Single Context Planning and the Computer - The Plan Database.

Bryan Alvey and Jonathan Moffett

Institute of Archaeology, London

ABSTRACT

This article demonstrates the ways in which single context plans can be captured by a computer, and their use in reconstructing phase plans for archive or publication. A single context plan database ,currently under development by the authors at the Institute of Archaeology, London, is outlined, which provides a user-friendly means of storage and retrieval.

1. Introduction

Much work has taken place in recent years on the methods by which information from archaeological sites can be recorded and manipulated using the computer. Most of the research has concentrated on how best to load written information onto a database. Archaeological data, however, comes in both written, graphic and photographic forms, and this paper seeks to indicate ways in which the graphic forms of archaeological data might best be recorded by the computer, and sets out some examples of how this information might be used. The paper will consider only on-site information, that is the graphic data that is recorded on the site as plans, sections etc. and in particular the means of reconstructing plans using the computer. It should be noted that the potential for storing other forms of graphic information, such as small find drawings, also has much potential (Main, 1978).

2. The Single Context Plan and its Predecessors

Over the past ten years there have been some notable advances made in site recording techniques (Barker, 1982). Often these have involved attempts to eradicate on-site subjective decisions from the analysis of a particular archaeological assemblage, and to provide a set of data from many sites in a standardised form which lacks statistical or subjective bias, and enables a more scientific approach and more meaningful comparisons between sites to take place. Notable among these advances has been the use and application of the Harris Matrix (Harris, 1979).

A Harris matrix is shown in Fig. 1, and resembles a hierarchy or tree diagram. The lines connecting the units represent stratigraphic relationships, and provide the analyst with an objective display of the sequence of depositions that make up the series of events through time. From this display the archaeologist attempts to group events together in phases or periods to highlight sequences of continuity and change in order to establish the pattern of development of the site by man. A more recent development along these lines is the diagram developed by Dalland (Dalland, 1984).

Both these techniques use the single context plan as an on-site recording technique to provide the evidence of a stratigraphic relationship between contexts. This is accomplished by plan overlay and enables the matrix to be constructed as an automatic procedure as the excavation progresses.

The single context plan is a development of earlier planning techniques. A common recording practice before the single context plan was the composite plan, a procedure that at the time of writing is still used widely by archaeologists in this country. A more detailed analysis of the composite plan is given in Harris (1979) but a brief description of its character and its defects is as follows.

The composite plan is an interpretation of the site that is thought to represent a particular "phase" or "period", i.e. a point in time that may be considered meaningful in the development of the site (see Fig. 2). The method's main advantage is that it shows all the layers that are exposed during a period of activity, and is easily understood by the analyst, and indeed by the general public. The disadvantages of the method are firstly that the plan must be drawn at the time of excavation when the particular combination of contexts that form the "period of activity" are exposed. This requires the decision to plan to be taken when the planner does not have all the information available to him (such as changes in pottery or bone distribution). Secondly, in drawing the entire surface at specific levels, the method assumes that only those parts of the contexts that form part of the general surface are worth recording. Thirdly, the excavator is required to excavate and make decisions from the latest point in time to the earliest, whereas the site develops from the earliest context to the latest. When this method of drawing is used, the analyst tends to restrict his graphic portrayal of the evidence by the few composite plans available to him, which post excavation may show does not necessarily represent the most important periods. Harris (op cit:69) notes of composite plans that "there is a great tendency for the recorded ...(composite).. plan to become the final 'phase' or 'period' plan and to be published as the same."

The advantages of the single context plan are numerous: the stratigraphic relationships of contexts can be tested in post excavation, by the use of overlays, and phase plans can be reconstructed from the earliest layers upwards. Harris notes that the single context plan is "a basic requirement for archaeological stratigraphy"(ibid:79). However, the present use of single context plans by archaeologists usually culminates, at least at archive level, in a display of each phase or period of a site that consists only of those contexts that were deposited during that period of activity and neglects to add all contexts from previous periods or phases that were exposed when such depositions took place. Whilst a representation similar to the composite plan is perfectly possible from single context plans, the process involves a laborious overlay of numerous plans for a successful output. This drawback has resulted in the production of plans less easily understood by the layman, and a disinclination on the part of the practising archaeologist to adopt the new method.

