

## **The Internet as a Tool for Communication in Design Projects**

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### **Abstract**

When entering a modern design practice, architecture & design students must not only be skilled in current CAD applications but must also be familiar in the transfer and organisation of information and data on the Internet. Similarly, the PgDip in Computer Aided Building Design (CABD) at the University of Strathclyde addresses not only the conventional spread of CAD tools but also investigates the promise of collaborative design through on-line communications and the sharing of project data. This aspect of technology forms the core of the Internet & WWW Module within which the aim is to investigate the strengths and weaknesses of the Internet as a design communication medium and also to promote group working, peer learning and the development of students' ICT and organisational skills, while also encouraging co-operative and collaborative working. [Abstract provided by Author]

The case study:

- provides details related to the teaching methods used on an internet based design project;
- outlines the technologies used in the project;
- provides an analysis of students' working methods, with data extracted from web logs and diaries;
- provides an analysis of the barriers and enablers to the implementation of this type of project;
- outlines what has been learned through carrying out the project;
- and provides recommendations and good practice for the implementation of similar projects.

**Keywords:** Design Studio, Internet, Design Projects, Collaborative Learning

### Good Practice Points:

- Establish all technologies well in advance, ensuring reliability.
- Update communications tools, but do not necessarily use the latest systems as they often do not integrate well with other systems and are often bug ridden. 'Netmeeting' is now used as it is a more 'all encompassing' 'low tech' piece of communication software. It allows for text communication, audio & video conferencing, sharing of applications and collaborative browsing.
- Maintain a heterogeneous environment in which a variety of tools can be used.
- Allow for technical hitches and have alternative methods of continuing project work.
- Allow students time to familiarise themselves with the software being used.
- Do not overestimate what can be achieved. Four weeks for the Internet Design Project was a realistic time scale for what was expected of the students.
- Inform the students of what to expect with team work and working in virtual environments.
- Establish procedures for working in this 'new environment'. This includes organising times to be online (and communicating).
- Try to maintain high levels of enthusiasm.

## Introduction

Advances in communication technologies, CAD and visualisation tools in the last decade have moved the design studio into the virtual environment. As Dr. Simoff clearly notes, in a landmark paper and subsequent monograph:

*“...the location of designers is irrelevant.....because the workspace of the studio is distributed across the net. Designers are able to enter the studio for interactive and non-interactive sessions connecting to the World Wide Web, multimedia mailers, and /or connecting to a video conferencing session.” (Maher et al, 1999)*

Virtual Design Studios (VDS) are proliferating in schools of architecture and engineering (Wojtowicz & Butelski, 1998; Smith, 1999; Kolarevic *et al*, 1999), and are proving to have many pedagogical benefits, such as vicarious exposure to other cultures through interactions with overseas students and teachers. The VDS setting invites students to reconsider the meaning of external sources of knowledge, but VDSs also bring many difficulties for learners, such as establishing trust and team cohesion and technical problems, amongst others (Kvan, 1997). This case study describes such a VDS offered to students on the postgraduate degree course in Computer-Aided Building Design (CABD) at the University of Strathclyde, Glasgow (1999-2003), noting both the benefits and barriers to use and the learning experiences encountered. It concludes with recommendations for good practice for the implementation of similar projects.

## The Project and Teaching Methods

The case study focuses on the initial offerings of the Internet Design Project, with more recent developments highlighted throughout the text where appropriate. Building on knowledge gained from the ICON projects (Sclater *et al*, 1997; MacGregor & Ion, 1999), the Internet Design Project has been offered to students every year since 1999. Students require a relative standard of IT expertise to carry out the project. It proved advantageous to schedule this module towards the end of the first semester of studies so as to ensure that all participants could draw on experience from preceding class modules covering basic CAD skills in 2D and 3D graphics, image processing and webpage design. This equips students with the skills required to establish a “point of presence” on the Internet, establish their “virtual design practice” and publish the outcomes of the design project online.

