

## GIS principles applied to an English country house: the Brodsworth Hall project

Ross W. A. Dallas<sup>1</sup>, D. Parker<sup>2</sup>, & D. W. Hilder<sup>3</sup>

(<sup>1</sup>*Architectural Photogrammetry, York*, <sup>2</sup>*University of Newcastle Upon Tyne, UK*, <sup>3</sup>*DWH Associates, UK*)

### 39.1. The approach

Applications of GIS have become widely accepted in recent years. The philosophy of allying spatial information with database information has proven to be a particularly powerful tool in fields such as town planning, geomorphology and biology. However, the majority of such applications have tended to be at the topographic scales of a map database, i.e. in the region of 1:10,000 to perhaps 1:50,000.

In principle, spatially related database information can clearly be applied at much larger scales. To a certain extent, this merges into the field of Facilities Management, but the GIS principles in themselves offer some quite unique ways forward. In terms of the sophisticated levels to which GIS applications have been carried, this project did not stretch the capabilities of such systems. Nevertheless, the application was most unusual, if not unique at the time, and presented complex technical problems in its own right.

### 39.2. The subject

English Heritage is responsible for the care and maintenance of some four hundred historic structures. A number of these are roofed buildings, and more specifically, country houses. In 1988 English Heritage took Brodsworth Hall country house into guardianship. This mid-Victorian building completed between 1861 and 1870 is located in South Yorkshire near the city of Doncaster. Its particular interest as a country house was that it had remained virtually untouched in the hundred and thirty years since it had been built. Virtually no structural alterations had taken place to the building, and the original contents were largely intact. Nevertheless the building was in quite poor condition, with extensive attention being needed to roofs, decorative surfaces, and the need for the installation of safe, modern services, etc. It is the aim of English Heritage however to present the building largely as found rather than attempt extensive renovation of materials and surfaces.

Interest in GIS applications has been growing in English Heritage, since as with most organisations the advent of cheap computer power, mainly delivered through PC computers, is in the process of changing many of the ways in which the organisation works. In conjunction with the repair programme which was to be carried out on Brodsworth, it was proposed that a GIS system could be established to help with the programme:

- building repair
- recording and conservation of the many artefacts found in the house
- setting up of a management system for use when the property becomes open to the public.

However, it was not possible to proceed to a full scheme immediately and a pilot project was initiated. The pilot project was set up to test the thesis that GIS principles would be applicable.

### 39.3. The project

The proposal was that all the survey documentation which had been obtained in digital form, showing floor plans, elevations and some sections, plus photographic images would be stored in the GIS system. A brief was prepared, and distributed to four leading academic organisations in the United Kingdom known to have specialist skills in developing Geographic Information Systems. The successful institution selected was the Department of Surveying of the University of Newcastle Upon Tyne. The staff were assisted by DWH Associates, who had prepared the initial assessment of the project.

The project was commenced in December 1991, and ran for three months. The Department was supplied with digital data of all existing surveys, and conducted in depth discussions and interviews with a number of key English Heritage staff involved in the project, both on the architectural and artefactual sides. This enabled them to tailor the development of the GIS platform appropriately to the requirements of the different staff involved. The scale of the survey data was at 1:20, showing all principal architectural features of the building. This was used as the basis of the GIS, and the areas of the building were subdivided into rooms, walls, etc. as suitable zones.

A key element of the work was the principle of the "Geographic Spine Index", as devised by DWH Associates. The reasoning behind this was that it would not be possible to store the already vast amounts of information which had been accumulated on the building. For example, Conservator's reports on individual pieces of furniture or pictures could run to many pages. The idea of indexing this information was therefore adopted, such that the user of the GIS would find the reference to the material, with a synopsis, but would then proceed to the original source as indicated in the computer program.

### 39.4. Objectives and stages

Four key objectives were identified in the initial DWH Associates report:

1. To develop a model/mechanism for the indexing and accessing of data relating to the individual property that could be applied to all properties.