The procedure set out below overcomes all the disadvantages of the single context plan through the use of a single context plan database.

3. The Single Context Plan Database

The database is currently under development at the Institute of Archaeology, London. It is designed to allow all of the single context plans from a site to be stored in a computer readable form so that they can be drawn on a graphics screen at any scale in the order required by the analyst, thus allowing a large number of plans to be considered in a composite plan form. The program consists of two major parts: a) an input and checking/editing program and b) a retrieval program. A third main element, an interface with a commercial database system, is to be developed.

The system uses the most common form of site recording of single context plans in use in the United Kingdom at the time of writing - a form adopted by such units as the Department of Urban Archaeology, the Museum of London (who have a detailed published account of this procedure (Museum of London, 1980)), The York Archaeological Trust and by such overseas groups as the Programa de Antropologia para el Ecuador. A short description of this is given below:

The site is split into grid squares of 4 or 5 metres. This allows the excavator to overlay his plans of each grid conveniently in an A4 or foolscap folder when such plans are drawn at a scale of 1:20. By the end of the excavation a folder of each grid exists which contains every layer encountered in that grid area from natural subsoil to topsoil.By using preformatted sheets of drafting film, a relationship can be tested quickly by overlay and the matrix constructed. It should be noted here that the grid implies no restriction of excavation - should a layer that is to be removed cover more than one grid, then 2 or more plan sheets are used for that context and placed in the relevant folder for each square. The removal of each context is automatic: when a context can be seen in its entirety it can be drawn and removed; when the context plan is overlaid onto previous plans of that grid square, a relationship is noted where previous contexts overlap the area of the context under excavation.

The method follows a strict procedure, using standard codes and symbols to denote different aspects of the context under excavation. For example, the position of a slope is noted by a hachure; the small find locations by triangles; the limit of excavation by, say, a dashed line, and the limit of a context by an unbroken line. In this way other archaeologists are able to "read" this set of symbols in order to understand the nature of the context. All plans are orientated to N according to the site grid.

4. The Plandata System

This is a suite of programs written in Pascal and initially developed on a Z80 based microcomputer, linked to an Autograph XK-1 graphics terminal and a TDS LC 20 (20" x 20") digitiser. The graphics terminal emulates a Tektronix 4014 graphics terminal. The procedures controlling the graphics are written in GKS (Hopgood, et al, 1983). This enables the system to transported relatively easily to other computers and other graphics terminals and digitisers, and the authors are currently implementing it on an IBM PC/AT. There are six programs in all, with two principal functions, input and retrieval. It is possible to edit a plan immediately after it has been digitised, and it is possible to make "cosmetic" corrections to any retrieved display, but it is not possible to modify a plan once it has been stored.

Currently, all the plans are stored in individual files. The average size is about 10 to 15 Kilobytes, although they can be as small as 2K or as large as 36K.

5. The Input Program

The input program is interactive with the user and runs both from a digitiser and the keyboard to the computer. As with the manual system described above, information regarding the position of the plan within the site grid (ie the grid square) is noted, as is the scale of the plan. The context number too is stored before digitising can take place. The format of the screen, and of the eventual output is shown opposite (Fig. 3) from test data. Eleven different symbol types have been noted as necessary for the coding of each plan. These include:

1) The limits of the context (exterior) - a continuous line. This is the line type that is used to define the limits of a context, and is the one most often in use. It can however only be used to show the exterior limits of a context: should an area within the exterior limits of a context be seen, such as a patch of erosion that exposes part of the context below, or a mound which forms part of the context below (see the illustration opposite (Fig. 3)), then a different line type 2) must be used.

