the angle of slope = $\tan^{-1}0.3$
$5ft < H \leqslant 8ft\ 6in$	the angle of slope = $\tan^{-1}0.25$
$8ft\ 6in < H \leqslant 15ft$	the angle of slope = $\tan^{-1}0.2$
$15ft < H$	the angle of slope = $\tan^{-1}0.18$

Up to ten pairs of slopes and heights may be specified.

If height-dependent slopes are specified, the program will compute for each station the left and right side slopes depending on the values of H for the station and whether each shoulder is in cut or fill. However, along any continuous section of cut or fill the program will vary the side slopes if any of the critical heights H are exceeded. In general, this is not acceptable. For each length, the 'worst case' slope can be selected by the user from the printout. These slopes can then be specified, using amendment data, as simple side slopes for each section of cut or fill.

Typicals are defined for earthworks calculations with □ points (i.e. underside road construction) related to the grade level and new construction ℄. O points show the finished profile.

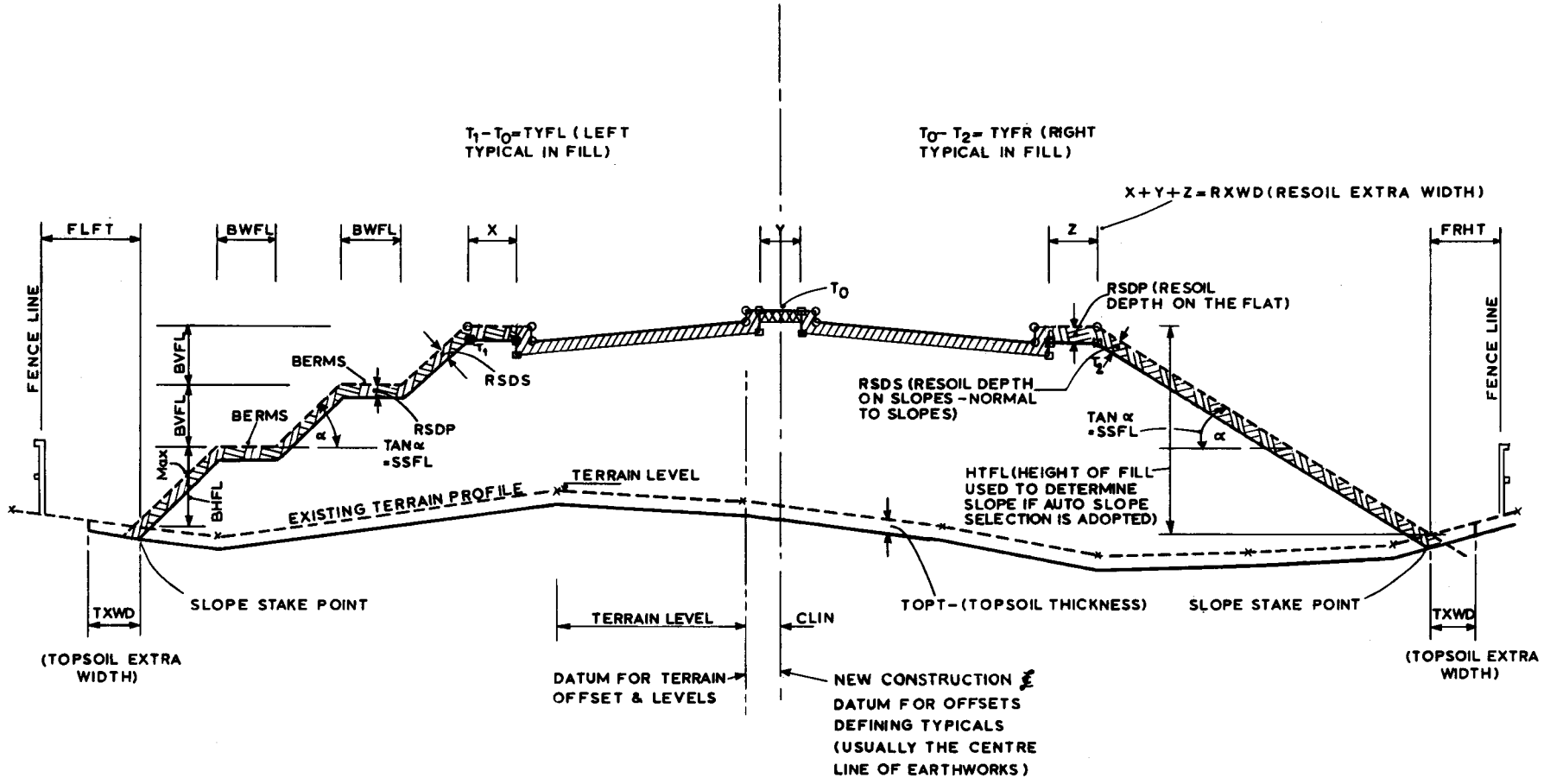


Figure 7 Fill cross-section

Typicals are defined for earthworks calculations with □ points (i.e. underside road construction) related to the grade level and new construction ℄. O points show the finished profile.

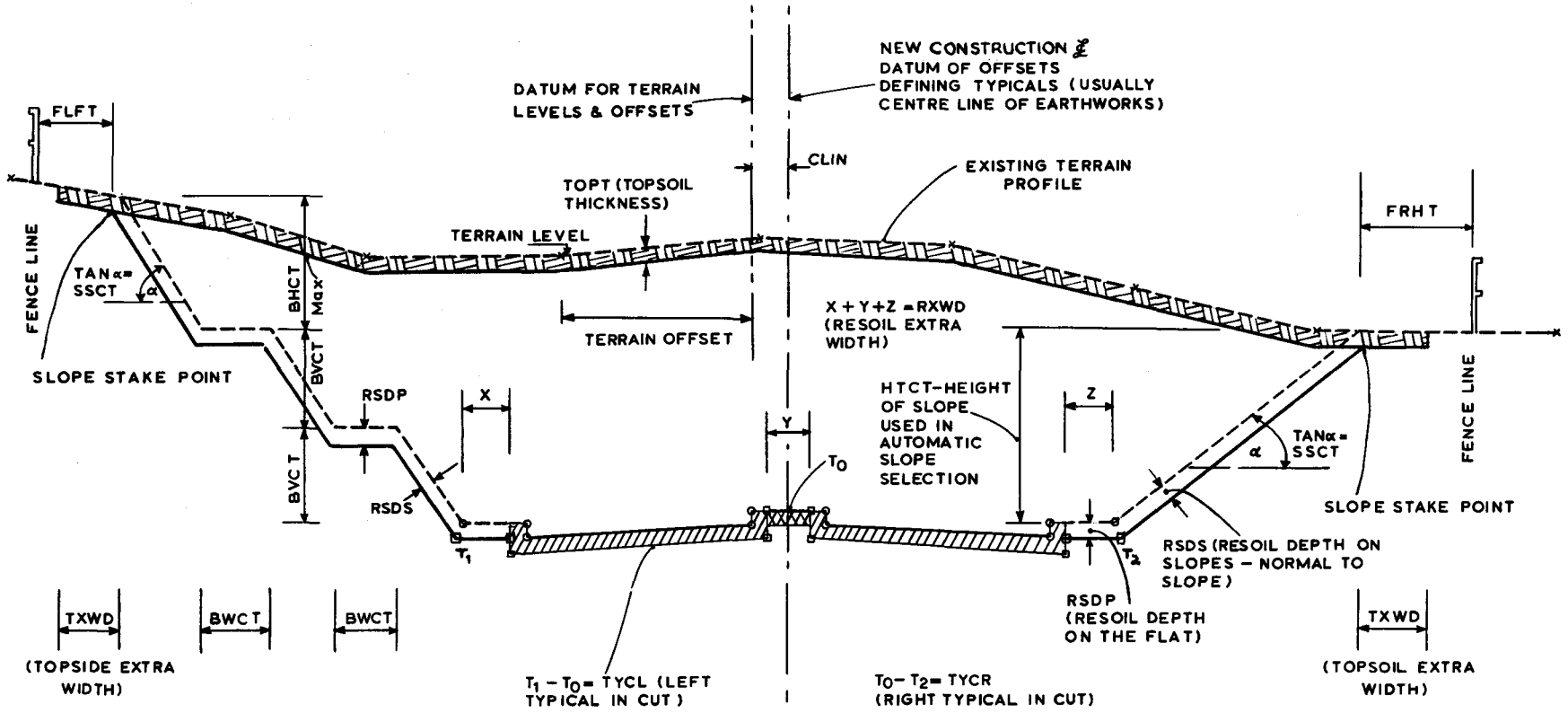


Figure 8 Cut cross - section

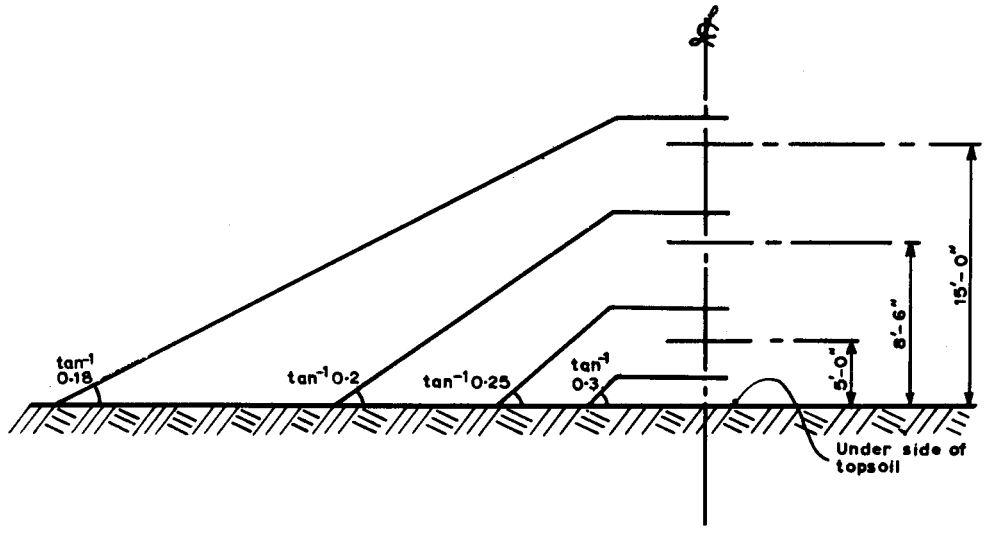


Figure 9 Height - dependent slopes

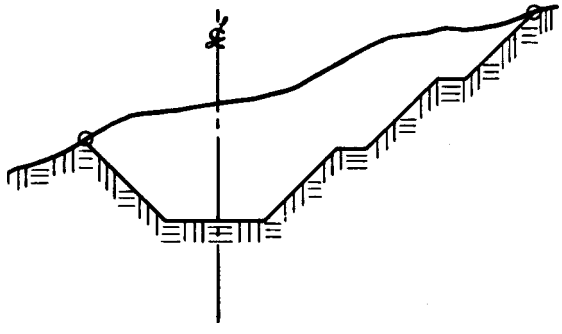


Figure 10 Berms

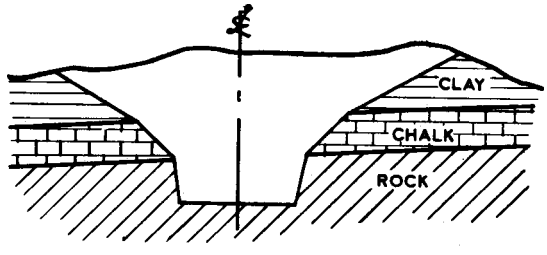


Figure 11 Material slopes

The program can then be re-run, using these amended values, and a new set of results obtained.

Berms 1.7.4

The data that the calculations program uses to generate berms in cut and in fill is detailed in 1.7.2. However, directives are also employed so that the engineer can direct the program to insert berms or not in any section of the route.

These directives are shown on Data Sheets 3a and remain valid until altered. For example, if

FILL BERM - meaning *Generate berms on embankment slopes* is input, it remains in force until

NO FILL BERM - meaning *Do not generate berms on embankment slopes* is input. Similarly, if the directive

CUT BERM - meaning *Generate berms on cutting slopes* is input, it remains in force until

NO CUT BERM - meaning *Do not generate berms on cutting slopes* is input.

Berms are horizontal in cross-section. They run parallel to the grade level unless BVCT or BVFL are changed from one station to the next. In this first version of the program, the 'maximum vertical separation of the top (or bottom) berm and slope stake level' (BHCT and BHFL in 1.7.2) criterion is applied at each station and may result in berms not running until they reach the slope stake line. This can be corrected, when it has been discovered from inspection of the results, by setting BHCT (in cut), or BHFL (in fill), to zero at the stations where berms have been truncated. This is achieved using the amendment program and a corrected set of results is produced by the computer.

Material Slopes 1.7.5

If the engineer wishes the program to construct cut side slopes from the material slopes specified in materials data (see 1.5), he must use the directive:

MATERIAL SLOPES

This directive will remain effective for all stations in cut until he specifies:

NO MATERIAL SLOPES

These directives form part of the station data. (See Data Sheets 3a, Examples 1 and 2, pages 14 and 17.)

The program does not permit the use of berms with material slopes.

Typicals 1.7.6

If stored typicals are to be used, the reference numbers of these are given by TYCL, TYCR, TYFL and TYFR (see 1.7.2) as shown on Data Sheet 3a. If , however, the stored typicals are not applicable (see 1.6.1), then these four variables must be punched as zero. Following these and starting on the next line, the specific typical must be defined using a series of offsets and levels. Offsets from left to right must be punched in the correct sequence. The offsets are measured from the construction centre-line which was specified in 1.7.2. The sign convention of these offsets is that when the typical is viewed in the direction of increasing chainage, offsets to the left are negative and those to the right are positive. The levels are absolute levels, based on ordnance datum or some agreed bench mark. A maximum of 58 pairs of offsets and levels may be specified. A specific typical must be completely specified, even if identical to one given previously. For a specific typical, the offset precedes the level, and they are separated by a space character as shown on Data Sheet 3a, Example 2.

The BREAK Indicator 1.7.7

A facility which the program provides is the BREAK indicator. This is used if earthwork quantities for cut or fill are not required to be calculated between the station at which the indicator is set and the

I.C.T. 1900 Series cut and fill program
tape input

Reference - Data Sheet 3c
Sheet number Ex. 1

b = Tabulator Character
∇ = Space Character
N = New Line

STATION DATA - Continued

This sheet must follow either sheet 3a or 3b at the station at which the "BREAK" is to occur

These values will be added. Delete if not required.

B	R E A K	N	
b	A L N D ∇ 0·17	N	Area of land
b	A S E E ∇ 380	N	Area for Resoil
b	A T O P ∇ 0·83	N	Area of Topsoil Strippage
b	V T O P ∇ 128·2	N	Volume of Topsoil Strippage
b	V T R E ∇ 28·7	N	Volume of Resoil
b	V F I L ∇ 683·9	N	Volume of Fill
b	V C U T ∇ 2190	N	Volume of Cut
b	G R A V ∇ 1090	N	Material and Volume 1
b	S O F T ∇ 1100	N	Material and Volume 2
b	∇	N	Material and Volume 3
b	∇	N	Material and Volume 4
b	∇	N	Material and Volume 5

up to 20

Note: With 'BREAK' set values are not calculated between this Station and the preceding Station i.e. at bridges, roundabouts etc.

I.C.T. 1900 Series cut and fill program tape input

Reference - Data Sheet 3c

Sheet number Ex. 2

b = Tabulator Character
V = Space Character
N = New Line

STATION DATA - Continued

This sheet must follow either sheet 3a or 3b at the station at which the "BREAK" is to occur

These values will be added. Delete if not required.

b	BREAKN	
b	ALNDVN	Area of land
b	ASEEVN	Area for Resoil
b	ATOPVN	Area of Topsoil Strippage
b	VTOPVN	Volume of Topsoil Strippage
b	VTREVN	Volume of Resoil
b	VFILVN	Volume of Fill
b	VCUTVN	Volume of Cut
b	VN	Material and Volume 1
b	VN	Material and Volume 2
b	VN	Material and Volume 3
b	VN	Material and Volume 4
b	VN	Material and Volume 5

up to 20

Note: With 'BREAK' set values are not calculated between this Station and the preceding Station i.e. at bridges, roundabouts etc.

I.C.T. 1900 Series cut and fill program
tape input/amendment

Reference - Data Sheet 4

Sheet number _____

ƀ = Tabulator Character
∇ = Space Character
N = New Line

delete if 'AMENDMENT' was last directive given

E θ D A N
T E R R A I N D A T A N

Delete these 2 boxes for all but first sheet of Terrain Data
OR

E θ S T N

Delete this box on first sheet

ƀ 1150 N Chainage

Offset	Level
-60	512·21
-40·5	518·71
-2	496·2
20	483
75·21	481·21

Maximum number 40

E θ S T N
ƀ 1250 N Chainage

Offset	Level
-96	527·2
-55	528
0	520·21
22·5	516·6
88·7	519·3

Maximum number 40

E θ S T N
ƀ 1350·67 N Chainage

Offset	Level
-120·2	531·2
3	517
73	513·8

Maximum number 40

E θ S T N
ƀ 1400 N Chainage

Offset	Level
-100·0	521·3
90·0	522·1

Maximum number 40

previous one. This facility may be used at bridges, tunnels, viaducts and roundabouts, etc. If the indicator is not set in these cases, the calculation of earthwork quantities is continuous through these structures. If the indicator is set, earthwork quantities, calculated manually or by computer program, may be input so that cumulative quantities will be correct. The quantities are:

ALND	Area of land required for construction
ASEE	Area for seeding
ATOP	Area of topsoil strippage
VTOP	Volume of topsoil strippage
VTRE	Volume of topsoil replacement
VFIL	Volume of fill
VCUT	Volume of cut

followed by a list of material names and corresponding volumes, including each material defined in strata data (see 1.9). Each pair of material names and volumes is punched on a separate line. Material volumes need not be given when VCUT is specified.

Each of the above values punched must be preceded by its code reference and separated from it by a space character as shown on Data Sheet 3c, Example 1 page 24. Each code must be preceded by a tabulate character.

All the above volumes are input in cubic yards or cubic metres. The areas are all input in square yards or square metres except the 'Area of land required for construction', which is input in acres (for British measure).

The break indicator, BREAK, is set before the end of station indicator (EOST) of the station following the break. Those of the above quantities that are not punched are assumed to be zero. (Data Sheet 3c, Example 2, page 25 shows an example where no values have been input.)

The station data must be preceded by the directive STATION DATA and terminated with the characters EODA. After the completion of the data for each station except the last, the terminator EOST must be punched. Chainages must be presented in increasing order. Each line of numeric data, as opposed to the directives and end indicators, must be preceded by a tabulate character.

A complete set of station data for a simple job is shown in Chapter 4.

Dump or Borrow Pits **1.7.8**

The BREAK facility can be employed to simulate the use of a dump or borrow pit.

A station must be specified at the chainage at which the pit occurs together with a 'dummy' station at a very small chainage past the pit station. The difference in chainage should be as small as possible, e.g. 0.001 (feet or metres), and certainly less than 1 foot or 1 metre. At the dummy station, the BREAK facility is used and the dump or borrow volumes are input in the list of variables that is allowed to follow the directive BREAK. Dump volumes are input as fill volumes and borrow volumes are input as cut volumes; they also appear in the detailed materials volumes list.

If the volume to be dumped is a material or materials unsuitable for fill, this must be input as a NEGATIVE value of CUT volume and also as negative volumes of the particular material(s).

Terrain Data **1.8**

The terrain data defines the profile of the existing ground at each station.

Variables Input for Each Station **1.8.1**

The following variables are punched in tabular form for each station: the chainage followed by pairs of offsets and levels for the terrain. The offsets are measured from the terrain datum, which was specified in 1.7.2. The sign convention for these offsets is as usual. Offsets to the left, when viewing the station in the direction of increasing chainage, are negative and those to the right are positive. The levels are absolute levels, based on ordnance datum or some agreed bench mark. A maximum of 40 pairs of offsets and levels, and not less than two pairs, may be specified for each station. The minimum condition is therefore a straight line. Chainages must be presented in increasing order. All the stations included in the terrain data must be included in the station data and no other stations may be defined.

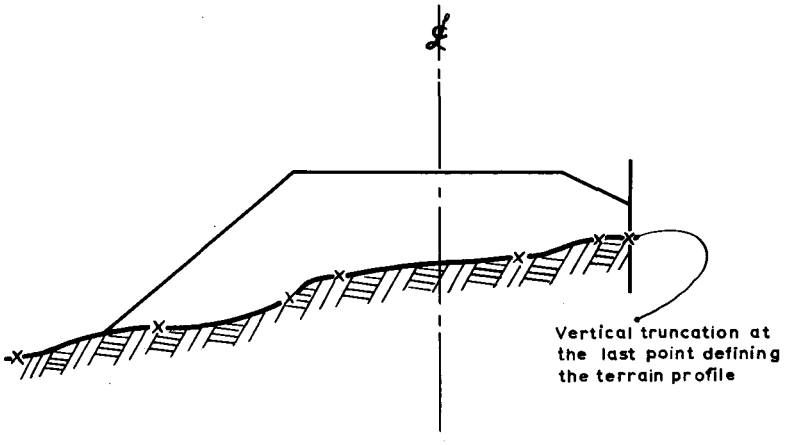


Figure 12 Truncation

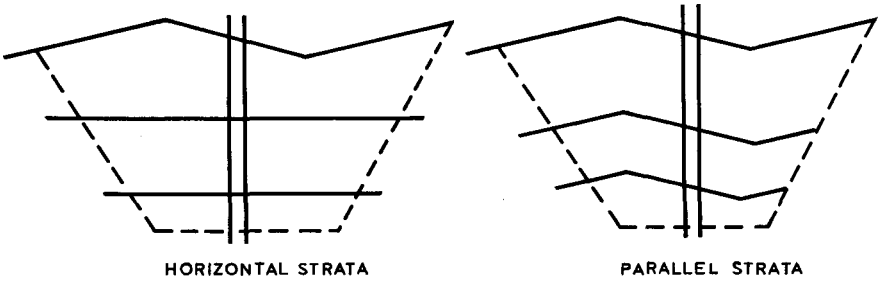


Figure 13

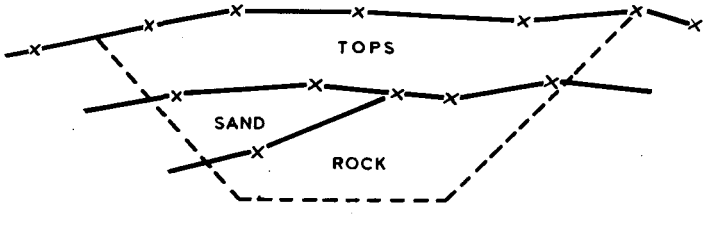


Figure 14

The calculations program joins adjacent terrain points with straight lines to form the terrain profile at each station. This must be borne in mind when selecting the points to be input.

Terrain data should normally extend beyond the future slope stake points of the completed earthworks. If full coverage is not given, truncation will occur, since terrain data is never extrapolated. Truncation means that the side slope in either cut or fill will terminate in a vertical slope to meet the extreme point of the terrain data. If this inadvertently occurs, areas and volumes will not be calculated as intended. Truncation is indicated on the output schedule by a 'T'. Use may be made of this facility at retaining or dwarf walls.

The terrain data must be preceded by the directive TERRAIN DATA and terminated with the characters EODA. After the completion of the data for each station except the last, the terminator EOST must be punched. An example of terrain data is shown on Data Sheet 4, page 26.

Each line of numeric data, as opposed to the directive and end indicators, must be preceded by a tabulate character. Each offset and level must be separated by a space character. Terrain data at a station must be presented from left to right when viewed in the direction of increasing chainage, i.e., offsets of successive points must not decrease algebraically.

Overhangs are not permitted in terrain data.

Strata Data 1.9

The strata data defines the profiles and materials encountered below ground level for each station in cut. Strata data can be used to obtain results at both the pre-construction (design or pre-planning) and post-construction (measurement) stages.

Pre-construction Stage 1.9.1

At the pre-construction stage, little information is available about the strata, and therefore assumptions have to be made. The available information is obtained from trial pits, bore holes, geological records, etc. This may be available at each station, that is, a bore hole or trial pit at each station giving the strata levels at one point for the station. However, assumptions have to be made about the strata profiles across the remainder of the station. It is probable too that the information is available only at, say, intervals of every ten stations. Thus, further assumptions must be made about the shapes of the strata interfaces in the longitudinal direction.

At each station, it is assumed that there is data for only one point on the station, that is, one bore hole or trial pit. The levels of the strata interfaces are given relative to the ordnance datum or some agreed datum. The program then provides for one of two assumed profile shapes for the width of the station, using the indicator HORIZONTAL or PARALLEL. (See Data Sheet 5a, Examples 1 and 2, pages 32 and 33.). HORIZONTAL indicates that the interface profiles are assumed to be horizontal for the entire width of each station, at the levels found at the bore holes. When HORIZONTAL strata interfaces are specified, the GROUND LEVEL given must be the level at the terrain centre-line, interpolated manually if necessary. PARALLEL indicates that interfaces are assumed to be parallel to the ground above, as defined in terrain data, at depths calculated by the program as the difference between the strata interface levels and the ground level at the bore hole.

Where bore hole information is not available for each station, the levels of strata at each station between bore holes are found by linear interpolation.

Having specified HORIZONTAL or PARALLEL for the stations, it applies to the whole length of the road and the indicator cannot be changed along the route.

Post-construction Stage 1.9.2

At the post-construction stage, as each strata interface is revealed, it may be recorded in the same way as a terrain level, i.e., as a profile with offsets and levels at each station. The points must be chosen in such a manner that when they are joined by straight lines, the resulting shape is as close an approximation as possible to the actual profile. The indicator DETAILED is specified at this stage (see Data Sheet 5b, page 34). The offsets and levels for an interface must continue right across a station even if this interface coincides with part of another interface. This could occur with a lens as shown in Figure 14.

The offsets and levels need not extend beyond the excavated slopes. Interface data not extending fully across the width of the excavation will be extrapolated horizontally by the program to calculate the

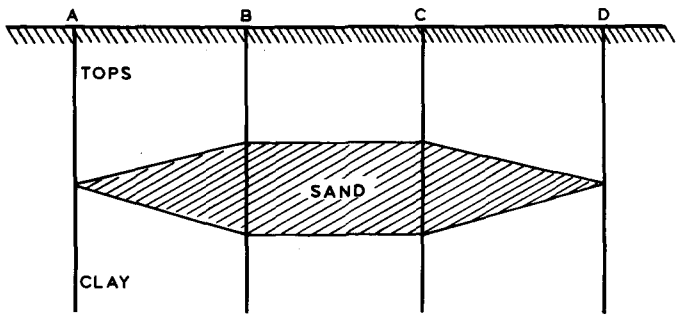


Figure 15

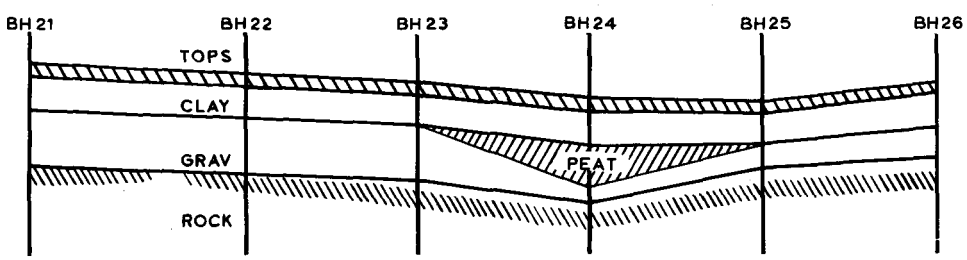


Figure 16

intersections with the side slopes. In this respect, there is a difference from the terrain data which is never extrapolated. For accuracy, the extreme offsets should be as close as is possible to the side slopes.

Having specified DETAILED, this applies to the whole length of the road. It is not possible to change from DETAILED to HORIZONTAL or PARALLEL along the route. No interpolation over intermediate stations is possible when using the DETAILED indicator, and a note will be printed on the line printer for each station at which information is not provided. Usually, topsoil is considered to have a constant thickness (PARALLEL to the terrain) but it is dealt with in the station data and is not repeated in the strata data. However, if the topsoil thickness varies across the station and it is wished to strip all topsoil, then it can be defined as a stratum using the name TOPS. If this is done, the volume of topsoil stripped is output under the heading TOPSOIL STRIP VOL and is not included in cut or fill volumes or in the mass-haul diagram. When topsoil is specified in strata data as a stratum at a station, the value of 'topsoil thickness' (TOPT on Data Sheet 3a) is ignored by the program at that station.

Variables Input for Each Station 1.9.3

The following variables are punched for each station, at both pre- and post-construction stages (see Data Sheets 5a and 5b, pages 32 to 34).

1 Station name. From two to eight alphanumeric characters are permitted. This does not have to be the same name as that specified in the station data (1.7.1) when using the indicator HORIZONTAL or PARALLEL. When using the DETAILED indicator, the station names must be identical.