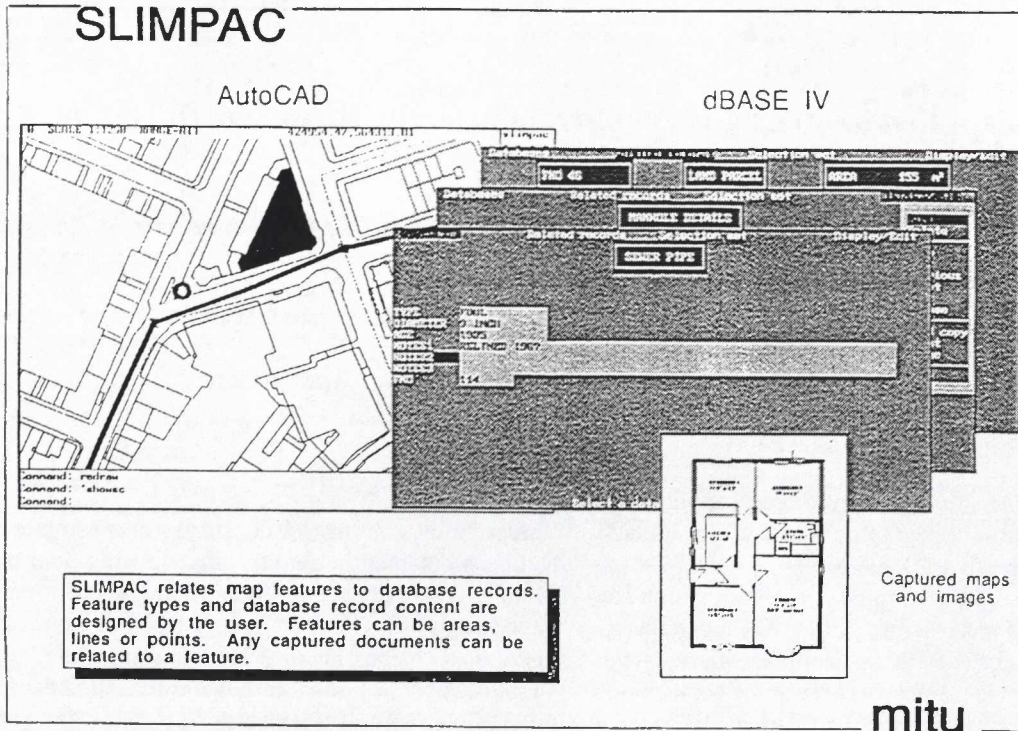


Figure 39.1: SLIMPAC and its relation of AutoCAD map features to dBASE IV database records.

2. To test the model/mechanism by applying it to Brodsworth Hall and to amend or modify it in the light of the practical application.
3. To investigate the use of the resulting data indexing and accessing system in support of representative English Heritage functions.
4. The overall aim being to see what synergy might be generated by this approach: how much data integration is realistically possible, to which data sets associated with a property this most sensibly applies and to form some assessment of the worth of such integration.

The work to achieve these objectives was seen as being divisible into three main stages. In summary, the stages were:

1. To develop the data indexing and accessing system and its application to Brodsworth Hall, including the attachment of representative data.
2. To extend the realisation of the model to a comprehensive cover of Brodsworth Hall and estate, containing all of the property data and information for the property.
3. To explore the use of the data indexing and accessing system developed for the property in relation to English Heritage's functions and review the generalised model in terms of its possible future application to other properties.

The first of these stages contained the major innovative effort in the formalisation of the model and the use of suitable computing tools to build it. The latter two stages would be essentially proving stages for the devised model and mechanisms. This paper reports on Stage 1 only, which is now complete. Stages 2 and 3 are yet to start.