Each year the CABD class, of anywhere between 30 and 45 students, is split into groups (design teams) of about four. Harasim *et al* (1997) note the importance of group size when designing collaborative activities. Too many participants may mitigate against effective decision making, particularly in an asynchronous environment. They suggest that having three to four members in a group is manageable. In early years of the Internet Design Project we have allowed groups of five students to work together and found that with the increase in numbers the dynamics within the group become too complex to manage, resulting in weaker group work and lower standards.

Over four weeks, each of the groups, with a tutor acting as the client, was required to:

- engage in online dialogue to formulate a brief detailing a studio and living accommodation for an artist (the client) using email (one week);
- develop outline/scheme design proposals using internet communication technologies (within the group and with the client) (two weeks);
- maintain a web log of communications and design development (in both text and image format) (continuously);
- construct a web diary of daily events including communications;
- prepare and make a formal web presentation of the final design solution to a client (and the other groups) using internet technologies (one week).

Class pedagogy was based around problem-based learning (PBL), common place now in architectural education. PBL offers a greater range of learning situations and allows the student greater control over the pace of his/her learning than in a lecture or classroom format. This was supported at key points by lectures from staff on basic content and theory. Group working seminars and tutor-led demonstrations of the communications software were also conducted. Leading experts from practice and software vendors were invited to make presentations to the students to contextualise current use in practice.

Moore (1993) notes three types of interaction which take place within remote and distance education, learner-content, learner-instructor and learner-learner interaction. The Internet Design Project focused more on learner-instructor and learner-learner interactions. The tutor/instructor was part of the team on the project (the client) and was present not only to guide the groups through the project, acting as a facilitator, but also more importantly was there to introduce the students to the process of reflection-in-action. Reflection-in-action, developed by Schon (1983), looks backward to immediate past experiences, and forward to experiences which are imminent. It entails as much anticipative thought and analysis as retrospective review. This was accomplished through web logs and diaries. Each stage of the project was forward-planned by reviewing past development and students recording this in their web logs.

Peer learning (learner-learner interaction) within teams supported student learning on the Internet Design Project. Dividing up tasks allowed students to cover more ground and examine more issues; discussing the problem online allowed the team members to examine and test their ideas at times and locations that suited the teams. Peer learning also strongly supports the learning of computer skills, through the sharing of software knowledge either at the terminals in labs, or through remote online communication.

The learning outcomes for the Internet Design Project were:

- to be able to communicate effectively using Internet technologies;
- to be able to critically assess the strengths and weaknesses of the technology employed;

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- to be able to conduct formal and informal dialogues both internally within the design team and externally with the client to produce a design brief and consequent solution;
- to be able to apply software tools creatively to the design and presentation of an agreed design solution; and
- to understand the dynamics of group working and design within a group.

The assessment criteria for the project were based on the quality of the final design proposals and the final web presentation, along with a review of the success (or otherwise) of each group's interactions. Team work is evidenced through the web diaries which also indicated how the work had been shared and who took on each of the required responsibilities.

### Evaluation

The evaluation of the project involved a number of methods. Students were observed throughout the project in the computer labs and the studios; staff could communicate with students online to obtain progress updates and they had access to the team web logs during the project. There was the opportunity to review the final scheme drawings and discuss the project with all the teams at the final web presentation. And at the end of the project, a questionnaire and focus groups gathered valuable qualitative data which was used each year to develop and improve the class.

Over the years students have been very positive about the project – '*...highlight of the year*'; '*good fun sending messages*'; '*worthy experience*', but found the group work frustrating and often became annoyed if the technology did not work. Communication by email often took a long time to be returned, however, real time sessions proved to be fast and effective and it was felt that the ability to 'send' a drawing and discuss its contents on a screen synchronously with a client or a designer, was indeed an improvement on traditional methods of communication - telephone, letter, fax.