2 Chainage.

3 Ground level. For HORIZONTAL and PARALLEL data.

4 Strata interface definition. This consists of two four-letter codes for the adjoining materials, separated by a solidus character. The four-letter codes of these materials must have been previously included in the materials data (see 1.5.1).

5 Offset of a point on the interface from the construction centre-line (DETAILED only).

6 Level of strata interface.

A maximum of seven materials (six interfaces) may be defined at each station. Chainages must be presented in increasing sequence. If the strata occur in the same order for consecutive stations or bore holes, the strata definitions need not be repeated for these stations. The levels for each station, however, must be presented in order. This order is assumed to be constant until a new order of strata is defined at a station. When this occurs, all the strata must be redefined, even if only one stratum is changed. (See Data Sheet 5a, Example 1, station BH 23.) When offsets and levels are used, they must be presented in that order and each pair separated by a space character. The sign convention for offsets and the order of punching these are as defined in 1.7.6.

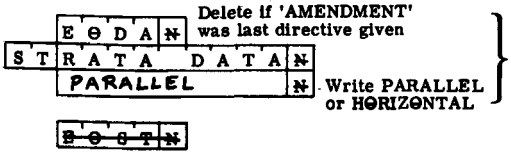
If a lens is formed as shown in Figure 15 then at the beginning of the lens, station A, the thickness of the sand stratum must be input as 0 (zero) in the 'Strata Level' column to allow the normal interpolation to be carried out. Station D is treated similarly. An example of this is shown on Data Sheet 5a, Examples 1 and 2, between stations BH 23 and BH 25. Figure 16 shows, in diagramatic form, the situation represented on these Data Sheets.

The strata data must be preceded by the directive STRATA DATA and terminated with the characters EODA. After the completion of the data for each station except the last, the terminator EOST must be punched. Each line of numeric data, as opposed to directives, indicators and material names, must be preceded by a tabulate character.

I.C.T. 1900 Series cut and fill program
tape input/amendment

Reference - Data Sheet 5a
Sheet number Ex. 1

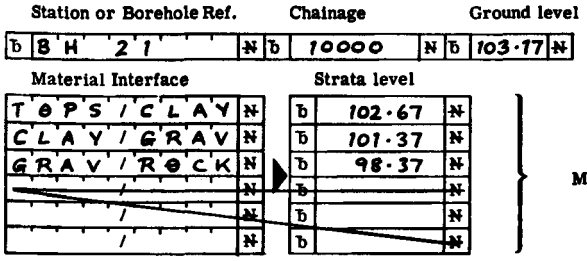
b = Tabulator Character
v = Space Character
N = New Line



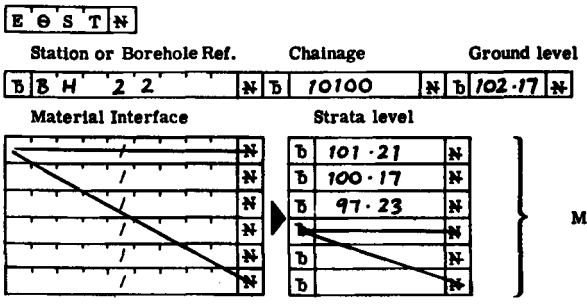
Delete these boxes on all but the first sheet of Strata Data

OR

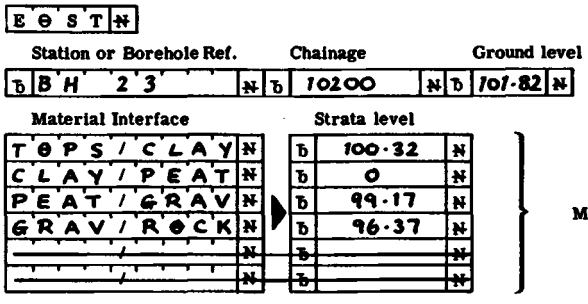
Delete on first sheet of Strata Data



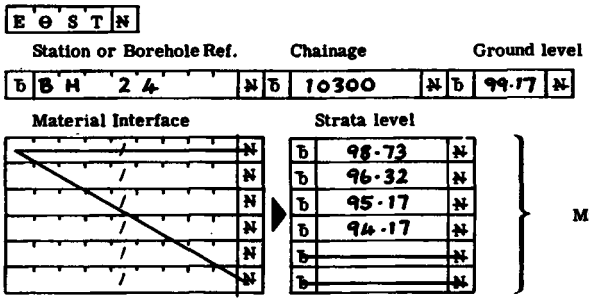
Note: If interfaces in same order as previously set, delete all material interface refs. Just input Strata Levels.



See Note above



See Note above

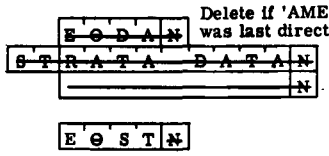


See Note above

I.C.T. 1900 Series cut and fill program
tape input/amendment

Reference - Data Sheet 5a
Sheet number Ex. 2

b = Tabulator Character
V = Space Character
N = New Line



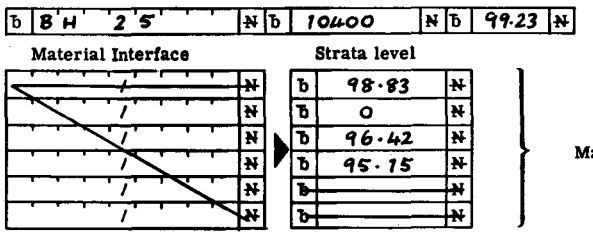
Delete if 'AMENDMENT' was last directive given

Write PARALLEL or HORIZONTAL

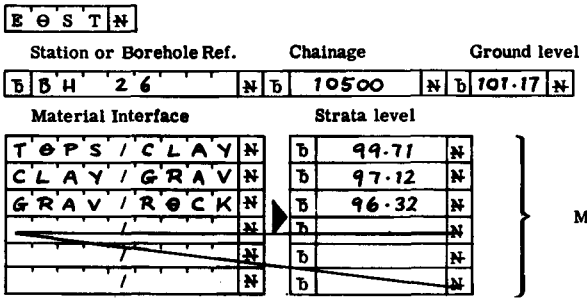
Delete these boxes on all but the first sheet of Strata Data

OR

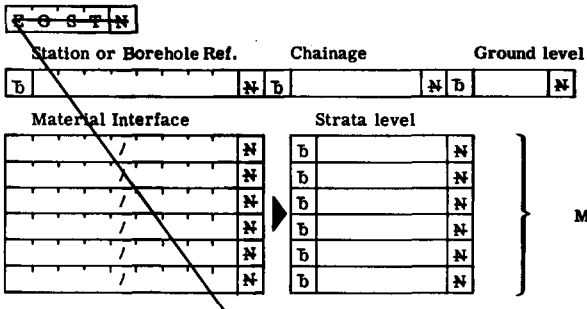
Delete on first sheet of Strata Data



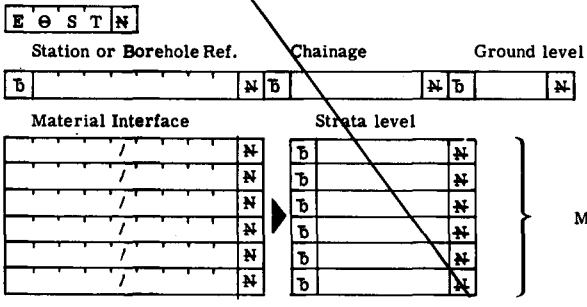
Note: If interfaces in same order as previously set, delete all material interface refs. Just input Strata Levels.



See Note above



See Note above



See Note above

I.C.T. 1900 Series cut and fill program
tape input/amendment

Reference - Data Sheet 5b

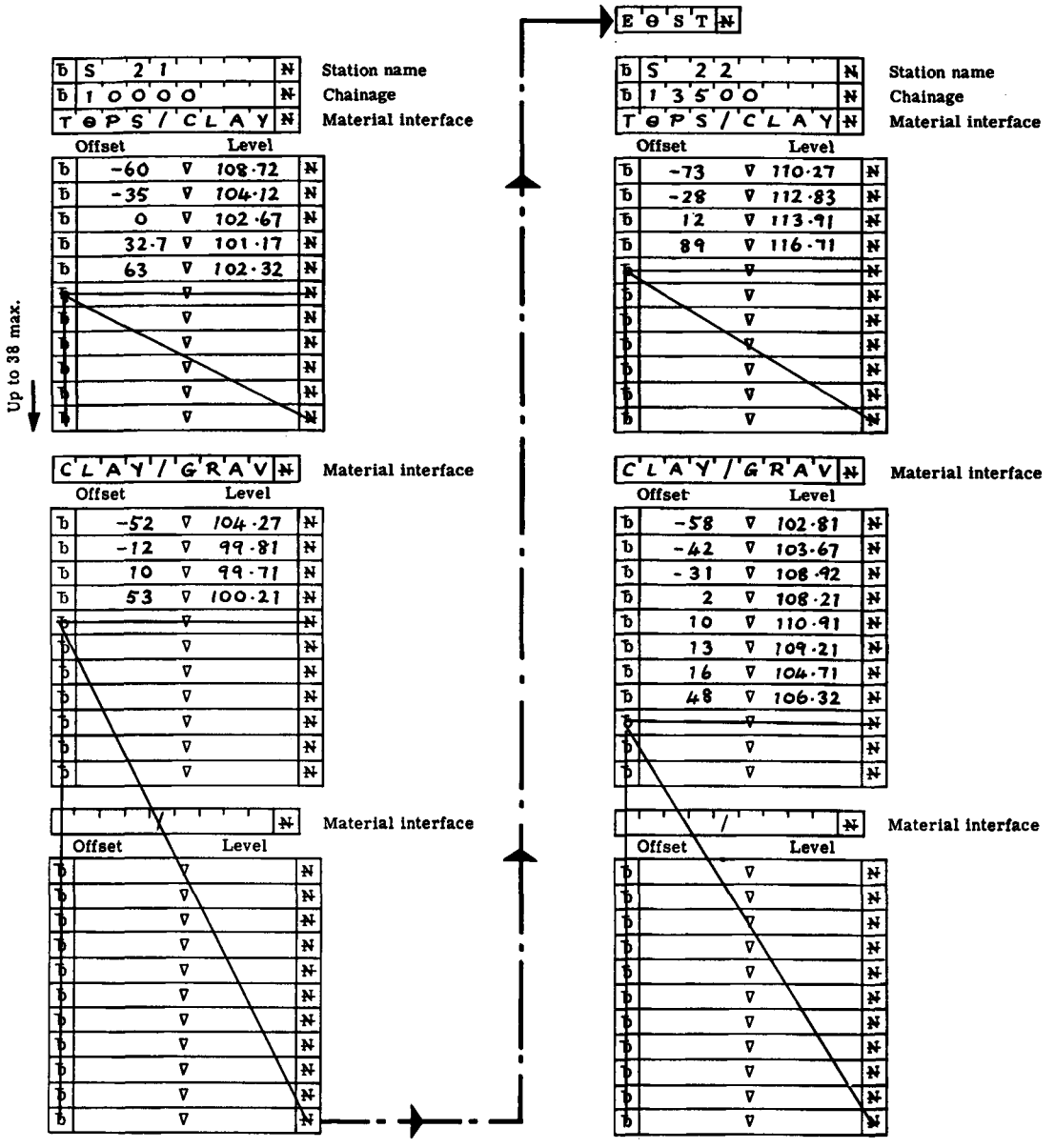
Sheet number _____

ƀ = Tabulator Character
∇ = Space Character
N = New Line

E∇O∇D∇A N Delete if 'AMENDMENT' was last directive given
S∇T∇R∇A∇T∇A D∇A∇T∇A N
D∇E∇T∇A∇I∇L∇E∇D N

} Delete these Boxes for all but first sheet of Strata Data
OR

E∇O∇S∇T N Delete on first Sheet of Strata Data



Note: This sheet shows 3 material interfaces for one station. In fact this could be up to 6 material interfaces. Each interface is shown here with 11 pairs of offset and level; this could be up to 38.

AMENDMENT PROGRAM - DATA ON PAPER TAPE

General 1.11

The primary function of the amendment program is to enable the user to update the information held in the Cut and Fill file without having to re-input all the initial data. The amendment program is used to alter any quantity of data held on magnetic tape files produced by the Cut and Fill input programs or the Cut and Fill calculations program, so that the effect of changes in any of the input variables can be readily evaluated.

The amendment program can be used to update only a valid file. A file that has been produced by an input or amendment run in which ERROR messages (as opposed to CAUTION messages) were output on the line printer, will not normally be valid. Any completed file produced by the calculations program can be considered valid in this context. When using the amendment program, data held on the old master file that is not required to be amended or deleted will be copied onto the new master file.

Unlike the input program, not all the main directives described earlier in Chapter 1 need be used; the directives only for the parts of the data to be altered are specified. There are (in addition to those described earlier in Chapter 1) six directives that are peculiar to the amendment program - AMENDMENT, DELETE, SKIP, SNGL, CRRY and NO BREAK. The use of these is described in the following sections. Apart from these additional directives, the format of the data is very similar to that of the input program. Where the format is different, a suggested form of Data Sheet has been drawn up; otherwise, the Data Sheets included in the earlier sections of this chapter are also applicable for amendment data.

Job Heading 1.12

If it is required to alter the job heading, the directive HEADING must be given. This is followed on the next line by the new job heading, which is terminated by a newline character as shown on Data Sheet 1 (page 36).

Amendment 1.13

The directive AMENDMENT is mandatory, and follows the new job heading if one has been specified, otherwise it is the first item on the data tape. It is not possible to specify different units to those used for the input program data. (See Data Sheet 1 page 36.)

Grade Data 1.14

The amended grade data must be preceded by the directive GRADE DATA and terminated with the characters EODA (see Data Sheet 1 page 36).

If it is required to amend the values of the grade level and curve length for a particular chainage, the chainage together with the amended values of the grade level and curve length are specified as for the input program. If the value of this chainage is exactly equal to the chainage for which the amendment is required on the old master file, then the new values of the grade level and curve length will be substituted when the grade data is written to the new master file.

If it is required to insert additional values of chainage, grade level and curve length, the three new values are specified (as for the input program) and these will be inserted automatically by the program in the correct position on the new master file.

If it is required to delete a value of chainage, grade level and curve length from the old master file, it is necessary to specify only the directive DELETE, followed on the next line by the relevant chainage.

If it is found that, after amending data held on the old master file, no further data from the old file is required to be copied to the new file, the directive SKIP is given. Any further new values of grade data may then be given in the usual way on subsequent lines. This facility may be used, for example, if it is required to re-specify all the grade data held on the old master file. To achieve this, the first line of data should contain the directive SKIP, and all subsequent lines should specify the new grade data in the usual way.

In all grade data, chainages must be in ascending order.

I.C.T. 1900 Series cut and fill program tape amendment

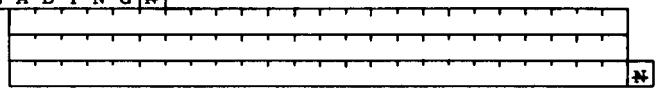
Reference - Data Sheet 1

Sheet number_____

b = Tabulator Character
∇ = Space Character
N = New Line

H E A D I N G N

Maximum No.



A M E N D M E N T N

G R A D E D A T A N

Insert b or a directive as applicable	Chainage at intersection of tangents	Grade level of intersection of tangents	Curve length	
	∇	∇		N

Unlimited

E O D A N Delete if 'AMENDMENT' was last directive given

M A T E R I A L S D A T A N

Insert b or a directive as applicable	Material name	Cut factor	Fill factor (0 if unsuitable)	Cut slope (Nat. Tan.)	
		∇	∇	∇	N

Unlimited

Note: 'Tops' may not be deleted

Materials Data 1.15

The amended materials data must be preceded by the directive MATERIALS DATA and terminated with the characters EODA (see Data Sheet 1 page 36).

If it is required to delete a material from the old file, the directive DELETE should be given, followed on the next line by the name of the material to be deleted.

Other lines of data consist of a tabulate character, material name, cut factor, fill factor and cut slope, as for the input program. If the material name given is the same as one contained on the old master file, then the new values of the cut factor, fill factor and cut slope will be substituted for those on the old file. Otherwise, the line of data will be added to the materials data of the new master file, as long as the total number of materials contained in this file does not exceed 20.

N.B. The directive SKIP may not be used in materials data.

Typicals Data 1.16

The amended typicals data must be preceded by the directive TYPICALS DATA and terminated with the characters EODA (see Data Sheet 2 page 12). After the completion of the data for each half-typical except the last, the terminator EOTY must be punched. Typicals may not be deleted from the old file, but may be amended, or new typicals may be added. Thus, the directives SKIP and DELETE may not be used in typicals data.

The method of specifying each half-typical is the same as for the input program. If the typical reference number given is the same as one contained on the old master file, then the subsequent new values of the offsets and levels will be substituted for those on the old master file. If the typical reference number is greater than the last one contained on the old file, then the program will add the given typical onto the end of the typicals data on the new master file. Typicals added in this way must increase their reference numbers sequentially; the reference number of the first typical added should be one larger than the last on the old file.

Station Data 1.17

The amended station data must be preceded by the directive STATION DATA and terminated with the characters EODA. After the completion of the data for each station except the last, the terminator EOST must be punched. New stations may be added and existing stations amended or deleted from the old master file. (See Data Sheets 3a page 38, 3b page 16 and 3c page 39.)

Stations are referenced within the program by chainage only, and station names are not checked. Any station at which data is amended will be given the station name of the relevant amendment data, regardless of the station name on the old master file. Similarly, the grade level will be given the value contained in the amendment data, unless it is zero, in which case the grade level will be calculated from the current grade data. For all stations on the old master file at which the grade level was calculated originally by the input program, the grade level will be re-calculated automatically by the amendment program, using the current grade data.

If it is required to delete the data for a particular station, including the corresponding terrain and strata data, then the directive DELETE must be specified. This should be followed by the station name, and chainage. The grade level or any other variable must not be given.

Variables at a particular station may be amended by giving the station name, chainage and grade level (as for input program data) and then the list of variables and their new values (as for input program data). Only the variables named will have new values assigned to them, the rest remaining as on the old master file. Note that, unlike the input program, amended values of variables may or may not be *carried through* to following stations. If the directive SNGL is used, the value of the variable will be changed only at the station in question. If the directive CRRY is used, the value of the variable will be changed at the station in question and at all subsequent stations unless a later amendment changes the value. These directives immediately precede the variable to which they refer and one or other must be given in front of all the station variables and directives, except for station name, chainage, grade level, BREAK and NO BREAK, and variables associated with a break (VCUT, ALND, etc.) as on Data Sheet 3c (page 39). The CRRY and SNGL directives should occur between the tabulate character and the variable name, without any intervening spaces.

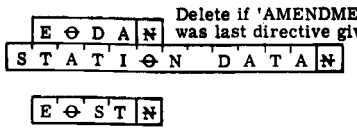
The directive NO BREAK is given if it is required to cancel the effect of the directive BREAK that was originally given at the station in the data of the input program.

I.C.T. 1900 Series cut and fill program
tape amendment

Reference - Data Sheet 3a

Sheet number___ _____

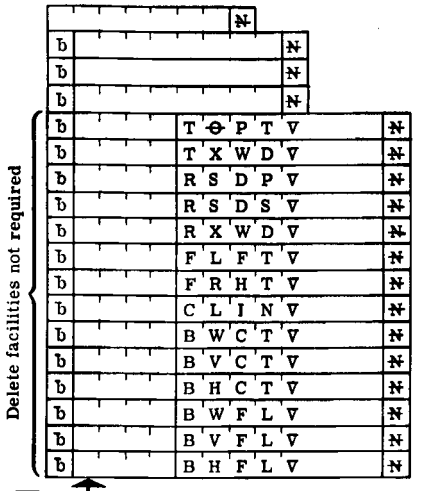
b = Tabulator Character
∇ = Space Character
N = New Line



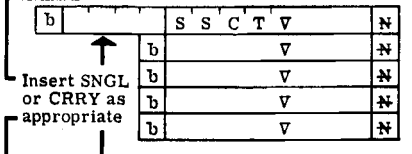
Delete these 2 boxes on all but the first Station Data Sheet

OR

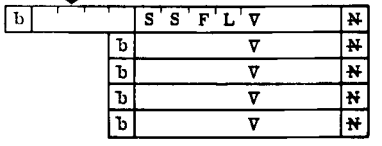
Delete on first Station Data Sheet



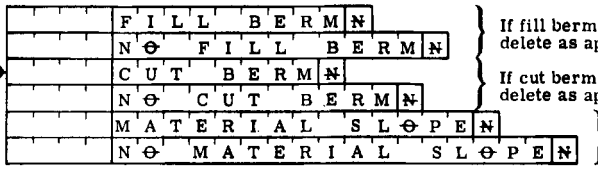
Insert directive if required otherwise delete.
Station name and/or number
Chainage
Grade level
Topsoil thickness
Topsoil extra width
Resoil depth-horizontal-verges-central res.
Resoil depth - normal - on slopes
Resoil extra width
Distance to fence line left
Distance to fence line right
Distance from ℄ terrain to datum of typicals
Berm in cut - width
Berm in cut - vertical separation
Berm in cut - Max. top vertical separation
Berm in fill - width
Berm in fill - vertical separation
Berm in fill - Max. btm. vertical separation



Side slope in cut - Natural Tan if simple.
If slope to be automatically selected from height of cut - give SSCT a value of 0 & fill in pairs of slopes (Nat. Tan) & heights of Cut - Max. No. of 10



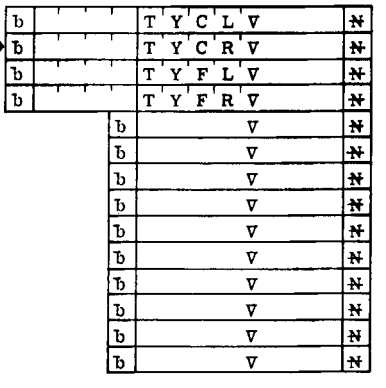
Side slope in fill - Natural Tan if simple
If slope to be automatically selected from height of fill - give SSFL a value of 0 & fill in pairs of slopes (Nat. Tan) & heights of Fill - Max. No. of 10.



If fill berm data set (BWFL, BVFL, BHFL) delete as applicable - if not, delete both

If cut berm data set (BWCT, BVCT, BHCT) delete as applicable - if not, delete both

If material slopes vary (see material data) delete as applicable - if not, delete both



Typical reference No. in Cut - left
Typical reference No. in Cut - right
Typical reference No. in Fill - left
Typical reference No. in Fill - right

If Typical is not standard TYCL, TYCR, TYFL, TYFR are set to 0 and Typical is defined by pairs of off sets and level - up to 58 No. pairs

Note: This forms first sheet of Station Data or can be used for subsequent Stations where variables alter.

I.C.T. 1900 Series cut and fill program tape amendment

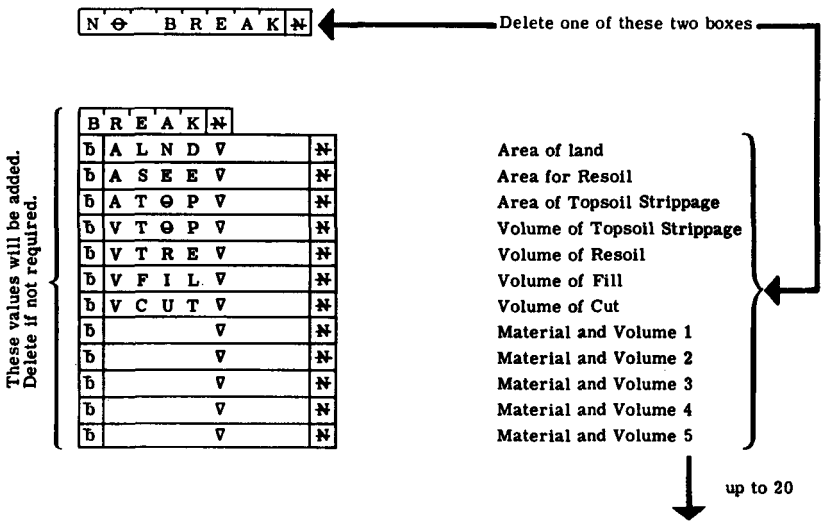
Reference - Data Sheet 3c

Sheet number _____

ƀ = Tabulator Character
V = Space Character
₦ = New Line

STATION DATA - Continued

This sheet must follow either sheet 3a or 3b at the station at which the "BREAK" is to occur



Note: With 'BREAK' set values are not calculated between this Station and the preceding Station i.e. at bridges, roundabouts etc.

A new station may be inserted in the station data by giving the station name, chainage and grade level in the usual way. Any of the station variables that are given for that station will assume the value specified; other variables will take the values of the corressponding variables of the station of next lower chainage on the old master file.

If it is found that, after amending data held on the old master file, no further data from the old file is required to be copied to the new file, the directive SKIP is given. Any further new stations may then be inserted as above. Note that if a new station is inserted, it entails adding new terrain data. If DETAILED strata data is being used, then a set of strata data must also be given (unless the station is in fill). For the HORIZONTAL and PARALLEL assumptions, the interface levels are automatically re-calculated from the original bore hole data, if sufficient data was given.

Throughout station data, chainage must be presented in increasing order.

Terrain Data **1.18**

The amended terrain data must be preceded by the directive TERRAIN DATA and terminated with the characters EODA (see Data Sheet 4 page 26). After the completion of the data for each station except the last, the terminator EOST must be punched. The terrain data for a particular station cannot be deleted by itself. It is also necessary to delete the corresponding station and strata data, as explained in 1.17.

Terrain data for any station may be amended and any new station added to the station data must be given a set of terrain data. The data for a station is given (as for the input program) by a chainage and up to 40 pairs of offsets and levels. When amending terrain data, the complete set of offsets and levels must be specified, even though it may be required to amend only one or two values. Whenever terrain data is amended or new data given at a station, the strata interface levels for the PARALLEL and HORIZONTAL strata assumptions (see 1.9.1) are automatically re-calculated.

Throughout terrain data, chainages must be presented in increasing order.

Strata Data **1.19**

The amended strata data must be preceded by the directive STRATA DATA with one of the directives PARALLEL, HORIZONTAL or DETAILED on the next line and terminated with the characters EODA. (See Data Sheets 5a page 32 and 5b page 34.)

It is possible to have any of the possible strata options on the new master file, regardless of that on the old master file. If it is required to change PARALLEL data to HORIZONTAL, merely give the directive HORIZONTAL with EODA on the next line. Similarly, for changing HORIZONTAL to PARALLEL, give the directive PARALLEL with EODA on the next line.

If it is required to change DETAILED to PARALLEL or HORIZONTAL, or vice versa, a complete new set of strata data must be given (as for the input program).

For DETAILED strata data, interface data may be amended at a station by giving the chainage, together with the complete new set of offsets and levels, in the same format as for the input program.

For PARALLEL or HORIZONTAL data, new bore hole data may be given in the same format as for the input program. If the chainage of a new bore hole is exactly equal to the chainage of one specified on the old master file, then the new bore hole data will be substituted for the old; otherwise, the new data will be inserted automatically in the correct position on the new master file. In any case, the strata interface levels will be re-calculated. Note that bore holes cannot be deleted or skipped.

Throughout strata data, chainages must be presented in increasing order.

N.B. The directive FINISH followed by a newline character *must* be punched at the end of the data for an amendment run.

INPUT PROGRAM - DATA ON CARDS

General 1.20

The preparation of data for the card input program is similar in principle to the preparation of data for the paper input program described in 1.1 to 1.10.

Data is prepared at the same stages in the project and at each stage data must be presented to the program in the sequence given in 1.1. Each type of data punched on cards must be preceded by its appropriate directive and followed by its appropriate terminator.

Data Sheets for Card Input 1.21

The suggested Data Sheets for card input are very similar to those for paper tape input and are included in Chapter 4. Some of these Data Sheets can also be used to record data for the card amendment program (see 1.23). The data punched on each card is generally equivalent to a line of data on paper tape. However, the following differences apply to card input:

Data Sheets 3a,3b — The station name, chainage and grade level for each station, which are contained in three lines of data on paper tape, are punched on a single card.

Data Sheets 5a — The station name, chainage and ground level for each station, which are contained in three lines of data on paper tape, are punched on a single card.

Data Sheet 5b — The station name and chainage, which are contained in two lines of data on paper tape, are punched on a single card.

The tabulate character on paper tape is replaced on cards by a skip to column 21 and the space character between items on paper tape is replaced by a skip to column 36, 51 or 66.

When recording data on these Data Sheets, the following points should be borne in mind:

1 Decimal points must always be included in numerical values. If the number is an integer, it is not necessary to write a zero after the decimal point.

2 Typical reference numbers entered on Data Sheets 2 and 3a must be followed by a full stop.

3 Zero quantities need not be entered on the Data Sheets.

4 As for paper tape input, any number of decimal places may be used in a numerical value, up to the width of the field. It should be noted that on the recommended Data Sheets, the number of columns for numerical values may be increased by the user on his own Data Sheets up to the maximum width of the field.

AMENDMENT PROGRAM - DATA ON CARDS

General 1.22

The preparation of data for the card amendment program is similar in principle to the preparation of data for the paper tape amendment program described in 1.11 to 1.19.