2) The limits of the context (interior) - a continuous line. This line type appears the same as that above to the user, but is differentiated from that above by its use in the shading procedure noted below in the retrieval system. Often in on-site records the interior context limits and the limits of internal features such as stones can be easily confused as the same line type is used (usually continuous) in each case.

3) The limits of internal features (1) - a dashed line. This line type is used for "whole" internal features such as stones, wood, pot frags etc., that have discrete areas. Using this line type allows a visual distinction to be made between internal limits of a context and internal features. This distinction is necessary

also in the shading procedure noted below.

4) The limits of internal features (2) - a dashed line. This line type is used for anomalous lines, such as creases in the ground or bases of slopes etc., and differs from the line type above in that the lines do not necessarily form a whole. Again this distinction may not be necessary for the user, and is not seen by him; the fact that the lines do not join shows that it cannot be a stone. The computer however will need this differentiation when shading is employed.

5) The limit of excavation - a long dashed line. This line type is used to determine the edge of a context which continues beyond the limit of excavation. This line therefore also shows the edge of excavation or trench section.

6) The plan edge of a context - a dotted line. This line type is used to show that a context extends beyond the grid square being drawn; to discover the true extent of the context, a further plan from another grid square will need to be consulted. An example of this appears in Fig. 3; in this case the context continues to the north and the grid square to the north will need to be consulted. A check is present here: should more than one plan exist of a context due to its extent over more than one grid square, then a suffix should be added to the plan context number to provide a unique number for the plan. In this way, the plan in Fig. 3 has been numbered 123A, whilst other plans of context 123 have the suffix B,C,D etc. When this line type is employed, a check is made on the original input for the plan number and ,if absent, is requested at this point.

7) The SF number - a triangle with the small find number next to it. This option is used where the exact location of a small find is required to be shown on plan; the small find symbol used here is a triangle and the "apex" of the triangle shows the exact point of the small find location. The number of the small find is then requested by the computer and drawn next to the triangle.

8)The level - an Ordnance Survey level symbol and the height above. This option shows the level of the ground at any point, and following the convention of most archaeological planning procedures, draws the Ordnance Survey level symbol, requests the level, and draws it above.

9)The Hachure - a triangle from whose apex extends a line perpendicular to the triangle's base. This option again follows the standard archaeological procedures for denoting slopes. In this case two points of the digitiser show the top and bottom of a slope and the hachure is drawn between (see Fig. 3).

10) The Context Number - text. This option allows the user to define the point at which the context number should be drawn. The context number appears at a larger size than other text included on the plan (such as small find numbers and levels)

11) The Postulated context area edge - dot dash. This is an additional context outline that should be used when a special form of context is encountered: as a single context outline is always required for the computer overlay, this type is employed where a single line is not used by the original planners, e.g. in stone spreads and skeletons. In each of these cases, this line type is used for a context edge and the details of the stones and bones, which hitherto had themselves formed the edge of the context, are drawn inside it.

The procedure is menu driven, user-friendly, and requires no computer experience for its operation. In the authors' experience the system is much faster for archaeological plan data than any other commercial program. As can be seen from Fig. 3, the output resembles in most respects the conventional single context plan that has been drawn manually on site, and any changes derive from minor differences in symbol codes or a greater refinement of line types.

6. Editing and Checking

Once a plan has been stored on the computer using the input program, the user is given the option of editing the plan to remove any mistakes. This can only be done immediately after input, when the plan is still on the digitiser. With the main context outline the operator is only allowed to remove "kinks", but other data can be added or deleted, or in the case of labels, moved.

7. The Retrieval System

There are three retrieval options. The first allows the operator to call up a plan, and then overlay it with others. The display area is decided by the first plan. The second option allows the user to specify an area and then to call up plans for display in that area. In both of the above options the user is allowed to store the sequence of plans called. The third option allows a repetition of the stored sequence. Some examples of display are shown in figures 4,5 and 6 (It should be noted that although figures 5 and 6 are drawn from real data (from a site in York), no references could be made to the matrix of this site and they have therefore been overlaid arbitrarily to produce these examples).