Continued external examination of the course and association with industry helps to maintain quality assessment and keep students informed of latest developments in professional practice. The Internet Design Project could be adapted easily, in part or whole, to other disciplines particularly those of the built environment.

### Working Methods

Examination of the material in the web logs and in the web diaries allowed staff an insight into the students' working methods and patterns. Although the project focussed on the experience of using internet technologies to progress a design project with a client, students were encouraged to meet face-to-face at points they thought necessary. It was noticeable that overseas students tended to meet face-to-face almost daily, whilst other students met every 2-3 days.

In the earlier years of the Internet Design Project more emphasis was on the communication and the use of the tools, so face-to-face was less. The purposes of the online sessions (email and real-time) were identified by the students as:

- reviewing of different proposals;
- discussing the development of the project;
- emailing ideas;
- experiencing desktop conferencing, and
- communicating with the client.

They now tend to use face-to-face to establish the project, assign work, identify roles and then use email and conferencing tools to progress the designs; 'meeting' online almost daily with as many members of the design team as possible. The real-time online sessions were arranged in a number of ways – face-to-face, or via email, or mobile phone. The better teams would elect a person in charge of communications and group organising, ensuring there was an agenda to the sessions and that all electronic material, especially images, were ready to hand and in the right format.

Students were allowed to form their own groups and meet beforehand but were not encouraged to physically meet the 'client'. This proved extremely difficult for a few groups – *'...could not see the client in person – very frustrating'*. Students who knew each other prior to the Internet Design Project found that they could communicate better and express their ideas more openly than groups who had never met.

Groups who agreed a sub-division of tasks early on in the Internet Design Project created more harmonious working relationships, aiding communication significantly. They found that identifying the overall group objectives, identifying and prioritising the tasks necessary to achieve these objectives and specifying the group working procedures were essential activities to starting the project. Most groups would *'capitalise on individual's strengths, each working on the areas he/she was best at'*. In nearly every group, all students wanted to contribute to the design – *'all worked on the brief & design development'*; *'whole team responsible for brief and design development'*. This often caused conflicts within the groups. Groups which appointed leaders seemed to perform more successfully - *'it was essential to have a good leader'*.

The portion of time spent working in the department and elsewhere varied from group to group. Over the years it appears to average at about 50% in the department and 50% at home. Students have reported that *'group work was carried out mainly at university with individual tasks (drawings, research, presentation) done at home'*.

## Findings on Technologies Used

Technologies were initially 'very low tech'; the aim being to keep the equipment and infrastructure as 'invisible' and maintainable as possible:

- University & home email

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- Microsoft's 'Netscape Communicator' v4.7 (pc platform) desktop conferencing
  - text based communications
  - file/document transfer
  - whiteboard (for marking up drawings)
  - audio & video desktop conferencing (more recently).

Students had prior basic knowledge of the necessary software used to create text, drawings, images and models – Microsoft Office, Adobe PhotoShop, FormZ (3D modeller), AutoCAD and Adobe PageMill (web editor) from previous classes on the course. This software was available to the students on 20 Pentium PCs and 20 iMacs in two Departmental labs. The groups tended to carry out design in a traditional manner, sketching on paper and then scanning these sketches as Jpeg files which were circulated electronically via email or used in real time sessions. Many students purchased their own educational copies of FormZ (a 3D-modeller and renderer) since this was one of the component tools of the course) for their PCs at home; all had Microsoft Office and some form of image editing tool and several had access to AutoCad at their part-time place of work. In earlier years, students carried out the web page design project using PageMill but more sophisticated software like Dreamweaver is now preferred by students which they are able to download from the internet on a 30 day trial.

Any staff training in connection with the project was on a self-taught basis and all testing of the communications software prior to implementation was undertaken in mini trials with a few willing student volunteers. Technical support was available from a technician and within tutor team expertise.

