Architecture in Landscape:

Integrated CAD Environments for Contextually Situated Design

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ABSTRACT

This paper explores the future role of a more holistic and integrated approach to the design of architecture in landscape. Many of the design exploration and presentation techniques presently used by particular design professions do not lend themselves to an inherently collaborative design strategy.

Within contemporary digital environments, there are increasing opportunities to explore and evaluate design proposals which integrate both architectural and landscape aspects. The production of integrated design solutions exploring buildings and their surrounding context is now possible through the design development of shared 3-D and 4-D virtual environments, in which buildings no longer float in space.

The scope of landscape design has expanded through the application of techniques such as GIS allowing interpretations that include social, economic and environmental dimensions. In architecture, for example, object-oriented CAD environments now make it feasible to integrate conventional modelling techniques with analytical evaluations such as energy calculations and lighting simulations. These were all ambitions of architects and landscape designers in the 70s when computer power restricted the successful implementation of these ideas. Instead, the commercial trend at that time moved towards isolated specialist design tools in particular areas. Prior to recent innovations in computing, the closely related disciplines of architecture and landscape have been separated through the unnecessary development, in our view, of their own symbolic representations, and the subsequent computer applications. This has led to an unnatural separation between what were once closely related disciplines.

Significant increases in the performance of computers are now making it possible to move on from symbolic representations towards more contextual and meaningful representations. For example, the application of realistic materials textures to CAD-generated building models can then be linked to energy calculations using the chosen materials. It is now possible for a tree to look like a tree, to have leaves and even to be botanicaly identifiable. The building and landscape can be rendered from a common database of digital samples taken from the real world. The complete model may be viewed in a more meaningful way either through stills or animation, or better still, through a total simulation of the lifecycle of the design proposal. The model may also be used to explore environmental/energy considerations and changes in the balance between the building and its context most immediately through the growth simulation of vegetation but also as part of a larger planning model.

The Internet has a key role to play in facilitating this emerging collaborative design process. Design professionals are now able via the net to work on a shared model and to explore and test designs

through the development of VRML, JAVA, whiteboarding and video conferencing. The end product may potentially be something that can be more easily viewed by the client/user. The ideas presented in this paper form the basis for the development of a dual course in landscape and architecture. This will create new teaching opportunities for exploring the design of buildings and sites through the shared development of a common computer model.

Background

Our perception of the trend in teaching both architecture and landscape is that both staff and students are losing the whole picture of design. The eclectic nature of design was always its strength in the past - the skills involved in designing the whole environment, exemplified by designers such as Paxton, Vanburgh, Lutyens, Scarpa, and Macintosh.

We want to be able to recover the integrated approach to design - not to get bogged down by technicalities. Power should be returned back to the designer whilst at the same time being able to refer to any kind of technical documentation and evaluation that might be required. The recognition of this problem has been highlighted in the development of dual programme of postgraduate study in Architecture and Landscape here at the University of Sheffield, in which we are attempting to incorporate current developments in CAD and networked computing to facilitate an integrated design methodology.

Illustration of the Problem of Fragmentation

Conventional paper-based presentations are limited. Drawing conventions isolate people from each other and encourage ever more specialisation as conventions become more sophisticated. Drawing conventions often become adopted by other disciplines without critical evaluation, and may not be the most appropriate form of representation required for a discipline in a particular context.

Axonometrics drawn by architects become difficult to reconcile with perspective views of landscapes as produced by landscape designers. Correspondingly, axonometrics drawn by landscape architects poorly illustrate landform and vegetation in relation to building layout (figure 1.)