Data Sheets for Card Amendment 1.23

Apart from the additional directives - AMENDMENT, DELETE, SKIP, SNGL, CRRY and NO BREAK - the recording of amendment data on Data Sheets is very similar to that for the card input program. Where a difference occurs, a suggested form of Data Sheet has been drawn up (see Chapter 4); otherwise the Data Sheets for the card input program are also applicable for amendment data.

The differences between card input and paper tape input are mainly as described in 1.21. However, a further difference that applies to the card amendment program is that if grade data or materials data is included in the amendment data, then the directive DELETE or SKIP is punched on the same card as the relevant data (see Data Sheet 1b for card amendment in Chapter 4).

A number of data validity checks are performed on input; the main error messages that may appear are listed below.

ERROR: UNITS NOT SET

ERROR: NO 'EODA'

ERROR: CHAINAGES *nnn, nnn* NOT IN ASCENDING ORDER

ERROR: MATERIAL *'xxxx'* REPEATED

ERROR: TOO MANY MATERIALS

ERROR: OVERHANG: TYPICAL *nn,* LINE *nn*

ERROR: TOO MANY CO-ORDINATES FOR TYPICAL *nn*

ERROR: FIRST TYPICAL NOT NO.1

ERROR: TYPICALS *nn, nn* NOT IN SEQUENCE

ERROR: NO BLANK COLUMNS BEFORE OFFSET *nn* AT CHAINAGE *nnn*

ERROR: NO TAB CHARACTER BEFORE OFFSET *nn* AT CHAINAGE *nnn*

ERROR: NO CHAINAGE OR GRADE LEVEL AT STATION *xxxx*

ERROR: NO 'EOST' AFTER 'TYFR' AT STATION *xxxx*

ERROR: STATION *xxxx*: *'xxxx'* NOT A VARIABLE NAME

ERROR: EXCESSIVE DATA FOLLOWS *'xxxx'* AT STATION *xxxx*

ERROR: INCORRECT LINE AFTER 'STRATA DATA'. PROGRAM HALTED

ERROR: NO BLANK COLUMNS BEFORE STATION NAME AT STATION *xxxx*

ERROR: NO TAB CHARACTER BEFORE STATION NAME AT STATION *xxxx*

ERROR: NO BLANK COLUMNS BEFORE CHAINAGE *nnn*

ERROR: NO TAB CHARACTER BEFORE CHAINAGE *nnn*

ERROR: EXCESSIVE DATA AT CHAINAGE *nnn*

ERROR: INSUFFICIENT DATA AT CHAINAGE *nnn*

ERROR: TWO TERMINATORS AT STATION *xxxx*

ERROR: INCORRECT SLOPE DATA AT STATION *xxxx*

ERROR: STATION *xxxx: nn* LINES AFTER *'xxxx/xxxx'*

ERROR: TOO MANY INTERFACES AT STATION *xxxx*

ERROR: STATION *xxxx:* FIRST MATERIAL OF INTERFACE *'xxxx/xxxx'*
DIFFERS FROM SECOND OF PREVIOUS INTERFACE *'xxxx/xxxx'*

ERROR: BOTTOM OF TOPSOIL ABOVE TERRAIN AT CHAINAGE *nnn*

ERROR: STATION *xxxx:* MATERIAL *'xxxx'* NOT SPECIFIED IN MATERIALS DATA

ERROR: NO BLANK COLUMNS BEFORE GROUND LEVEL AT STATION *xxxx*

ERROR: NO TAB CHARACTER BEFORE GROUND LEVEL AT STATION *xxxx*

ERROR: STATION *xxxx:* FIRST MATERIAL *'xxxx'* DIFFERS FROM THAT AT PREVIOUS STATION (*'xxxx'*)

ERROR: STATION *xxxx:* INTERFACE *'xxxx/xxxx'* NOT FOLLOWED BY A ZERO. PROGRAM HALTED

ERROR: ALL TERRAIN OFFSETS ON ONE SIDE OF DATUM AT CHAINAGE *nnn*

ERROR: LEVELS *nnn, nnn* NOT IN DESCENDING ORDER AT CHAINAGE *nnn*

ERROR: NO DATA GIVEN FOR CHAINAGE *nnn*

ERROR: NEW TYPICAL NOT GIVEN AT STATION *xxxx*

ERROR: NO STATION DATA GIVEN FOR CHAINAGE *nnn*

ERROR: SUPPLIED TYPICAL EXTENDS BEYOND TERRAIN AT CHAINAGE *nnn*

ERROR: LINE *nn:* INCORRECT CURVE LENGTH

ERROR: STATION *xxxx*: TYPICAL REF. NO. *nn* TOO LARGE

ERROR: SUM OF MATERIAL CUT VOLUMES DOES NOT EQUAL 'VCUT' AT STATION *xxxx*

ERROR: STRATA INTERFACE *n* EXTENDS BEYOND TERRAIN AT STATION *xxxx*

ERROR: OVERHANG IN SUPPLIED TYPICAL AT STATION *xxxx*

ERROR: OVERHANG IN CHAINAGE AT CHAINAGE *nnn*

ERROR: OVERHANG IN INTERFACE *n* AT STATION *xxxx*

ERROR: INSUFFICIENT GRADE DATA AT CHAINAGE *nnn*

ERROR: WRONG DATA CARDS. PROGRAM HALTED.

ERROR: WRONG DATA TAPE. PROGRAM HALTED.

ERROR: *xxxx* DATA GIVEN IN WRONG ORDER

AMENDMENT PROGRAM ERROR MESSAGES 1.25

The input program error messages may also be output during a run of an amendment program; the main additional messages are listed below.

ERROR: DIRECTIVE 'AMENDMENT' OMITTED

ERROR: SUPERFLUOUS 'EODA' FOLLOWS 'AMENDMENT'

ERROR: CHAINAGE *nnn* REQUIRING DIRECTION NOT FOUND ON MASTER FILE

ERROR: INCORRECT CURVE LENGTH AT CHAINAGE *nnn*

ERROR: INCORRECT LAST VALUE OF CURVE LENGTH

ERROR: MATERIAL '*xxxx*' REQUIRING DELETION NOT FOUND ON MASTER FILE

ERROR: TOO MANY MATERIALS: '*xxxx*' NOT ADDED

ERROR: AMENDED TYPICAL NO. *nn* REPEATED

ERROR: TOO MANY OFFSETS AND LEVELS FOR TYPICAL *nn*

ERROR: ADDED TYPICAL NO. *nn* NOT CONSECUTIVE WITH LAST (NO.*nn*)

ERROR: RESET MATERIAL CUT VOLUMES AT STATION *xxxx*

ERROR: STATION *xxxx*: INDICATOR '*xxxx*' NOT RECOGNISED

ERROR: NEW TYPICAL NOT GIVEN AT STATION *xxxx*

ERROR: NO TERRAIN DATA GIVEN FOR INSERTED STATION *xxxx*

ERROR: CHAINAGE *nnn* GREATER THAN LAST CHAINAGE ON MASTER FILE

CAUTION: NO STRATA DATA GIVEN FOR CHAINAGE *nnn*

ERROR: NEW TYPICAL NOT GIVEN AT STATION *xxxx*

ERROR: NO STATION DATA GIVEN FOR CHAINAGE *nnn*

ERROR: SUPPLIED TYPICAL EXTENDS BEYOND TERRAIN AT CHAINAGE *nnn*

ERROR: LINE *nn:* INCORRECT CURVE LENGTH

ERROR: STATION *xxxx*: TYPICAL REF. NO. *nn* TOO LARGE

ERROR: SUM OF MATERIAL CUT VOLUMES DOES NOT EQUAL 'VCUT' AT STATION *xxxx*

ERROR: STRATA INTERFACE *n* EXTENDS BEYOND TERRAIN AT STATION *xxxx*

ERROR: OVERHANG IN SUPPLIED TYPICAL AT STATION *xxxx*

ERROR: OVERHANG IN TERRAIN AT CHAINAGE *nnn*

ERROR: OVERHANG IN INTERFACE *n* AT STATION *xxxx*

ERROR: INSUFFICIENT GRADE DATA AT CHAINAGE *nnn*

ERROR: WRONG DATA CARDS. PROGRAM HALTED.

ERROR: WRONG DATA TAPE. PROGRAM HALTED.

ERROR: *xxxx* DATA GIVEN IN WRONG ORDER

AMENDMENT PROGRAM ERROR MESSAGES 1.25

The input program error messages may also be output during a run of an amendment program; the main additional messages are listed below.

ERROR: DIRECTIVE 'AMENDMENT' OMITTED

ERROR: SUPERFLUOUS 'EODA' FOLLOWS 'AMENDMENT'

ERROR: CHAINAGE *nnn* REQUIRING DIRECTION NOT FOUND ON MASTER FILE

ERROR: INCORRECT CURVE LENGTH AT CHAINAGE *nnn*

ERROR: INCORRECT LAST VALUE OF CURVE LENGTH

ERROR: MATERIAL *'xxxx'* REQUIRING DELETION NOT FOUND ON MASTER FILE

ERROR: TOO MANY MATERIALS: *'xxxx'* NOT ADDED

ERROR: AMENDED TYPICAL NO. *nn* REPEATED

ERROR: TOO MANY OFFSETS AND LEVELS FOR TYPICAL *nn*

ERROR: ADDED TYPICAL NO. *nn* NOT CONSECUTIVE WITH LAST (NO.*nn*)

ERROR: RESET MATERIAL CUT VOLUMES AT STATION *xxxx*

ERROR: STATION *xxxx*: INDICATOR *'xxxx'* NOT RECOGNISED

ERROR: NEW TYPICAL NOT GIVEN AT STATION *xxxx*

ERROR: NO TERRAIN DATA GIVEN FOR INSERTED STATION *xxxx*

ERROR: CHAINAGE *nnn* GREATER THAN LAST CHAINAGE ON MASTER FILE

CAUTION: NO STRATA DATA GIVEN FOR CHAINAGE *nnn*

Chapter 2

OUTPUT

General 2.1

The results for the Cut and Fill program are output on the line printer but if the system on which the program is run includes a graph plotter, a plot of the cross-section at each station and a plot of longitudinal sections can also be obtained.

Line Printer Output Sets 2.2

It is unnecessary for the user to have the complete output if this is not required. The output is divided into sets and the user can specify that any one or any number of sets is to be output. Each set of results has fixed tabular formats and headings. When a particular set has been specified for output, all the headings in that set will be output even if some are superfluous to the requirements.

The output sets are referenced by their numbers, each of which is unique and is printed at the beginning of each output sheet.

The reference numbers are as follows:

Set Reference Number	*Output Description*
1	Setting-out sheet number 1
2	Setting-out sheet number 2
3	Land area and soil data
4	Cut and fill volumes (with cut factor and fill factor)
5	Cut and fill volumes (without cut factor and fill factor)
6	Material volumes
7	Cross-haul volumes
8	Mass-haul diagram
9	Data printout

Output Sheets 2.3

Before the headings of the particular output set, each sheet is headed by:

1 Project title. This is the job heading, as described in 1.2 and 1.12.

2 Date on which the results were printed by the computer.

3 Sheet number. These are consecutive from 1 upwards and the same number appears on corresponding output sets.

4 Set reference number.

The common cross-reference for all output sets is the station chainage, which appears on all output sheets.

Description of Output Sets 2.4

The Introduction shows the headings under which results would be obtained if all output sets except the data printout were specified. A brief description of each of the output sets is now given.

The units used in all the outputs sets are either British or Metric, depending upon the units specified in the Unit Specification of the input data (see 1.3). In Figures 2a and 2b (pages 2 and 4) British units are used.

Set 1 - Setting-out Sheet Number 1 2.4.1

A maximum of 20 chainages can appear on one sheet. The letter that follows values of the left side slope and the right side slope indicates the type of side slope as follows:

S - simple, or height-dependent.

B - berms; this letter is followed by the number of berms inserted in the side slope, e.g. B6.

M - material slope; in this case, the value given is that at the slope stake point.

After the values for the left and right stake point offsets, the letter C or F is printed, which indicates that the half-typical is in cut or fill respectively. When truncation occurs (see 1.8.1), the letter T prefixes C or F. If the variable FLFT (see 1.7.2) is zero, no values are printed in the penultimate column of the sheet. Similarly, if the variable FRHT is zero, no values are printed in the last column.

Set 2 - Setting-out Sheet Number 2 2.4.2

For each cross-section (i.e. station), offsets and levels are printed from left to right on the sheet for each point on the new construction. For each half of a station, up to three lines of 15 points each can be printed. The level is printed directly under the corresponding offset. When the data for the first station has been output, the heading is printed again, then the offsets and levels for the next station are output and so on. Offsets to the left of the construction centre-line have a preceding negative sign. All offsets are measured from the construction centre-line.

The points so defined for each station consist of:

1 points defining the terrain,

2 points defining the typical,

3 points defining berms (if any),

4 points defining changes in slopes as a result of material changes (if any),

5 slope stake points.

Thus, this output gives points which, when joined in order by straight lines, reveal the whole new cross-section.

Set 3 - Land Area and Soil Data 2.4.3

A maximum of 20 chainages can appear on one sheet. If the variable VTOP (see 1.7.7) is zero, no values are printed in the columns headed by 'topsoil strip area' and 'topsoil strip vol'. If the variable VTRE (see 1.7.7) is zero, no values are printed in the columns headed by 'topsoil laying vol'.

'At station' values refer to the value between that station and the previous station. 'Cumulative' values refer to the value between that station and the first station.

The width of the land area is from fence line to fence line or between the slope stake points if the variables FLFT and FRHT are zero.

The topsoil strip area and volume refer to the original ground. The topsoil laying volume is the volumes of resoil in side slopes, side verges, central reservation, extra width, etc.

The grassing area is the area for seeding or turfing and includes the side slopes, side verges, central reservation, extra width, etc.

Set 4 - Cut and Fill Volumes 2.4.4

A maximum of 20 chainages can appear on one sheet. CF and FF are, respectively, the cut factor and fill factor as defined in 1.5.1. After values in the column headed by CUT*FF-FILL, C or F is printed depending on whether the residual is cut or fill. Similarly, either C or F is printed after values in the last column on the sheet. Volumes of topsoil (strip and replacement) are not included in any of the quantities on this output set. This output is specified if either CF or FF, or both, are other than unity.

Set 5 - Cut and Fill Volumes 2.4.5

A maximum of 20 chainages can appear on one sheet. After values in the columns headed by CUT-FILL and CUMULATIVE CUT-FILL, C or F is printed depending on whether the residual is cut or fill. Volumes of topsoil (strip and replacement) are not included in any of the quantities on this output set. This output is specified only if both CF and FF are unity.

Set 6 - Material Volumes 2.4.6

For each station chainage, a maximum of seven materials may be printed, together with their respective 'at station' values. Cumulative values may be printed for up to 20 materials. The totals of each column for a station are printed after the information for each station. If a station is completely in fill, the output for this station simply consists of the chainage followed by 'NO CUT'.

The material names printed are the four-letter codes which were specified in the materials data (see 1.5.1).

The 'dump volume at station' is printed only as a total for each station. It is the sum of volumes of materials which have a fill factor of zero and thus give a zero value in the CUT*FF column.

Volumes of topsoil (strip and replacement) are not included in any of the quantities on this output set.

Set 7 - Cross-haul Volumes 2.4.7

A maximum of 20 chainages can appear on one sheet. Values are printed only when they are non-zero, that is when there is both cut and fill at the current station. Cumulative values refer only to a stretch of non-zero cross-haul, but the values under TOTAL CROSS-HAUL refer to the entire route.

Set 8 - Mass-haul Diagram 2.4.8

This output is graphical and not tabular. The following values are plotted:

1 Chainage, on the vertical axis; scale 50 ft. = 1 line or, when metric units are used, 25m = 1 line.

2 Cumulative (CUT*FF-FILL), on the horizontal axis. The scale is set after the maximum cut and fill values have been established. This also positions the zero line.

The mass-haul graph is indicated by asterisks.

Set 9 - Data Printout 2.4.9

This output option enables all data from any magnetic tape produced by an input, amendment or calculations run, to be printed out for checking purposes.

This option includes the facility of calling for data in certain bands of chainages only (see Data Sheet 6 page 46). Up to six pairs of chainages may be specified, and data will be printed for all stations within the specified bands. Data for an individual station may be printed by giving the station chainage as both the start and finish chainages of a band. If no chainages are specified, data for the whole route will be printed.

Specification of Required Output 2.5

The sets that are required to be output must be specified and input to the program. This input is preceded by the directive OUTPUT and terminated with the characters FINISH.

The required output options are specified by numbers (see 2.2). When using paper tape input, each of these options must be preceded by a tabulate character and followed by a newline character. Each

I.C.T. 1900 Series cut and fill program
tape input/amendment

Reference - Data Sheet 6
Sheet number_____

b = Tabulator Character
V = Space Character
N = New Line

E O D A N — Required for INPUT and AMENDMENT programs

F I N I S H N — AMENDMENT program only Delete for INPUT program

Delete both if OPTION LIST is being prepared separately.

12" Run out on paper tape

O U T P U T N

Delete those boxes not required

b 1 N — SETTING OUT SHEET 1
Chainage - Station No. Grade Lvl - Side Slopes - Station points - Fence line

b 2 N — SETTING OUT SHEET 2
Chainage - Points defining station - Offsets & levels

b 3 N — LAND AREA & SOIL DATA
Chainage - Land Area - Topsoil strip area & vol. - Resoil area & vol.

b 4 N — CUT & FILL VOLUMES [+ C.F. & F.F.]
Chainage - Cut vol, × CF, × FF, Fill, Balance at Station & Cumulative

b 5 N — CUT & FILL VOLUMES [-C.F. & F.F]
Chainage - Cut vol, Fill vol, Balance at Station & Cumulative

b 6 N — MATERIAL VOLUMES
Chainage, Material, Cut vol, × CF × FF, Dump at Station & Cumulative

b 7 N — CROSS HAUL [for stations in both cut & fill]
Chainage - cross haul at stations, Cumulative, Total

b 8 N — MASS HAUL DIAGRAM
Plot of Balance of Cut × FF - Fill against Chainage

b 9 N — DATA PRINTOUT
All data held on an input, amendment or calculations file

from chainage		to chainage
b	V	N
b	V	N
b	V	N
b	V	N

FOR OPTION 9 ONLY
Up to 6 lines allowed
DELETE if data for whole route is required.

F I N I S H N

Note: This data sheet must terminate both the initial set of data and all sets of amendment data.

pair of chainages for option 9 is also preceded by a tabulate character and followed by a newline character; the two chainages of a pair are separated by one or more space characters.

When using card input, output options are all punched on the same card in consecutive columns starting at column 21 and this card has OUTPUT punched in columns 1 to 6. Each pair of chainages for option 9 is punched on a separate card, starting in columns 21 and 36.

For example, if the output of all sets is required, the input would be as shown on Data Sheet 6 (page 46).

OUTPUT OF CROSS-SECTIONAL AREAS 2.6

A special program is available which reads the magnetic tape produced by the calculations program and outputs on the line printer the areas of cut and fill at each station, together with material cut areas where applicable.

GRAPH PLOTTER OUTPUT 2.7

Different programs are available for use with the 30" graph plotter and the 12" graph plotter. There are two types of program; the first produces cross-sectional drawings at specified chainage along the route and the second produces longitudinal sections and mass-haul drawings covering specified bands of chainage.

The information for the drawings may be transmitted directly to a graph plotter on-line, or may alternatively be written to a magnetic tape. In the latter case, the information is read subsequently from the magnetic tape to a graph plotter, possibly on a different 1900 Series installation, by use of the standard library program #XJGA (see the ICL 1900 Series manual *Graph plotter*). This off-line plotting technique is useful on a multiprogramming machine because the cut and fill plotter programs will run much faster when writing plotting information to tape than when controlling the plotter directly; #XJGA is a relatively small program and its use should facilitate time sharing. The other advantage of the off-line method is that a user whose computer configuration does not include a graph plotter can run the Cut and Fill plotter program using this facility and send the magnetic tape to an installation where a graph plotter is available.

The programs are controlled at run time by parameters input on either punched cards or paper tape and by selection of switches. The output file, CAFCA OUTPUT, produced by the Cut and Fill calculations program, #X2C6, must be input.

Note: The programs are designed for use with 1900 Series graph plotters with increments of 0.010 inch/step or 0.005 inch/step. If a metric plotter is used, the user should adjust his chosen scales accordingly in order to obtain properly scaled drawings.

CROSS-SECTIONAL DRAWINGS 2.8

Cross-sections are drawn for stations within chainage bands specified by the user, and output for stations in up to six bands may be requested on any one run of the program. The parameters required by the program should be in the format shown on Data Sheet 7 (page 48).

First and Second Scales 2.8.1.

Two scales may be chosen by the user for a series of drawings corresponding to data on one output file.

The program will normally use the first scale, but if the resulting drawing would be too large to fit onto the graph plotter paper the second or reserve scale will be used. If this scale is also unsuitable, the program will calculate a suitable scale which will always be 1, 2, or 5 times a suitable power of ten. If the user wishes the program to calculate a suitable scale, then both scales must be entered as zero.

The values of the scales entered on the data sheet in the box provided should be the number of feet which are to be represented by one inch on the drawing if British units have been used on the Cut and Fill output file, or the number of metres which are to be represented by one metre on the drawing if Metric units have been used. The values entered may be whole numbers or may contain a decimal point.

Chainage Bands 2.8.2.

The user may choose up to six bands within which stations should be plotted, and the number of bands must be entered on the data sheet as a whole number with no decimal point.

Each band is specified as extending from the *first chainage* to the *second chainage*, and the chainages specified on any one run of the program must be in ascending order. A chainage need not be a whole number and need not

I.C.T. 1900 Series cut and fill program

Graphical Output: Cross sections

Reference - Data Sheet 7

Sheet number

∇ = Space character
↓ = New line character on paper tape or end of card.

First scale | Second scale

	∇		↓
	↓		

No. of chainage bands

First chainage | Second chainage | Interval *n*

	∇		∇		↓
	∇		∇		↓
	∇		∇		↓
	∇		∇		↓
	∇		∇		↓
	∇		∇		↓

Stations plotted are $1, 1+n, 1+2n$ $1+3n$ ETC

I.C.T. 1900 Series cut and fill program

Graphical Output: Longitudinal sections

Reference - Data Sheet 8

Sheet number

∇ = Space character
↓ = New line character on paper tape or end of card

First vertical scale | Second vertical scale

	∇		↓
	↓		
	↓		
	↓		

Horizontal scale
Maximum length of drawing
No. of chainage bands

First chainage | Second chainage

	∇		↓
	∇		↓
	∇		↓
	∇		↓
	∇		↓
	∇		↓

coincide with a station, but output will only be given for stations within the band.

For each chainage band the user must specify an interval n as a whole number. Within each band, output will be given for the first and every nth subsequent station (that is, the stations plotted will be numbers 1, $1 + n$, $1 + 2n$, $1 + 3n$, etc). Output will be produced for every station in the band only if the user sets $n = 1$.

Output Format 2.8.3

The first drawing will be preceded by the project title and the date.

Each successive cross-section will contain:

1 The terrain, identified by the title TERRAIN, and the new construction, both drawn with unbroken lines;

2 Optionally, the strata interfaces, including topsoil, drawn with dashed lines;

3 The grade level, identified by the title GRADE LEVEL and the new construction centre-line, plotted as mutually perpendicular chain-dotted lines.

The text beneath each cross-section will, in general, include the station name, the chainage, the grade level, the offsets and levels of the stake points, the fence line offsets, the scale of the drawing and a list of the materials in the order given in the original data for the Cut and Fill input program. The user may, optionally, choose to output only the essential text, consisting of the station name, the chainage, the grade level, and the scale of the drawing.

LONGITUDINAL SECTIONS AND MASS-HAUL DIAGRAMS 2.9

Longitudinal sections and, optionally, mass-haul diagrams are drawn for stations within chainage bands specified by the user; each drawing will begin and end on a station. Provision is made in the program for up to six chainage bands. The parameters required by the program should be in the format shown on Data Sheet 8 (page 48).

Vertical and Horizontal Scales 2.9.1

Two vertical scales must be chosen by the user for a series of longitudinal sections corresponding to data on one output file.

The program will normally use the first scale, but if the resulting drawing would be too large to fit onto the graph plotter paper the second or reserve scale will be used. If this scale is also unsuitable, the chainage band will be split up into smaller sub-sections, and these will be plotted using the second scale where possible. If it is found that the second scale is still unsuitable for a sub-section containing three stations or less, the program will calculate and use its own scale.

The program will calculate a vertical scale for the mass-haul diagrams, if these are requested.

The longitudinal sections and, where these are requested, the corresponding mass-haul diagrams, will be on the same horizontal scale. This will be that specified by the user, unless the resultant drawing would be longer than the maximum length specified by the user, in which case a suitable scale will be calculated by the program.

The values of the scales entered on the data sheet in the boxes provided should be the number of feet which are to be represented by one inch on the drawing if British units have been used on the Cut and Fill output file, or the number of metres to be represented by one metre on the drawing if Metric units have been used. The values entered may be whole numbers of may contain a decimal point.

Maximum Length of the Drawing 2.9.2

The user must enter the maximum length in inches of the drawing as a whole or a decimal number. The horizontal scale will be changed if necessary to keep the length within this maximum.

Chainage Bands 2.9.3

The user may choose up to six bands within which stations should be plotted, and the number of bands must be entered on the data sheet as a whole number with no decimal point.

Each band is specified as extending from the first chainage to the second chainage, and the chainages specified on any one run of the program must be in ascending order. A chainage need not be a whole number and need not coincide with a station; only the stations within the band will be drawn.

The program will include up to fifty stations in one drawing; if the specified chainage band contains more than fifty stations it will be split into sub-sections of fifty stations or less.

Longitudinal Sections: Output **2.9.4**

The first drawing will be followed by the project title and the date in the case of a 30" plotter and preceded by them in the case of a 12" plotter.

Each drawing commences with the ordinate title LONG. SECT. LEVELS and has its ordinate labelled FEET or METRES depending on the units used on the Cut and Fill output file. The scales used are written beneath every drawing.

Each station in a chainage band is marked by a vertical chain-dotted line, alongside which the station chainage is written.

If all the grade levels in one drawing have been computed earlier by the Cut and Fill input program, then the exact vertical curve is plotted; otherwise the grade line consists of a series of unbroken straight lines joining station to station. The grade line is labelled GRADE.

The terrain line, labelled TERRAIN, is also plotted as a series of unbroken straight lines.

Mass-haul Diagrams: Output **2.9.5**

The user may choose to include the mass-haul diagrams corresponding to the longitudinal sections selected.

If so, each diagram is drawn immediately above the corresponding longitudinal section and commences with the title MASS HAUL. The vertical axis is labelled CUBIC YARDS or CUBIC METRES as appropriate. The cumulative cut times fill factor, minus the fill volume, is plotted as straight lines joining station to station. Each station is indicated by a vertical chain-dotted line.

Chapter 3

OPERATING INSTRUCTIONS

General 3.1

The program names are as follows:

#X2C2	Input program	- data on paper tape
#X2C3	Amendment program	- data on paper tape
#X2C4	Input program	- data on cards
#X2C5	Amendment program	- data on cards
#X2C6	Calculations program	
#X2C7	Line printer output program	
#X2CA	Cross-sectional area printout program	
#X2CB	30" graph plotter output program	- cross-sectional drawings
#X2CC	12" graph plotter output program	- cross-sectional drawings;
#X2CD	30" graph plotter output program	- longitudinal sections and mass-haul diagrams
#X2CE	12" graph plotter output program	- longitudinal sections and mass-haul diagrams

#X2C2, #X2C3, #X2C4, #X2C5, #X2C6, #X2C7 and #X2CA have executive priorities of 50; #X2CB, #X2CC, #X2CD and #X2CE have executive priorities of 80.

The programs are normally loaded from magnetic tape by typing the following message on the console typewriter:

FI #X2C*m* #*name*

where *m* is 2, 3, 4, 5, 6, 7, A, B, C, D, or E. The program is held on a tape PROGRAM*name* and the search program is called #*name*.

If the programs are on paper tape or cards in binary dump form, they are loaded by typing the message

LO #X2C*m* n

where n is the unit number of the tape or card reader used.

Paper Tape Input Program #X2C2 3.2

Core store required: 11,827

Peripherals required: 1 paper tape reader,
1 line printer,
2 magnetic tape decks loaded with scratch tapes.

The program is activated by typing the message

GO #X2C2 20

When a tape reader has been allocated to the program, the following message is output on the console typewriter:

0 #X2C2 ; UNIT n :-FIX

and the data tape(s) should be loaded on tape reader n. The program first reads the job heading and prints this on the line printer, followed by the name of each section of input data as it is read. If the data has been properly prepared, the only other information that is printed is a list of stations at which no strata interface data has been given when DETAILED strata interface data has been specified; this is intended as a check that no station in cut has been omitted from the interface data.

