

## The Changing Patterns of Architectural Design Education in the UK

Professor Bob Giddings, BA BArch MA DPhil RIBA FCIQB FFB  
*School of the Built Environment, Northumbria University, UK*  
*bob.giddings@northumbria.ac.uk*

Margaret Horne, BSc MPhil CEng MBCS CIP  
*School of the Built Environment, Northumbria University, UK*  
*m.horne@northumbria.ac.uk*

### Abstract

Digital technologies have been introduced to students of architecture for over two decades and at present it could be argued that students are producing some of the highest quality designs, and some of the most interesting forms ever to come from University Schools. The value of computer aided design (CAD) is also being demonstrated in architectural practice, with high profile, large budget, bespoke and iconic buildings designed by internationally renowned architects. This paper reviews the changing patterns of architectural design education and considers the contribution digital technologies could make to buildings with more commonplace uses. The study offers a perspective on different kinds of buildings and considers the influence that emerging technologies are having on building form. It outlines digital technologies, alongside students' application for architectural design and considers the role they could play in the future, in developing a shared architectural language. It is suggested that some of the biggest opportunities for future research will be in the design of external spaces, often a neglected part of architectural design education.

### 1. Introduction

Success in architectural education has often been defined as mastering three-dimensional (3D) thinking. Students have constantly struggled with this concept and their intellectual development has invariably been hampered by representational methods. Traditionally, the only methods of representing three-dimensional thinking have been by drawing – perspective, axonometric, isometric; and by constructing physical models. Both can suffer from the ambiguity of deciding whether they are design or presentation tools; which is something that students may take some while to appreciate. Drawings have the disadvantage of not being true three-dimensional representations, but merely two dimensional representations of three dimensional situations. They are also limited by a single viewpoint. This can be carefully selected by the student to suggest a spatial quality in the design that does not really exist. Models also have disadvantages. Generally, they are viewed from above, which produces less impact than from the human viewpoint; and they imply a neatness in the environment that cannot be replicated in practice (Giddings and Horne, 2002). Both have two further disadvantages. Structure, materials and construction can be shown in a superficial way, as the forms of representation are not dependent on their accuracy.

Yet, perhaps the greatest impediment has been the effect on the design process. Drawings and models can involve considerable time investment by students. Thus testing can take longer than the developing thought processes. Students also test their ideas less often than is desirable because of the time and effort needed to generate further drawings and models. This tends to lead to inflexibility in the students' progress and a willingness to accept a less favourable solution because the drawings and models for it have already been completed. As higher standards of presentation are constantly being required, the design process generally

becomes curtailed at a relatively early stage. The design is fixed and the remaining project time spent on presentation. This means that design time is only a proportion of total project time, and proposals that are not fully resolved can be offered as final solutions.

## **2. Development of digital technologies**

Digital technologies have been introduced to students of architecture for over two decades. As computer aided design evolved, it has witnessed several changes in research direction, from CAD which stood for computer aided drafting and simulated the use of drafting tools, to CAD which enabled the production of photo-realistic models of buildings, to CAD which is now primarily concerned with design exploration and collaborative design activity (Duarte, 2005). Computer aided design today encompasses technologies based on purely geometrical principles to technologies based on building elements (building information modeling (BIM)), to technologies incorporating animation, interactivity and immersiveness (virtual reality (VR)) and to, more recently, augmented reality (AR). In the context of this paper, digital technologies encompass the ever developing range that is now available for architectural design. More progressive Schools of Architecture have long embraced the challenges that technology has brought and continue to evaluate the opportunities it offers to the design process (Petric and Maver, 2003). Yet for many students, CAD still means computer aided drafting and an electronic media for a traditional process. Despite the fact that digital media have been used in architectural design studios at universities for over twenty years, architectural students are generally taught to draw the same way their tutors learned – with traditional media first (Goldman 2005). However, the new generation of digital technologies is providing electronic three-dimensional representations that can be quickly assembled, recorded, tested and adjusted. Design and presentation methods can be harmonized, reducing the traditional prolonged presentation period. Such representations are enabling the development and testing of designs to be faster and more accurate; and students can now quickly and accurately produce designs to a much more sophisticated level. It could be argued that students are now producing some of the highest quality designs, and some of the most interesting forms ever to come from University Schools.

