From CAAD Lab to Studio: Integration of CAAD with studio in a ‘linear’ based scheme of study

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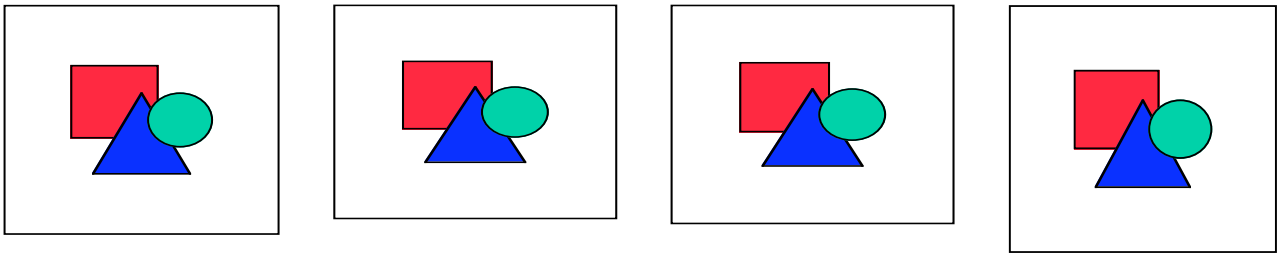
Abstract: This paper traces the relationship of CAAD with creative studio work within a ‘year based’ school of architecture where the curriculum is founded on a series of ‘Core Projects’. These ‘Core Projects’ are structured so that undergraduates undertake a structured study of the essentials of architecture in an orderly progression. Within this pattern CAAD is not a stand-alone subject or module and as students do not work in units, it is difficult to run specialist CAAD options. The subject is regarded as another skill in communication and tuition in CAAD is provided as part of the acquisition of central architectural skills. CAAD, therefore is regarded as one of the components of skills and knowledge needed to support and the ‘Core Projects’ which account for about 70% of the course assessment. The paper will analyse the evolution of CAAD education within this kind of course in Architecture, reflecting on some of the tensions that have arisen through this and use student work to illustrate some of the lessons learnt over this period

Design Teaching in the Welsh School of Architecture

Project work at the Welsh School of Architecture is based around a year-based system, where the curriculum is founded on a series of ‘Core Projects’. These ‘Core Projects’ are structured so that undergraduates undertake a structured study of the essentials of architecture in an orderly progression (figure1.) [Parry 1995].



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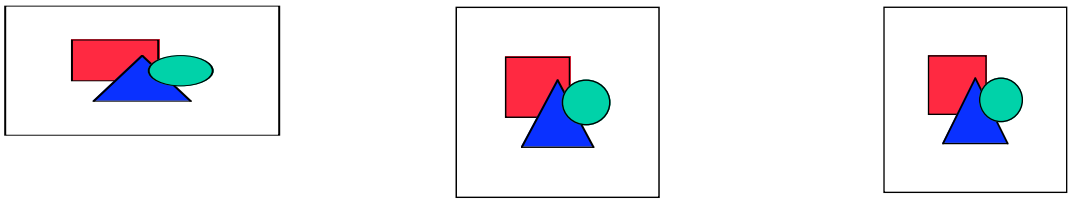

CP5 CP6 CP7

Figure 1. The progression of core projects throughout the school

The ‘Core Projects’ consist of a series of design projects which progress from the relatively simple to the more complex. The linear course has many strengths - such as a comprehensive programme of study which provides progression for students and staff. These have been recognised during the regular teaching audits that the school has been involved in and these aspects have contributed to the ‘Excellent’ teaching rating that the school holds.

All students in each cohort undertake the series of ‘Core Projects’ simultaneously and all on the course receive CAAD tuition aimed at providing skills that support each project. Since the introduction of CAAD into the course, integration of the subject within the architectural design process in studio projects has been one of the school’s main objectives

CAAD - The Early Years

Computer Aided Design was first introduced into the Welsh School of Architecture in 1989. It was initially decided that the school would adopt the PC platform using AutoCAD software. The PC platform was chosen largely because this was the technology being used by the department's Architectural Science Research Group who were principally responsible for the integration of this technology into the teaching program. It could be argued that this was a decision that hampered creative student use of computers for a number of years, and only as software originally only available for Apple Macintosh computers has become available for the PC platform has student work on the computers really blossomed.