Prior to the display of the first plan, the user is shown a menu allowing a specification of features to be displayed. Thus it is possible to have all the data shown, or just a part, such as all the find spots only or simply the context outlines.

8. Conclusions and Future Developments of Plandata

The main use of this system is currently that of a terminal tool. Screen dumps are the only method of producing hard copies. The next important step in the systems development is the use of hidden line removal to allow composite plans to be sent to a plotter.

A further development is for procedures to enable the shading of a context to indicate some attribute of that context, such as an aspect of soil type, or the frequency of pottery types etc. A third development is the creation of a program to convert the format of the datafiles to one that can be displayed using a commercial 3D CAD system. It is felt that the 3D package could be used to produce a 3D graphic display of the contexts in their correct position on the ground on the x and y axes, with the third dimension determined by their stratigraphic position in the hierarchy. This 3D model could then be redrawn for viewing at any angle, shaded to display any aspect of the contexts, and manipulated for interpretation. For a more detailed discussion on the use of 3D systems for looking at the stratigraphical matrix see Alvey (in prep).

This system has the potential for drastically reducing the time spent by archaeologists in the manipulation of single plan data, and allows the most flexible system for composite plan construction and manipulation. Future developments will allow attributes of contexts to be viewed in plan form and for a 3D model to be constructed that will not only show stratigraphic relationships, but also attributes by shading and the shapes of the contexts under investigation.

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References

Alvey, B A P; (in prep).
Beyond the Harris Matrix: 3D applications of a single context plan database.

Barker, P; 1982.
Techniques of Archaeological Excavation. (2nd edition) London: Batsford.

Dalland, M; 1984.
"A Procedure for use in Stratigraphical Analysis", in Scottish Archaeological Review Vol. 3, part 2 1984 116 -127.

Harris, E; 1979.
The Principles of Archaeological Stratigraphy. London: Academic Press.

Hopgood, F R A, Duce, D A, Gallop, J R and Sutcliffe, D C; 1983.
Introduction to the Graphical Kernal System: GKS. London: Academic Press.

Main, P; 1978.
"The Storage, Retrieval and Classification of Artefact Shapes", in Computer Applications in Archaeology, 1978, 39-

48.

The Museum of London; 1980.
Site Manual Part 1: The Written Record. London: Museum of London.

Redknap, M and Millett, M; 1980
"Excavations on a Romano British Farmstead at Elstead, West Sussex", in Sussex Archaeological Collections Vol. 118 1980 197-229.

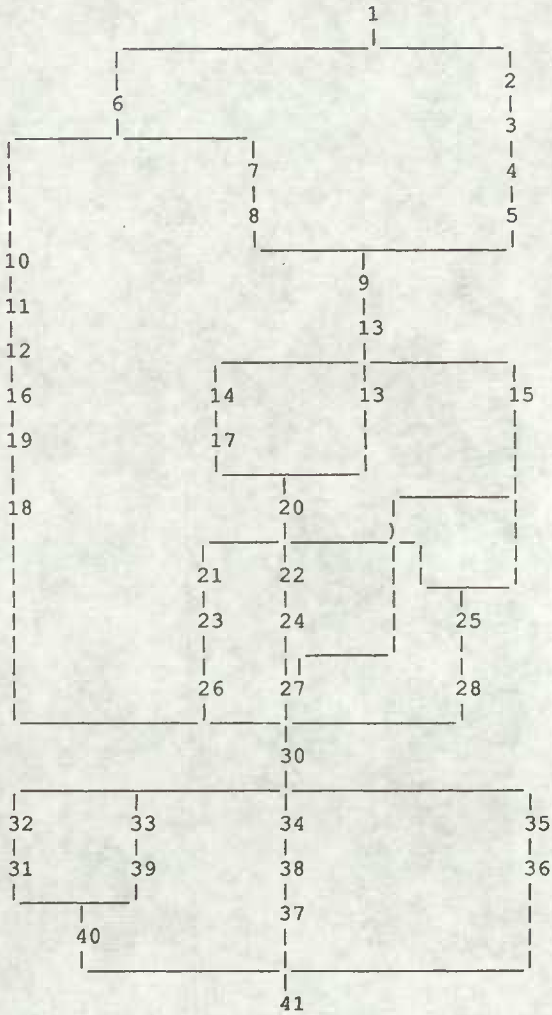

Fig 1. A test representation of a Harris Matrix.