## **3. Student projects**

Digital technologies now have a well established research track record (Asanowicz, 1998, Achten et al, 1999). However, effective integration into the academic curriculum is an ongoing challenge to academics who have to balance the expectations of increasingly computer-literate students with the demands of curricula devised to meet the needs of professional practice (Horne and Hamza, 2006). Nonetheless, some interesting student projects are emerging that demonstrate appropriate application of digital technologies for both design and presentation. Students who fully understand the functionality of the tools are beginning to harness their capabilities to enhance design exploration. The following student projects have been selected to illustrate how students are using computer aided design tools, in three different contexts:

The first project is a regeneration scheme in Newcastle upon Tyne, UK. The students favoured the use of computer technology to explore their designs and one of the results can be seen in the figure 1. However the studio programme stipulated that freehand sketching, scaled drawings and physical scale models were to be used in the presentation. The 3D computer model enabled interaction with, and navigation around the design during its formulation, contributing greatly to the decision making process; and photo-realistic images and pre-

programmed fly-throughs were used for presentation purposes. Being able to navigate around a developing model facilitates the generation of ideas, increases the time spent on design analysis and reduces the focus on final presentation. However, in this case, time was lost through the duplication of electronic media with traditional techniques. It may be difficult to understand why this duplication occurred, but there appears to be something deep in the psyche of architectural tutors that causes them to insist on the replication of their own design education process. There was also a fear of black-box technology, and the last vestiges of a master-pupil relationship in which the master must be seen to have greater skill and knowledge than the pupil.