### **Email**

Email and file attachments were initially used, to establish a brief between the design team and the client. This proved an easy introduction to the project as all students were familiar with email capabilities. Most had email accounts at home and (more recently) some groups set up 'Hotmail' accounts for the purpose of the Internet Design Project. Clients pulled images from the Web to illustrate precedents, preferred styles and material choices which were then sent to their design team. Jpegs of proposals were imported into Word, annotated and emailed back to the client for comment.

It was noticeable that the students were 'chatty' and informal when using email to communicate within the groups i.e. student to student. However, when communicating with the client the electronic dialogue became far more formal. The students accounted this to their perceptions of the appropriate type of dialogue expected in practice between a designer and a client. But perhaps the tutor being the client had something to do with that dialogue becoming more formal! With the asynchronous nature of email there was uncertainty during the Internet Design Project as to whether emails had arrived and there was no guarantee of an immediate reply. In some instances, when response times were not fast enough, communications began to break down and *'time was wasted in waiting for replies'*. To counter this, groups communicated online several times a day, some groups requesting

emails be directed to both home and workplaces as well, allowing work to continue into the evening. Most groups soon exposed the limitations of using e-mail as the sole means of communication and had concerns with text-only communication when applied to graphical concepts. Textual communication had to be precise, self-explanatory and unambiguous and often tended to be over verbose in order to achieve clarity. It soon became apparent that the ability to attach drawings and sketches (as files) was extremely useful as these could describe much more.

### **Synchronous Communication**

Real-time desktop conferencing offered a better level of communication. Initially the Internet Design Project relied on 'Netscape Communicator' for these real-time sessions but latterly Microsoft Office's 'NetMeeting' was used (as it offers audio & video conferencing using a web cam). The software was mounted on two groups of PCs situated at geographically remote sites on campus. Early in the project the systems were demonstrated to the students and some time was set aside for them to investigate and experiment with the functionality. Each group was subsequently required to carry out a minimum of three sessions of real time communications with their clients in order to:

- show images of precedents and begin to develop the brief,
- develop an aspect of the scheme online, and,
- discuss the final scheme.

Students were also required to carry out real-time sessions within their design teams on the Department computers. Very few students entered into real time communication away from the university, instead choosing to carry out the majority of their remote online communication asynchronously via email and file attachments.

The students mainly used the chat facility and the whiteboard of 'Communicator' and more recently 'NetMeeting'. The whiteboard was used for real-time sessions both amongst the design team and between the client and the design team, usually by importing and then annotating drawings (Jpegs) created on other CAD software. This ability proved "*a highly effective and user friendly method of communication*" in the exchanging of information. The drawing tools supplied with the whiteboard were rather primitive and best used only for marking up drawings created in more sophisticated packages. The students often used the text directly onto the whiteboard to add comments to the drawings rather than opening up additional text boxes which often reduced the size of the available viewable window on the screen.

Having text and drawings visible at the same time seemed essential for the development of the proposals. One criticism of working on the whiteboard was the difficulty in knowing who was in control and the students quickly had to establish a set of procedures for writing, drawing, and taking turns. One student found, *'It was more effective using text messages on the whiteboard and drawing at the same time'* whilst another found it simpler to keep the discussion to the 'chat' window whilst viewing the drawing on the whiteboard simultaneously (see Fig.1).