The initial purchase of computers allowed a group of twelve students to peruse an option project using CAD. The project lasted for four weeks and followed the completion of the year’s principal core projects for the B.Sc. in Architectural Studies Year 2. The brief was to design a selection of energy efficient houses which could then be replicated and arranged on a given site. It became apparent that time was a major constraint upon the development of the project as none of the students had any knowledge of CAD, and a vast portion of the project was spent learning how to use the technology at the expense of the design. Students quickly realized that the technology did not lend itself well to designing directly on the computer, and quickly reverted to traditional 2B pencil methods of design. However a number of successful examples of the use of CAAD were produced (figure 2).

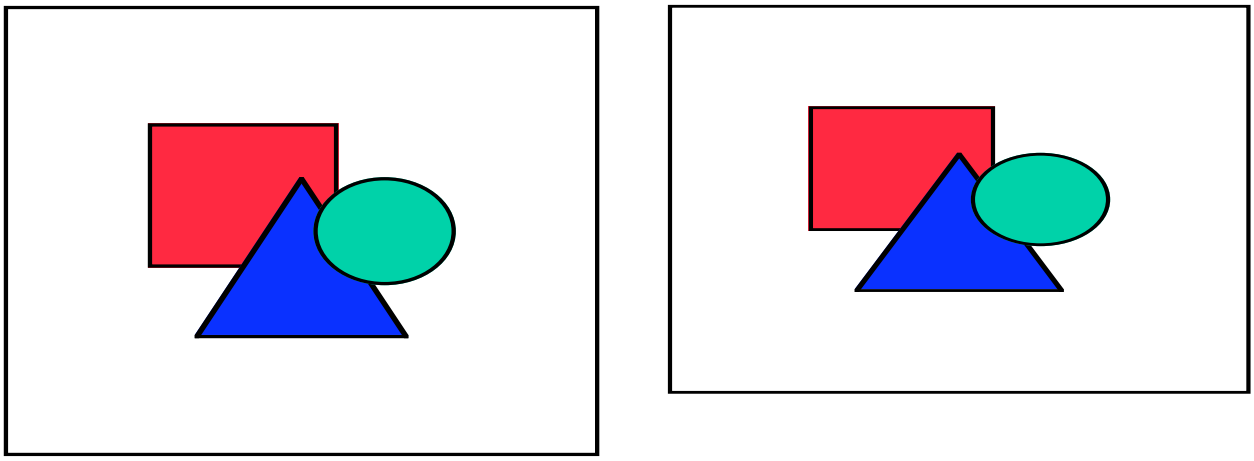

Figure 2. Entries for the British Gas (Wales) energy efficient design awards

CAAD as a professional skill

As computer use in practice became more prevalent, it was seen as essential that all students be CAD literate by the time they leave the school and go into practice; therefore an option project was no longer considered appropriate. Because of limited availability of computing facilities, the year was divided into four groups, and each group received approximately 2.5 days instruction on 2D and 3D AutoCAD. CAD was taught as a skill which was independent of general studio work, and little attempt was made to encourage students to think how they might use computers in a creative way, beyond what architectural practice was currently implementing.

In addition to the general CAD training it was possible to timetable a number of optional projects that involved CAD. Generally these took the form of vertical studio projects during the summer term. There was also an option in the third year of the B.Sc. course where students were given the opportunity to model a building designed as part of Core Project 6, a highly serviced commercial office building (Figure3). Unfortunately, with the advent of course modularization, and a consequent loss of teaching weeks it became increasingly impossible to run these option projects.

A number of students did take the initiative to produce project work on CAD, but work often appeared to have been limited by the features available in AutoCAD. With the introduction of *3D studio* into the school, students were able to produce seductive, high quality renderings of buildings, which may be of little architectural merit. It was often those students with weak design skills who were perusing work on computer and therefore a number of members of staff made attempts to prevent students from using the technology.