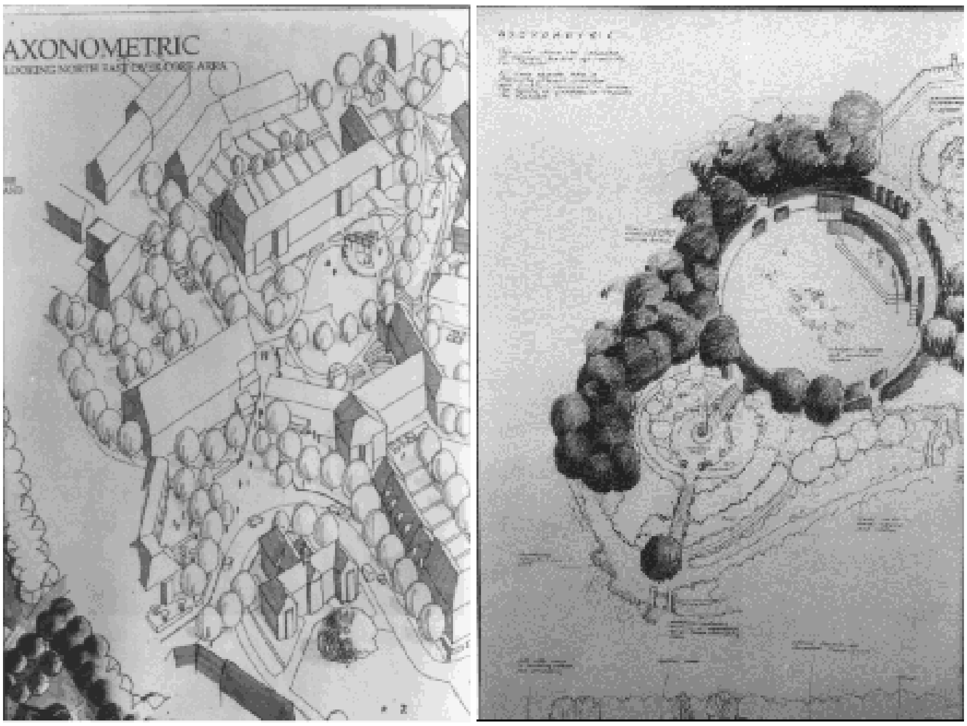

Figure 1: Conventional Presentation of Landscape/Architectural Axonometrics

This fragmentation also extends into CAD based representation. Architectural models are typically unrelated to the surrounding context of the site, and often 'float in space' e.g. the student work shown in figure 2. Landscape models often leave the buildings out and this manifests itself in the form of 'holes' in the landscape e.g. figure 2 again.

Many elements used in CAD based models are symbol based, and these are often very specific to professional symbolic conventions e.g. engineering symbols vs architectural vs landscape. Although symbolic conventions may well be valid for paper based representations, they are unnecessary in computer representations. We believe that current technology is capable of support a greater degree of realism in this interdisciplinary field. Vegetation should look like vegetation. Alternatively, in order to improve response times during the design, it would be feasible to consider the use of hybrid systems in which more abstract and conceptual objects co-existed with more realistic representations if this was required.


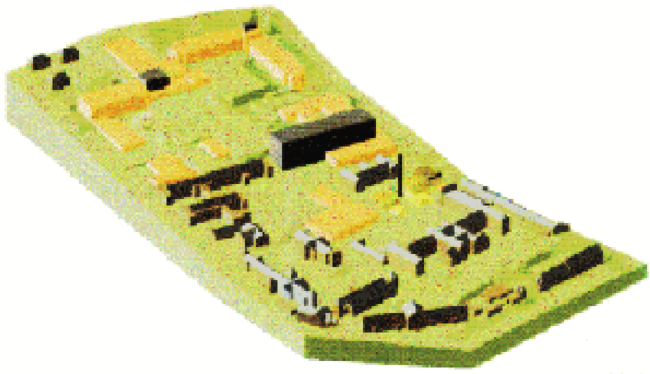

Figure 2: A 'floating' building and a 'floating' landscape

A further limitation is that the production of drawings tends to freeze certain processes, particularly organic processes in landscape. This is also true to some extent of architecture in that the kind of architecture produced by Gaudi, for example, and organic architecture in general, does not lend itself easily to current CAD modelling techniques. Again, we believe that current technology is capable of offering designers the opportunity to forecast how their schemes will develop e.g. how planting may subsequently change views from buildings, and equally how it may have an effect on the energy consumption of buildings.

A further example that is frequently visible in most design studios is the dramatic separation between site studies carried out by both architecture and landscape students, and the subsequent modelling of design schemes which are not in any way integrated into the site data that was used at the start of the design process. Survey information is frequently lost or passed up in some part of a studio project. Instead, this information should be kept, along with the development of the design scheme, and referred to when necessary.