### 39.5. The design criteria

The DWH Associates report also recognised three fundamental design criteria:

1. a key element in much of the data associated with a property is that they are locationally, or geographically, referenced. They are referenced if not to the whole property then at least to part of that property.
2. there was a need to index the data but not to necessarily absorb the data into a single information system.
3. the data required indexing through a wide range of drawing scales. Compared to other GIS applications, the mapping scales considered are very large, but the range of scales is still wide. They range from those suitable for recording trees on an estate, up to those suitable for recording cracks in building facade stonework.

The three key design criteria led to the coining of the title "Geographical Spine Index" or "GSI", as being perhaps a more appropriate description of the process than "GIS".

### 39.6. Technology requirements

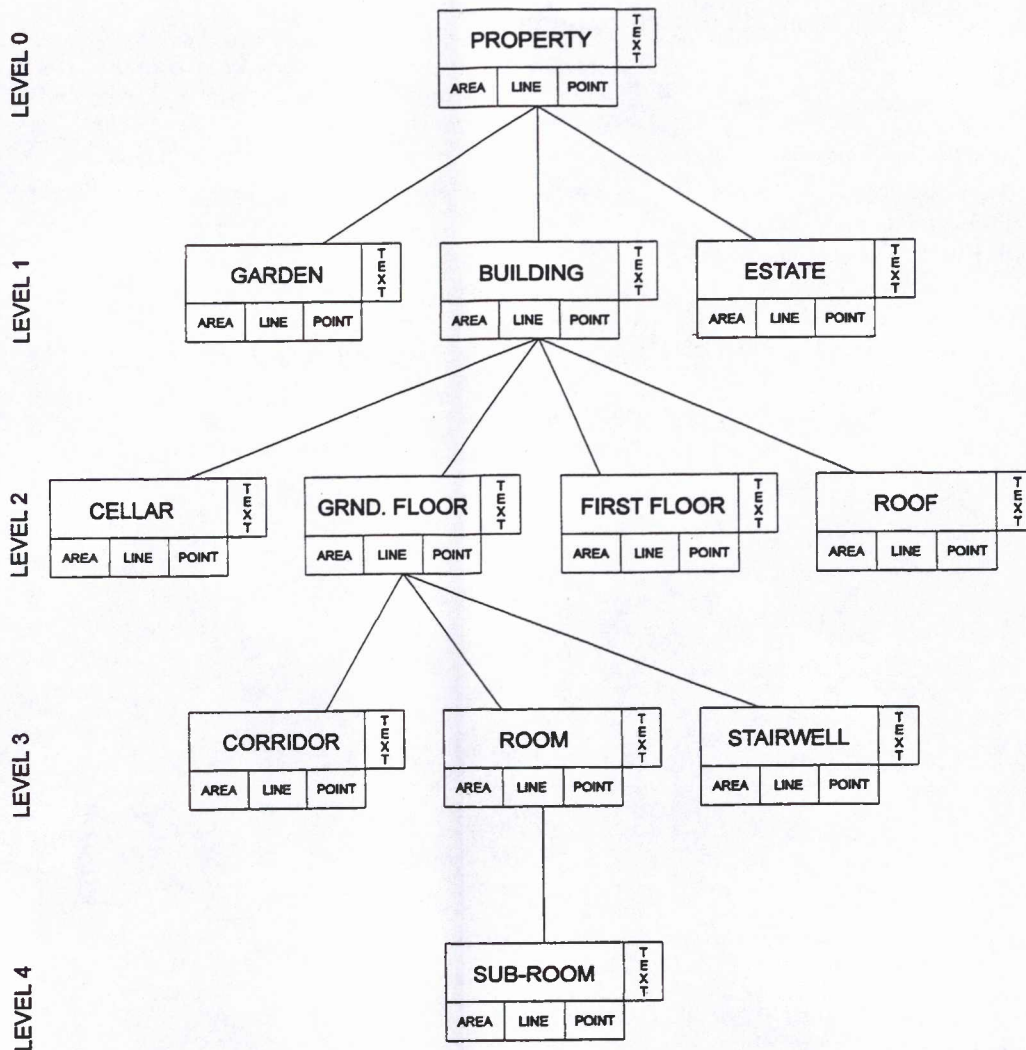
A GIS package was however seen to be required to build the GSI. The analytical requirements of the system were not demanding, however. The implementation required more of a "recording and procedural" rather than a "what if" system.