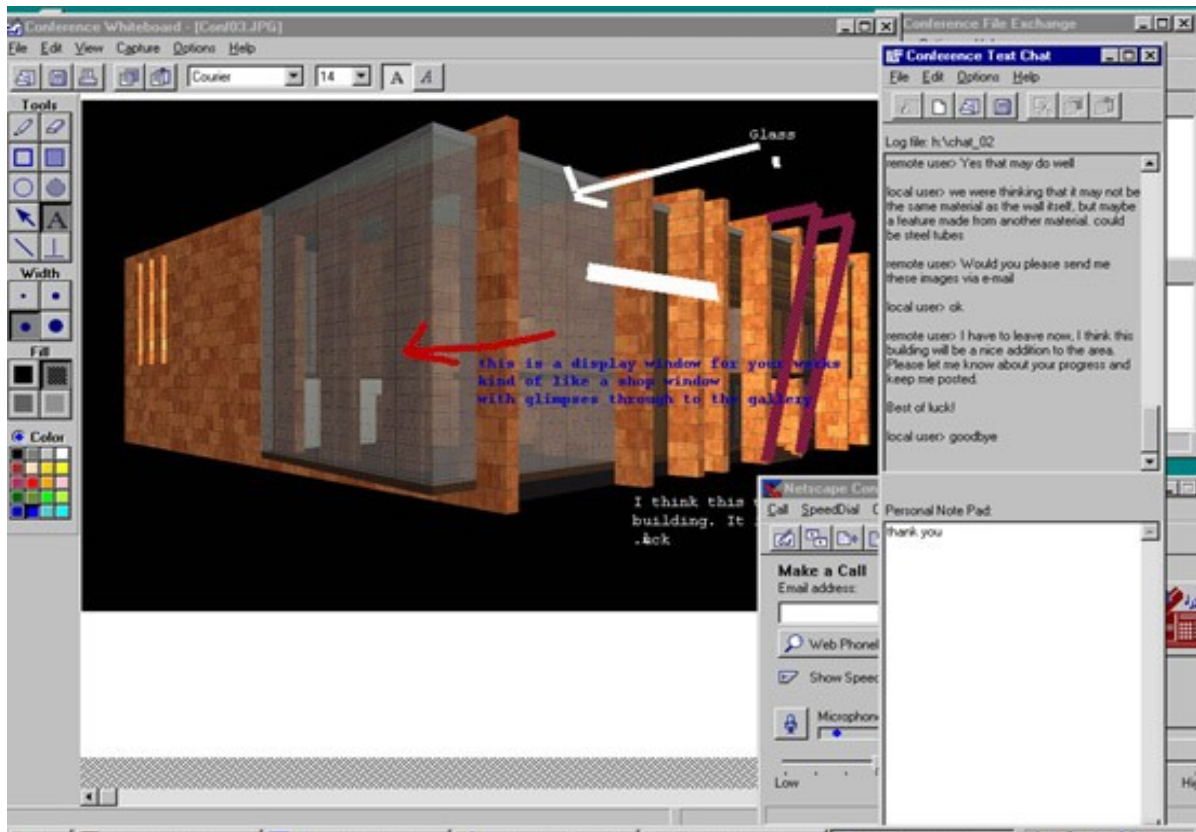


Fig.1: Development of proposals using 'Communicator's' whiteboard and 'chat' simultaneously

Students had to establish 'new rules' for working in this environment particularly associated with the visually intensive field of the built environment. When using the whiteboard, some groups agreed upon a colour coding system for different team members. Codes were established for ending messages in chat sessions in order not to waste too much time anticipating a longer response. Students were often misunderstood when engaging in their virtual communications. Difficulties were overcome in the strategic wording of communications by using humour and adopting a more informal approach to communications. Students experienced 'it is easier to ignore, cut-off or dominate the other person in a virtual setting.'

### Video Conferencing

Subsequent developments of the Internet Design Project, as a result of student demand for better remote communication, have explored the use of audio and video conferencing. The Internet Design Project now uses Microsoft's 'NetMeeting' to conduct all online communications. Most students agreed that audio communication in conjunction with the whiteboard was a fairly effective means of conveying design ideas from the designer to the client. Video capabilities, using two remote PCs and web cams, on the other hand, were felt to be rather crude. Even over an intranet, speech lagged behind the image, causing

dissatisfaction. The quality of drawings viewed via the video camera was also extremely poor forcing the students back to the whiteboard. Despite proving less useful for developing the designs, students noted their enjoyment of the video conferencing sessions. They realised the importance of audio and video in the conveying of expression and meaning to communication, something which text-based conferencing alone cannot do quite so effectively.