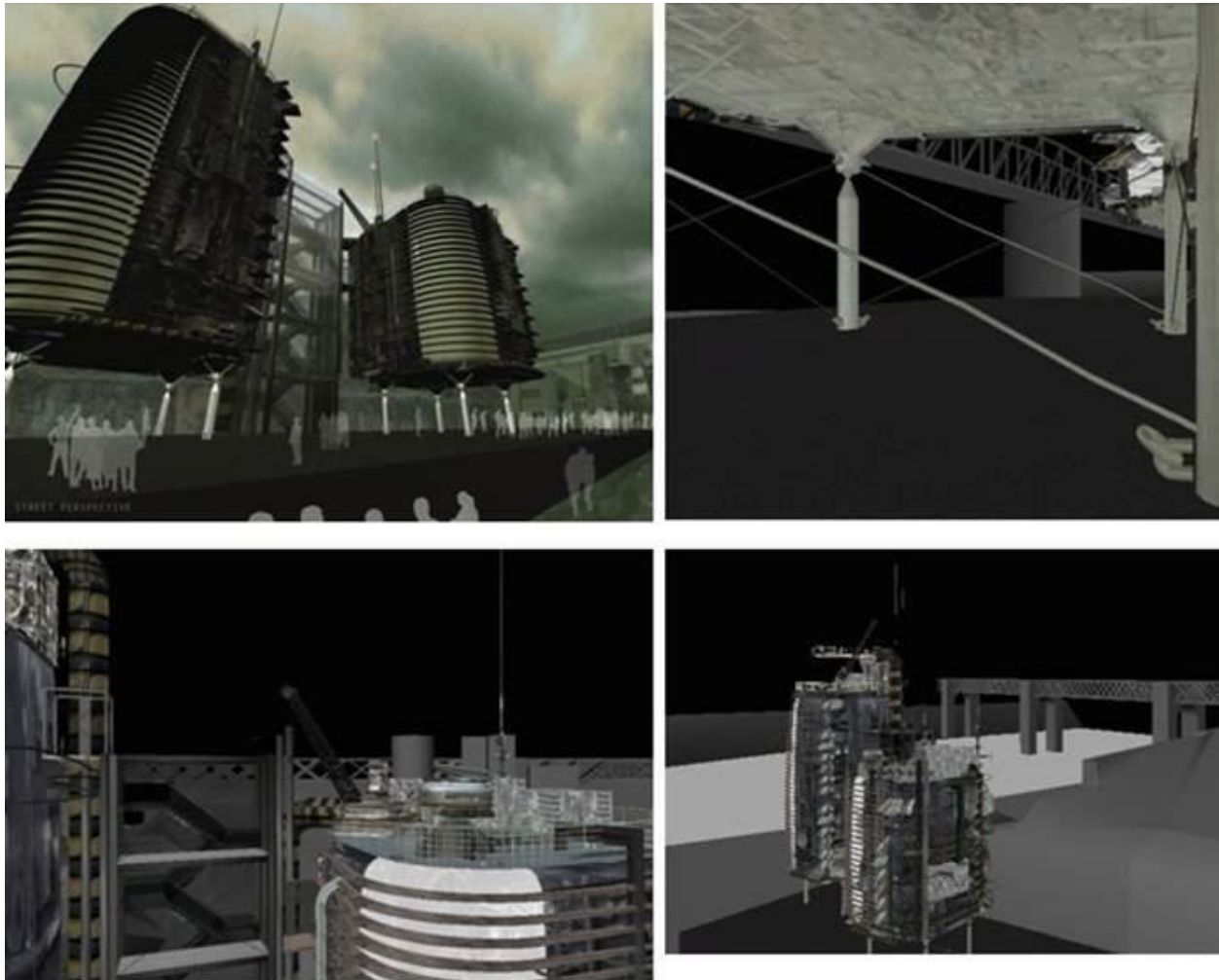


Figure 1. Student Image: Oliver Jones 2005

Figure 2 shows a student project which was centred on both the design of a building and its production phase. The project was based around modular / volumetric construction where many of the components would be made in factory conditions. The student considered structure and construction during the early stages of the design process and developed the computer model to enable a potential client to understand how the modules would fit together and the building assembled. In such circumstances, it might be surprising that free hand sketching was the preferred method for the initial conceptual design and construction method, followed by the creation of a highly detailed interactive computer model. This could be because

it is still difficult to perceive the precise nature of the computer model as a tool for creating and manipulating an embryonic concept. It can be considered that the fluidity and ambiguity generated by the freehand pencil unlocks the possibilities of lateral thought in a way that cannot be achieved with digital devices (Latham, Swenarton, Sampson, 1998).