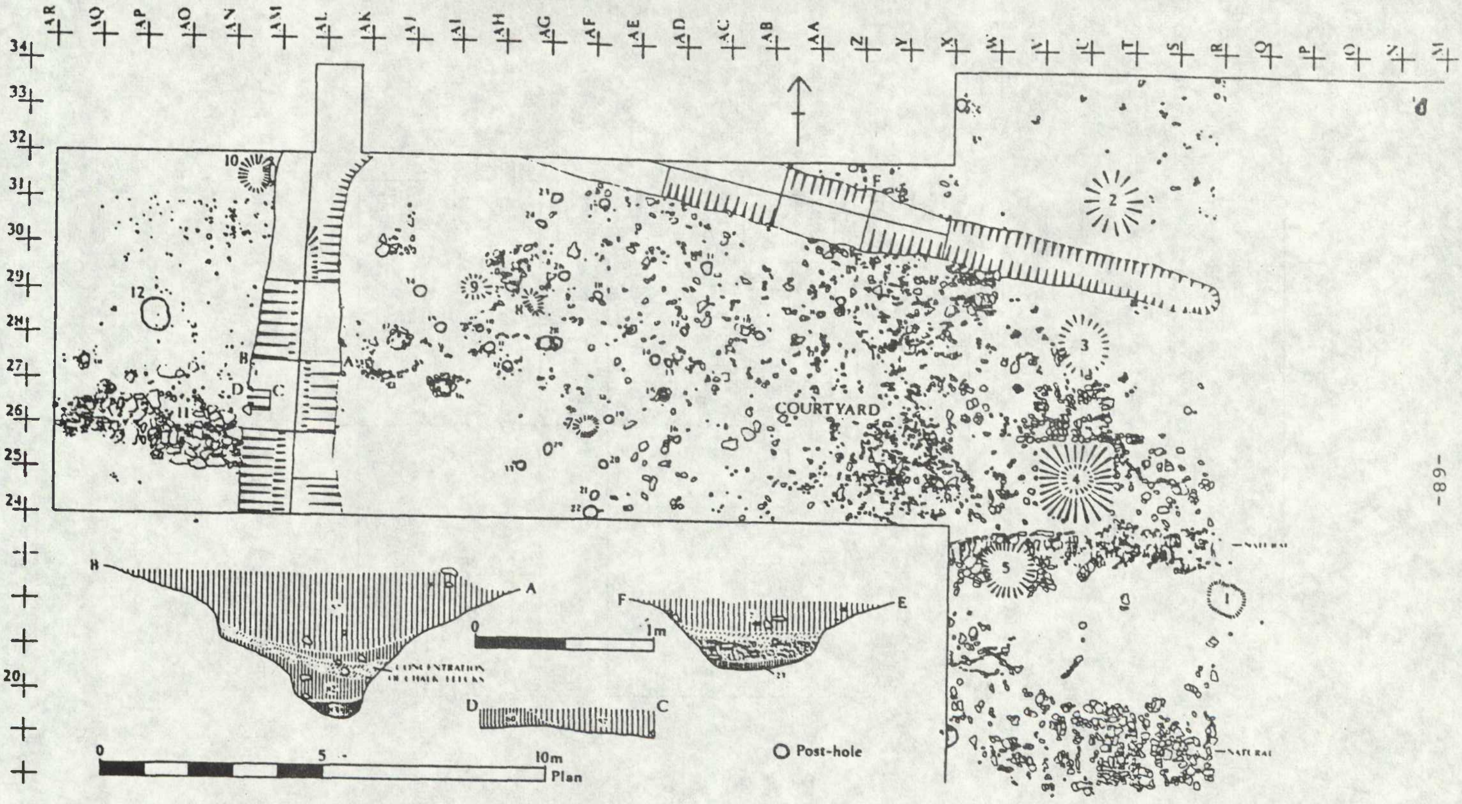

Figure 2: An example of a composite plan (from Redknap and Millett 1980, p. 204).