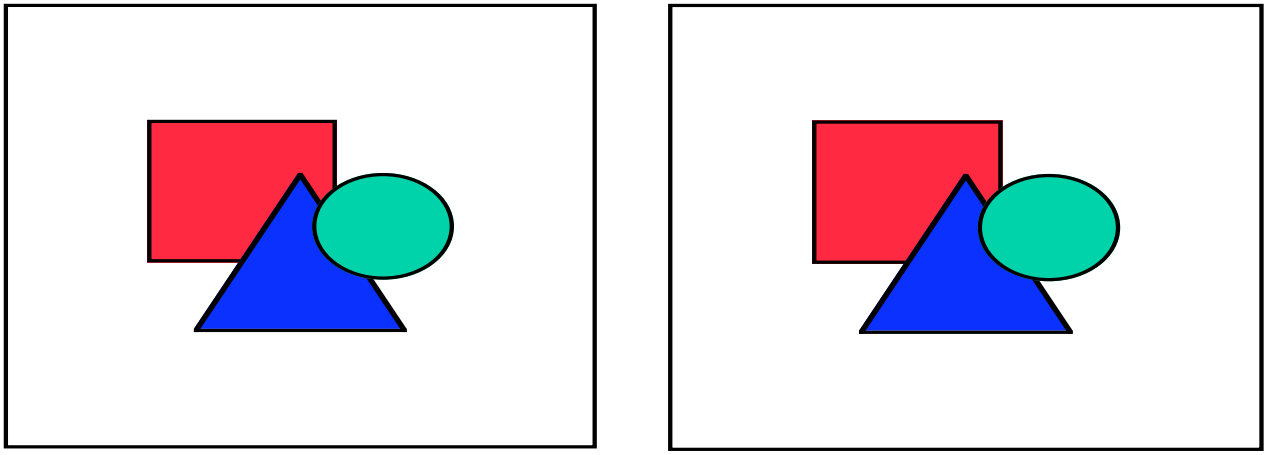

Figure 3. Use of CAAD to explore space planning and detail design

Developing a creative approach to Architectural Computing

The advent of modularization, and the consequent loss of option projects lead the department to rethink its philosophy on how and when CAAD should be taught. It became necessary to integrate CAAD into the Core Projects to a much greater extent and thus a *common thread* of Architectural Computing was developed which would run through the entire course.

Computer Aided Design is widely used in architectural practice, principally as a means to document design, so that a building can be built. In architectural education there is a greater emphasis on the design process, the generation of ideas and the understanding of concepts and principles. During their education, students rarely produce the type of technical drawing that practice might demand. In many schools of architecture, it is generally considered that this type of drawing is best taught within the environment of practice.

It is believed by some that the purpose of teaching Computer-Aided Design in Architecture Schools is to provide the students with the necessary skills demanded by practice. This is a view that is commonly held by students as they see computer aided design skills as a means to later employment. The argument that students should be trained in CAD for Practice can be criticized in a number of ways:

- Undergraduates in first year are three years away from employment, and therefore developing the skills required for practice at this stage may be premature.

- If a skills training approach is taken, it would be necessary to teach students every single Computer Aided Design package that they are likely to utilize in practice.

- There is insufficient time within the curriculum to train students fully in the use of computer aided design

- There are certain key computer techniques that students are likely to use to a far greater extent during their education, than in practice. These need to be developed first.

- Students may develop new computer techniques which practice will subsequently find useful.

- Students learn a narrow set of techniques *passively* but find it difficult to reapply those techniques to new and unfamiliar circumstances.

The developments that have been introduced into the Welsh School of Architecture promote an *active* approach to architectural computing education [Bridges 1994]. Rather than presenting the students with a vast array of tools and expecting them to learn these by rote, the teaching concentrates on the understanding of a number of core concepts, which the students can reflect on and then apply to other circumstances - the emphasis being placed on problem solving. Students are made aware of the palette of tools that are available to them and are subsequently encouraged to explore the technology in terms of its capabilities in their own time, they can then assess which techniques are appropriate to the particular task that they have in hand.

In order to achieve these aims, the school has established a *common thread* of Architectural Computing which runs through each of the core projects. The basic concepts of Architectural computing are taught during four week long *transferable skills* course, known as the *Quartet Project* [Roberts 1998], which takes place soon after students enter the school. The cohort is divided into 4 groups and each group rotated around four different projects each designed to teach a particular transferable skill. Following the *Quartet Project* a number of *studies* that involve the use of computers form part of each of the core projects. These studies use Architectural Computing to investigate a particular architectural issue related to students design work. Thus students can begin to appreciate when the use of CAD might be appropriate. Students are also encouraged to use computers independently, beyond those areas specified in the *common thread* and apply the skills learned to their particular needs

The Architectural Computing section of the *Quartet Project* aims to equip students with the necessary understanding of the potential and limitations of using computers as part of their studies. The project does not aim to 'train' students in the detailed use of a particular CAD package as there is insufficient time. It is generally felt that the time would be better spent enforcing a number of basic concepts, which can be reapplied to any package at a later stage. Having completed the project students are expected to have developed the following key skills:

- Confidence and Competence in using information technology

- Spatial Awareness and understanding of three dimensional space within the frame of a 2D computer screen

- The ability to apply set of techniques to their own work

- An understanding of the relationship between a buildings form and its function

- A comparison of the benefits of computer modeling with physical modeling

During the week emphasis is placed on moving data between applications, and trying out different options - key skills which students will require in order to use computers in a creative manner. Students primarily use PhotoShop to manipulate and montage images and MiniCAD to build simple models. The decision to introduce MiniCAD was taken because it provided a simpler interface by which students could produce basic 3 dimensional models in a relatively short period of time.

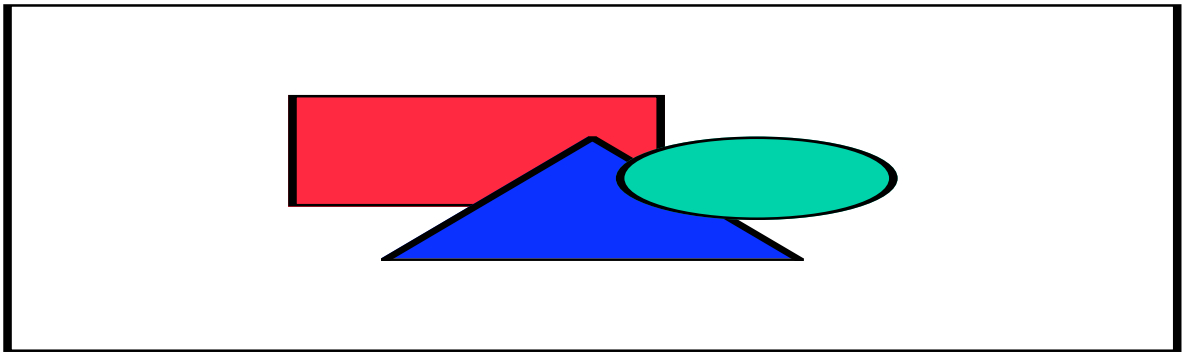

Figure 4. Examples of student work produced within 3.5 days of the Quartet Project

Initially students are taught the basics of each package and are then set a series of exercises within which they need to explore the software and think laterally in order to succeed. An analogy is made between building a model on computer and building a physical model out of a series of pieces of cardboard, with holes cut for windows. The initial shapes for each elevation are drawn as a series of 2D shapes, extruded to the thickness of a piece of card and then assembled to form a three dimensional form. The students use these techniques to model a simple building which they design during one of the other quartet project weeks (figure 4). As the students also build the same model out of cardboard at some point during the project - this allows them to make a useful comparison between computer modeling and physical modeling. It is interesting to note the differences in the work produced by those students who come to the CAD classes with a completed cardboard model and those who build the cardboard model after the CAD model. It is generally seen that the former produce Computer models of a higher standard., whilst the latter group start to realize how CAD might influence their designs.

Following the completion of the *Quartet Project* students have the opportunity to apply the skills learned within the core design projects. A number of these projects have a compulsory IT aspect. These "studies" are selected because the use of computer is seen as an appropriate means of enhancing design understanding. Examples of such studies are: -

- *An exercise in relating buildings to their immediate context***:** In the second semester of their first year, students use Computer Aided Design to investigate how their design proposals would relate to the context within which their project was located. This is done by the creation of block models of their proposals which can be placed within a model of the context. They can use these models to gain a rough approximation of the effects of daylight and shadows. This is an area which we hope to develop further with forthcoming cohorts, and students will use a number of different techniques, including photomontages, over a number of different design projects to understand the visual impact implications of their proposals.

• *An exercise exploring the use of computers in the development of architectural design ideas* It was initially intended that the principal computer based project in second year would be an elective allowing students to explore the use of computers in the development of design idea. This was piloted by a group of 12 students who used the technology to help with the analysis of case study buildings, which was then taken forward to the design of their own buildings. The project was largely successful, although a number of technical problems meant students were not able to use the technology to its full potential. This was borne out by student feedback.