Figure 2. Student Image: Christopher Burkitt 2006

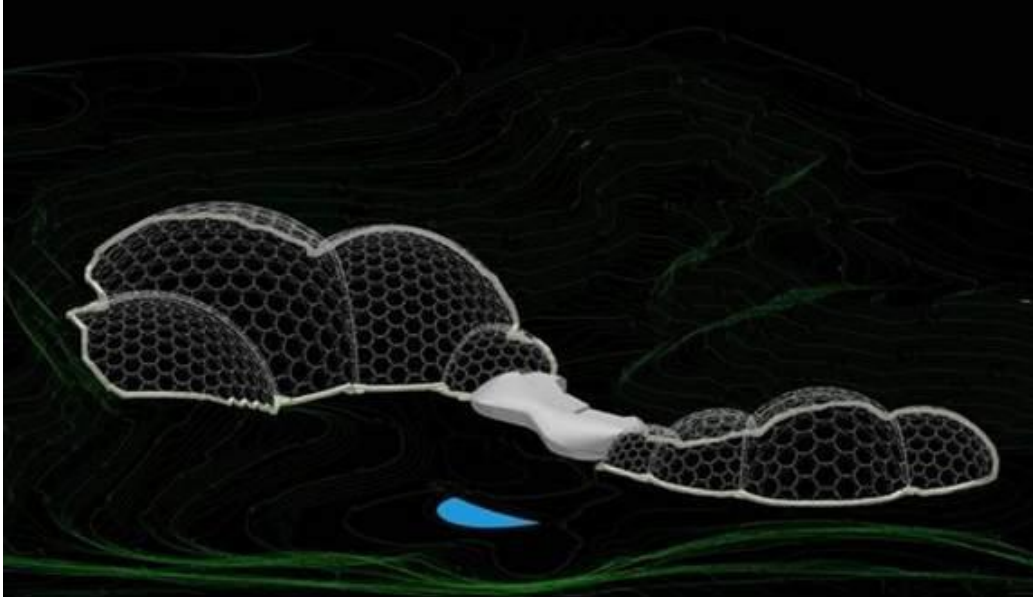
Figure 3 illustrates a student project that was designed in three dimensions from the conceptual design stage. However, it demonstrated two further concerns that have been articulated by architectural tutors. The first concern is that the library of standard components in the building information modeling software may lead to uncritical design decisions. In this case, the student was challenged to explore the creation of customised components, curved structures and non-standard forms – parameters that may well not be replicated in practice. The second concern is that although the emerging technology of building information modeling is fostering a closer relationship between designer and fabricator (Scheer, 2006), this technology is abstracting the designer further from the reality of buildings and its materials, than ever before. One outcome could be that the designer increasingly passes on design decisions to specialist suppliers, losing control on the integrity of the design in the process.