### Web Log and Web Diary

In addition to the communications aspect of the project the students were required to create a web diary of daily events, noting the group's responsibilities and the development of the project (Fig. 2).

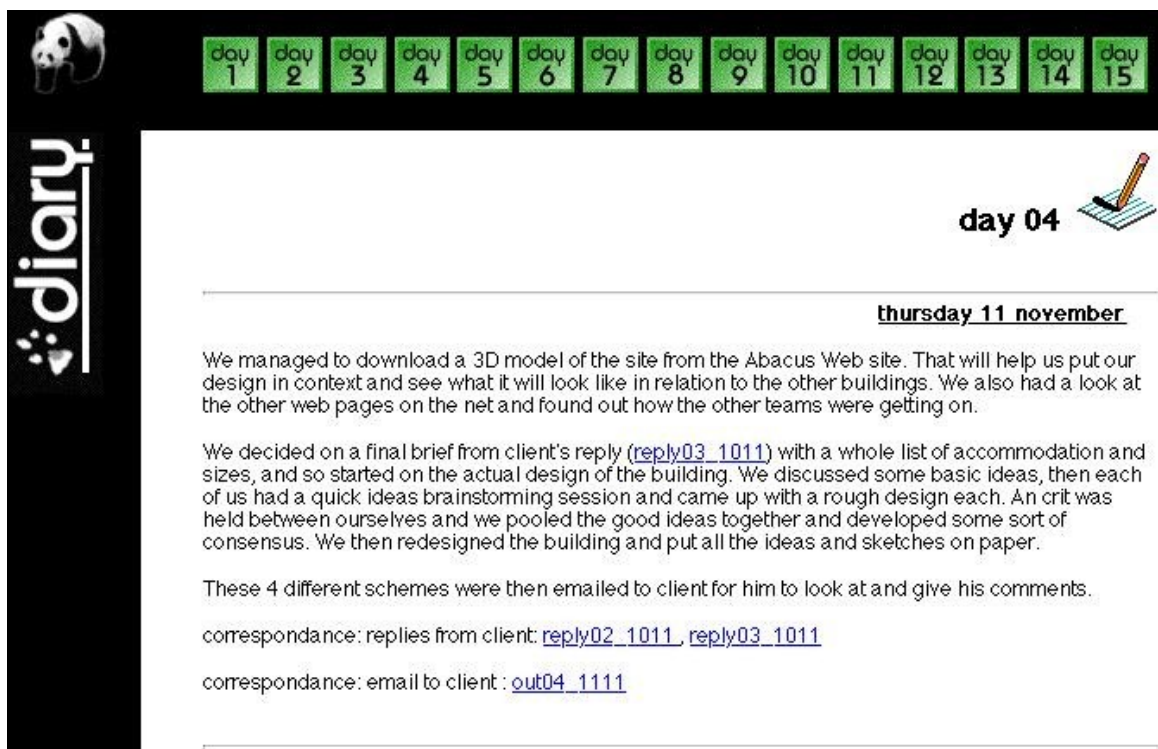


Fig. 2: Diary entry outlining daily activities, presented on the web

To support this, each group had web space on the Departmental server (referred to as the web log) created for them by a CAD technician, to upload all communications, text, notes, images, etc. They were instructed in the uploading of the information using simple ftp software and only each design team's members and their tutor had access to their own logs throughout the project. The log was then edited to produce a diary of daily events, communications and development. This was to simulate the keeping of a diary of project events in practice. Some students found this 'useful in helping organise information and emails' but most found it '...tedious and over laborious'; 'a chore and hassle'. The web log (which chronologically stored their information and communications) has been eliminated from the project due to the time taken to upload and download information. Now the students

set up joint e-mail accounts and delegate individuals in the group responsible for storing data, images, etc on their computers until they are required for input to the web diary, or for the final presentation.

