MODELLING BUILDINGS AND CLASSIFYING DATA IN CAD SYSTEMS

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ABSTRACT

This paper presents the results of some studies of data modelling and layering practice carried out for the draft British Standard 'Construction Drawing Practice - Guide for graphic representation by computer'. This standard, BS 1192 Part 5, is currently a draft on which public comments have been received but which will not be final until 1989. Its objectives are to complement developing international data exchange standards by guiding those designing buildings with CAD to organise data so that its structure can be transferred. It has three main elements:

1. Translation of system terminology into standard terms.
2. A simple representation of data structures.
3. Guidance on allocating building data to layers.

In the first study six of the systems most widely used in the UK were represented in IDEF IX data modelling format to show their similarities and differences, and the standard includes a simplified data structure which can be related to each of these. Typical variations are identified and system terminology is related to standard terms proposed.

The second study looked at current practice in allocating layers or categories, both by FEDCAD in user groups and by CICA in individual members using CAD. A number of criteria for classifying layers were found and these included, in order of frequency:

1. Job specific elements.
2. Elements of drawings, eg. grids, text.
3. Elements of buildings, eg. phases, floors, services.
4. Standard element systems, eg. CI/SfB.
5. Types of drawing eg. plans, elevations, perspectives.

The recommendations of the standard are that a common system should be used allowing flexibility in the numbers of layers. CI/SfB Table 1 and the Common Arrangement are seen as suitable systems appropriate to different stages of the design process.

THE BRITISH STANDARD

BS1192 Construction Drawing Practice, Part 5 'Guide for graphic representation by computer' is approaching its final draft. A committee of experienced CAD users, managers, consultants and system developers is producing the standard which is aimed primarily at users of CAD systems. The recommendations are based upon studying data structures of systems commonly used in the UK construction industry and of the ways in which users classify data.

The first task of the committee was to reassure those who have worked on manual drawing standards that computer systems could meet general requirements for drawings. The next task was to demonstrate that a model of a project was built up in the computer and that drawings were only one form of output from the model. The committee then addressed the additional considerations that computers raise particularly when graphics data is exchanged with other systems. How is the data structured and how much of the structure can be passed across? The work has been based on the experience of some of the 2800 UK firms using CAD.