Figure 3. Student Image: Craig Peel 2005

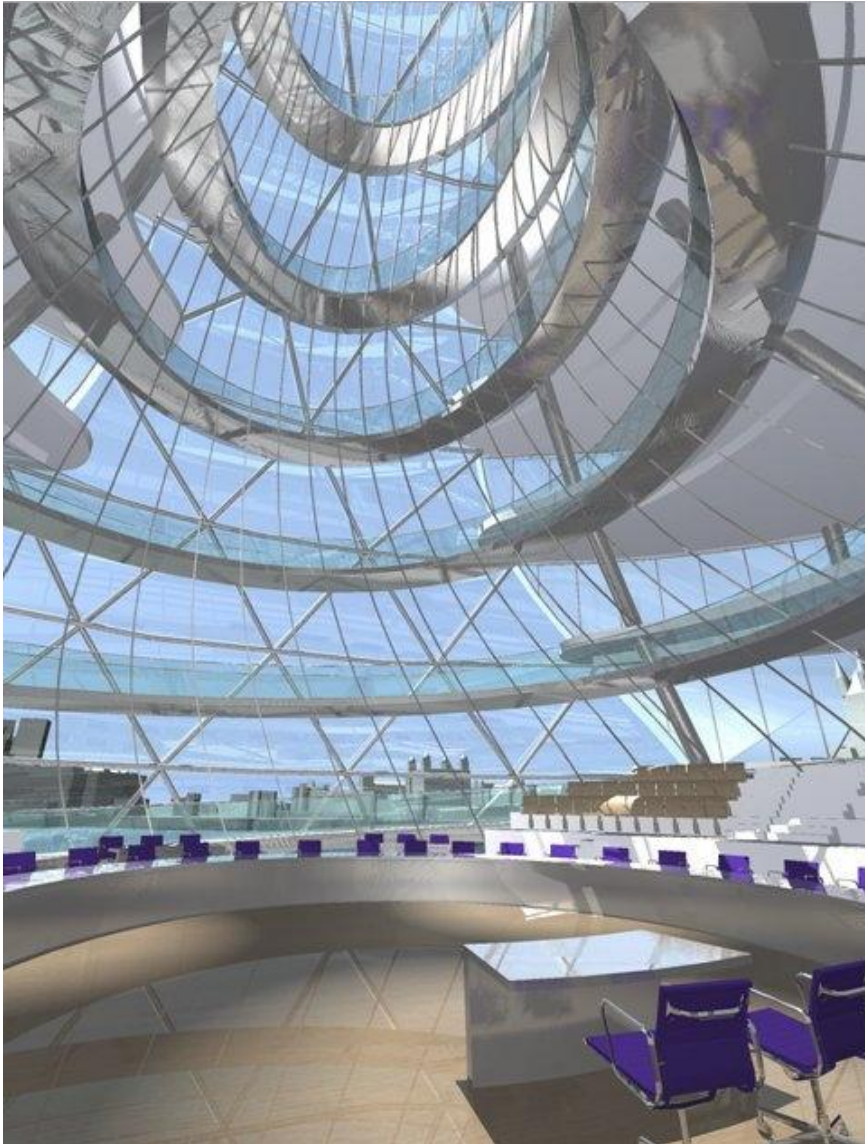
#### 4. Implications for Practice

High profile, large budget, bespoke and iconic designs by internationally renowned architects are also demonstrating the value of digital media. Designs such as the Eden Project (Figure 4) have demonstrated the possibilities opened up by digital technologies and offer inspiration to an increasingly computer literate student population who are excited by non-rectilinear geometry that can convey the essence of a building through its form (Giddings and Horne 2002).



*Figure 4. Eden Project, Nicholas Grimshaw & Partners*

The future for these kinds of projects seems assured. Digital technologies have enabled extraordinary new buildings to be designed and built. Forms of nature are providing inspiration for increasingly complex built forms and architects are rediscovering the joy of sculpting unusual geometries (Novitski, 2000). The computer's processing capability in structural analysis and production and fabrication techniques is a major contributor to the changing shape of architecture. Architects are exploring the new possibilities opened up by CAD software, modern analysis and simulation methods (Mitchell, 2000).



*Figure 5. Digital Model of City Hall London*

Whilst it must be acknowledged that the high-profile, well-publicised iconic buildings are receiving considerable attention, it can be argued that such projects occupy only a very small proportion of the built environment. It is likely that the vast majority of architectural graduates will design buildings with more commonplace uses, and these constitute the majority of built form and new construction. Figure 6 shows an exaggerated historical view of an iconic building framed by contextual buildings (Lozano 1990). Traditionally, the latter were constructed from custom and practice, rarely involved architects, and fitted into their localities.