A considerable number of data checks are carried out by the program, and if errors are found, error messages are output on the line printer. These error messages are designed to be self-explanatory, as the following two examples illustrate:

ERROR: TOO MANY CO-ORDINATES FOR TYPICAL 12

ERROR: INCORRECT SLOPE DATA AT STATION S256/B

When an error is detected, the program continues reading the data to check for further errors but in some instances it may, of necessity, skip data until the beginning of the next section is reached. Certain types of errors in the strata interface data cause the program to halt; these are also signalled by the message DATA ERROR on the console typewriter.

Finally, the message END OF RUN is output on the line printer and the console typewriter and the program is suspended. The output magnetic tape file is labelled CAFCA INPUT and will be on the tape deck that was allocated to the program as UNIT 0. The write-permit ring should be removed from this tape, so that the tape is ready for use by the next program.

Paper Tape Amendment Program #X2C3 3.3

Core store required: 10,496 words

Peripherals required: 1 paper tape reader,

1 line printer,

1 magnetic tape deck loaded with the file to be amended (no write-permit ring),

2 magnetic tape decks loaded with scratch tapes.

As this program is overlaid, a fourth tape deck containing the library tape will be needed throughout the run.

If it is required to amend the file labelled CAFCA INPUT (output from #X2C2), the message

ON #X2C3 1

must be typed. Otherwise, the program will amend a file labelled CAFCA OUTPUT (output from #X2C6).

The program is activated by typing the message

GO #X2C3 20

When a tape reader has been allocated to the program, the following message is output on the console typewriter:

0 #X2C3 ; UNIT n :-FIX

and the data tape(s) should be loaded on tape reader n. The program first reads the job heading on the file to be amended and prints this on the line printer together with the new job heading, if one has been specified on the data tape.

The amendment program checks the program data in a similar way to the input program, with any errors being indicated on the line printer by error messages.

If the input file is no longer required and the program is still running, the magnetic tape containing this file will be rewound and released and the message

0 #X2C3 ; DISPLAY: INPUT FILE FREE

will be typed on the console typewriter. The magnetic tape may then be unloaded from the tape deck. Similarly, if the program has read in all the data from paper tape before it has finished running, the tape reader will be disengaged and released, and the message

0 #X2C3 ; DISPLAY: ALL DATA READ IN

will be typed on the console typewriter. The data tape may then be removed from the tape reader.

Finally, the message END OF RUN is output on the line printer and the console typewriter and the program is suspended. The output magnetic tape file is labelled CAFCA INPUT and will be on the tape deck that was allocated to the program as UNIT 1. The write-permit ring should be removed from this tape, so that the tape is ready for use by the next program. The input magnetic tape file should be unloaded from the tape deck so that this file, now presumably out of date, is not used as input data by other programs.

Card Input Program #X2C4 3.4

Core store required: 11,377 words

Peripherals required: 1 card reader,

1 line printer,

2 magnetic tape decks loaded with scratch tapes.

The program is activated by typing the message

GO #X2C4 20

When a card reader has been allocated to the program, the following message is output on the console typewriter:

0 #X2C4 ; UNIT n :-FIX

and the data cards should be loaded in card reader n. The program then proceeds in exactly the same way as the paper tape input program (see 3.2).

Card Amendment Program #X2C5 3.5

Core store required: 9,795 words

Peripherals required: 1 card reader,

1 line printer,

1 magnetic tape deck loaded with the file to be amended (no write-permit ring),

2 magnetic tape decks loaded with scratch tapes.

As this program is overlaid, a fourth tape deck containing the library tape will be needed throughout the run.

If it is required to amend the file labelled CAFCA INPUT (output from #X2C4), the message

ON #X2C5 1

must be typed. Otherwise, the program will amend a file labelled CAFCA OUTPUT (output from #X2C6).

The program is activated by typing the message

GO #X2C5 20

When a card reader has been allocated to the program, the following message is output on the console typewriter:

0 #X2C5 ; UNIT n :-FIX

and the data cards should be loaded in card reader n. The program then proceeds in exactly the same way as the paper tape amendment program, except that, if the program has read in all the data from cards before it has finished running, the card reader will be disengaged and released and the message

0 #X2C5 ; DISPLAY: ALL DATA READ IN

will be typed on the console typewriter. The data cards may then be removed from the card reader.

Calculations Program #X2C6 **3.6**

Core store required: 11,614 words

Peripherals required: 3 magnetic tape decks, two loaded with scratch tapes and the other loaded with the output tape from #X2C2, #X2C3, #X2C4 or #X2C5, labelled CAFCA INPUT (no write-permit ring). No line printer is required.

Normally the volume calculations are by the truncated cone formula as described on page 3 but if the 'average end area' formula is required, sense switch 1 must be set by typing the following message on the console typewriter:

ON #X2C6 1

A confirmatory message will be typed when the program is running.

The program is activated by typing the message

GO #X2C6 20

The data from the input tape is processed, and an output magnetic tape containing all the input and calculated information is written.

Every ten stations during processing, a message is typed giving the name of the station that has been reached. The name of the last station is also typed. When processing is complete, the message SUMS ALL DONE is typed and the program is deleted. The output tape is labelled CAFCA OUTPUT and will be on the tape deck that was allocated to the program as UNIT 1. The write-permit ring should be removed from this tape, so that the tape is ready for use by the next program.

If berm slopes have been specified, and the program suspends itself and types a station name followed by the message TOO MANY BERMS, the program has tried to insert ten or more berms on one side of the named station. The data for this station should be examined, probably for a wrong grade level or too small an interval between berms. If a station name is typed followed by the message TYPICAL > LIMIT, the program has tried to use a standard half-typical that is not contained in the input data. This can arise only if an error message in the input or amendment programs has been ignored.

The program cannot continue beyond either of these messages and must be restarted using a correct input tape.

If the full typical at a station extends beyond the extreme terrain point on each side, the program will stop and type out the program name, followed by the message TYPICAL TOO WIDE. The program may be restarted by typing GO #X2C6, but the results at that station and the next station will be incorrect, and the program may go illegal.

Line Printer Output Program #X2C7 **3.7**

Core store required: 11,520 words

Peripherals required: 1 paper tape reader *or* 1 card reader (at beginning only),

1 line printer,

1 magnetic tape deck loaded with an output tape from any of the preceding programs, but usually from the calculations program, #X2C6. This tape must not have a write-permit ring.

If it is required to read in the steering list (see 2.5) on cards, then the message

ON #X2C7 1

must be typed. Otherwise, the program will assume that the steering list is on paper tape.

If it is required to input a magnetic tape file labelled CAFCA INPUT, then the message

ON #X2C7 2

must be typed (normally, only print option 9 will be used for an input file). Otherwise, the program will expect to input a file labelled CAFCA OUTPUT.

The program is activated by typing the message

GO #X2C7 20

on the console typewriter. When a tape reader or card reader has been allocated to the program, the following message is output on the console typewriter:

0 #X2C7 ; UNIT n :-FIX

and the steering list specifying the required output should be loaded on tape reader n or card reader n. This list is checked and if it is incorrect the program will suspend itself after typing the message WRONG TAPE READ, WRONG CARD READ or ILLEGAL OPTION as appropriate. The program may be restarted to read the correct list by typing the message GO #X2C7 on the console typewriter. If the list is acceptable, STEERING LIST OK is typed and the program will continue and commence output on the line printer. When output is complete, the message OUTPUT COMPLETE is typed and the program deletes itself.

CROSS-SECTIONAL AREA PRINTOUT PROGRAM #X2CA 3.8

Core store required: 4,672 words

Peripherals required: 1 line printer,

1 magnetic tape deck loaded with the output tape CAFCA OUTPUT. This tape must not have a write-permit ring.

The program is activated by typing the message

GO #X2CA 20

on the console typewriter. When output is complete, the message OUTPUT COMPLETE is typed and the program deletes itself.

GRAPH PLOTTER OUTPUT PROGRAMS #X2CB AND #X2CC 3.9

These programs produce cross-sectional drawings.

Core store required: 11,765 words (#X2CB)

or

11,786 words (#X2CC)

Peripherals required: 1 card reader or 1 paper tape reader;

1 magnetic tape deck loaded with the output file CAFCA OUTPUT (no write-permit ring);

1 30" graph plotter (#X2CB)
or
1 12" graph plotter (#X2CC)
} on-lining

or

1 magnetic tape deck loaded with a scratch tape for off-lining. This tape must have a write-permit rang.

After loading, the program outputs the message

0#X2CB; HALTED:- LD or 0#X2CC; HALTED:- LD

If the parameters are on punched cards, then the message

ON #X2CB 1 or ON #X2CC 1

must be typed. Otherwise the parameters will be assumed to be on paper tape.

If on-line plotting is required, then the message

ON #X2CB 2 or ON #X2CC 2

must be typed. Otherwise off-line plotting will be assumed. If the plotter to be used plots in increments of 0.010 inch/step, then the message

ON #X2CB 3 or ON #X2CC 3

must be typed. Otherwise the plotter will be assumed to plot in increments of 0.005 inch/step.

If the program is to halt at the end of the first drawing, then the message

ON #X2CB 4 or ON #X2CC 4

must be typed. Otherwise the program will produce all the drawings required before halting.

If no strata data is required for the first drawing(s), then the message

ON #X2CB 5 or ON #X2CC 5

must be typed. Otherwise all strata data will be given.

If only the essential text is required for the first drawing(s), then the message

ON #X2CB 6 or ON #X2CC 6

must be typed. Otherwise the full text will be given.

The program is activated by typing the message

GO #X2CB 20 or GO #X2CC 20

on the console typewriter. When a card or paper tape reader has been allocated to the program, the following message is output:

0#X2CB; UNIT n:- FIX or 0#X2CC; UNIT n:- FIX

and the parameters should be loaded on card reader n or tape reader n.

If more than six chainage bands have been specified, the program will type the message TOO MANY BANDS and accept only the first six bands. If the second scale value is less than the first, the second scale will be ignored and the message SCALES ERROR typed. If a specified chainage band extends beyond the last chainage in the Cut and Fill output file, the program will type the message END OF FILE and produce drawings for all stations present on the file.

If switch 4 is on at the end of the current drawing, and switch 2 is on (that is, plotting is on-line) the program types the message

0#X2CB; HALTED:- PICTURE PLOTTED

or

0#X2CC; HALTED:- PICTURE PLOTTED

The state of switches 4, 5 and 6 may be changed at this stage. Resetting of switches 5 and 6 will affect the stata data and text given in subsequent drawings. If switch 4 is set off, no further program halt will occur. The program is reactivated by typing the message

GO #X2CB or GO #X2CC

At the end of the plot, if switch 2 is off, the program will terminate and type the message

0#X2CB; HALTED:- END OF PLOT

or

0#X2CC; HALTED:- END OF PLOT

Otherwise the program will type the message:

0#X2CB; HALTED:- END OF RUN

or

0#X2CC; HALTED:- END OF RUN

In both cases, drawings from any other Cut and Fill output file may be obtained by loading the file, re-setting any switches required, and re-activating the program.

If switch 2 is off (that is, plotting is off-line), data will be written to the scratch tape, which will be labelled CAFPLOT XSEC and given a reel sequence number of zero, a file generation number of zero, and a retention period of 999 days. The tape may be used as input to #XJGA.

The effect of the switches is summarized in the table below:

Switch	*ON*	*OFF*
1	Parameters input on cards.	Parameters input on paper tape.
2	On-line plotting	Off-line plotting.
3	Increments of 0.010 inch/step.	Increments of 0.005 inch/step.
4	Halt at end of current drawing.	No halt procedure.
5	No strata data required.	Strata data required.
6	Essential text required.	Full text required.

GRAPH PLOTTER OUTPUT PROGRAMS #X2CD AND #X2CE 3.10

These programs produce longitudinal sections and, optionally, mass-haul diagrams.

Core store required: 12,007 words (#X2CD)

or

11,927 words (#X2CE)

Peripherals required:

1 card reader or 1 paper tape reader;

1 magnetic tape deck loaded with the output file CAFCA OUTPUT (no write-permit ring);

1 30" graph plotter (#X2CD)
or
1 12" graph plotter (#X2CE)
} on-lining

or

1 magnetic tape deck loaded with scratch tape for off-lining. This tape must have a write-permit ring.

1 magnetic tape deck loaded with a scratch tape for computation of grade levels. This tape must have a write-permit ring.

After loading, the program outputs the message:

0#X2CD; HALTED:- LD or 0#X2CE: HALTED:- LD

An extra scratch tape is required if the grade levels were computed from GRADE DATA supplied to the input program.

If the parameters are on punched cards, then the message

ON #X2CD 1 or ON #X2CE 1

must be typed. Otherwise the parameters will be assumed to be on paper tape.

If on-line plotting is required, then the message

ON #X2CD 2 or ON #X2CE 2

must be typed. Otherwise off-line plotting will be assumed.

If the plotter to be used plots in increments of 0.010 inch/step, then the message

ON #X2CD 3 or ON #X2CE 3

must be typed. Otherwise the plotter will be assumed to plot in increments of 0.005 inch/step.

If the program is to halt at the end of the first drawing, then the message

ON #X2CD 4 or ON #X2CE 4

must be typed. Otherwise the program will produce all the drawings required before halting.

If no mass-haul diagram is required for the first section(s), then the message

ON #X2CD 5 or ON #X2CE 5

must be typed. Otherwise a mass-haul diagram will be given.

The program is activated by typing the message

GO #X2CD 20 or GO #X2CE 20

on the console typewriter. When a card or paper tape reader has been allocated to the program, the following message is output:

0#X2CD; UNIT n:- FIX or 0#X2CE; UNIT n:- FIX

and the parameters should be loaded on card reader n or tape reader n.

If more than six chainage bands have been specified, the program will type the message TOO MANY BANDS and accept only the first six bands. If the second vertical scale value is less than the first, the second scale will be ignored and the message SCALES ERROR typed. If a chainage band contains more than fifty stations, it will be split into sub-sections of up to fifty stations and the message STATIONS > 50 typed. If a specified chainage band extends beyond the last chainage in the Cut and Fill output file, the program will type the message END OF FILE and include in the drawing all stations present in the file. If a specified chainage band contains less than three stations, the band will be ignored and the message < THREE STATIONS typed; the program will proceed to the next band, if any.

If switch 4 is on, the program halts at the end of the current drawing, typing the message

0#X2CD; HALTED:- PICTURE PLOTTED or 0#X2CE; HALTED:- PICTURE PLOTTED

The state of switches 4 and 5 may be changed at this stage if switch 2 is on (that is, plotting is on-line). Re-setting of switch 5 will determine whether mass-haul diagrams are given with subsequent sections. If switch 4 is set off, no further program halt will occur. The program is re-activated by typing the message

GO #X2CD or GO #X2CE

If switch 2 is off, the program will terminate and type the message

0#X2CD; HALTED:- END OF PLOT or 0#X2CE; HALTED:- END OF PLOT

Otherwise the program will type the message

0#X2CD; HALTED:- END OF RUN or 0#X2CE; HALTED:- END OF RUN

In both cases, drawings from any other Cut and Fill output file may be obtained by loading the file, re-setting any switches required, and re-activating the program.

If switch 2 is off (that is, plotting is off-line), data will be written to the scratch tape, which will be labelled CAFPLOT LONG and given a reel sequence number of zero, a file generation number of zero, and a retention period of 99 days. This tape may be used as input to #XJGA.

The effect of the switches is summarized in the table below:

Switch	*ON*	*OFF*
1	Parameters input on cards	Parameters input on paper tape
2	On-line plotting	Off-line plotting
3	Increments of 0.010 inch/step	Increments of 0.005 inch/step.
4	Halt at end of current drawing.	No halt procedure.
5	No mass-haul diagram required with current section.	Mass-haul diagram required with current section.

The programs are written in 1900 FORTRAN (with the exception of a few small subroutines) and a number of error checks are included by the FORTRAN compiler. Messages relating to errors detected by these additional check facilities are output to the console typewriter and the program is halted. A typical example of an error detected in this way would be an alphabetic character occurring in a number punched on cards or paper tape. After the detection of such an error, operator action is necessary to restart the program or to delete it.

A complete list of error messages is given in the appropriate 1900 FORTRAN Compiler Specification.

Chapter 3A

GEORGE 1 AND 2

GENERAL 3A.1

The GEORGE operating system enables programs to be run on 1900 Series computers with the minimum amount of human intervention. The system is fully described in the ICL 1900 Series manual *Operating Systems GEORGE 1 and 2* (edition 3, TP 4229). The information given in this chapter provides the necessary information for users wishing to run the Cut and Fill suite of programs under GEORGE.

Instructions to the GEORGE operating system are given in the form of a job description written by the user in the language of the GEORGE system and punched into cards or paper tape. The job description consists of a series of statements specifying what is to be done at certain stages of the job and in response to certain events which may occur during the job. In short, GEORGE will carry out most of the actions which normally are carried out by the operator on the basis of the users' written instructions.

These instructions must include information about the order in which the programs included in the job are to be run, their entry points and terminations and the peripherals used. The following section contains the information required to run the Cut and Fill programs under GEORGE 1 and 2.

THE CUT AND FULL PROGRAMS UNDER GEORGE 1 AND 2 3A.2

The user must select which of the programs #X2C2, #X2C3, #X2C4, #X2C5, #X2C6, #X2C7, #X2CA, #X2CB, #X2CC, #X2CD and #X2CE he wishes to enter in any given run.

Peripheral unit numbers 3A.2.1

The peripheral unit numbers used by the various programs are given below.

PAPER TAPE INPUT PROGRAM #X2C2 3A.2.1

Paper tape input	TR0
Line printer output	LP0
M.T. master output file (CAFCAVINPUT)	MT0
Work M.T.	MT1

PAPER TAPE AMENDMENT PROGRAM #X2C3 3A.2.1.2

Paper tape input	TR0
Line printer output	LP0
M.T. master input file (CAFCAVOUTPUT or CAFCAVINPUT)	MT3
M.T. master output file (CAFCAVINPUT)	MT1
Work M.T.	MT2

CARD INPUT PROGRAM #X2C4		3A.2.1.3
Card input	CR0	
Line printer output	LP0	
M.T. master output file (CAFCA∇INPUT)	MT0	
Work M.T.	MT1	
CARD AMENDMENT PROGRAM #X2C5		3A.2.1.4
Card input	CR0	
Line printer output	LP0	
M.T. master input file (CAFCA∇OUTPUT or CAFCA∇INPUT)	MT3	
M.T. master output file (CAFCA∇INPUT)	MT1	
Work M.T.	MT2	
CALCULATIONS PROGRAM #X2C6		3A.2.1.5
M.T. master input file (CAFCA∇INPUT)	MT0	
M.T. master output file (CAFCA∇OUTPUT)	MT1	
Work M.T.	MT2	
OUTPUT PROGRAM #X2C7		3A.2.1.6
Paper tape input	TR0	
Card input	CR0	
M.T. master file input (CAFCA∇OUTPUT)	MT0	
Line printer output	LP0	
CROSS-SECTIONAL AREA PRINTOUT PROGRAM #X2CA		3A.2.1.7
M.T. master input file (CAFCA∇OUTPUT)	MT0	
Line printer output	LP0	
GRAPH PLOTTER CROSS-SECTIONAL DRAWINGS PROGRAMS #X2CB and #X2CC		3A.2.1.8
Paper tape input	TR0	
Card input	CR0	
M.T. master input file (CAFCA∇OUTPUT)	MT0	
Graph plotter output	GP0	
Scratch tape for off-lining (renamed CAFPLOT∇XSEC)	MT2	
GRAPH PLOTTER LONGITUDINAL SECTIONS PROGRAMS #X2CD and #X2CE		3A.2.1.9
Paper tape input	TR0	
Card input	CR0	
M.T. master input file (CAFCA∇OUTPUT)	MT0	
Graph plotter output	GP0	
Scratch tape for off-lining (renamed CAFPLOT∇LONG)	MT2	
Work tape	MT1	

Entry points and terminations **3A.2.2**

All programs are entered at entry point 20; the terminations are given in the table below.

Program	*Terminations*
#X2C2	DISPLAY:- END OF RUN DELETED:-
#X2C3	DISPLAY:- END OF RUN DELETED:-
#X2C4	DISPLAY:- END OF RUN: DELETED:-
#X2C5	DISPLAY:- END OF RUN DELETED:-
#X2C6	DISPLAY:- SUMS ALL DONE DELETED:-
#X2CA	DISPLAY:- OUTPUT COMPLETE DELETED:-
#X2CB #X2CC	HALTED:- PICTURE PLOTTED or HALTED:- END OF PLOT or HALTED:- END OF RUN
#X2CD #X2CE	HALTED:- PICTURE PLOTTED or HALTED:- END OF PLOT or HALTED:- END OF RUN

Example **3A.2.3**

The example in Chapter 4, page 55, uses the programs #X2C4 (card input), #X2C6 (calculations) and #X2C7 (line printer output). A suitable job description for running this example under GEORGE 1 or 2 would be as follows:

```
JOB CUTFILL1, 44544, ENGINEER
1   DATA MT (PROGRAM TAPE)
47A DATA CR0
47B DATA LP0
46C DATA MT0 (CAFCA∇INPUT)
4D  DATA MT1 (SCRATCH∇TAPE)
6A  DATA MT1 (CAFCA∇OUTPUT)
6B  DATA MT2 (SCRATCH∇TAPE)
7A  DATA MT0 (CAFCA∇OUTPUT)
IN  1
LOAD #X2C4
IN 47A, 4D
OUT 47B, 4D, 46C
RESUME
AT DELETED, GO TO 8A
END
8A IN 1
LOAD #X2C6
IN 46C, 6B
OUT 6A, 6B
RESUME
AT DELETED, GO TO 8B
END
8B IN 1
LOAD #X2C7
IN 47A, 7A
OUT 47B
RESUME
END
****
```

Chapter 4

CUT AND FILL EXAMPLE

General 4.1

The following pages show the input data for a typical cut and fill problem, and the line printer output that would be obtained when the cut and fill programs are run with this data.

The example is presented in four parts. The first part describes the problem and sets out the data to be used.

The second part shows this data entered on the appropriate Data Sheets. For this example, the data was input from cards and, as for paper tape input (see 1.1), a series of Data Sheets for card input has been designed to act as models for users, and these are used in this example. Most of the card Data Sheets are suitable for card input or amendment. Three Sheets, 1b, 3a and 3c, are suitable only for input data. The three corresponding Sheets for amendment data are included for completeness after the input data, although obviously these would not be required for this example.

The third part of this Appendix shows the line printer output obtained when all nine output options have been specified. The description of the line printer output is given in Chapter 2 but in any case this output should be self-explanatory. For option nine, the output for only the first two stations is shown here. The format of the output for the other fifteen stations is exactly the same. The fourth part shows some examples of corresponding cross-sectional drawings, longitudinal sections and mass-haul diagrams (see Figures 17 to 22)

Description of Problem 4.2

A series of road improvements is to be carried out along an existing road. Volumes and areas are required from particular sections for the Bill of Quantities. It is also required to calculate the grade level at all stations, fix side slopes depending on material encountered and select only suitable material for fill. There are 750 cu. yds. of fill available from an earlier contract, which may be used if required.

The data available for input is:

Grade Data 4.2.1

Chainage	*Grade Level*	*Length of Curve*
0	30	0
200	32	210
600	26.2	200
800	28.2	0

Materials Data

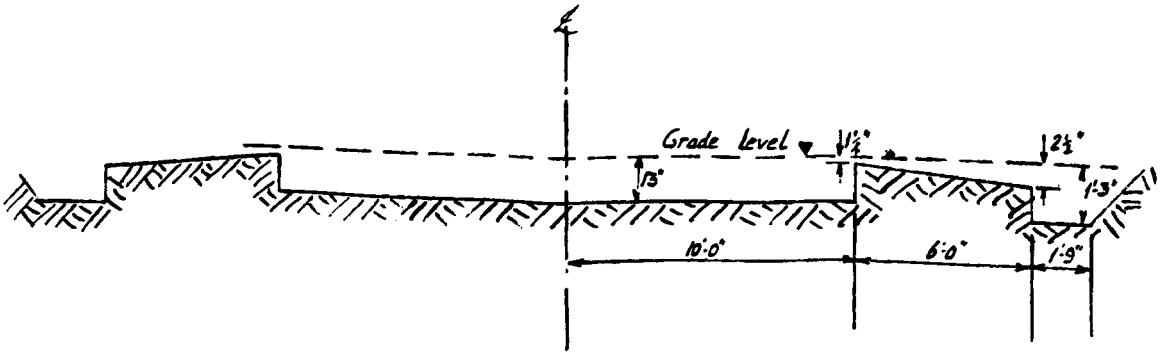
4.2.2

Material	*Cut Factor*	*Fill Factor*	*Cut Slope*
Topsoil	1.1	0.8	0.667
Peat	1.1	0	0.667
Gravel/Sand	1.1	0.8	0.667
Rock	1.5	1.25	4.0

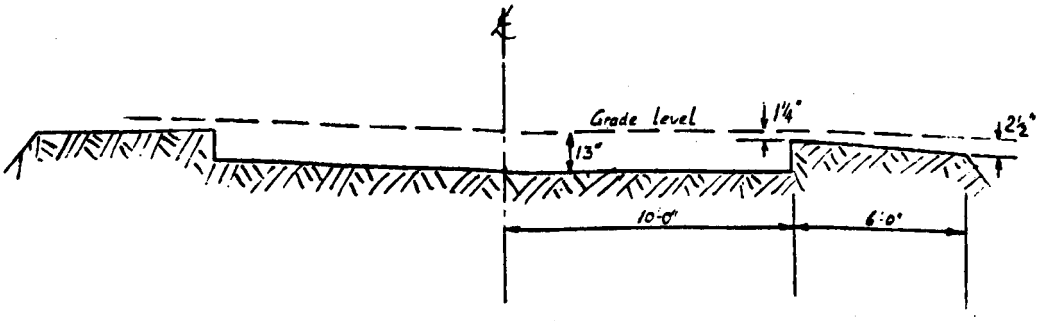
Typicals Data

4.2.3

The typical cross-section in cut:



The typical cross-section in fill:



Station Data

4.2.4

Station Name	*Chainage*	*Grade Level*
S1	0	30
S2	50	
S3	100	To be calculated using grade data.
..	...	
S15	700	
S16	760	
S17	800	

No berms are required.

Slopes in fill are all to be $\tan^{-1}$ 0.667. Slopes in cut are to depend on the material encountered, and are to be as indicated under 'Materials Data'.

The results of a survey of the line of the road are as follows. Offsets to the left of the centre-line are negative (looking in the direction of increasing chainage). Each offset in the following list is followed by its reduced level.

Station	*Chainage*				
S1	0	-27.25 : 26.1	-21.0 : 26.6	-9.5 : 24.85	0 : 24.31
		8.0 : 23.9	19.5 : 25.3	28.4 : 26.32	
S2	50	-29.5 : 22.3	-18.4 : 23.45	-8.0 : 23.7	0 : 22.9
		9.5 : 23.1	20.0 : 24.9	29.5 : 26.3	
S3	100	-31.5 : 22.1	-19.0 : 22.66	-9.5 : 23.0	0 : 22.45
		11.1 : 23.6	18.5 : 26.32	27.0 : 29.98	
S4	150	-33.6 : 21.2	-20.0 : 22.11	-7.3 : 24.32	0 : 25.9
		10.0 : 26.83	20.0 : 28.72	30.5 : 30.84	
S5	200	-34.0 : 22.84	-19.75 : 24.93	-7.25 : 28.41	0 : 30.4
		12.5 : 35.63	20.25 : 38.85	35.25 : 39.89	
S6	250	-32.0 : 25.21	-15.25 : 28.87	-9.75 : 28.92	0 : 29.80
		10.0 : 32.32	18.5 : 39.42	36.5 : 41.62	
S7	300	-33.25 : 30.5	-13.25 : 32.13	-6.5 : 36.83	0 : 39.04
		11.25 : 46.87	20.0 : 51.44	36.5 : 48.33	
S8	350	-33.5 : 33.22	-20.5 : 33.64	-8.25 : 38.87	0 : 41.97
		10.0 : 49.34	23.5 : 54.06	37.75 : 50.92	
S9	400	-34.3 : 33.82	-18.75 : 41.11	-8.0 : 47.93	0 : 51.32
		12.25 : 56.38	22.5 : 53.75	37.75 : 49.03	
S10	450	-35.5 : 32.55	-20.0 : 42.93	-8.75 : 50.88	0 : 55.61
		11.5 : 50.73	21.75 : 49.80	34.5 : 48.26	
S11	500	-34.25 : 25.0	-18.75 : 28.44	-9.25 : 36.42	0 : 41.93
		10.0 : 45.68	18.75 : 39.84	31.75 : 34.48	
S12	550	-34.25 : 25.31	-22.5 : 26.84	-10.25 : 34.8	0 : 37.63
		9.75 : 38.04	18.75 : 39.84	31.75 : 34.48	
S13	600	-29.5 : 23.01	-16.5 : 23.22	-9.25 : 26.96	0 : 29.43
		11.25 : 32.84	18.75 : 37.09	33.25 : 30.14	
S14	650	-31.5 : 19.14	-18.5 : 19.33	-8.0 : 21.62	0 : 22.48
		12.75 : 26.70	21.0 : 28.99	31.75 : 30.72	
S15	700	-33.25 : 18.53	-19.5 : 19.22	-10.25 : 18.28	0 : 16.21
		11.01 : 20.43	22.5 : 24.81	30.25 : 29.04	
S16	760	-33.25 : 18.55	-19.0 : 18.18	-11.5 : 17.01	0 : 14.32
		9.25 : 18.84	23.5 : 22.42	31.25 : 26.81	
S17	800	-33.25 : 17.62	-18.75 : 18.04	-12.0 : 16.32	0 : 15.81
		9.75 : 17.22	24.75 : 19.31	34.5 : 24.44	

The results from a series of bore holes along the route are as follows:

	Chainage	*R.L.'s of upper surfaces of materials encountered*			
BH 01	0	Topsoil 24.3	Gravel 22.9	Rock 13.63	
BH 02	175	Topsoil 28.6	Gravel 28.0	Peat 15.5	Rock 15.0
BH 03	310	Topsoil 40.0	Gravel 39.5	Peat 37.6	Rock 31.0
BH 04	480	Topsoil 51.2	Gravel 51.0	Peat 48.1	Rock 47.8
BH 05	660	Topsoil 22.0	Gravel 21.5	Rock 14.0	
BH 06	780	Topsoil 15.9	Gravel 15.4	Rock 10.5	

Strata are assumed to be parallel to the surface.