## Benefits of Internet Design Project

Introduced in direct response to increased student numbers, the Internet Design Project's increasing reliance on peer learning is proving quite successful. The collaborative approach promotes a dynamic creative process whilst the production of the web diary offers a platform for documentation and reflection. University study simulates professional practice by promoting team work skills; developing organisational skills and keeping up-to-date with new communications methods used in practice. The students on this programme will all be exposed to these technologies when they graduate; they will have the advantage of prior experience and first hand knowledge of problems involved when communicating in this mode. *'We can see how useful it could be in practice to link professionals at a distance'* and *'...useful in practice but will not supplant face-to-face meetings'*.

## Barriers

The barriers experienced can be summarised in two main categories; technical and social. Unreliable software and lack of technical training and support caused frustration from time to time and had a negative effect on groups. But the social elements of communicating within virtual teams seemed to cause greater problems, e.g. not knowing collaborators in advance; not having clearly defined roles and responsibilities; misunderstanding each other in virtual space; frustration with asynchronous collaboration and differing student personalities.

Reflection and subsequent change to the programme over time, including improved introductions to the project and better preparation of the students, has managed to overcome many of these barriers.

## Learning Experiences

A number of key issues became apparent as a result of the project:

- Physical distance becomes increasingly irrelevant when working collaboratively on design projects.
- The designer and client (from disparate locations) can *'pinpoint exact areas of discussion....look at various design solutions, with immediate comment and counter comment'* and then *'agree on schematic design to be further developed by the designer, all very quickly.'*
- The Internet Design Project offered students new insights into alternative methods of working utilising communications technologies. They experienced some of the possibilities and limitations of the new communication tools shown to them and used various combinations to facilitate the development of their proposals.

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- They had to establish 'new rules' for working in this environment in order not to be misunderstood.
- Each had the opportunity to develop skills in teamwork throughout the process of the project - essential for working in practice.
- The web logs and web diaries offered opportunities for reflection and informed planning of each stage of the development of the proposals.

### Recommendations and good practice for the implementation of similar projects

Each year, the Internet Design Project is re-evaluated and refined on the basis of what has been learnt over the preceding session. Several recommendations can be made from our experience of what makes a successful Internet Design Project:

- Establish all technologies well in advance, ensuring reliability.
- Update communications tools, but do not necessarily use the latest systems as they often do not integrate well with other systems and are often bug ridden. 'Netmeeting' is now used as it is a more 'all encompassing' 'low tech' piece of communication software. It allows for text communication, audio & video conferencing, sharing of applications and collaborative browsing.
- Maintain a heterogeneous environment in which a variety of tools can be used.
- Allow for technical hitches and have alternative methods of continuing project work.
- Allow students time to familiarise themselves with the software being used.
- Do not overestimate what can be achieved. Four weeks for the Internet Design Project was a realistic time scale for what was expected of the students.
- Inform the students of what to expect with team work and working in virtual environments.
- Establish procedures for working in this 'new environment'. This includes organising times to be online (and communicating).
- Try to maintain high levels of enthusiasm.

### Conclusions

Communications over a distance can be particularly difficult to sustain and it is significant that the most successful groups were those that maintained enthusiasm and worked co-operatively. *'Group interest was high which contributed to the success of our project.'* The support of the educator is also essential in helping students in an online environment and by making the tutor part of the design process, ie the client, teams had an advisor ready at hand.

We found that effective collaborative work necessitates a high level of feedback. Although email allowed the attachment of diagrams and other graphics, the inability to discuss these in real time hampered the collaborative design process. Synchronous collaboration, occurring 'same time, any place', provided a sense of immediacy, the ability to plan and solve problems and make decisions more quickly, which proved very useful to the students (Marjanovic, 1999).

## Acknowledgements

Dr. Michael Grant, Director of Computer-aided Building Design Course

Charlie Brown, Chief Technician

Peter Welsh, Part-time tutor

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