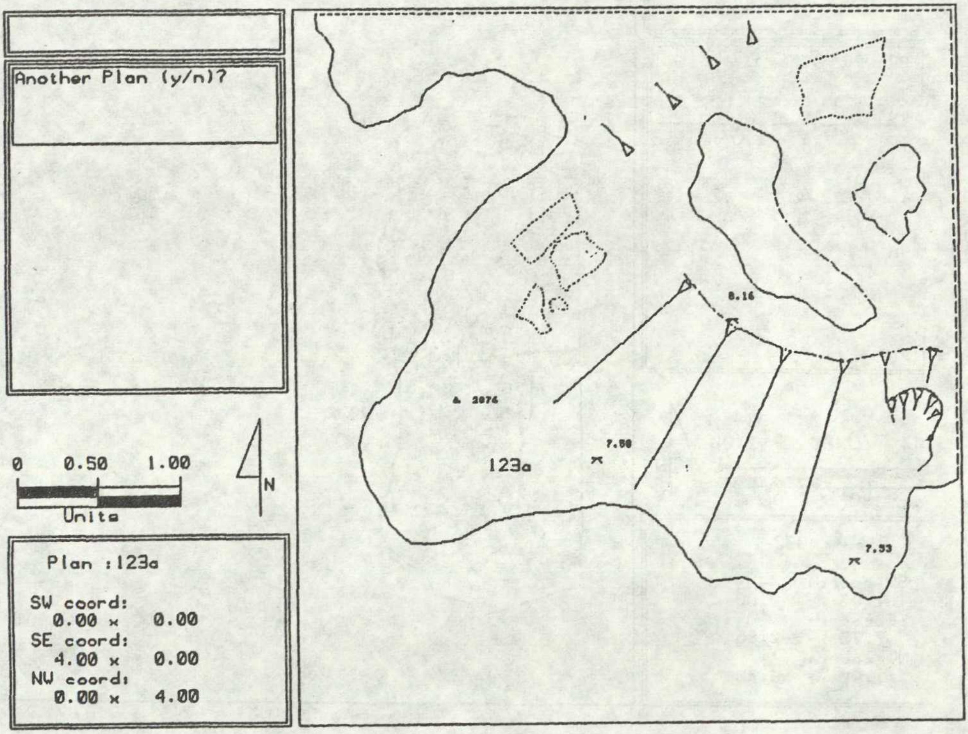

Fig 3. A single context plan output from 'PLANDATA' constructed from test data.