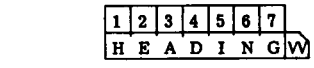
This data is shown entered on the Data Sheets for card input on the following pages.

Note how the fill from the previous contract is entered in as a break on the first station, and also how the typicals data is dealt with, all dimensions being entered as feet.

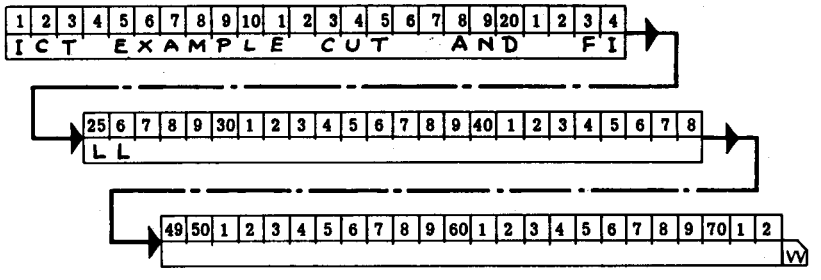
I.C.T. 1900 Series cut and fill program
card input/amendment

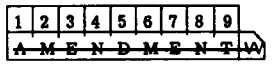
Reference - Data Sheet 1a
Sheet number 1 of 18

W = remainder of card blank



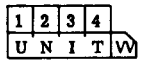
1 card





Delete if not applicable

OR



either BRIT. or METR.

Delete these boxes if this is on an amendment run

Note: Decimal points must always be punched, but a following zero can be omitted.

I.C.T. 1900 Series cut and fill program
card input

Reference - Data Sheet 1b
Sheet number 2 of 18

VV = remainder of card blank
SK = for skip-set at columns 21, 36, 51, 66

1 2 3 4 5 6 7 8 9 10
G R A D E D A T A VV

Chainage at Intersection of Tangents	Grade level of Intersection of Tangents	Curve Length
0.	30.	0.
200.	32.	210.
600.	26.2	200.
800.	28.2	0

1 2 3 4 5 6 7 8 9 10 1 2 3 4
E O D A VV
M A T E R I A L S D A T A VV

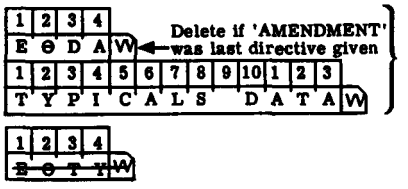
Material Name	Cut Factor	Fill Factor (0 if unsuitable)	Cut Slope (Natural Tangent)
TOPS	1.1	0.8	0.667
PEAT	1.1	0	0.667
GRAV	1.1	0.8	0.667
ROCK	1.5	1.25	4.

Maximum number shown

I.C.T. 1900 Series cut and fill program
card input/amendment

Reference - Data Sheet 2
Sheet number 3 of 18

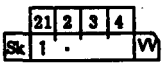
[W] = remainder of card blank
Sk = for skip-set at columns 21, 36



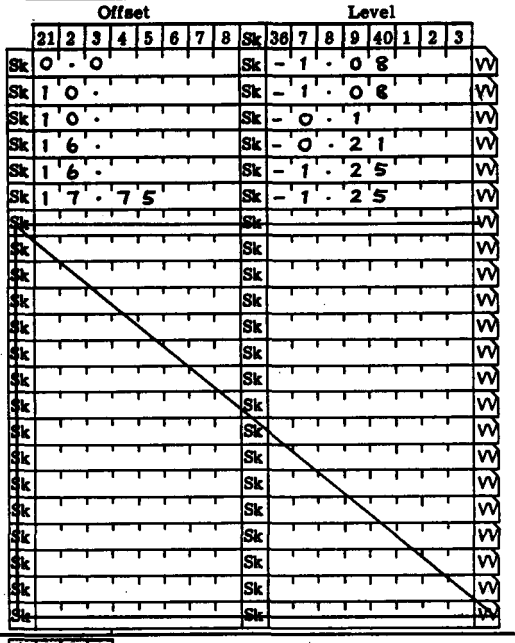
Delete these 2 boxes for all but first sheet of typicals data

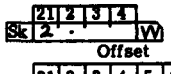
OR

- Delete this box on first sheet

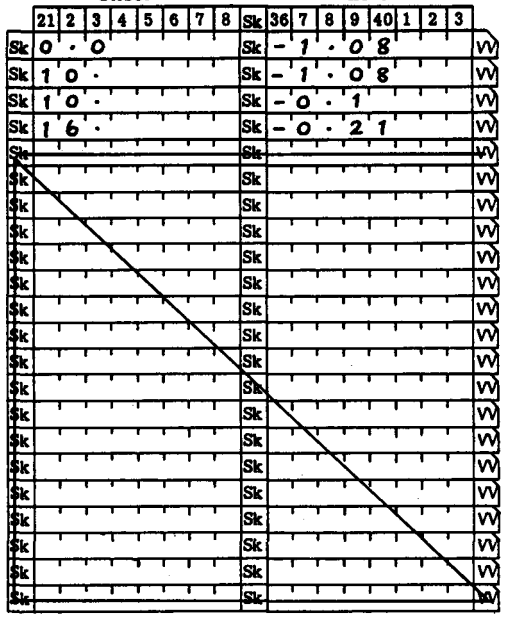


Typical Ref. left justified, followed by a full stop





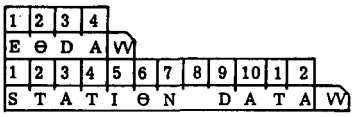
Typical Ref. left justified, followed by a full stop



I.C.T. 1900 Series cut and fill program
card input

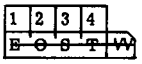
Reference - Data Sheet 3a
Sheet number 4 of 18

W = remainder of card blank
Sk = for skip-set at columns 21, 36, 51, 66



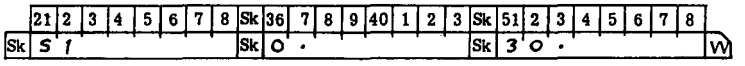
Delete these 2 boxes on all but the first Station Data Sheet

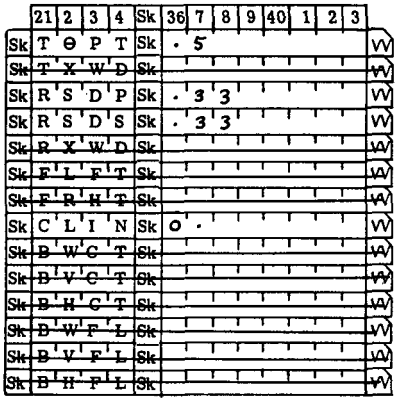
OR



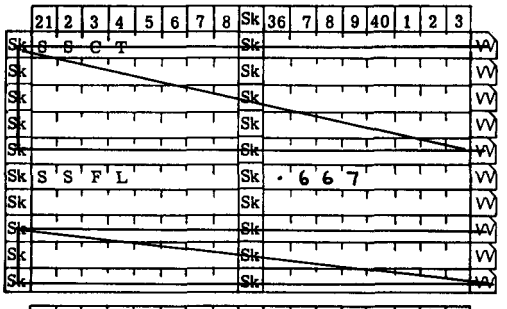
Delete on first Station Data Sheet

Station Name and/or No. Chainage Grade Level





Topsoil Thickness
Topsoil Extra Width
Resoil Depth - horizontal - verges, central res.
Resoil Depth - Normal - on slopes
Resoil Extra Width
Distance to Fence line Left
Distance to Fence line Right
Distance from ℄ Terrain to Datum of Typicals
Berm in Cut - Width
Berm in Cut - Vertical Separation
Berm in Cut - Max.Top Vert. Separation
Berm in Fill - Width
Berm in Fill - Vertical Separation
Berm in Fill - Max. Btm. Vert. Separation

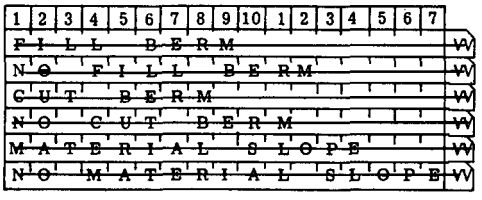


Side slope in cut - Natural Tan if simple.

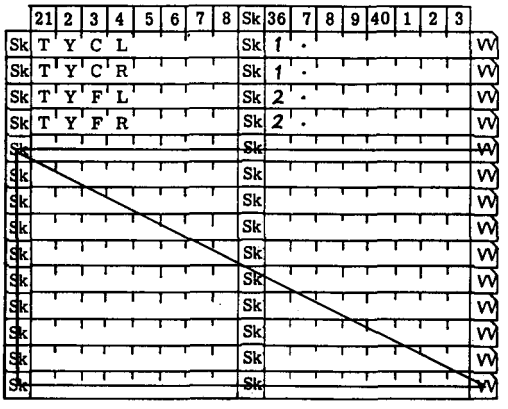
If slope to be automatically selected from height of cut - Give SSCT a value of 0 & fill in pairs of slopes (Nat. Tan) & heights of Cut - Max.No. of 10

Side slope in Fill - Natural Tan if simple.

If slope to be automatically selected from height of Fill - Give SSFL a value of 0 & fill in pairs of slopes (Nat. Tan) & heights of Fill - Max.No. of 10



If Fill berm data set (BWFL, BVFL, BHFL) delete as applicable - if not, delete both
If Cut berm data set (BWCT, BVCT, BHCT) delete as applicable - if not, delete both
If material slopes vary (See material data) delete as applicable - if not, delete both



Typical Reference No. in Cut - Left
Typical Reference No. in Cut - Right
Typical Reference No. in Fill - Left
Typical Reference No. in Fill - Right

Numbers left justified and followed by a full stop.

If Typical is not standard TYCL, TYCR, TYFL & TYFR are set to 0 and
Typical is defined by pairs of Off sets and Levels - up to 58 No. pairs

Note: This forms first sheet of Station Data or can be used for subsequent Station where variables alter

I.C.T. 1900 Series cut and fill program
card input

Reference - Data Sheet 3c
Sheet Number 5 of 18

W = remainder of card blank
SK = for skip-set at columns 21, 36.

STATION DATA - continued

This sheet must follow either sheet 3a or 3b at the station at which the 'BREAK' is to occur.

1	2	3	4	5	
B	R	E	A	K	W

21	2	3	4	SK	36	37	38	39	40	41	42	43	44	45	46	
SK	A	L	N	D	SK										W	Area of Land
SK	A	S	E	E	SK										W	Area for Resoil
SK	A	T	O	P	SK										W	Area of Topsoil Strippage
SK	V	T	O	P	SK										W	Volume of Topsoil Strippage
SK	V	T	R	B	SK										W	Volume of Resoil
SK	V	F	I	L	SK	7	5	0	.						W	Volume of Fill
SK	V	C	U	T	SK										W	Volume of Cut
SK					SK										W	Material & Volume 1
SK					SK										W	Material & Volume 2
SK					SK										W	Material & Volume 3
SK					SK										W	Material & Volume 4
SK					SK										W	Material & Volume 5

These values will be added
Delete if not required

Up to 20

Note: With 'BREAK' set values are not calculated between this Station and the preceding Station i.e. at bridges, roundabouts etc.

I.C.T. 1900 Series cut and fill program
card input/amendment

Reference - Data Sheet 3b

Sheet number 6 of 18

W = remainder of card blank

Sk = for skip-set at columns 21, 36, 51.

STATION DATA Continued

This sheet to be used for successive stations where variables remain constant.

1	2	3	4			Station name and/or number (Min 2 ch. max 8) 21–28	Sk	Chainage 36–43	Sk	Grade level (set to 0 if it is to be calculated) 51–58	
E	Θ	S	T	W	Sk	S2	Sk	50·	Sk	0·	W
E	Θ	S	T	W	Sk	S3	Sk	100·	Sk	0·	W
E	Θ	S	T	W	Sk	S4	Sk	150·	Sk	0·	W
E	Θ	S	T	W	Sk	S5	Sk	200·	Sk	0·	W
E	Θ	S	T	W	Sk	S6	Sk	250·	Sk	0·	W
E	Θ	S	T	W	Sk	S7	Sk	300·	Sk	0·	W
E	Θ	S	T	W	Sk	S8	Sk	350·	Sk	0·	W
E	Θ	S	T	W	Sk	S9	Sk	400·	Sk	0·	W
E	Θ	S	T	W	Sk	S10	Sk	450·	Sk	0·	W
E	Θ	S	T	W	Sk	S11	Sk	500·	Sk	0·	W
E	Θ	S	T	W	Sk	S12	Sk	550·	Sk	0·	W
E	Θ	S	T	W	Sk	S13	Sk	600·	Sk	0·	W
E	Θ	S	T	W	Sk	S14	Sk	650·	Sk	0·	W
E	Θ	S	T	W	Sk	S15	Sk	700·	Sk	0·	W
E	Θ	S	T	W	Sk	S16	Sk	760·	Sk	0·	W
E	Θ	S	T	W	Sk	S17	Sk	800·	Sk	0·	W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W
E	Θ	S	T	W	Sk		Sk		Sk		W

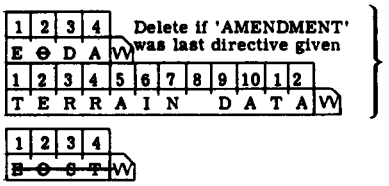
I.C.T. 1900 Series cut and fill program
card input/amendment

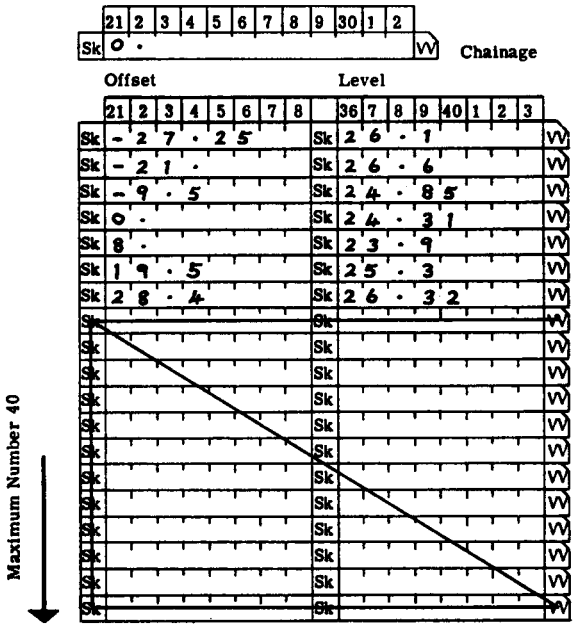
Reference - Data Sheet 4

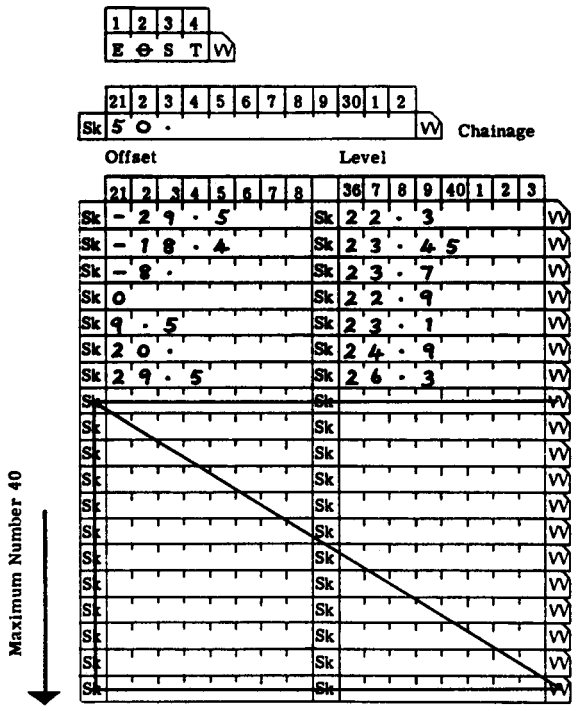
Sheet number: 7 of 18

W = remainder of card blank

Sk = for skip-set at columns 21, 36.



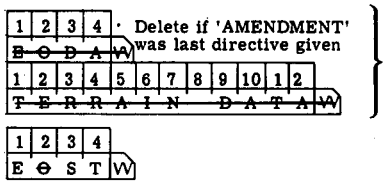


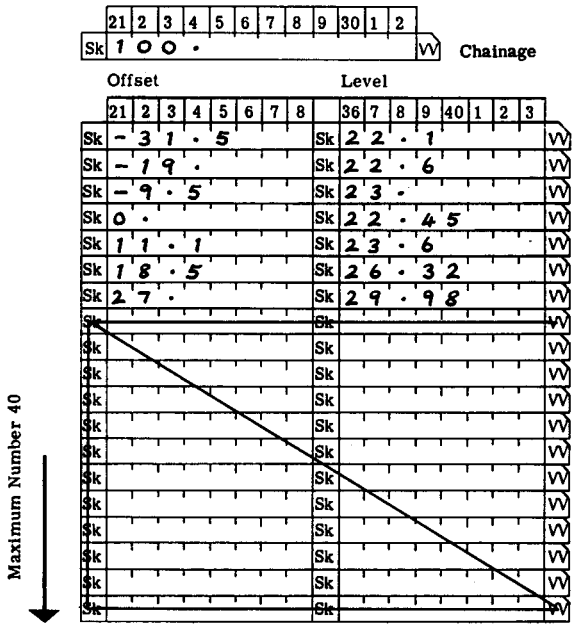


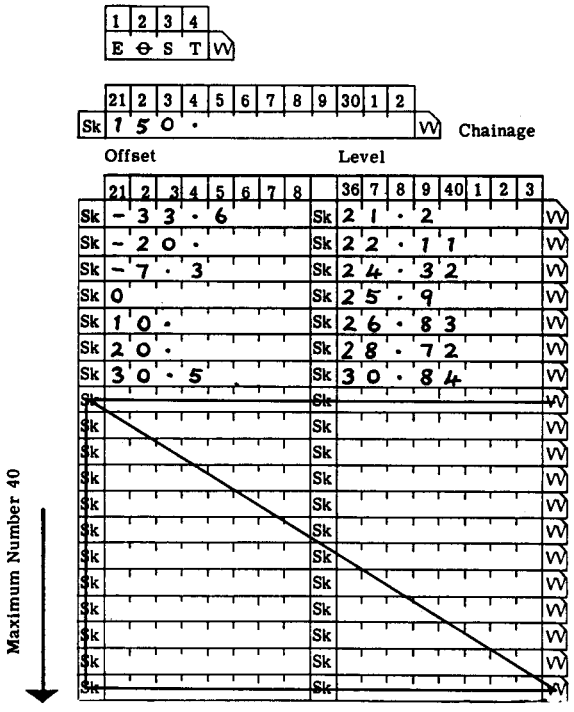
I.C.T. 1900 Series cut and fill program
card input/amendment

Reference - Data Sheet 4
Sheet number 8 of 18

W = remainder of card blank
Sk = for skip-set at columns 21, 36.







I.C.T. 1900 Series cut and fill program
card input/amendment

Reference - Data Sheet 4
Sheet number 9 of 18

W = remainder of card blank
Sk = for skip-set at columns 21, 36.

1 2 3 4 · Delete if 'AMENDMENT' was last directive given
B O D A W

1 2 3 4 5 6 7 8 9 10 1 2
T B R R A I N D A T A W

} Delete these 2 boxes for all but first sheet of terrain data

OR

1 2 3 4
E O S T W

Delete this box on 1st sheet

21 2 3 4 5 6 7 8 9 30 1 2
Sk 2 0 0 · W Chainage

Offset								Level							
21	2	3	4	5	6	7	8	36	7	8	9	40	1	2	3
Sk	−	3	4	·				Sk	2	2	·	8	4		W
Sk	−	1	9	·	7	5		Sk	2	4	·	9	3		W
Sk	−	7	·	2	5			Sk	2	8	·	4	1		W
Sk	0							Sk	3	0	·	4			W
Sk	1	2	·	5				Sk	3	5	·	6	3		W
Sk	2	0	·	2	5			Sk	3	8	·	8	5		W
Sk	3	5	·	2	5			Sk	3	9	·	8	9		W
Sk								Sk							W
Sk								Sk							W
Sk								Sk							W
Sk								Sk							W
Sk								Sk							W
Sk								Sk							W
Sk								Sk							W
Sk								Sk							W
Sk								Sk							W
Sk								Sk							W
Sk								Sk							W

Maximum Number 40

1 2 3 4
E O S T W

21 2 3 4 5 6 7 8 9 30 1 2
Sk 2 5 0 · W Chainage

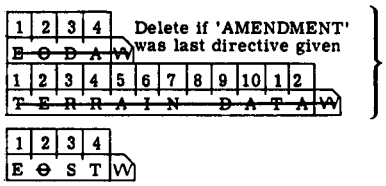
Offset								Level							
21	2	3	4	5	6	7	8	36	7	8	9	40	1	2	3
Sk	−	3	2	·				Sk	2	5	·	2	1		W
Sk	−	1	5	·	2	5		Sk	2	8	·	8	7		W
Sk	−	9	·	7	5			Sk	2	8	·	9	2		W
Sk	0	·						Sk	2	9	·	8			W
Sk	1	0	·					Sk	3	2	·	3	2		W
Sk	1	8	·	5				Sk	3	9	·	4	2		W
Sk	3	6	·	5				Sk	4	1	·	6	2		W
Sk								Sk							W
Sk								Sk							W
Sk								Sk							W
Sk								Sk							W
Sk								Sk							W
Sk								Sk							W
Sk								Sk							W
Sk								Sk							W
Sk								Sk							W
Sk								Sk							W
Sk								Sk							W

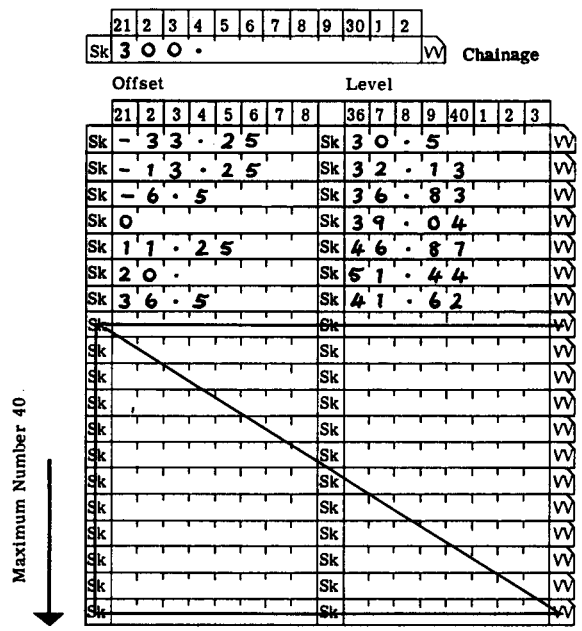
Maximum Number 40

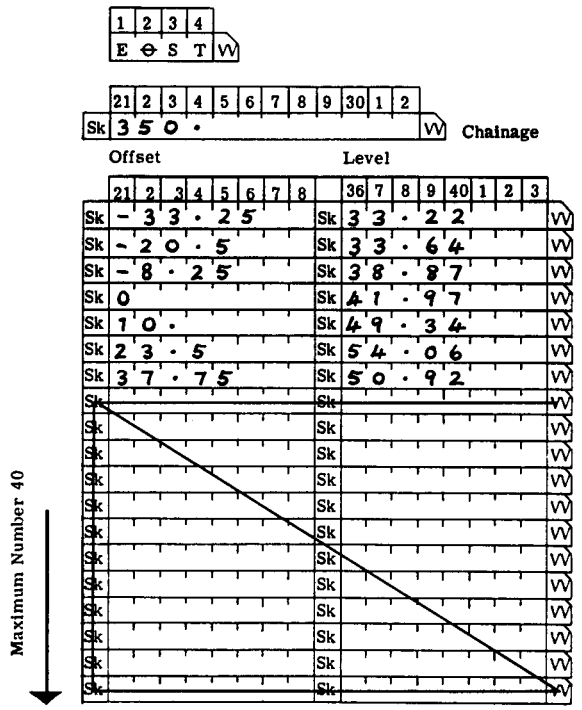
I.C.T. 1900 Series cut and fill program
card input/amendment

Reference - Data Sheet 4
Sheet number: 10 of 18

W = remainder of card blank
Sk = for skip-set at columns 21, 36.



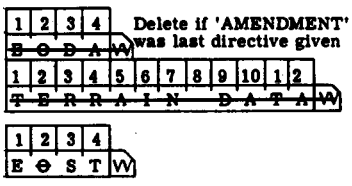




I.C.T. 1900 Series cut and fill program
card input/amendment

Reference - Data Sheet 4
Sheet number: 11 of 18

W = remainder of card blank
Sk = for skip-set at columns 21, 36.

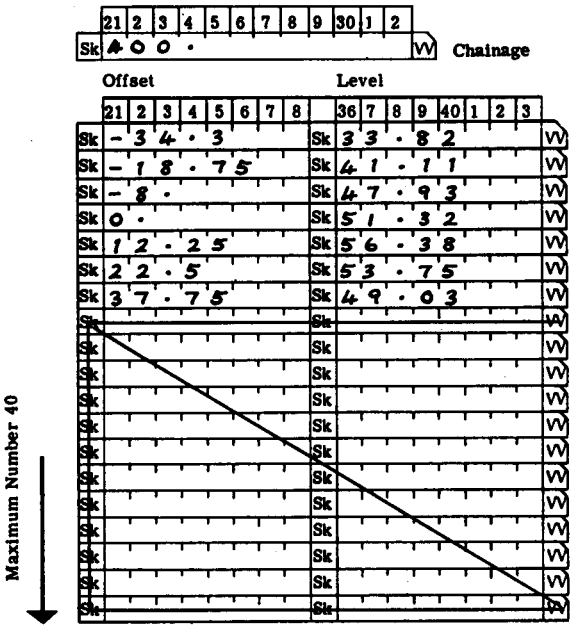


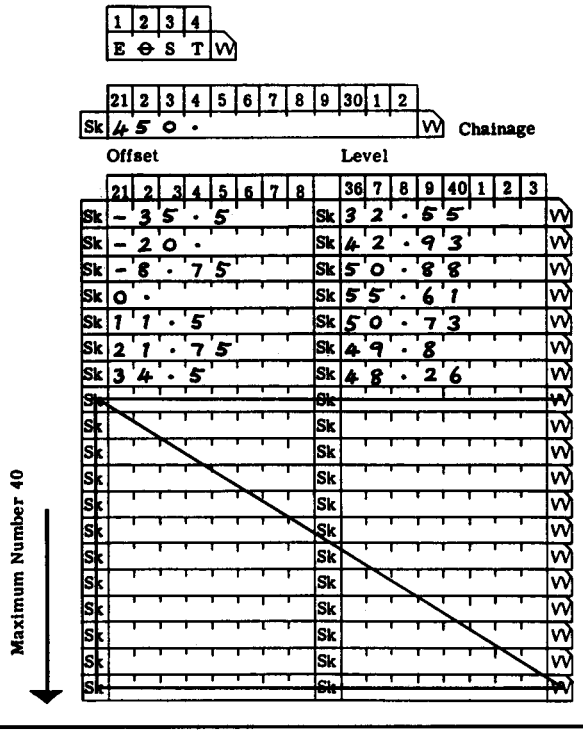
Delete if 'AMENDMENT' was last directive given

Delete these 2 boxes for all but first sheet of terrain data

OR

Delete this box on 1st sheet

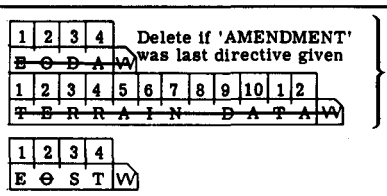


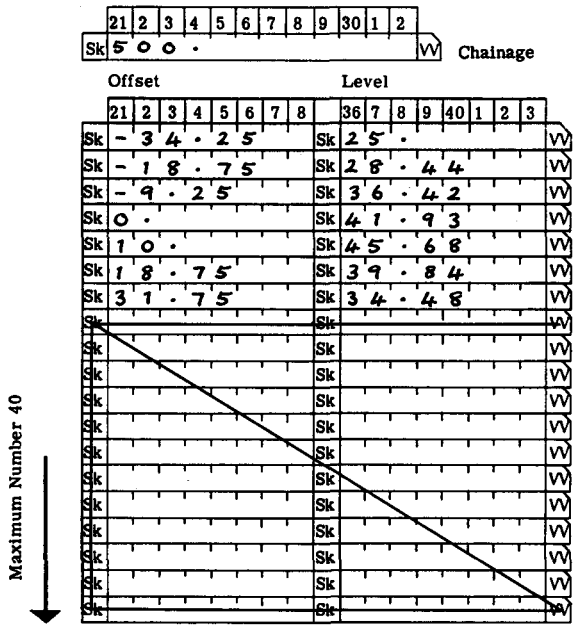


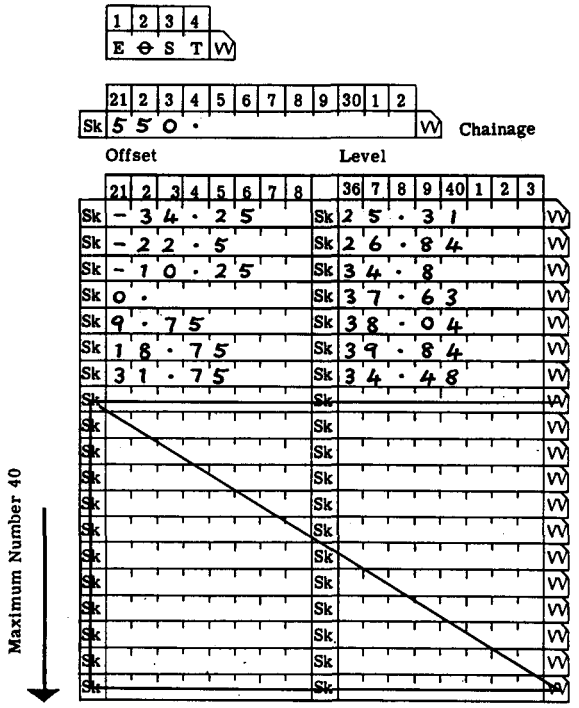
I.C.T. 1900 Series cut and fill program
card input/amendment

Reference - Data Sheet 4
Sheet number 12 of 18

W = remainder of card blank
Sk = for skip-set at columns 21, 36.