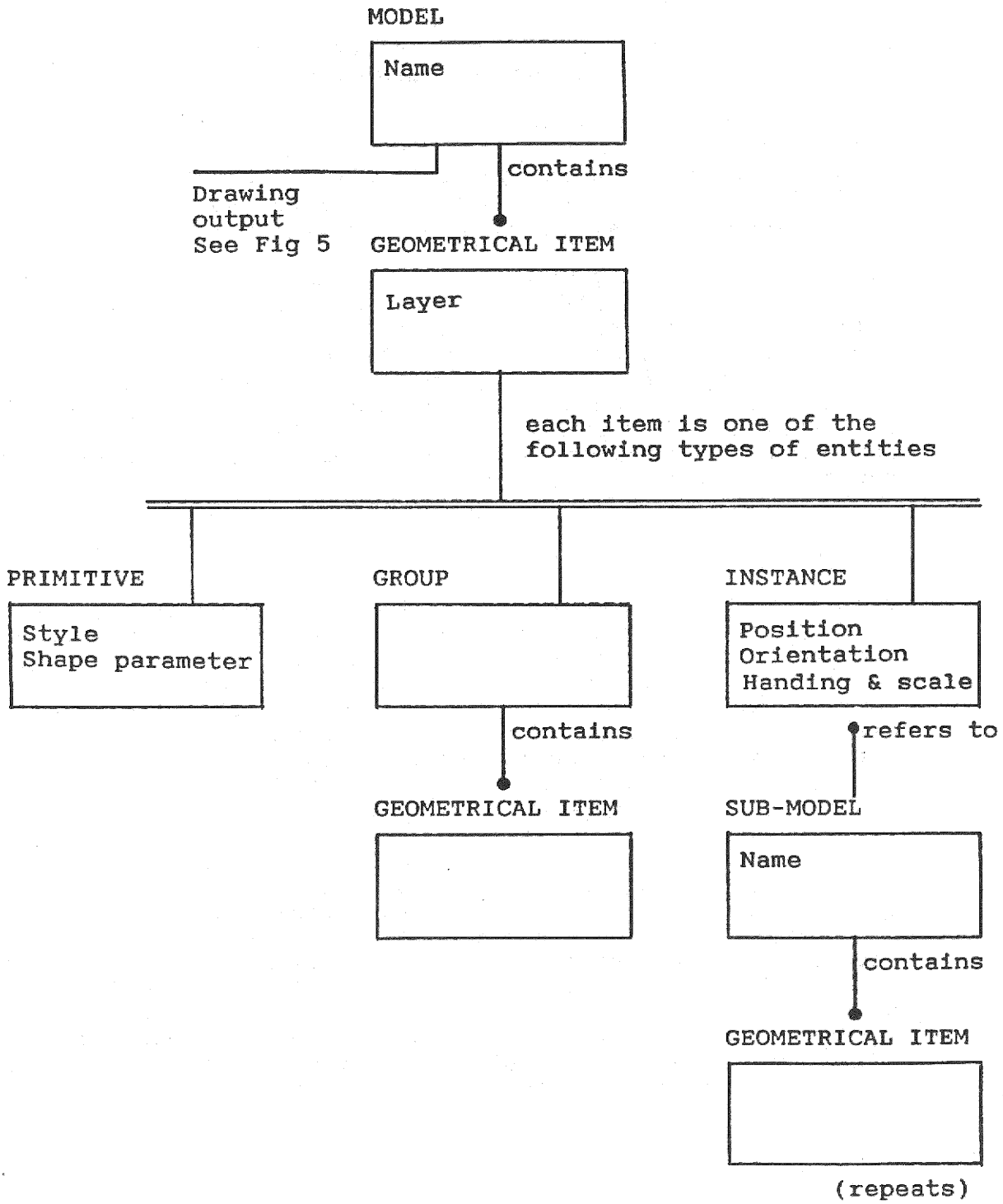
STUDIES OF SYSTEM MODELS

While the standard is not aimed at those producing CAD systems, it was necessary to understand the ways in which different systems handle and output data. Several vendors were very helpful in providing confidential information on the data structures of their systems which were represented in IDEF IX data modelling format.

It became apparent that, when the most specific features of each system were removed, and their particular terms converted to a common basis, apparently different systems handle data in a very similar way. It is currently proposed that a diagram of this common element is used in the standard for explanation and to relate to the proposed terminology. Part of the role of the standard is to help those unfamiliar with CAD to see systems stripped of the complex presentation used for marketing purposes.

However a standard is not primarily an educational document and recommendations must predominate. One of the main areas in which common organisation of data is most valuable for any one wishing to retain that organisation while transferring data, is in the use of layers.

COMMON DATA STRUCTURE DIAGRAM AS PROPOSED



CURRENT LAYERING PRACTICE

Wishing to base the standard on current practice rather than insert new and theoretical techniques, the Federation of CAD User Groups and CICA were commissioned to collect examples of office and project layer charts to see if there was any common practice. From nine users groups and about twenty examples, it was apparent that systems allowed different numbers of layers or categories and that users applied these very differently.

A number of common elements, often mixed together were found. In order of frequency, these were:

1. Job specific elements
2. Elements of drawings eg. grids, text.
3. Elements of buildings eg floors, services, phases
4. Standard element systems eg CI/SfB Table 1
5. Types of drawings eg.plans, elevations, perspectives

If, as is currently the case, the data is being used only within a single office, then the needs of users for efficient file operation and project control dictate the layers used. As soon as that data needs to relate to more than one department or company, some conventions should be agreed. This can be done at the beginning of the project if all parties are known but a standard classification system would help both project design teams and the longer term needs of project data storage.

RECOMMENDATIONS FOR CLASSIFICATION

The committee recommends that an existing, widely used, classification systems as the basis for allocating layers according to the number available and required on a project. In the UK there are two contenders: Table 1 of CI/SfB based upon building elements which are more appropriate to the early design stage, and the Common Arrangement which uses work sections organised by materials and trades. The latter is a recent development and is being promoted for coordinating all project documents.

The standard is likely to suggest either system with the choice, depending upon the stage to which the job has progressed when it goes onto a CAD system, and the views of the project teams. In either case there are additional layers required to handle drawing elements which must be separated for efficiency of handling large quantities of data and, ideally, a 3D matrix should be used with a drawing element, such as hatching, relating to each of the building elements or work sections so that it can be turned off for brickwork but not for floor areas, for example.

In recommending a classification system it is necessary to provide flexibility to allow users an appropriate number of layers and to reflect that layering is often very personal to a particular operation. The advantages of a common system are that there is a point of reference to start from and that, if a project is started by a single firm it can reserve layers for those involved at a later stage and provide the client with an archive which conforms to a conventional arrangement.

DRAFT PROPOSAL FOR MAIN HEADINGS FOR LAYER CLASSIFICATION

DRAWING ELEMENTS	BUILDING ELEMENTS OR CI/SfB Table 1	WORK SECTIONS Common Arrangement
01 Drawing sheet	1. Ground, substructure	A. Preliminaries B. Complete buildings
02 Frame, title block	2. Structure, Primary elements	C. Demolition alteration D. Groundwork
03 Grids	3. Secondary elements	E. Concrete F. Masonry
04 Hatching	4. Finishes to structure	G. Structure, metal, timber H. Cladding
05 Free annotation	5. Services, mainly piped	J. Waterproofing K. Linings
06 Detail for large scale	6. Services, mainly electrical	L. Windows, doors M. Surface finishes
07 Dimensions	7. Services, mainly ducted	N. Furniture, equipment P. Fabric sundries
08 Vacant	8. Fittings and furniture	Q. Paving, etc R. Disposal systems
09 Vacant	9. External elements	S. Piped systems T. Heating, cooling U. Ventilation V. Electrical W. Communication X. Transport Y. Services spec Z. Fabric spec.

CONCLUSIONS

The experience of drafting this standard, which is not yet finalised, is that considerations of modelling tend to upset an industry in which drawings have always been fundamental. It has proved difficult to draft a standard for the general user which does not try to standardise the systems themselves. Layering conventions are the most specific need and these will only become important when data exchange is more prevalent. Finally, all this work is being done to fit alongside an international exchange standard which does not yet exist but which is already looking very complex.