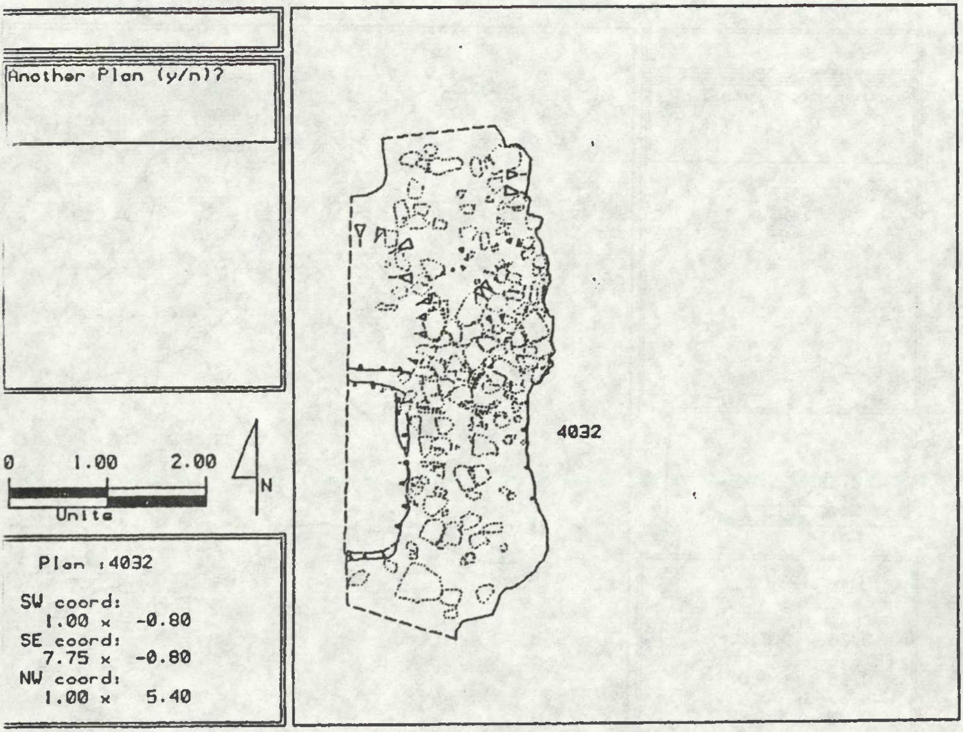

Fig 4. A single context plan (no. 4032), without levels, from an excavation in York using 'PLANDATA'

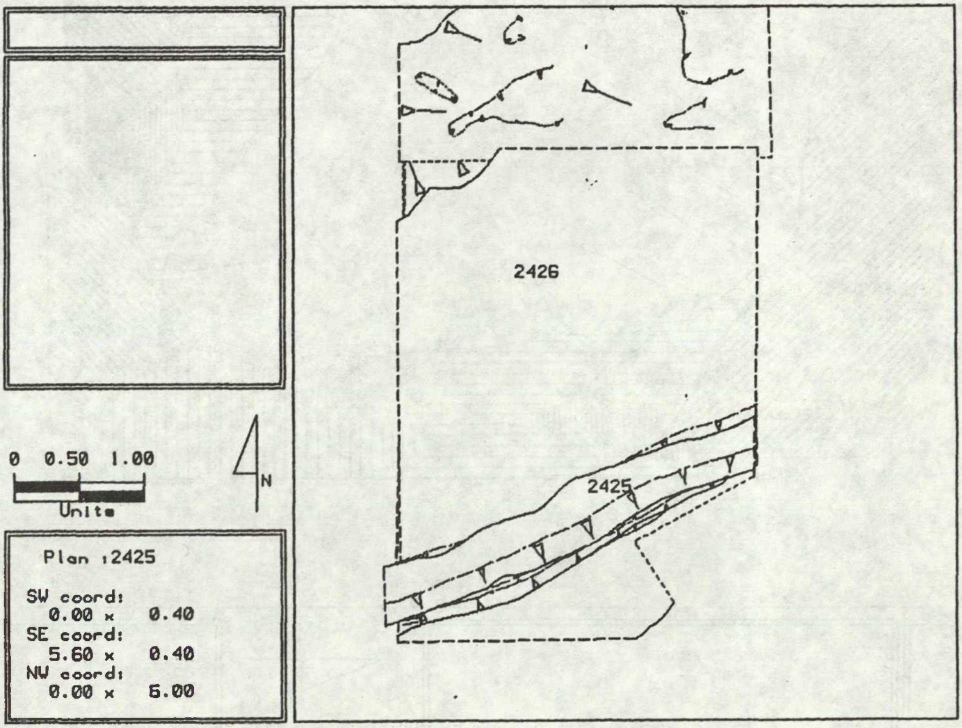

Fig 5. A composite plan, without levels, constructed from single context plan data from a York excavation, using 'PLANDATA'.