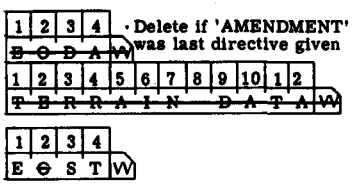


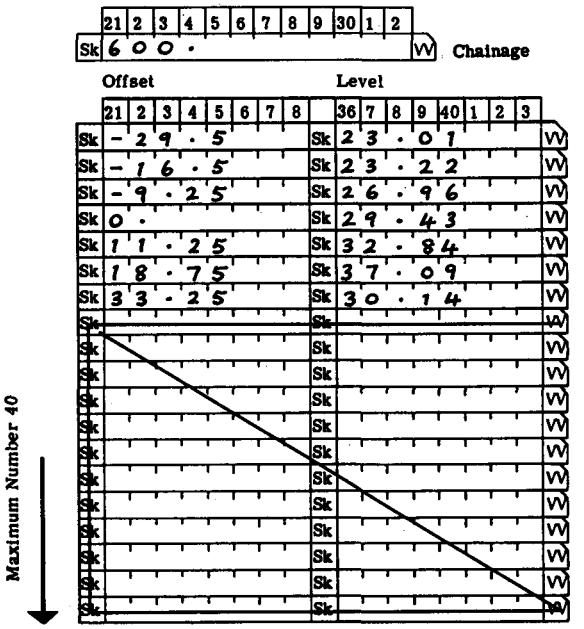


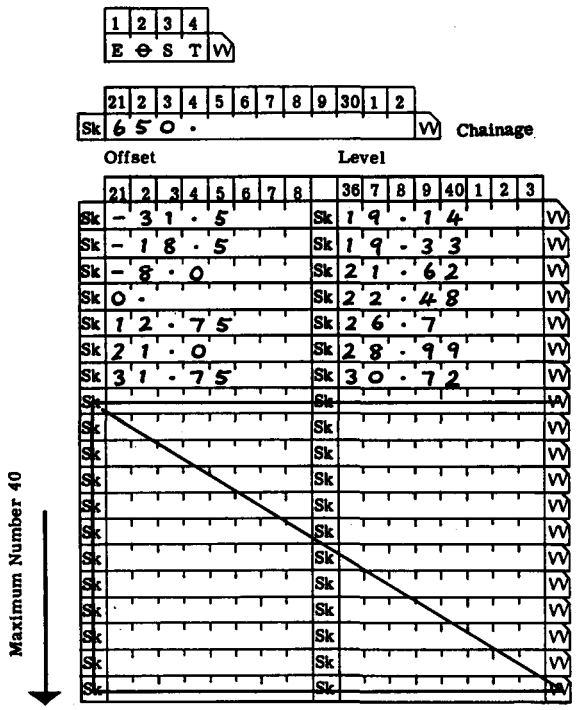
I.C.T. 1900 Series cut and fill program
card input/amendment

Reference - Data Sheet 4
Sheet number 13 of 18

W = remainder of card blank
Sk = for skip-set at columns 21, 36.



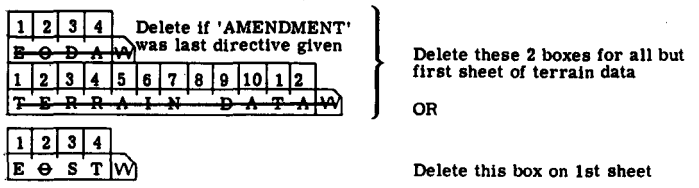


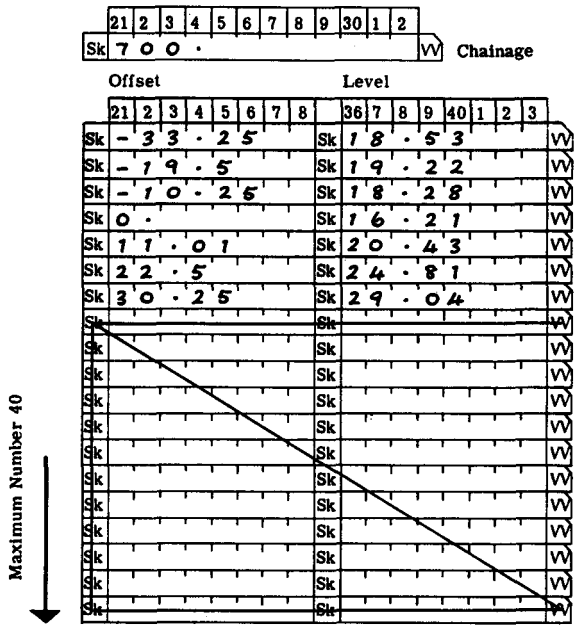


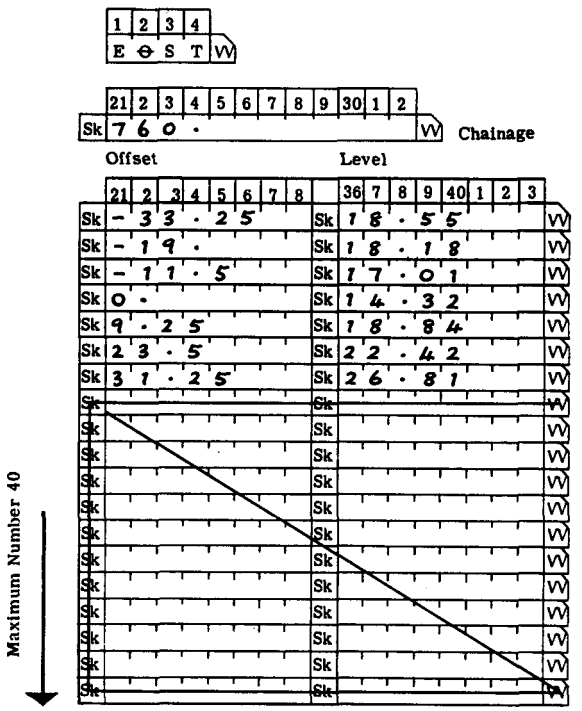
I.C.T. 1900 Series cut and fill program
card input/amendment

Reference - Data Sheet 4
Sheet number 14 of 18

W = remainder of card blank
Sk = for skip-set at columns 21, 36.



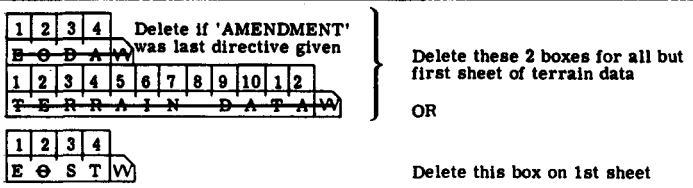


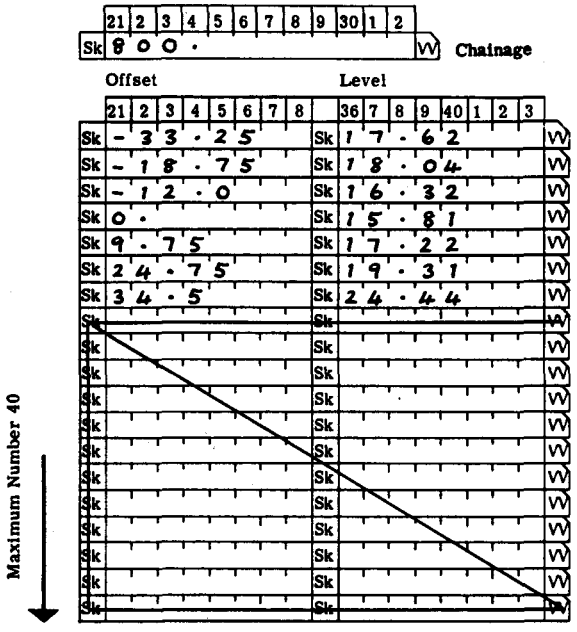


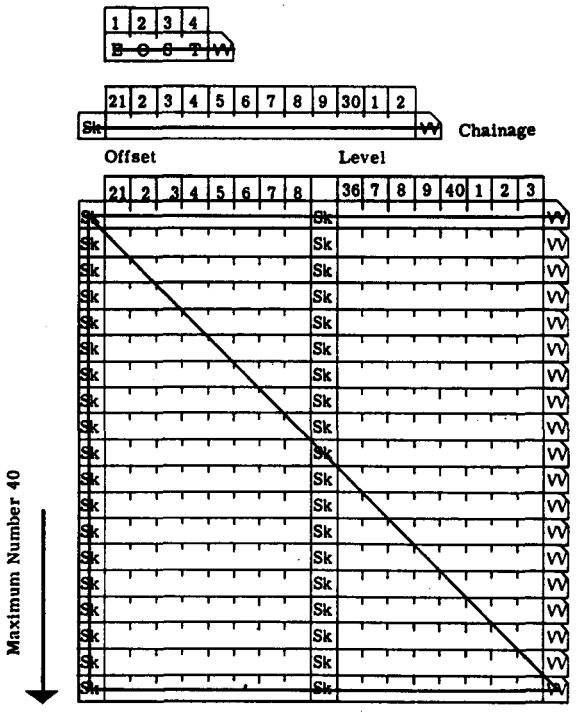
I.C.T. 1900 Series cut and fill program
card input /amendment

Reference - Data Sheet 4
Sheet number 15 of 18

W = remainder of card blank
Sk = for skip-set at columns 21, 36.



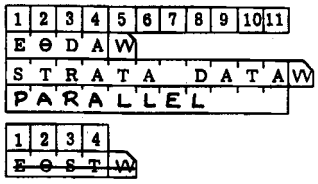




I.C.T. 1900 Series cut and fill program
card input/amendment

Reference - Data Sheet 5a
Sheet number 16 of 18

W = remainder of card blank
Sk = for skip-set at columns 21, 36, 51, 66



Delete if 'AMENDMENT' was last directive given

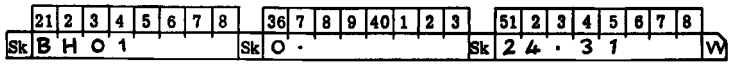
Write PARALLEL or HORIZONTAL

Delete these boxes on all but the first sheet of Strata Data

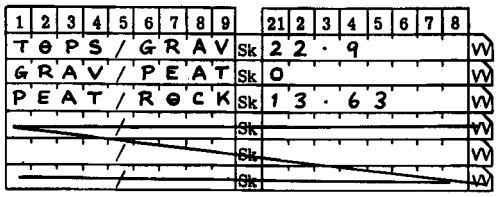
OR

Delete on first sheet of Strata Data

Station or Borehole Ref. | Chainage | Ground level

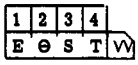


Material Interface | Strata level

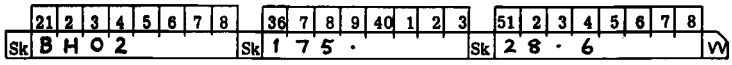


Maximum 6

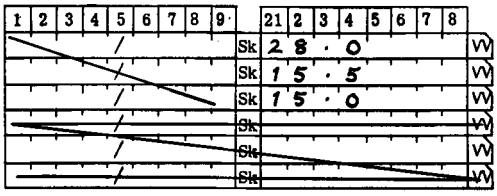
Note: If interfaces in same order as previously set, delete all material interface refs. Just input Strata Levels.



Station or Borehole Ref. | Chainage | Ground level

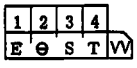


Material Interface | Strata level

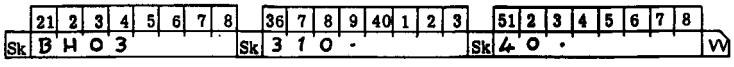


Maximum 6

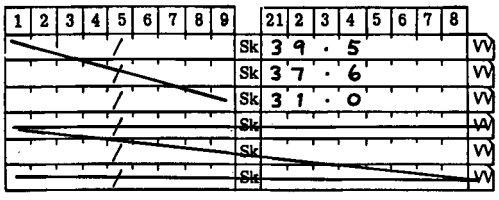
See Note above



Station or Borehole Ref. | Chainage | Ground level



Material Interface | Strata level



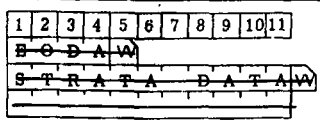
Maximum 6

See Note above

I.C.T. 1900 Series cut and fill program
card input/amendment

Reference - Data Sheet 5a
Sheet number 17 of 18

W = remainder of card blank
Sk = for skip-set at columns 21, 36, 51, 66

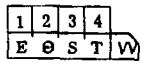


Delete if 'AMENDMENT' was last directive given

Write PARALLEL or HORIZONTAL

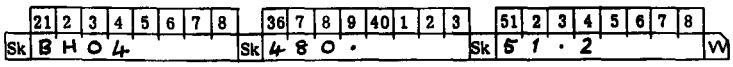
Delete these boxes on all but the first sheet of Strata Data

OR

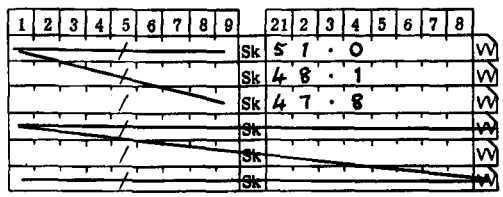


Delete on first sheet of Strata Data

Station or Borehole Ref. Chainage Ground level

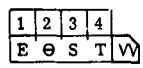


Material Interface Strata level

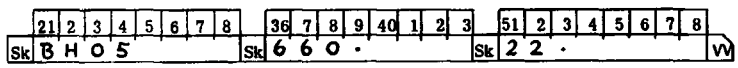


Maximum 6

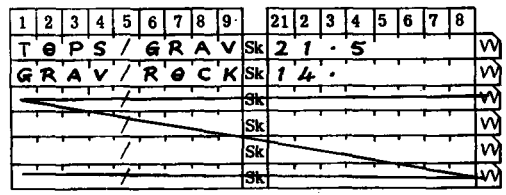
Note: If interfaces in same order as previously set, delete all material interface refs. Just input Strata Levels.



Station or Borehole Ref. Chainage Ground level



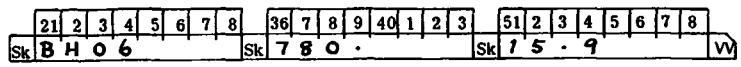
Material Interface Strata level



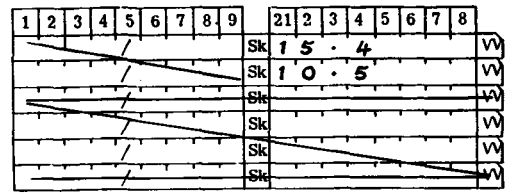
Maximum 6

See Note above

Station or Borehole Ref. Chainage Ground level



Material Interface Strata level

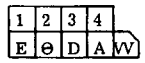


Maximum 6

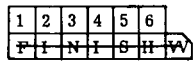
See Note above

I.C.T. 1900 Series cut and fill program
card input/amendment

W = remainder of card blank
Sk = for skip-set at columns 21, 36

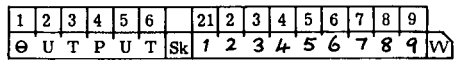


Required for Input and Amendment programs



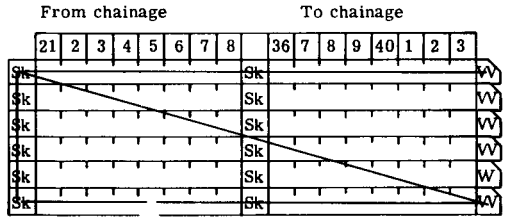
Amendment program only delete for input program

Delete both if option list is being prepared separately



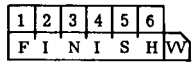
Enter options required (1 to 9)

For option 9 only up to 6 of the following cards may be inserted giving chainage bands for which output is required



Delete if data is required for the whole route

For all options



OPTIONS

1 SETTING OUT SHEET 1
Chainage-Station No.-Grade Lvl.-Side Slopes-Stake Points-Fence line

2 SETTING OUT SHEET 2
Chainage-Points defining station-Offsets & Levels

3 LAND AREA & SOIL DATA
Chainage-Land Area Topsoil strip area & vol.-Resoil area & vol.

4 CUT & FILL VOLUMES (+ C.F. & F.F.)
Chainage-Cut vol., Fill vol. Balance at Station & Cumulative

5 CUT & FILL VOLUMES (- C.F. & F.F.)
Chainage-Cut vol., Fill vol., Balance at Station & Cumulative

6 MATERIAL VOLUMES
Chainage-Material, Cut vol., × C.F. × F.F. Dump at Station & Cumulative

7 CROSS HAUL (for sections in both cut & fill)
Chainage-Cross haul at Stations, Cumulative, Total

8 MASS HAUL DIAGRAM
Plot of Balance of Cut × F.F. -Fill against Chainage

9 INPUT DATA
All input data on master file

4048 (8.67)

I.C.T. 1900 Series cut and fill program
card amendment

Reference - Data Sheet 1b
Sheet number________________

VV = remainder of card blank
Sk = for skip-set at columns 21, 36, 51, 66

1	2	3	4	5	6	7	8	9	10	
G	R	A	D	E		D	A	T	A	VV

Insert directive if required 1 2 3 4 5 6 7		Chainage at Intersection of Tangents 21 2 3 4 5 6 7 8 9 30		Grade level of Intersection of Tangents 36 7 8 9 40 1 2 3		Curve Length 51 2 3 4 5 6 7 8	
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV
	SK		SK		SK		VV

1	2	3	4	5	6	7	8	9	10	1	2	3	4	
E	O	D	A	VV										
M	A	T	E	R	I	A	L	S		D	A	T	A	VV

← delete 'EODA' if 'AMENDMENT' was last directive given

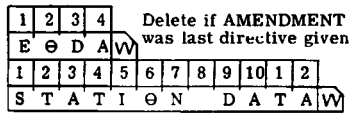
Note: 'Tops' may not be deleted

Insert directive if required 1 2 3 4 5 6 7		Material Name 21 2 3 4		Cut Factor 36 7 8 9 40 1		Fill Factor (0 if unsuitable) 51 2 3 4 5 6		Cut Slope (Natural Tan) 66 7 8 9 70 1 2	
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV
	SK		SK		SK		SK		VV

I.C.T. 1900 Series cut and fill program
card amendment

Reference - Data Sheet 3a
Sheet number_____

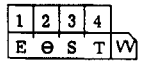
W = remainder of card blank
Sk = for skip-set at columns 21,36



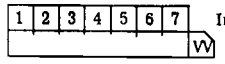
Delete if AMENDMENT was last directive given

Delete these 2 boxes on all but the first Station Data Sheet

OR

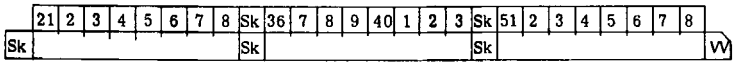


Delete on first Station Data Sheet

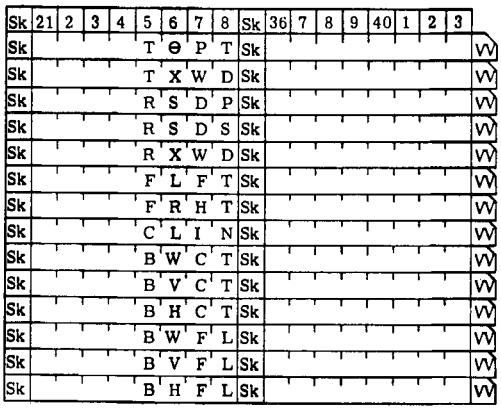


Insert directive if required otherwise delete.

Station Name and/or No. Chainage Grade Level



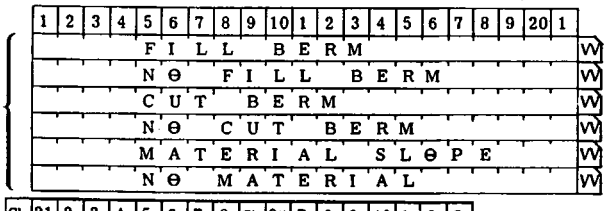
Enter SNGL or CRRY as appropriate



Topsoil Thickness
Topsoil Extra Width
Resoil Depth - horizontal - verges, central res.
Resoil Depth - Normal - on slopes
Resoil Extra Width
Distance to Fence line Left
Distance to Fence line Right
Distance from ℄ Terrain to Datum of Typicals
Berm in Cut - Width
Berm in Cut - Vertical Separation
Berm in Cut - Max Top Vert. Separation
Berm in Fill - Width
Berm in Fill - Vertical Separation
Berm in Fill - Max Btm. Vert. Separation

Side slope in cut - Natural Tan if simple
If slope to be automatically selected from height of cut - Give SSCT a value of 0 & fill in pairs of slopes (Nat. Tan) & heights of Cut - Max No. of 10.

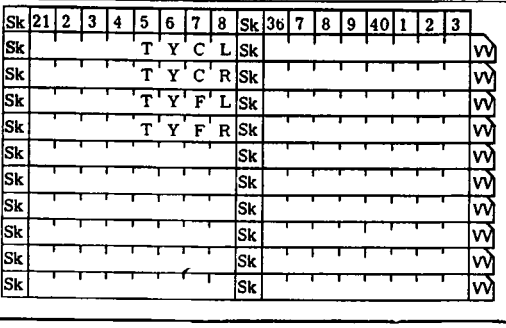
Side slope in Fill - Natural Tan if simple.
If slope to be automatically selected from height of Fill - Give SSFL a value of 0 & fill in pairs of slopes (Nat. Tan) & heights of Fill - Max No. of 10



If Fill berm data set (BWFL, BVFL, BHFL) delete as applicable - if not, delete both

If Cut berm data set (BWCT, BVCT, BHCT) delete as applicable - if not, delete both

If material slopes vary (See material data) delete as applicable - if not, delete both



Typical Ref. No. in Cut - Left
Typical Ref. No. in Cut - Right
Typical Ref. No. in Fill - Left
Typical Ref. No. in Fill - Right

Numbers left justified and followed by a full stop.

If Typical is not standard TYCL, TYCR, TYFL and TYFR are set to 0 and Typical is defined by pairs of Off sets and Levels - up to 58 pairs.

Note: This forms first sheet of Station Data or can be used for subsequent Stations where variables alter

I.C.T. 1900 Series cut and fill program card amendment

(W) = remainder of card blank
Sk = for skip-set at columns 21, 36.

Reference 3c
Sheet number

STATION DATA - continued

This sheet must follow either sheet 3a or 3b at the station at which the 'BREAK' is to occur.

Delete one of these two boxes.

1	2	3	4	5	6	7	8
N	Θ		B	R	E	A	K	W

1	2	3	4	5
B	R	E	A	K	W

21	2	3	4	Sk	36	37	38	39	40	41	42	43	44	45	46	
Sk	A	L	N	D	Sk										W	Area of Land
Sk	A	S	E	E	Sk										W	Area for Resoil
Sk	A	T	Θ	P	Sk										W	Area of Topsoil Strippage
Sk	V	T	Θ	P	Sk										W	Volume of Topsoil Strippage
Sk	V	T	R	E	Sk										W	Volume of Resoil
Sk	V	F	I	L	Sk										W	Volume of Fill
Sk	V	C	U	T	Sk										W	Volume of Cut
Sk					Sk										W	Material & Volume 1
Sk					Sk										W	Material & Volume 2
Sk					Sk										W	Material & Volume 3
Sk					Sk										W	Material & Volume 4
Sk					Sk										W	Material & Volume 5
Sk					Sk										W	
Sk					Sk										W	
Sk					Sk										W	
Sk					Sk										W	
Sk					Sk										W	
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Sk					Sk										W	
Sk					Sk										W	
Sk					Sk										W	
Sk					Sk										W	

These values will be added. Delete if not required.

Up to 20

Note: With 'BREAK' set values are not calculated between this Station and the preceding Station i.e. at bridges, roundabouts etc.

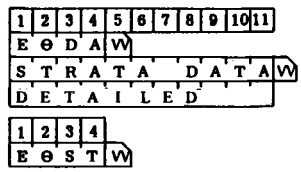
FORM 14/49/5/11.67

Printed in Great Britain

I.C.T. 1900 Series cut and fill program card input/amendment

[W] = remainder of card blank
Sk = for skip-set at columns 21, 36, 51, 66

Reference 5b
Sheet number



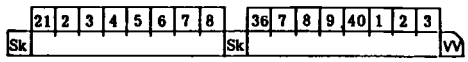
Delete if 'AMENDMENT' was last directive given

Delete these boxes on all but the first sheet of Strata Data

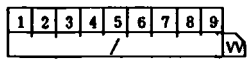
OR

Delete on first sheet of Strata Data

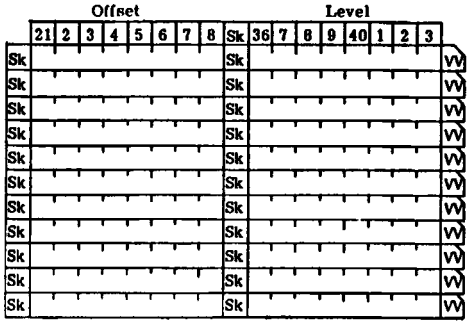
Station name Chainage



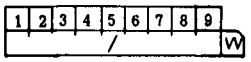
Material Interface



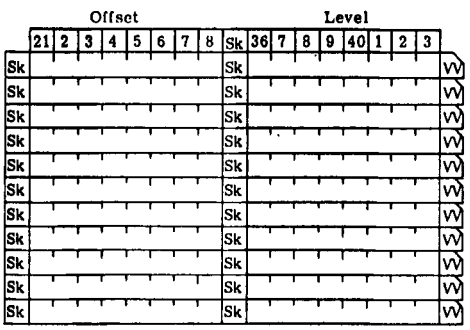
Offset Level



Material Interface



Offset Level



This sheet shows 2 material interfaces for one station. In fact this could be up to 6 material interfaces. Each interface is shown here with 11 pairs of offsets & levels-this could be up to 38.

FORM 14/51/2/11.67

Printed in Great Britain

I.C.T. 1900 Series cut and fill program

Graphical Output: Cross sections

Reference - Data Sheet 7
Sheet number

∇ = Space character
↓ = New line character on paper tape or end of card.