Remembering that the objective was not to create a final product but to prove and evaluate a concept, it was seen to be an advantage to utilise a foundation package; one incorporating only the basic GIS functionality but in which customisation and enhancements were simple. This would help ensure that any developments could be easily implemented in future versions and generations of software products.

Vector based graphics could cope with most of the requirements. Raster displays would certainly be needed for simple display of scanned documents and, potentially, for a background in a co-ordinate reference frame to be used as a



Figure 39.2: The "zoning" concept applied to Brodsworth Hall.



base for indexing objects. The system adopted needed to be able to accept data in a form as close as possible to that in which it was currently held, to minimise the data capture requirements. A PC base was preferred, if for no other reason than this was the base of most of the other computerised technical work in English Heritage.

The SLIMPAC program developed at the University of Newcastle was adopted for the investigation. The package integrates the market leading CAD software AutoCAD with the industry standard textual database dBaseIV. Nothing is taken away from either AutoCAD or dBaseIV and much, relating to the handling and analysis of spatial data, is added. From its early conception back in 1984, the program has been designed as a basic toolbox to integrate large scale plans with associated textual data.

### 39.7. The implementation

The key to SLIMPAC is a feature. A feature is any area, line or point in an AutoCAD drawing which has been uniquely linked to a single record in a single database table. Once this relationship is established, any number of other records in other database tables can be related. All the features of dBaseIV are available to input and extract information in these tables. Any number of scanned images and any number of views of AutoCAD drawings can

also, via the database, be related to features. Fig. 39.1 shows an overview of the SLIMPAC concept.

All digital maps, architectural plans, sections etc. of Brodsworth are indexed in a single database table: this is automatic on loading. The user may select any drawing of interest, a floor plan for example. They immediately have access to all the objects associated with that floor. Then, the user can use the "ZONEIN" command to look at say a room only on that floor, to limit access to data associated to the room and objects within it, or "ZONEOUT" to the level above to gain access to the data on another floor or the whole estate. Alternatively, a feature such as a wall may be selected, its elevation viewed, and access gained to data about objects visible on this view. Having an index on these predetermined physical zones does not rule out access by zoning in on any ad hoc region. Fig. 39.2 shows how this "zoning" concept was applied to Brodsworth.

### 39.8. Conclusions

A "working model" has been set up, which can be used to demonstrate the principles of this method of data storage handling, manipulation and access. In the time scale of the project, it was only possible to load the model with a relatively small sample of data. Nevertheless, the demon-

stration is convincing and gives a concrete reality to the concept.

### Acknowledgements

Dr. David Parker and Dr. George Taylor, of the Department of Surveying at the University of Newcastle Upon Tyne, and Mr. Derek Hilder of DWH Associates, are thanked for their help. For the Brodsworth Hall project, the main staff interviewed were on the architectural side, principally the Senior Architect in charge of the project, Mr. Donal MacGarry. On the artefacts side the principal member of staff who assisted was Ms. Dorian Church.

### Bibliography

- PARKER, D. 1992. *Spatial data indexing for historic structures, a Pilot Study* Report prepared for English Heritage by the Department of Surveying, University of Newcastle Upon Tyne.
- PARKER, D. 1993. "A geographical spine index for comprehensive property information" Paper presented at the GIS93 Symposium, NEC.

Ross W. A. Dallas,  
(formally English Heritage)  
Architectural Photogrammetry Consultant  
23, East Mount Road  
The Mount  
York GB-YO2 2BD