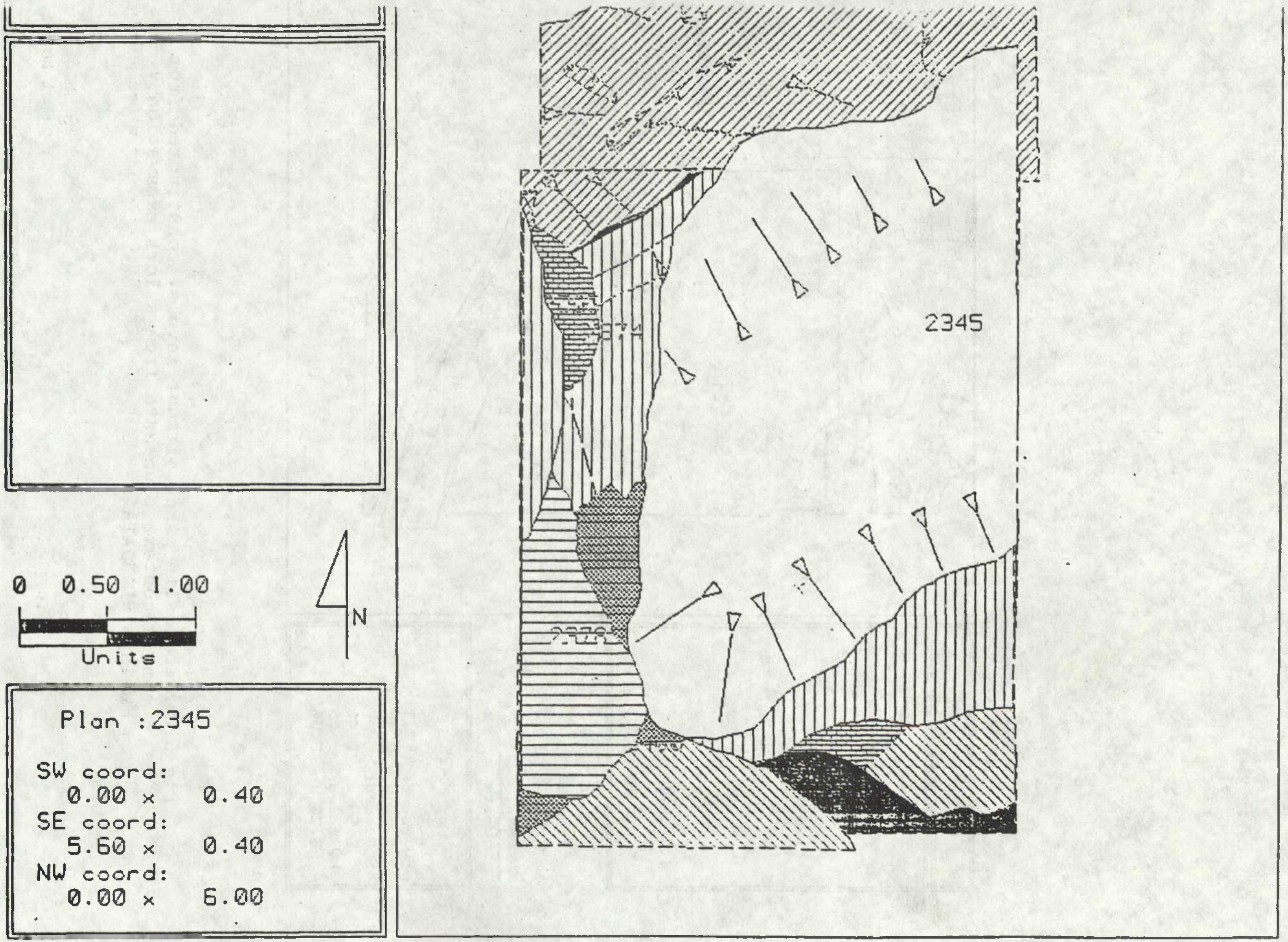

Fig 6. A composite plan, from 'PLANDATA', without levels and with shading procedures using single context plan data from an excavation in York.