First scale		Second scale	
0	∇	0	↓
2	↓		

No. of chainage bands

First chainage		Second chainage		Interval *n*	
120	∇	170	∇	1	↓
420	∇	470	∇	1	↓
	∇		∇		↓
	∇		∇		↓
	∇		∇		↓
	∇		∇		↓

Stations plotted are $1, 1+n, 1+2n$ $1+3n$ ETC

I.C.T. 1900 Series cut and fill program

Graphical Output: Longitudinal sections

Reference - Data Sheet 8
Sheet number

∇ = Space character
↓ = New line character on paper tape or end of card

First vertical scale		Second vertical scale	
5	∇	5	↓
20	↓		
30	↓		
2	↓		

Horizontal scale
Maximum length of drawing
No. of chainage bands

First chainage		Second chainage	
100	∇	360	↓
370	∇	510	↓
	∇		↓
	∇		↓
	∇		↓
	∇		↓

ICL 1900 CUT AND FILL SERIES

DATA INPUT PROGRAM #X2C4/11

DATE : 05/10/70

FOUND : HEADING:

ICT EXAMPLE CUT AND FILL

FOUND : UNITS

FOUND : GRADE DATA

FOUND: MATERIALS DATA

FOUND : TYPICALS DATA

FOUND : STATION DATA

FOUND : TERRAIN DATA

FOUND : STRATA DATA

CAUTION: NO DATA GIVEN FOR CHAINAGE 800.00

* * * END OF RUN * * *

I . C . T 1 9 0 0 ** C U T A N D F I L L P R O G R A M
(#X2C7/10)

****

PROJECT TITLE: ICT EXAMPLE CUT AND FILL

DATE RUN: 05/10/70

VOLUME FORMULA: TRUNCATED CONE

PRINT OPTIONS CHOSEN:

1: SETTING-OUT: GENERAL
2: SETTING-OUT: CROSS-SECTIONS
3: LAND AREA AND TOPSOIL QUANTITIES
4: CUT AND FILL VOLUMES (WITH C.F. AND F.F.)
5: CUT AND FILL VOLUMES (WITHOUT C.F. AND F.F.)
6: MATERIAL VOLUMES
7: CROSS-HAUL VOLUMES
8: MASS-HAUL DIAGRAM
9: INPUT DATA

I . C . T 1 9 0 0 ** C U T A N D F I L L P R O G R A M
(#X2C7/10)

****

PROJECT TITLE: ICT EXAMPLE CUT AND FILL

DATE RUN: 05/10/70

VOLUME FORMULA: TRUNCATED CONE

1: SETTING-OUT: GENERAL

PROJECT TITLE: ICT EXAMPLE CUT AND FILL

DATE: 05/10/70 SHEET NO 1/1

CHAINAGE FT	STN NO	GRADE LEVEL FT	SIDE SLOPE LEFT TAN	SIDE SLOPE RIGHT TAN	LEFT STAKE OFFSET AND POINT	LEVEL FT	RIGHT STAKE OFFSET AND POINT	LEVEL FT	OFFSET TO FENCE LEFT FT	RIGHT FT
0.00	S1	30.00	0.67 S	0.67 S	23.16 F	25.02	24.06 F	24.41		
50.00	S2	30.50	0.67 S	0.67 S	29.50 TF	21.29	24.79 F	24.43		
100.00	S3	31.00	0.67 S	0.67 S	30.38 F	21.20	21.91 F	26.84		
150.00	S4	31.32	0.67 S	0.67 S	31.75 F	20.61	20.51 F	28.11		
200.00	S5	31.36	0.67 S	0.00 S	28.01 F	23.14	35.25 TF	30.11		
250.00	S6	31.10	0.67 S	0.00 S	22.08 F	26.83	36.50 TF	29.85		
300.00	S7	30.55	0.00 S	0.00 S	33.25 TC	29.30	36.50 TF	29.30		
350.00	S8	29.82	0.00 S	0.00 S	33.25 TC	28.57	37.75 TF	28.57		
400.00	S9	29.10	0.00 S	0.00 S	34.30 TC	27.85	37.75 TF	27.85		
450.00	S10	28.37	0.00 S	0.00 S	35.50 TC	27.12	34.50 TF	27.12		
500.00	S11	27.65	0.00 S	0.00 S	26.89 C	26.40	31.75 TF	26.40		
550.00	S12	27.08	0.00 S	0.00 S	27.84 C	25.83	31.75 TF	25.83		
600.00	S13	26.81	0.67 S	0.00 S	21.80 F	22.73	33.25 TF	25.56		
650.00	S14	26.85	0.67 S	0.00 S	27.89 F	18.71	31.75 TF	25.60		
700.00	S15	27.20	0.67 S	0.67 S	29.12 F	18.24	20.92 F	23.71		
760.00	S16	27.80	0.67 S	0.67 S	30.41 F	17.98	24.04 F	22.23		
800.00	S17	28.20	0.67 S	0.67 S	32.25 F	17.15	27.55 F	20.28		

I . C . T 1 9 0 0 ** C U T A N D F I L L P R O G R A M
(#X2C7/10)

****

PROJECT TITLE: ICT EXAMPLE CUT AND FILL

DATE RUN: 05/10/70

VOLUME FORMULA: TRUNCATED CONE

2: SETTING-OUT: CROSS-SECTIONS

PROJECT TITLE: ICT EXAMPLE CUT AND FILL DATE: 05/10/70 SHEET NO 1/2

OFFSETS AND LEVELS OF POINTS DEFINING STATION CROSS-SECTIONS (OFFSETS FROM NEW CENTRE-LINE). ALL VALUES IN FEET

CHAINAGE: 0.00

TERRAIN										
OFFSETS	-27.25	-21.00	-9.50	0.00	8.00	19.50	28.40			
LEVELS	26.10	26.60	24.85	24.31	23.90	25.30	26.32			
NEW CONSTRUCTION										
OFFSETS	-23.16	-16.00	-10.00	-10.00	0.00	0.00	10.00	10.00	16.00	24.06
LEVELS	25.02	29.79	29.90	28.92	28.92	28.92	28.92	29.90	29.79	24.41

CHAINAGE: 50.00

TERRAIN										
OFFSETS	-29.50	-18.40	-8.00	0.00	9.50	20.00	29.50			
LEVELS	22.30	23.45	23.70	22.90	23.10	24.90	26.30			
NEW CONSTRUCTION										
OFFSETS	-29.50	-16.00	-10.00	-10.00	0.00	0.00	10.00	10.00	16.00	24.79
LEVELS	21.29	30.29	30.40	29.42	29.42	29.42	29.42	30.40	30.29	24.43

CHAINAGE: 100.00

TERRAIN										
OFFSETS	-31.50	-19.00	-9.50	0.00	11.10	18.50	27.00			
LEVELS	22.10	22.60	23.00	22.45	23.60	26.32	29.98			
NEW CONSTRUCTION										
OFFSETS	-30.38	-16.00	-10.00	-10.00	0.00	0.00	10.00	10.00	16.00	21.91
LEVELS	21.20	30.79	30.90	29.92	29.92	29.92	29.92	30.90	30.79	26.84

CHAINAGE: 150.00

TERRAIN										
OFFSETS	-33.60	-20.00	-7.30	0.00	10.00	20.00	30.50			
LEVELS	21.20	22.11	24.32	25.90	26.83	28.72	30.84			
NEW CONSTRUCTION										
OFFSETS	-31.75	-16.00	-10.00	-10.00	0.00	0.00	10.00	10.00	16.00	20.51
LEVELS	20.61	31.11	31.22	30.24	30.24	30.24	30.24	31.22	31.11	28.11

PROJECT TITLE: ICT EXAMPLE CUT AND FILL DATE: 05/10/70 SHEET NO 2/2

OFFSETS AND LEVELS OF POINTS DEFINING STATION CROSS-SECTIONS (OFFSETS FROM NEW CENTRE-LINE). ALL VALUES IN FEET

CHAINAGE: 200.00

TERRAIN										
OFFSETS	-34.00	-19.75	-7.25	0.00	12.50	20.25	35.25			
LEVELS	22.84	24.93	28.41	30.40	35.63	38.85	39.89			
NEW CONSTRUCTION										
OFFSETS	-28.01	-16.00	-10.00	-10.00	0.00	0.00	10.00	10.00	16.00	16.00
LEVELS	23.14	31.15	31.26	30.28	30.28	30.28	30.28	31.26	31.15	30.11
OFFSETS	17.75	35.25								
LEVELS	30.11	30.11								

CHAINAGE: 250.00

TERRAIN										
OFFSETS	-32.00	-15.25	-9.75	0.00	10.00	18.50	36.50			
LEVELS	25.21	28.87	28.92	29.80	32.32	39.42	41.62			
NEW CONSTRUCTION										
OFFSETS	-22.08	-16.00	-10.00	-10.00	0.00	0.00	10.00	10.00	16.00	16.00
LEVELS	26.83	30.89	31.00	30.02	30.02	30.02	30.02	31.00	30.89	29.85
OFFSETS	17.75	36.50								
LEVELS	29.85	29.85								

CHAINAGE: 300.00

TERRAIN										
OFFSETS	-33.25	-13.25	-6.50	0.00	11.25	20.00	36.50			
LEVELS	30.50	32.13	36.83	39.04	46.87	51.44	41.62			
NEW CONSTRUCTION										
OFFSETS	-33.25	-17.75	-16.00	-16.00	-10.00	-10.00	0.00	0.00	10.00	10.00
LEVELS	29.30	29.30	29.30	30.34	30.45	29.47	29.47	29.47	29.47	30.45
OFFSETS	16.00	16.00	17.75	36.50						
LEVELS	30.34	29.30	29.30	29.30						

PROJECT TITLE: ICT EXAMPLE CUT AND FILL DATE: 05/10/70 SHEET NO 3/2

OFFSETS AND LEVELS OF POINTS DEFINING STATION CROSS-SECTIONS (OFFSETS FROM NEW CENTRE-LINE). ALL VALUES IN FEET

CHAINAGE: 350.00

TERRAIN										
OFFSETS	-33.25	-20.50	-8.25	0.00	10.00	23.50	37.75			
LEVELS	33.22	33.64	38.87	41.97	49.34	54.06	50.92			
NEW CONSTRUCTION										
OFFSETS	-33.25	-17.75	-16.00	-16.00	-10.00	-10.00	0.00	0.00	10.00	10.00
LEVELS	28.57	28.57	28.57	29.61	29.72	28.74	28.74	28.74	28.74	29.72
OFFSETS	16.00	16.00	17.75	37.75						
LEVELS	29.61	28.57	28.57	28.57						

CHAINAGE: 400.00

TERRAIN										
OFFSETS	-34.30	-18.75	-8.00	0.00	12.25	22.50	37.75			
LEVELS	33.82	41.11	47.93	51.32	56.38	53.75	49.03			
NEW CONSTRUCTION										
OFFSETS	-34.30	-17.75	-16.00	-16.00	-10.00	-10.00	0.00	0.00	10.00	10.00
LEVELS	27.85	27.85	27.85	28.89	29.00	28.02	28.02	28.02	28.02	29.00
OFFSETS	16.00	16.00	17.75	37.75						
LEVELS	28.89	27.85	27.85	27.85						

CHAINAGE: 450.00

TERRAIN										
OFFSETS	-35.50	-20.00	-8.75	0.00	11.50	21.75	34.50			
LEVELS	32.55	42.93	50.88	55.61	50.73	49.80	48.26			
NEW CONSTRUCTION										
OFFSETS	-35.50	-17.75	-16.00	-16.00	-10.00	-10.00	0.00	0.00	10.00	10.00
LEVELS	27.12	27.12	27.12	28.17	28.27	27.29	27.29	27.29	27.29	28.27
OFFSETS	16.00	16.00	17.75	34.50						
LEVELS	28.17	27.12	27.12	27.12						

PROJECT TITLE: ICT EXAMPLE CUT AND FILL DATE: 05/10/70 SHEET NO 4/2

OFFSETS AND LEVELS OF POINTS DEFINING STATION CROSS-SECTIONS (OFFSETS FROM NEW CENTRE-LINE). ALL VALUES IN FEET

CHAINAGE: 500.00

TERRAIN										
OFFSETS	-34.25	-18.75	-9.25	0.00	10.00	18.75	31.75			
LEVELS	25.00	28.44	36.42	41.93	45.68	39.84	34.48			
NEW CONSTRUCTION										
OFFSETS	-26.89	-17.75	-16.00	-16.00	-10.00	-10.00	0.00	0.00	10.00	10.00
LEVELS	26.40	26.40	26.40	27.44	27.55	26.57	26.57	26.57	26.57	27.55
OFFSETS	16.00	16.00	17.75	31.75						
LEVELS	27.44	26.40	26.40	26.40						

CHAINAGE: 550.00

TERRAIN										
OFFSETS	-34.25	-22.50	-10.25	0.00	9.75	18.75	31.75			
LEVELS	25.31	26.84	34.80	37.63	38.04	39.84	34.48			
NEW CONSTRUCTION										
OFFSETS	-27.84	-17.75	-16.00	-16.00	-10.00	-10.00	0.00	0.00	10.00	10.00
LEVELS	25.83	25.83	25.83	26.87	26.98	26.00	26.00	26.00	26.00	26.98
OFFSETS	16.00	16.00	17.75	31.75						
LEVELS	26.87	25.83	25.83	25.83						

CHAINAGE: 600.00

TERRAIN										
OFFSETS	-29.50	-16.50	-9.25	0.00	11.25	18.75	33.25			
LEVELS	23.01	23.22	26.96	29.43	32.84	37.09	30.14			
NEW CONSTRUCTION										
OFFSETS	-21.80	-16.00	-10.00	-10.00	0.00	0.00	10.00	10.00	16.00	16.00
LEVELS	22.73	26.60	26.71	25.73	25.73	25.73	25.73	26.71	26.60	25.56
OFFSETS	17.75	33.25								
LEVELS	25.56	25.56								

PROJECT TITLE: ICT EXAMPLE CUT AND FILL DATE: 05/10/70 SHEET NO 5/2

OFFSETS AND LEVELS OF POINTS DEFINING STATION CROSS-SECTIONS (OFFSETS FROM NEW CENTRE-LINE). ALL VALUES IN FEET

CHAINAGE: 650.00

TERRAIN										
OFFSETS	-31.50	-18.50	-8.00	0.00	12.75	21.00	31.75			
LEVELS	19.14	19.33	21.62	22.48	26.70	28.99	30.72			
NEW CONSTRUCTION										
OFFSETS	-27.89	-16.00	-10.00	-10.00	0.00	0.00	10.00	10.00	16.00	16.00
LEVELS	18.71	26.64	26.75	25.77	25.77	25.77	25.77	26.75	26.64	25.60
OFFSETS	17.75	31.75								
LEVELS	25.60	25.60								

CHAINAGE: 700.00

TERRAIN										
OFFSETS	-33.25	-19.50	-10.25	0.00	11.01	22.50	30.25			
LEVELS	18.53	19.22	18.28	16.21	20.43	24.81	29.04			
NEW CONSTRUCTION										
OFFSETS	-29.12	-16.00	-10.00	-10.00	0.00	0.00	10.00	10.00	16.00	20.92
LEVELS	18.24	26.99	27.10	26.12	26.12	26.12	26.12	27.10	26.99	23.71

CHAINAGE: 760.00

TERRAIN										
OFFSETS	-33.25	-19.00	-11.50	0.00	9.25	23.50	31.25			
LEVELS	18.55	18.18	17.01	14.32	18.84	22.42	26.81			
NEW CONSTRUCTION										
OFFSETS	-30.41	-16.00	-10.00	-10.00	0.00	0.00	10.00	10.00	16.00	24.04
LEVELS	17.98	27.59	27.70	26.72	26.72	26.72	26.72	27.70	27.59	22.23

CHAINAGE: 800.00

TERRAIN										
OFFSETS	-33.25	-18.75	-12.00	0.00	9.75	24.75	34.50			
LEVELS	17.62	18.04	16.32	15.81	17.22	19.31	24.44			
NEW CONSTRUCTION										
OFFSETS	-32.25	-16.00	-10.00	-10.00	0.00	0.00	10.00	10.00	16.00	27.55
LEVELS	17.15	27.99	28.10	27.12	27.12	27.12	27.12	28.10	27.99	20.28

I . C . T 1 9 0 0 ** C U T A N D F I L L P R O G R A M
(#X2C7/10)

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PROJECT TITLE: ICT EXAMPLE CUT AND FILL

DATE RUN: 05/10/70

VOLUME FORMULA: TRUNCATED CONE

3: LAND AREA AND TOPSOIL QUANTITIES

PROJECT TITLE: ICT EXAMPLE CUT AND FILL DATE: 05/10/70 SHEET NO 1/3

CHAINAGE	LAND AREA AT STN	LAND AREA CUM	TOPSOIL STRIP AREA AT STN	TOPSOIL STRIP AREA CUM	TOPSOIL STRIP VOL AT STN	TOPSOIL STRIP VOL CUM	GRASSING AREA AT STN	GRASSING AREA CUM	TOPSOIL LAYING VOL AT STN	TOPSOIL LAYING VOL CUM
FT	ACRE	ACRE	SY	SY	CY	CY	SY	SY	CY	CY
0.00	0.00	0.00	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0
50.00	0.06	0.06	283.56	283.6	120.88	120.9	125.23	125.2	13.69	13.7
100.00	0.06	0.12	299.33	582.9	104.82	225.7	142.19	267.4	15.63	29.3
150.00	0.06	0.18	294.58	877.5	80.23	305.9	135.40	402.8	14.89	44.2
200.00	0.07	0.25	335.37	1212.8	68.69	374.6	156.35	559.2	17.15	61.4
250.00	0.07	0.32	365.74	1578.6	63.54	438.2	161.09	720.3	17.69	79.1
300.00	0.07	0.39	416.16	1994.7	62.27	500.4	167.52	887.8	18.37	97.4
350.00	0.08	0.47	492.39	2487.1	60.94	561.4	193.75	1081.5	21.31	118.7
400.00	0.08	0.55	518.01	3005.1	50.89	612.3	200.14	1281.7	22.01	140.8
450.00	0.08	0.63	526.37	3531.5	38.98	651.2	197.36	1479.0	21.71	162.5
500.00	0.07	0.71	459.73	3991.2	28.98	680.2	160.11	1639.1	17.50	180.0
550.00	0.07	0.78	388.03	4379.2	30.01	710.2	131.19	1770.3	14.43	194.4
600.00	0.07	0.84	361.48	4740.7	37.82	748.1	129.33	1899.7	14.22	208.6
650.00	0.07	0.91	341.67	5082.4	46.94	795.0	141.02	2040.7	15.48	224.1
700.00	0.06	0.97	314.17	5396.6	49.82	844.8	138.85	2179.6	15.23	239.3
760.00	0.07	1.04	360.72	5757.3	58.04	902.9	162.27	2341.8	17.81	257.1
800.00	0.05	1.09	260.17	6017.4	42.30	945.2	134.26	2476.1	14.74	271.9

I . C . T 1 9 0 0 ** C U T A N D F I L L P R O G R A M
(#X2C7/10)

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PROJECT TITLE: ICT EXAMPLE CUT AND FILL

DATE RUN: 05/10/70

VOLUME FORMULA: TRUNCATED CONE

4: CUT AND FILL VOLUMES (WITH C.F. AND F.F.)

PROJECT TITLE: ICT EXAMPLE CUT AND FILL

DATE: 05/10/70 SHEET NO 1/4

CHAINAGE FT	CUT VOL CY	CUT*CF CY	CUT*FF CY	FILL VOL CY	CUT*FF-FILL CY		CUM CUT CY	CUM CUT*CF CY	CUM CUT*FF CY	CUM FILL CY	CUM CUT*FF-FILL CY	
0.00	0.00	0.00	0.00	750.00	750.00	F	0.0	0.0	0.0	750.0	750.0	F
50.00	0.00	0.00	0.00	522.04	522.04	F	0.0	0.0	0.0	1272.0	1272.0	F
100.00	0.00	0.00	0.00	620.10	620.10	F	0.0	0.0	0.0	1892.1	1892.1	F
150.00	0.00	0.00	0.00	563.63	563.63	F	0.0	0.0	0.0	2455.8	2455.8	F
200.00	82.13	90.34	65.70	310.89	245.19	F	82.1	90.3	65.7	2766.7	2701.0	F
250.00	241.10	265.21	174.18	110.18	64.00	C	323.2	355.5	239.9	2876.8	2637.0	F
300.00	610.77	756.94	432.75	22.98	409.77	C	934.0	1112.5	672.6	2899.8	2227.2	F
350.00	1322.16	1708.69	983.87	0.00	983.87	C	2256.2	2821.2	1656.5	2899.8	1243.3	F
400.00	1899.96	2585.10	1741.55	0.00	1741.55	C	4156.1	5406.3	3398.1	2899.8	498.2	C
450.00	2258.99	3185.36	2404.30	0.00	2404.30	C	6415.1	8591.6	5802.4	2899.8	2902.5	C
500.00	1613.01	2274.87	1794.13	0.00	1794.13	C	8028.1	10866.5	7596.5	2899.8	4696.7	C
550.00	947.22	1277.18	1008.83	0.00	1008.83	C	8975.4	12143.7	8605.3	2899.8	5705.5	C
600.00	616.92	777.01	597.72	14.24	583.48	C	9592.3	12920.7	9203.0	2914.1	6289.0	C
650.00	198.41	233.77	174.86	145.41	29.46	C	9790.7	13154.5	9377.9	3059.5	6318.4	C
700.00	16.69	18.36	13.35	443.30	429.95	F	9807.4	13172.8	9391.2	3502.8	5888.5	C
760.00	0.00	0.00	0.00	862.90	862.90	F	9807.4	13172.8	9391.2	4365.7	5025.6	C
800.00	0.00	0.00	0.00	706.60	706.60	F	9807.4	13172.8	9391.2	5072.3	4319.0	C

I . C . T 1 9 0 0 ** C U T A N D F I L L P R O G R A M
(#X2C7/10)

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PROJECT TITLE: ICT EXAMPLE CUT AND FILL

DATE RUN: 05/10/70

VOLUME FORMULA: TRUNCATED CONE

5: CUT AND FILL VOLUMES (WITHOUT C.F. AND F.F.)

PROJECT TITLE: ICT EXAMPLE CUT AND FILL

DATE: 05/10/70 SHEET NO 1/5

CHAINAGE FT	CUT VOL CY	FILL VOL CY	CUT-FILL CY	CUM CUT CY	CUM FILL CY	CUM CUT-FILL CY
0.00	0.00	750.00	750.00 F	0.00	750.00	750.00 F
50.00	0.00	522.04	522.04 F	0.00	1272.04	1272.04 F
100.00	0.00	620.10	620.10 F	0.00	1892.14	1892.14 F
150.00	0.00	563.63	563.63 F	0.00	2455.77	2455.77 F
200.00	82.13	310.89	228.76 F	82.13	2766.66	2684.53 F
250.00	241.10	110.18	130.91 C	323.23	2876.84	2553.61 F
300.00	610.77	22.98	587.79 C	934.00	2899.82	1965.82 F
350.00	1322.16	0.00	1322.16 C	2256.16	2899.82	643.66 F
400.00	1899.96	0.00	1899.96 C	4156.12	2899.82	1256.30 C
450.00	2258.99	0.00	2258.99 C	6415.12	2899.82	3515.30 C
500.00	1613.01	0.00	1613.01 C	8028.13	2899.82	5128.31 C
550.00	947.22	0.00	947.22 C	8975.36	2899.82	6075.54 C
600.00	616.92	14.24	602.68 C	9592.28	2914.06	6678.22 C
650.00	198.41	145.41	53.00 C	9790.69	3059.47	6731.21 C
700.00	16.69	443.30	426.61 F	9807.38	3502.77	6304.61 C
760.00	0.00	862.90	862.90 F	9807.38	4365.67	5441.71 C
800.00	0.00	706.60	706.60 F	9807.38	5072.26	4735.11 C

I . C . T 1900 ** CUT AND FILL PROGRAM
(#X2C7/10)

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PROJECT TITLE: ICT EXAMPLE CUT AND FILL

DATE RUN: 05/10/70

VOLUME FORMULA: TRUNCATED CONE

6: MATERIAL VOLUMES

PROJECT TITLE: ICT EXAMPLE CUT AND FILL DATE: 05/10/70 SHEET NO 1/6

CHAINAGE	VOLUMES BETWEEN STATION AND PRECEDING STATION					- - - - - - CUMULATIVE VOLUMES - - - - - -				
	MATERIAL	CUT VOL	CUT*CF	CUT*FF	DUMP VOL	MATERIAL	CUT VOL	CUT*CF	CUT*FF	DUMP VOL
FT	NAME	CY	CY	CY	CY	NAME	CY	CY	CY	CY
0.00	NO CUT	----------								
50.00	NO CUT	----------								
100.00	NO CUT	----------								
150.00	NO CUT	----------								
200.00										
	GRAV	82.13	90.34	65.70		PEAT	0.0	0.0	0.0	
	PEAT	0.00	0.00	0.00		GRAV	82.1	90.3	65.7	
	ROCK	0.00	0.00	0.00		ROCK	0.0	0.0	0.0	
	TOTALS	82.13	90.34	65.70	0.00		82.1	90.3	65.7	0.0
250.00										
	GRAV	217.73	239.50	174.18		PEAT	23.4	25.7	0.0	
	PEAT	23.37	25.70	0.00		GRAV	299.9	329.8	239.9	
	ROCK	0.00	0.00	0.00		ROCK	0.0	0.0	0.0	
	TOTALS	241.10	265.21	174.18	23.37		323.2	355.5	239.9	23.4
300.00										
	GRAV	208.55	229.41	166.84		PEAT	212.9	234.1	0.0	
	PEAT	189.50	208.45	0.00		GRAV	508.4	559.3	406.7	
	ROCK	212.72	319.09	265.91		ROCK	212.7	319.1	265.9	
	TOTALS	610.77	756.94	432.75	189.50		934.0	1112.5	672.6	212.9
350.00										
	GRAV	236.44	260.09	189.15		PEAT	662.8	729.1	0.0	
	PEAT	449.95	494.95	0.00		GRAV	744.9	819.3	595.9	
	ROCK	635.77	953.65	794.71		ROCK	848.5	1272.7	1060.6	
	TOTALS	1322.16	1708.69	983.87	449.95		2256.2	2821.2	1656.5	662.8
400.00										
	GRAV	242.81	267.10	194.25		PEAT	1082.1	1190.3	0.0	
	PEAT	419.31	461.24	0.00		GRAV	987.7	1086.4	790.1	
	ROCK	1237.84	1856.76	1547.30		ROCK	2086.3	3129.5	2607.9	
	TOTALS	1899.96	2585.10	1741.55	419.31		4156.1	5406.3	3398.1	1082.1

PROJECT TITLE: ICT EXAMPLE CUT AND FILL DATE: 05/10/70 SHEET NO 2/6

CHAINAGE	VOLUMES BETWEEN STATION AND PRECEDING STATION					- - - - - - CUMULATIVE VOLUMES - - - - - -				
	MATERIAL	CUT VOL	CUT*CF	CUT*FF	DUMP VOL	MATERIAL	CUT VOL	CUT*CF	CUT*FF	DUMP VOL
FT	NAME	CY	CY	CY	CY	NAME	CY	CY	CY	CY
450.00										
	GRAV	269.16	296.08	215.33		PEAT	1320.8	1452.9	0.0	
	PEAT	238.66	262.52	0.00		GRAV	1256.8	1382.5	1005.5	
	ROCK	1751.18	2626.76	2188.97		ROCK	3837.5	5756.3	4796.9	
	TOTALS	2258.99	3185.36	2404.30	238.66		6415.1	8591.6	5802.4	1320.8
500.00										
	GRAV	287.35	316.09	229.88		PEAT	1395.0	1534.6	0.0	
	PEAT	74.27	81.69	0.00		GRAV	1544.2	1698.6	1235.3	
	ROCK	1251.40	1877.09	1564.24		ROCK	5088.9	7633.4	6361.1	
	TOTALS	1613.01	2274.87	1794.13	74.27		8028.1	10866.5	7596.5	1395.0
550.00										
	GRAV	342.13	376.35	273.71		PEAT	1412.0	1553.2	0.0	
	PEAT	16.99	18.69	0.00		GRAV	1886.3	2074.9	1509.1	
	ROCK	588.10	882.14	735.12		ROCK	5677.0	8515.5	7096.3	
	TOTALS	947.22	1277.18	1008.83	16.99		8975.4	12143.7	8605.3	1412.0
600.00										
	GRAV	362.82	399.10	290.25		PEAT	1420.2	1562.2	0.0	
	PEAT	8.13	8.95	0.00		GRAV	2249.1	2474.0	1799.3	
	ROCK	245.98	368.96	307.47		ROCK	5923.0	8884.5	7403.7	
	TOTALS	616.92	777.01	597.72	8.13		9592.3	12920.7	9203.0	1420.2
650.00										
	GRAV	157.93	173.72	126.34		PEAT	1421.8	1564.0	0.0	
	PEAT	1.66	1.83	0.00		GRAV	2407.1	2647.8	1925.6	
	ROCK	38.82	58.22	48.52		ROCK	5961.8	8942.7	7452.2	
	TOTALS	198.41	233.77	174.86	1.66		9790.7	13154.5	9377.9	1421.8
700.00										
	GRAV	16.69	18.36	13.35		PEAT	1421.8	1564.0	0.0	
	ROCK	0.00	0.00	0.00		GRAV	2423.7	2666.1	1939.0	
						ROCK	5961.8	8942.7	7452.2	
	TOTALS	16.69	18.36	13.35	0.00		9807.4	13172.8	9391.2	1421.8
760.00	NO CUT	----------								
800.00	NO CUT	----------								