There was also concern that this elective could only be taken by a select few and so it was decided that certain elements of the project would be made available to all students in the cohort. Students were asked to use the computer to prepare a detailed study of a particular part of their building, rather than to work on the building as a whole. The studies looked particularly at the internal visual aspects of their designs, including positioning of electric lighting - something that had been difficult to simulate by more traditional methods. This integrated well with a number of other studies that the students carried out on the environmental performance of their buildings, and students were able to make a contrast between a number of ways of modeling their buildings in environmental terms, in order to determine what would be the most appropriate technique for a particular task.

- *An exercise in space planning* Students in B.Sc. year 3 use CAD as part of a project to design a modern commercial building, Students used the software to experiment with a number of furniture layouts. In future years it is anticipated that this project will have a greater emphasis on the development of professional skills, and this will compliment well with a CAD Summer School, which the school has now been successfully running for a number of years.

• *Elective in Digital Architecture:* students in their B.Arch. final year have undertaken an elective in the use of multimedia techniques in the presentation of their designs. Students initially take part in a symposium discussing how computers may be used within the architectural design process. Then, using multimedia software students work with digital artists in developing a video or interactive presentation to capture the essence of their design projects

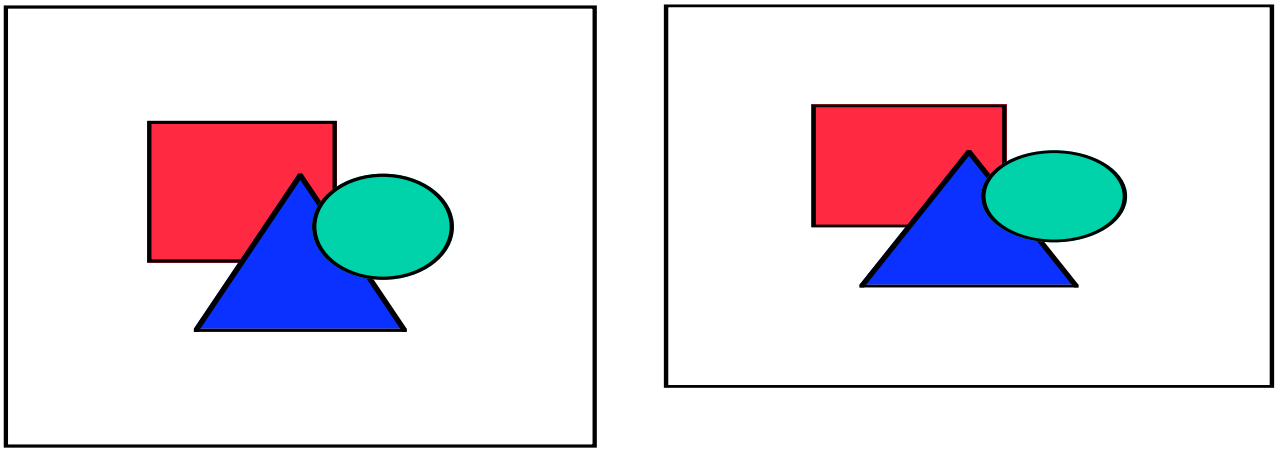

Figure 5. Student Work from the digital architecture elective

These *studies* have the joint aim of re-enforcing the skills developed in the initial Quartet Project but also suggest methods by which technology actively within the design studio. Thus students become equipped with a palette of tools and students are encouraged to u the computers are located within the design studios. However, creative use of this facility has been limited in recent years. It is possi an inspiration to use the technology, especially if there is no explicit element of assessment for using computers. It may also be possi design teachers tend not to regard Computer Aided Design as a creative media, but more of a tool for production of drawings and tha CAD teaching have little involvement with design studio teaching. Recently there has however been a trend years for a large proport the school to be carried out by architects from well established practices. These practices have tended to move away from the idea th production tool and have started exploring more creative aspects of Architectural Computing. Thus we are starting to see a number p staff encouraging students to use computers creatively. This is a positive move and has been seen to increase student use of the CAA