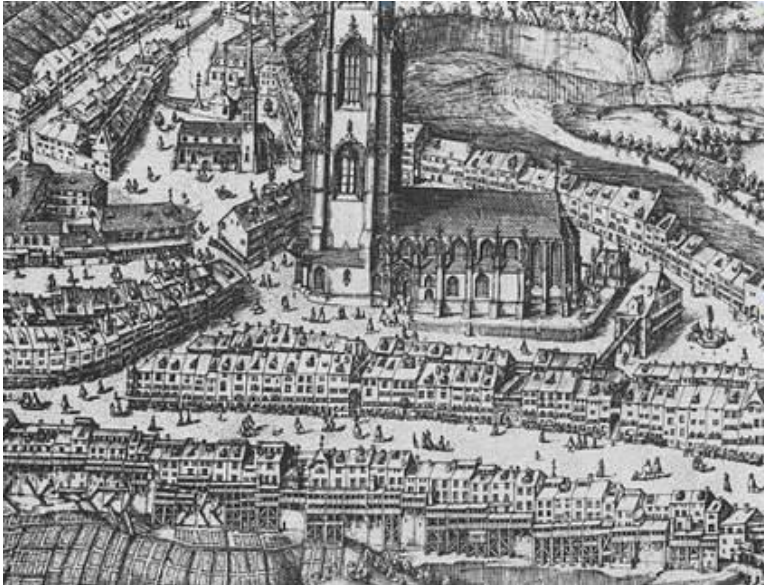


Figure 6. *Iconic Building framed by Contextual Buildings*

However, as the 20<sup>th</sup> Century progressed, the scale of these developments and the loss of local builders, meant that what had been contextual buildings, increasingly became part of the design and construction industry. Before the end of that century, concern was already being expressed about their appearance. It has been considered that one of the major reasons for the destruction of our towns and cities in visual terms is that ordinary buildings of recent years are each trying to draw attention to themselves (Sahai, 1991). At the other end of the spectrum, the demand for cheapness in the production of the built environment has generated the dull and mundane. National pervasiveness of some sectors, such as speculative house building, has produced a consensus lamenting the lack of regional distinctiveness in domestic design. There has been a continuing search for a shared architectural language. The likelihood is that digital information models based on building elements, will become increasingly used for the design of these buildings. Much of the development has been directed towards ease-of-use, and to a large extent this has been achieved. The benefits have already been considerable; in terms of use as a design tool rather than a drafting tool, reduced time in presenting the information, relationships between building elements, instant schedules for doors, windows etc., and many more. However, every advance also carries dangers. In the hands of current graduates, such systems can assist subtle building design. The first danger is therefore related to a totally electronic design education. As Craig Peel's tutors pointed out, unless all the benefits of the traditional education can be translated into electronic media, graduates may become increasingly detached from the nature of buildings, and just work within a virtual world.

Another fear is that as the tools become easier to use, the ease-of-use that was so welcomed by architects, may be their downfall. If systems become so simple that anybody can use them, then anybody will use them. Clients whose primary interest is generating floor space may feel that a BIM system could replace the architect, especially if the system has a standard library of components. Some clients may employ unqualified assistants to press the buttons, or may even undertake the process themselves. This scenario is not encouraging for increased design quality and interesting building forms, which require intuition, spontaneity and exploration, as well as geometrical precision. In the hands of unqualified practitioners, this fear can easily become reality, and the built environment could turn into an ever growing incoherent array of catalogue buildings. (Martins et al, 2007).

In the meantime, research is ongoing to develop computational tools which enable design exploration in an intuitive way rather than a rigid parametric way. This may involve some quite sophisticated computer skills, and most architects may be unwilling to become engaged at that level. Nevertheless, it is an attempt by the developers of computer aided design technologies to match their tools to the concepts around which designers wish to develop their skills (Aish, 2005) and to decrease the remoteness between designer and artifact. Research presents the challenges of teaching computational geometry to architectural students, and proposes a multi-level pedagogical scheme introducing associative geometry and parametric modeling/design into architectural design education (Iordanova, 2007; Burry, 2007).

## **5. Conclusions and observations**

This paper has been submitted to foster debate on architectural design education which is incorporating digital technologies. It has raised some concerns about the future use and application of such technologies from the architects' perspective, whilst proposing that three-dimensional computer modeling technologies emerging for current architectural students offer a truly 3D form of design exploration. Architectural education that encourages the use of digital technologies is beginning to enable students to combine simple rectilinear shapes with sophisticated curved surfaces and non-symmetrical forms alongside consideration for both the construction and fabrication stages. The divergence in architectural practice at the turn of the 21<sup>st</sup> century, into those who do *boxes* and those who do *blobs* (Mitchell, 2000), may be beginning to end with a generation of students who wish to see the two techniques converging, based on an architectural education which continues to strive for the integration of design and building technology. Digital technologies are now enabling a move from drafting and visualisation to the generation and optimisation of design, and will play an increasingly important role in the design of different building types. One of the central debates is whether these new processes can make a significant contribution to establishing a shared architectural language or whether they will generate an ever growing incoherent array of catalogue buildings.

## **6. Future research**

The authors of this study support the school of thought that those architectural practices who are looking beyond the drafting and visualization solutions offered by digital technology are finding that they are changing work practices in the course of this interaction (Toamassian and Marx, 2006). An emerging generation of students who can understand how digital technologies can be applied to architectural design, as well as anticipating future applications, is important for the development of architectural practice, and its re-structuring in the digital era. Arguably, some of the biggest opportunities for digital technologies can be found in the design of external spaces, as it is even more difficult to evaluate proposals for external spaces than those for buildings. In addition to modeling the external spaces themselves, there is now developing technologies that can simulate a range of environmental conditions generated by the designs.



## 7. Acknowledgements

Undergraduate students Oliver Jones, Christopher Burkitt and Craig Peel whose projects appear in this paper.

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