I . C . T 1 9 0 0 ** C U T A N D F I L L P R O G R A M
(#X2C7/10)

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PROJECT TITLE: ICT EXAMPLE CUT AND FILL

DATE RUN: 05/10/70

VOLUME FORMULA: TRUNCATED CONE

7: CROSS-HAUL VOLUMES

PROJECT TITLE: ICT EXAMPLE CUT AND FILL DATE: 05/10/70 SHEET NO 1/7

CHAINAGE FT	CROSS-HAUL AT STATION CY	CUMULATIVE CROSS-HAUL CY	TOTAL CROSS-HAUL CY
NO CROSS-HAUL			
200.00	65.70	65.7	
250.00	110.18	175.9	
300.00	22.98	198.9	198.9
NO CROSS-HAUL			
600.00	14.24	14.2	
650.00	145.41	159.7	
700.00	13.35	173.0	371.9
NO CROSS-HAUL			

I . C . T 1900 ** C U T A N D F I L L P R O G R A M
(#X2C7/10)

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PROJECT TITLE: ICT EXAMPLE CUT AND FILL

DATE RUN: 05/10/70

VOLUME FORMULA: TRUNCATED CONE

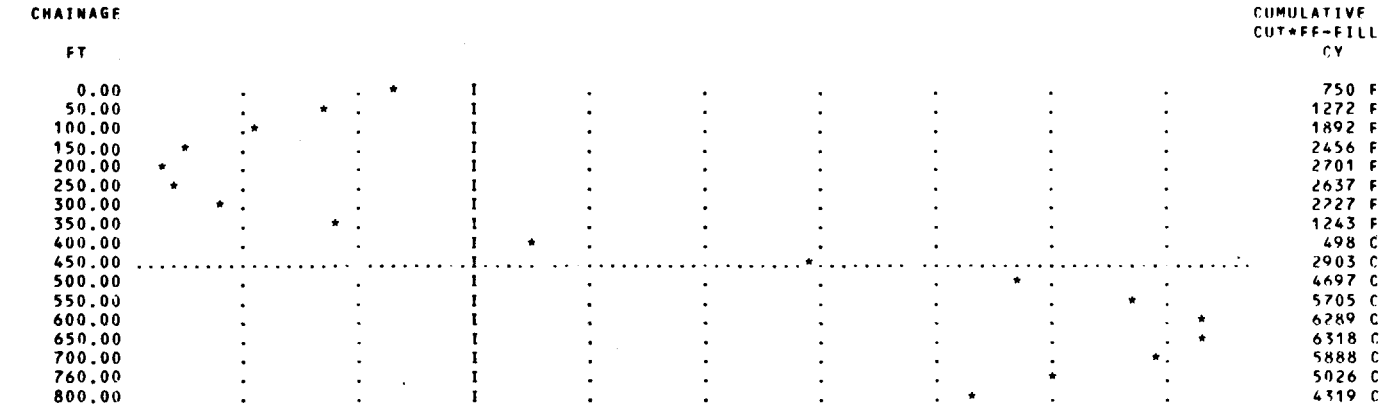
8: MASS-HAUL DIAGRAM

PROJECT TITLE: ICT EXAMPLE CUT AND FILL

DATE RUN: 05/10/70 SHEET 8

MASS HAUL DIAGRAM CHAINAGE (VERT AXIS) V. AMENDED CUMULATIVE VOLUME OF CUT TIMES FILL FACTOR MINUS FILL (HORIZ AXIS)

HORIZONTAL SCALE : ONE INCH REPRESENTS 1000 CY



CHAINAGE FT	CUMULATIVE CUT*FF-FILL CY	
0.00	750	F
50.00	1272	F
100.00	1892	F
150.00	2456	F
200.00	2701	F
250.00	2637	F
300.00	2227	F
350.00	1243	F
400.00	498	C
450.00	2903	C
500.00	4697	C
550.00	5705	C
600.00	6289	C
650.00	6318	C
700.00	5888	C
760.00	5026	C
800.00	4319	C

I . C . T 1 9 0 0 ** C U T A N D F I L L P R O G R A M
(#X2C7/10)

****

PROJECT TITLE: ICT EXAMPLE CUT AND FILL

DATE RUN: 05/10/70

VOLUME FORMULA: TRUNCATED CONE

9: INPUT DATA

PROJECT TITLE: ICT EXAMPLE CUT AND FILL DATE: 05/10/70 SHEET NO 9

BRITISH UNITS

GRADE DATA

CHAINAGE	LEVEL	LENGTH OF CURVE
0.00	30.00	0.00
200.00	32.00	210.00
600.00	26.20	200.00
800.00	28.20	0.00

MATERIALS DATA

NAME	CUT FACTOR	FILL FACTOR	SLOPE
TOPS	1.10	0.80	0.667
PEAT	1.10	0.00	0.667
GRAV	1.10	0.80	0.667
ROCK	1.50	1.25	4.000

TYPICALS DATA

NO. 1

OFFSETS	0.00	10.00	10.00	16.00	16.00	17.75
LEVELS	-1.08	-1.08	-0.10	-0.21	-1.25	-1.25

NO. 2

OFFSETS	0.00	10.00	10.00	16.00
LEVELS	-1.08	-1.08	-0.10	-0.21

PROJECT TITLE: ICT EXAMPLE CUT AND FILL DATE: 05/10/70 SHEET NO 9

STATION DATA

CHAINAGE= 0.00 STATION NAME: S1 GRADE LEVEL= 30.00 (INPUT)

TOPT=	0.50	TXWD=	0.00	RSDP=	0.33	RSDS=	0.33	RXWD=	0.00	FLFT=	0.00	FRHT=	0.00
CLIN=	0.00	BWCT=	0.00	BVCT=	0.00	BHCT=	0.00	BWFL=	0.00	BVFL=	0.00	BHFL=	0.00

SIDE SLOPE IN CUT HEIGHT
0.000 0.00

SIDE SLOPE IN FILL HEIGHT
0.667 0.00

HEIGHT DEPENDENT IN CUT

HEIGHT DEPENDENT IN FILL

TYCL= 1 TYCR= 1 TYFL= 2 TYFR= 2

BREAK OCCURS

ALND=	0.00	ASEE=	0.00	ATOP=	0.00	VTOP=	0.00	VTRE=	0.00	VFIL=	750.00	VCUT=	0.00

TERRAIN DATA

OFFSETS	-27.25	-21.00	-9.50	0.00	8.00	19.50	28.40
LEVELS	26.10	26.60	24.85	24.31	23.90	25.30	26.32

STRATA DATA PARALLEL

BOREHOLE AHEAD: CHAINAGE = 175.00 GROUND LEVEL = 28.60
TOPS/GRAV 28.00 GRAV/PEAT 15.50 PEAT/ROCK 15.00

BOREHOLE BEHIND: CHAINAGE = 0.00 GROUND LEVEL = 24.31
TOPS/GRAV 22.90 GRAV/PEAT 13.63 PEAT/ROCK 13.63

PROJECT TITLE: ICT EXAMPLE CUT AND FILL DATE: 05/10/70 SHEET NO 9

STATION DATA

CHAINAGE= 50.00 STATION NAME: S2 GRADE LEVEL= 30.50 (COMPUTED)

TOPT=	0.50	TXWD=	0.00	RSDP=	0.33	RSDS=	0.33	RXWD=	0.00	FLFT=	0.00	FRHT=	0.00
CLIN=	0.00	BWCT=	0.00	BVCT=	0.00	BHCT=	0.00	BWFL=	0.00	BVFL=	0.00	BHFL=	0.00

SIDE SLOPE IN CUT	HEIGHT
0.000	0.00

SIDE SLOPE IN FILL	HEIGHT
0.667	0.00

HEIGHT DEPENDENT IN CUT

HEIGHT DEPENDENT IN FILL

TYCL= 1 TYCR= 1 TYFL= 2 TYFR= 2

TERRAIN DATA

OFFSETS	-29.50	-18.40	-8.00	0.00	9.50	20.00	29.50
LEVELS	22.30	23.45	23.70	22.90	23.10	24.90	26.30

STRATA DATA PARALLEL

BOREHOLE AHEAD: CHAINAGE = 175.00 GROUND LEVEL = 28.60

TOPS/GRAV	28.00	GRAV/PEAT	15.50	PEAT/ROCK	15.00

BOREHOLE BEHIND: CHAINAGE = 0.00 GROUND LEVEL = 24.31

TOPS/GRAV	22.90	GRAV/PEAT	13.63	PEAT/ROCK	13.63

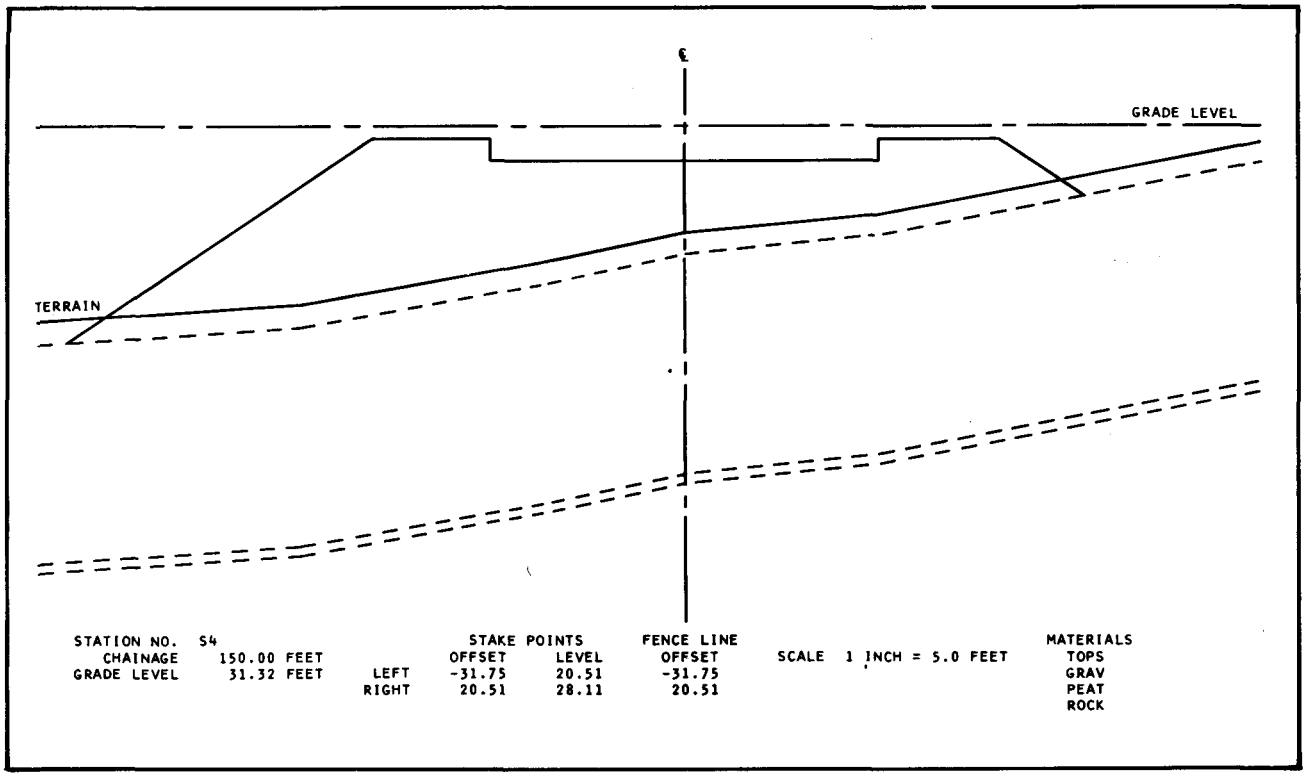


Figure 17 Cross-section in Fill

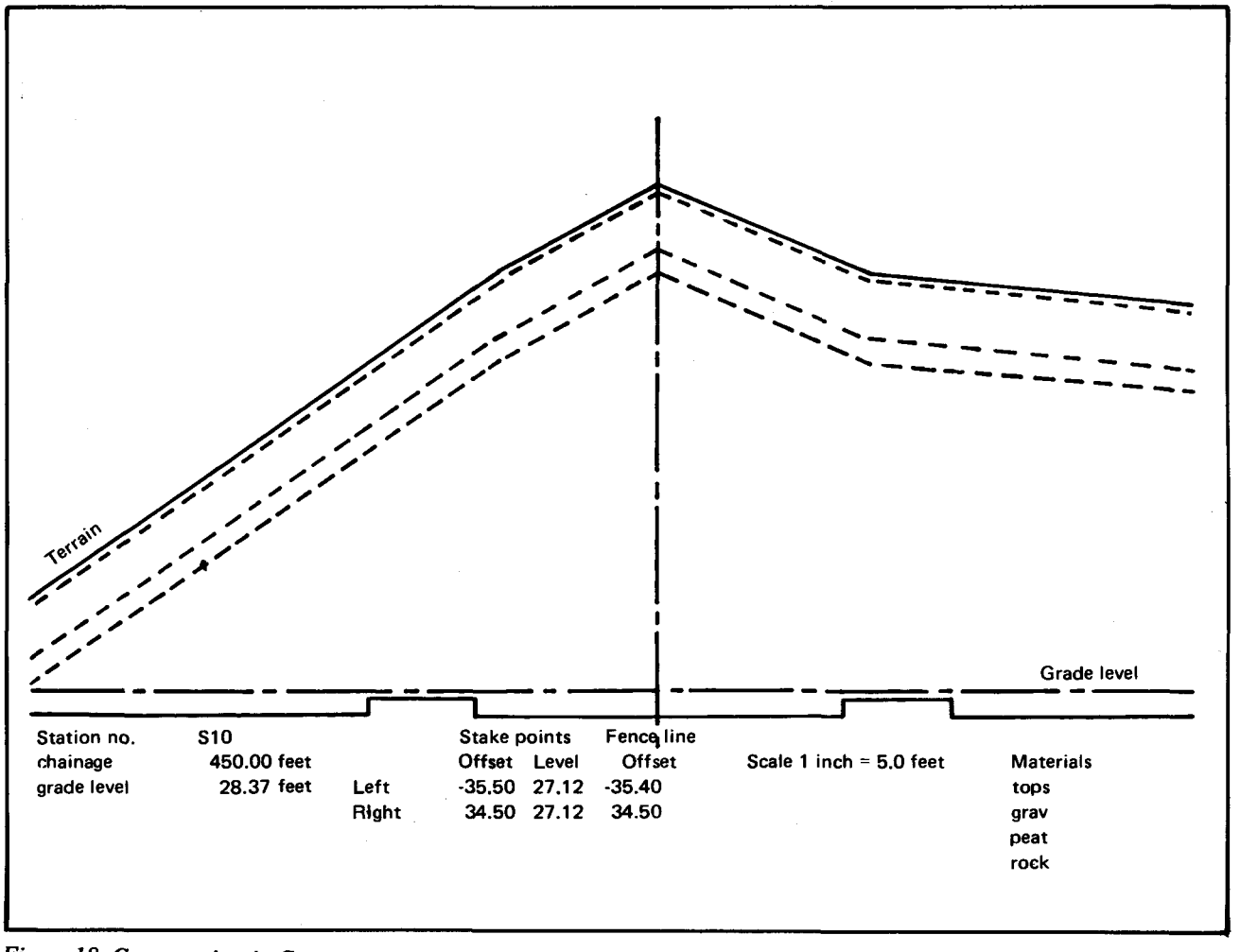


Figure 18 Cross-section in Cut

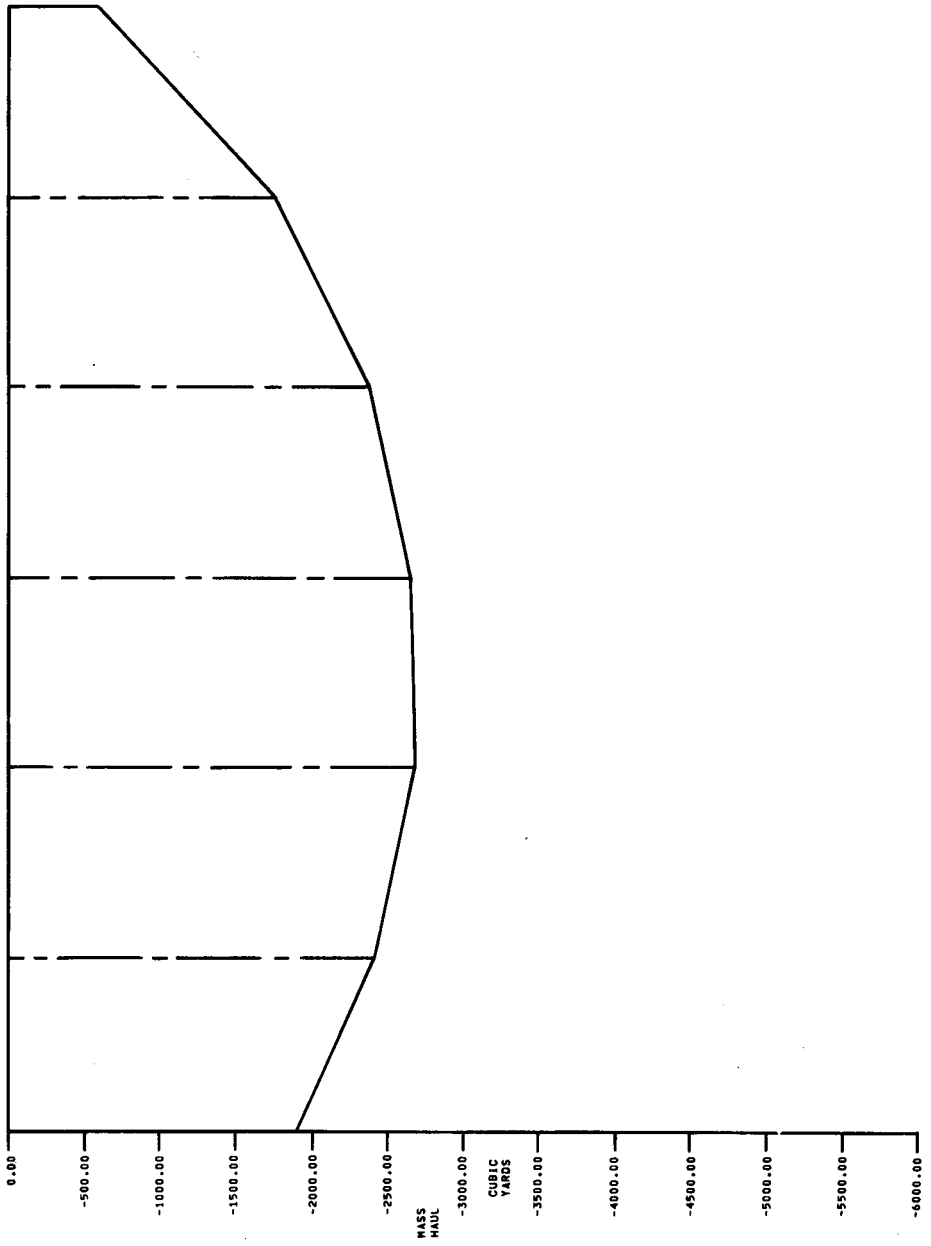


Figure 19 Mass Haul diagram

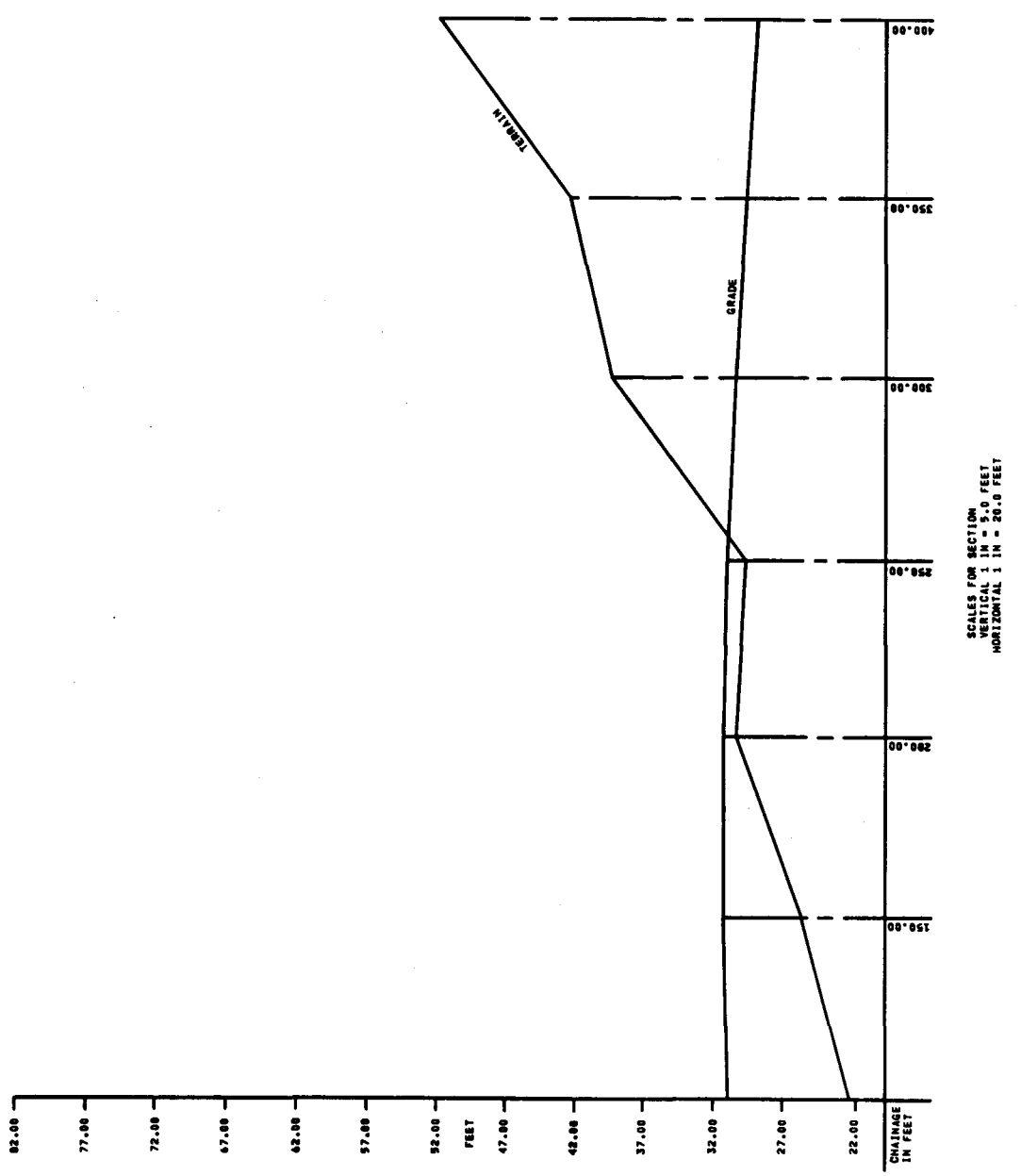


Figure 20 Longitudinal sections

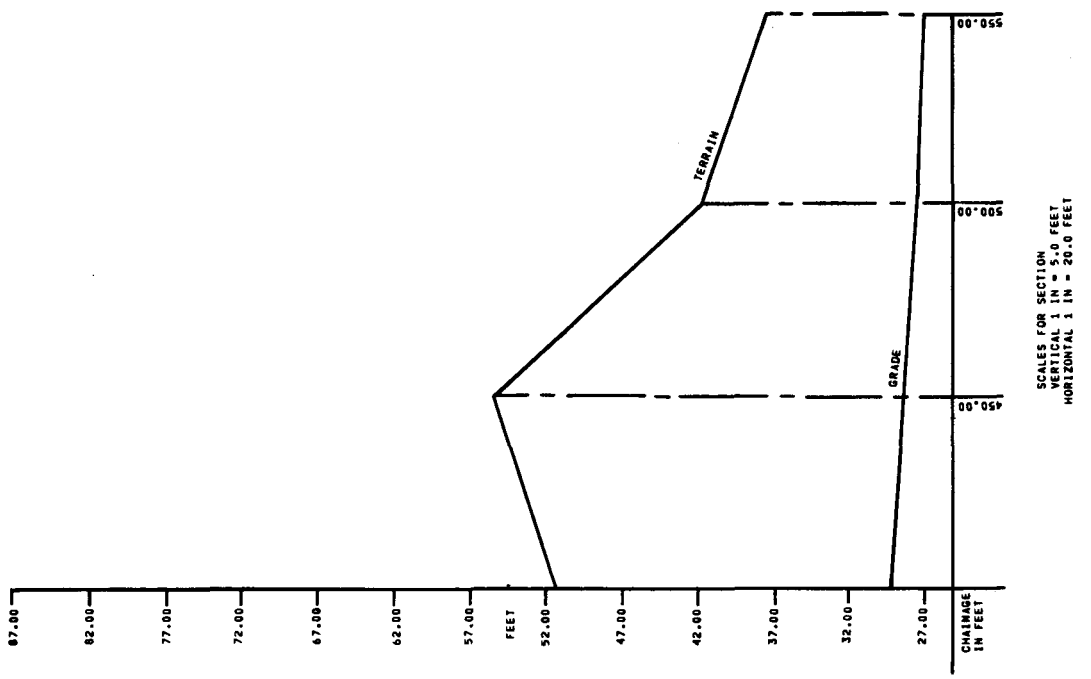


Figure 21 Longitudinal sections

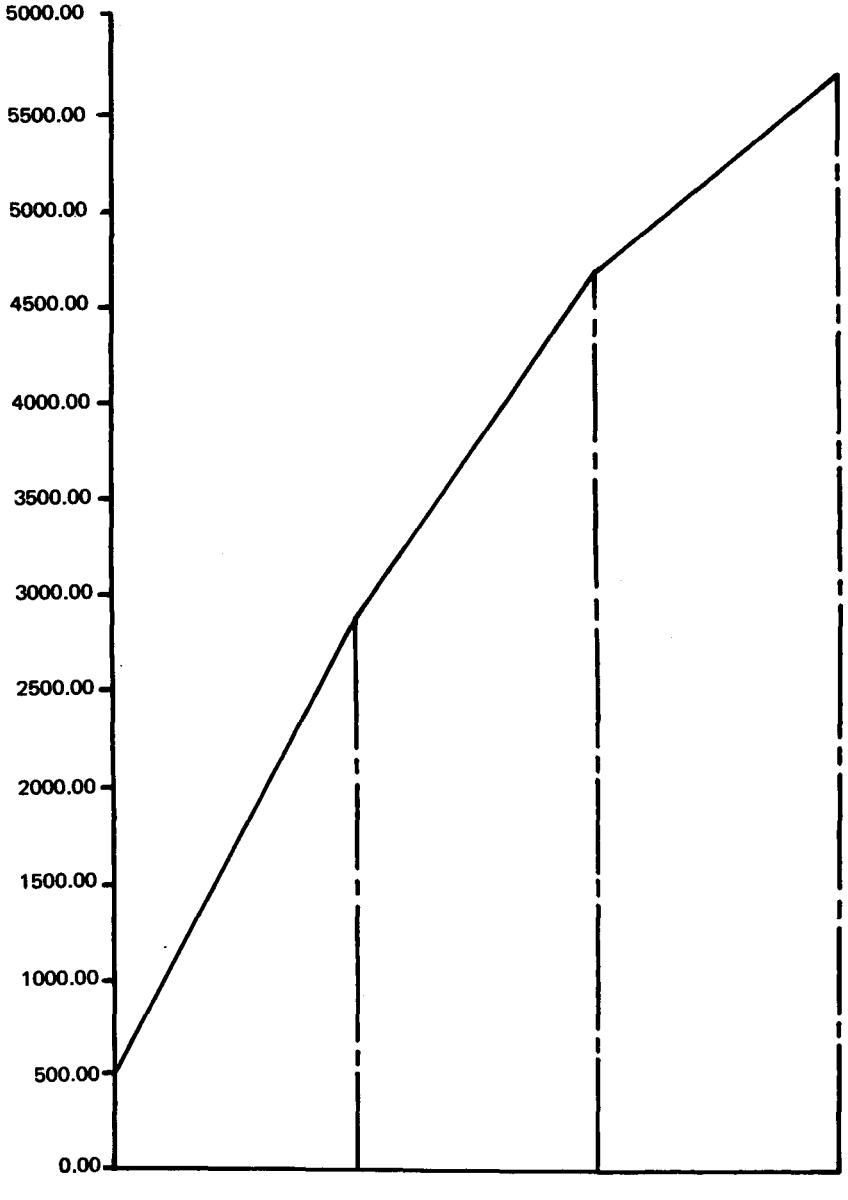


Figure 22 Longitudinal sections

Index

Amendment record

Should any additions or amendments to this Manual be necessary, they will be issued in the form of Amendment Lists.
When such changes have been incorporated, an appropriate entry should be made in the table below and the pink instruction sheet(s) should be filed behind this page.

List number	Item number
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4	5 to 8
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