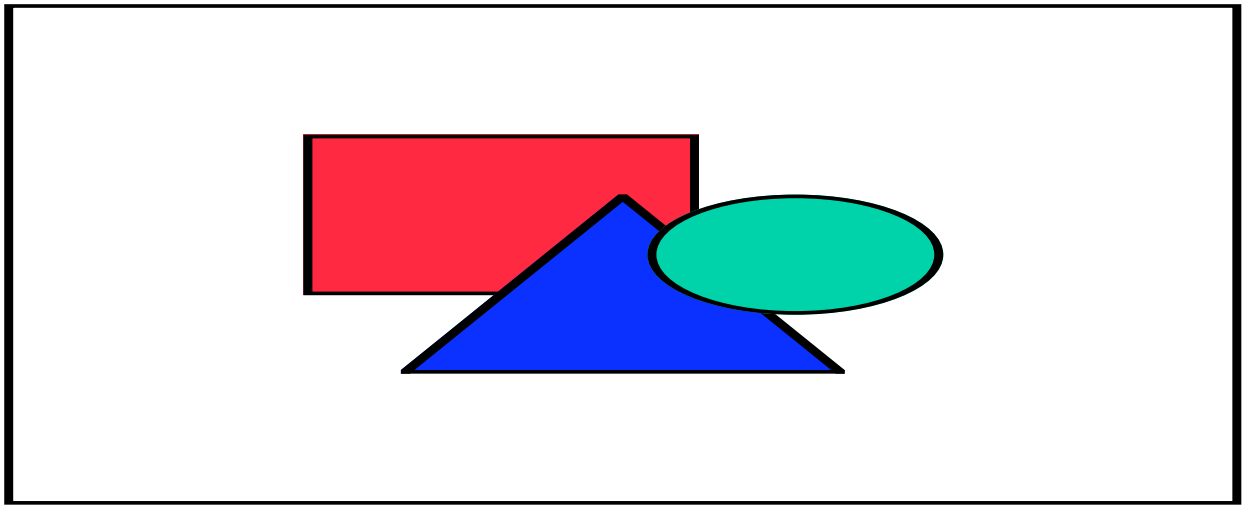

Figure 6. Tutors readily encourage the use of photomontages in student presentations

Conclusions

This paper has illustrated the development of CAAD within a school of architecture that adopts a linear curriculum, from one that was purely option based, to a facility which can be used universally by all students. It also shows that there has been a move away from the mechanical CAD *training* ethos towards a philosophy, which embraces the creative aspects of architectural computing. These changes have meant that we are now producing whole cohorts of students who have a reasonable understanding of Architectural Computing, rather than a small number of CAD virtuosos as had been the case in previous years. Whilst the integration of the subject within the architectural design process in studio projects has been one of the school's main objectives, tensions still exist between CAAD and studio and a number of fundamental challenges have been faced:-

- *What are the key skills in CAAD and how can they are taught to large cohorts effectively?*

- *Who should be responsible for teaching CAAD?*

- *How much time should be allocated for students to learn CAAD skills?*

- *What resources are needed to support and develop CAAD as a studio based discipline?*

Whilst it is still not possible to provide a conclusive answer to these questions, experience has shown that students tend to learn computing skills best when they actually need to use those particular skills. Spending vast proportions of time learning every single command within a CAD package for no apparent reason is not an appropriate use of student time. By limiting these *skilling* sessions to the bare minimum and encouraging students to experiment with the technology in their own time, ensures that whole cohorts can be taught in relatively short periods of time. The key skill in CAAD appears not to be an ability to use every single command, but an ability to think logically and apply and what has been taught to a particular circumstance, and the schools emphasis on application of skills to studies related to projects

enforces this.

A recent innovation has been the displacement of computing equipment from a specialist computing lab into the design studio. Unfortunately, for security reasons it has not been possible to locate the departments more powerful machines into the studios. Therefore these machines tend to be used for mundane purposes such as using the internet and word processing, and students continue to leave the studio to carry out CAD work. Students are also encouraged to bring their own computers into the design studio, but is an option that has generally not been taken up.

Within the school CAAD tends to be taught by specialist Computer Aided Design staff, who tend to be remote from the design studio. Therefore the subject is often regarded by students as a *bolt-on* extra, rather than an integral part of the design process. Having design tutors actively teaching CAAD, may help to blur this distinction, but specialist staff who are more likely to be researching the latest innovations in the technology serve to expand the students horizons about what is currently possible. The use of part time practicing staff who are actively using the technology within their practices can only be an advantage in encouraging integration of CAAD into studio.

Whilst we can not yet claim that our aim of fully integrating CAAD into the design studio has been achieved, positive moves outlined in the paper are clearly encouraging this integration to take place. Our policy of teaching CAAD as small studies which form part of core project may have its tensions with existing studio culture, but it does ensure that a maximum number of students gain an understanding of the technology within a limited period of time. As tutors and students start to realize the potential for Architectural Computing as part of studio projects the barriers between the Computing Studio and the Design studio will eventually be lifted.

References

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