Existing Design Methodology

The prevailing methodology of design, whether manual (paper) based or computer based, tends to fall into the design methods approach to design developed originally in the 60s. In architecture this manifests itself in the form of the Analysis/Synthesis/Evaluation approach in which much of the design emphasis is placed upon the analysis of well-understood and bounded aspects of design such as energy, lighting, acoustics, etc. This then leads to the use of elaborate numerical calculations which have always been separated from the design scheme itself. Synthesis - the development of the scheme - is something that takes place in isolation from the analysis and evaluation. The corresponding approach in landscape is Survey/Analysis/Design (SAD) in which the survey studies become detached from the design schemes that are eventually generated. This again raises the issue of poor access to data. Current methodologies are inflexible in that too much time is wasted in design development. There is the danger of losing touch with the original evaluation, or of duplicating design effort e.g. by applying similar tests to the test proposal, such as for the evaluation of micro climate.

New Developments in Computing

A rapidly expanding area is Geographic Information Systems (GIS) in which large amounts of information can be accessed and exploited in design situations. This information includes social as well as physical aspects. Not only is such information available, but it is also becoming more accessibility across the internet to users in remote locations. An increasing amount of information, therefore, is becoming available in digitised form. In Britain, Ordnance Survey data exists in this form (see http://www.ordsvy.gov.uk).

Another expanding area is the use of object-oriented technology in CAD, which encourages the continuous development of design schemes within integrated environments such that the history of the development of schemes can be recorded and referenced as required. Object based modelling can be used to move beyond purely the historical aspect, and can also be exploited in teaching environments [Saggio, 1992].

Object-oriented technologies also facilitate the support of collaborative design work in which divergent models can be separately modified by different users, potentially using different applications. CAD systems such as ArchiCad (ref.), for example, are increasingly object-based. Web-based software development also seems to be moving in a similar direction with developments such as JAVA, which offers the capability of demonstrating concepts and principles, and the provision of immediate feedback and user control [Pang & Edmonds, 1997].

New Design Methodology

Opportunities for increasing design collaboration are offered by new computing technologies and should be encouraged and exploited. The development of more wholistic design schemes becomes possible when design takes place within integrated computer environments. Exchange of information between participants becomes more straightforward, and schemes can be developed in an ongoing and cyclical fashion in contrast to the linear design methods approaches. Compatiblity becomes less of an issue when operating system environments can handle (without necessarily recognising) multiple types of information. Accessibility of information is inceasingly possible provided users have web access. A methodology in which all of these factors are exploited should be encouraged within design studio environments, even though persuading design specialists to relinquish their isolated but increasingly eccentric specialisms (e.g. experts in 2-D production drawing, specialists for the production of perspectives - a process which is time consuming and frequently incorrect) may meet some resistance. The technology is there - now it's time to let design students use it.

Virtual Enviroments as Design Contexts

Much research has already taken place on the development of virtual environments of existing sites and cities (e.g. [Day,1994], and the CIMI centre's virtual reality model of the city of Nottingham, England.). We propose that this work forms the starting point for the contextualisation of both landscape and architectural design projects.

Conclusion

This paper has focused on the issue of resource sharing for alternative design professions working collaboratively on design schemes. The present status quo has been described in which this kind of collaborative activity seems to be constrained and discouraged, both by the available computer hardware technology, and by design staff constraints. There are presently still too many academic departments where computer based design activity is seen as a specialisation, as isolated modules not part of the mainstream studio teaching environment.

Our paper has highlighted the real need to upgrade staff skills to accomodate these changes. This need has become increasingly more pressing with an almost uncontrollable change of rules of communication between staff and students. Certain members of staff are simply unable to access student work when it isn't presented in conventional paper or model format.

We believe that with recent technological developments, there is an opportunity for a range of previously unconnected but related design subjects or students to work together. An increasing amount of online data is available that constitues real design sites that students can visit, visualise, and thus develop their own appreciation of computer generated spaces or even actual places, along with more conventional images such as plans. Printouts of this information can then be taken into the field, and laptop computers can be used to design on site. We intend to use this model as a basis for new design courses in Architecture and Landscape at the University of Sheffield, UK.

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