Architectural Education Objectives and the Use of Multimedia

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The Background

The almost universal curriculum format for schools of architecture involves conventional lecturing techniques in the areas of history, structures, construction. building materials, urban planning, contextual studies and of late CAAD. Conventional academic wisdom dictates that the information and techniques gained from these lectures be applied through the design studio where this acquired data is synthesized with design concepts to produce an end product.

Conventional lecture styles have usually imparted information through the spoken word emphasized and accompanied by written support through the use of hand-outs, black/white boards, overhead projection and the ubiquitous slides! More adventurous exponents have endeavoured to incorporate videos, films and projection of computer generated screens to supplement the basic information transfer. The transmission retention/comprehension rates of concepts, ideas and basic data have depended greatly on the charisma of the individual lecturer, his command of the subject and the students' enthusiasm to partake of the process of information transference. The inherent problems of lectures being a one way action with little, if any, participatory involvement of the students have caused concerned lecturers to resort to seminars, tutorial, tests, exercises and other forced participation modes to involve students in their own education.

Bligh in his book "What's the Use of Lectures" states *"the lectures indispensability is not obvious from present evidence. Similarly, the electure method is not economic in terms of time or anything else, if it cannot achieve its required objectives, and this achievement is opened to investigation.*"[1] The addition of the design teaching component in the case of architecture students increases the complexity of the lecture problem and the usual one on one studio teaching methods do not ensure the optimum use of staff resources. As class sizes increase and fields of study become more complex and diverse the studio design staff find themselves under considerable pressure. Continuous assessment techniques, individual presentations and critiques place an additional burden on the students and on the staff.

The belief that staff in Universities and Institutes of Higher Learning should more actively in research is a universal demand from bodies and from the institution's administrators themselves. There is a direct conflict between the time allocated to teaching duties and to the time available for research activities. Although some recent comprehensive research in Australia indicates that there is little, if any, support in the thesis that higher research outputs produce higher standards of teaching [2] the immediate funding policies take this as fact

and Architecture programmes, because of their high staff/student ratios and long contact hours are probably under the greatest pressure of all the university courses.

Traditionally, lecture courses for undergraduate students have been of a repetitive nature as the basic skills and information have to be impacted to each new intake of students. With conventional methodologies there have been only minor opportunities to vary the contents of these lectures and the intellectual challenge to staff is considerably reduced as each year passes.

With these limitations imposed by conventional teaching methods the Faculty of Architecture at the University of Hong Kong in 1991 took a conscious step towards the development of self-learning modules for students to complement the normal lecturing and studio methodologies. The net result has been the development of a new 3D Interactive Multimedia Studio where the process of teaching becomes dynamic rather than static, cumulative rather than repetitive and open-ended rather than closed-staged.

It is proposed that instead of the conventional split of formal lectures/seminars and the studio-based design courses students be introduced, from the first year to an alternative element of learning in the form of self-learning modules. These modules are not intended to eliminate lectures but more to produce an integration between the passive accumulation of information and techniques and the active application of them in the design studio environment through the use of computers capable of handling multimedia [3] formats.

Additionally this system will permit the students to progress at different rates through the materials and will allow them to return to a particular topic for reference or revision. The self-learning modules will, at first, be installed in the present computer laboratory but it is hoped that within a short space of time each design studio will be equipped with a number of workstations capable of delivering these packages and through them providing on-line access to other data-bases.

As the number of these self-learning modules increases, so too, will the interaction between currently disparate courses e.g. History, Structures and Construction. Students will be presented with more holistic introductions to the complex field of Architecture. The reliance on lectures will diminish and level of integration will increase. Students will not have to rely on personal notes but will be able to retrace or revise at their own pace. Because of the interactive nature of the methods of access to data-base information contained in the self-learning modules can be extracted and applied to the students' studio projects.

The System

The prototype, identified as Temple Tutor, started with the primary objective of producing an interactive method of accessing a data-base that encompasses the entire range of convent tonally taught lecture subjects as well as studio design teaching requirements. To achieve this objective a multimedia system was proposed but after careful examination of the available systems on the market it was decided to develop a purpose built system that could cover a much wider field than the standard multimedia software could provide particularly with respect to the ability to incorporate 3D modelling. Initially the research team investigated the possibility of utilizing a PC based platform but it was relatively quickly determined that the speed and graphic capabilities would not be adequate. The PC inputs, however, were not discarded and the ability of the final system to accept PC generated data played an important role in the developed software.

A pivotal decision was taken early in the project to utilize a 3D digital model as the primary means of assembling and identifying disparate pieces of data and the "explode" and "reasonable" techniques of Object Orientated Modelling permit a system to be broken down into sub-assemblies and components each of which can be linked to a variety of data-bases. The 3D digital model acts as a guide to the system and the approach to self-learning can be in a systematic cumulative layer upon layer approach or by a specific topic-in-depth search.

After considerable investigation and with a very limited budget it was decided to purchase SGI Iris(Indigo) workstations as a suitable multimedia platform. These have been configured with 48MB of' RAM, SGI video boards, 1.2 gigabyte harddisks, CD-ROM drives and DAT tape drives. A LAN connects the research team's Indigos with the Faculty computer laboratory which contains Personal Iris workstations as well as digitizers, plotters, scanners, printers and a film recorder. The LAN also connects to the University network and this permits interconnection with other Universities in Hong Kong and overseas.

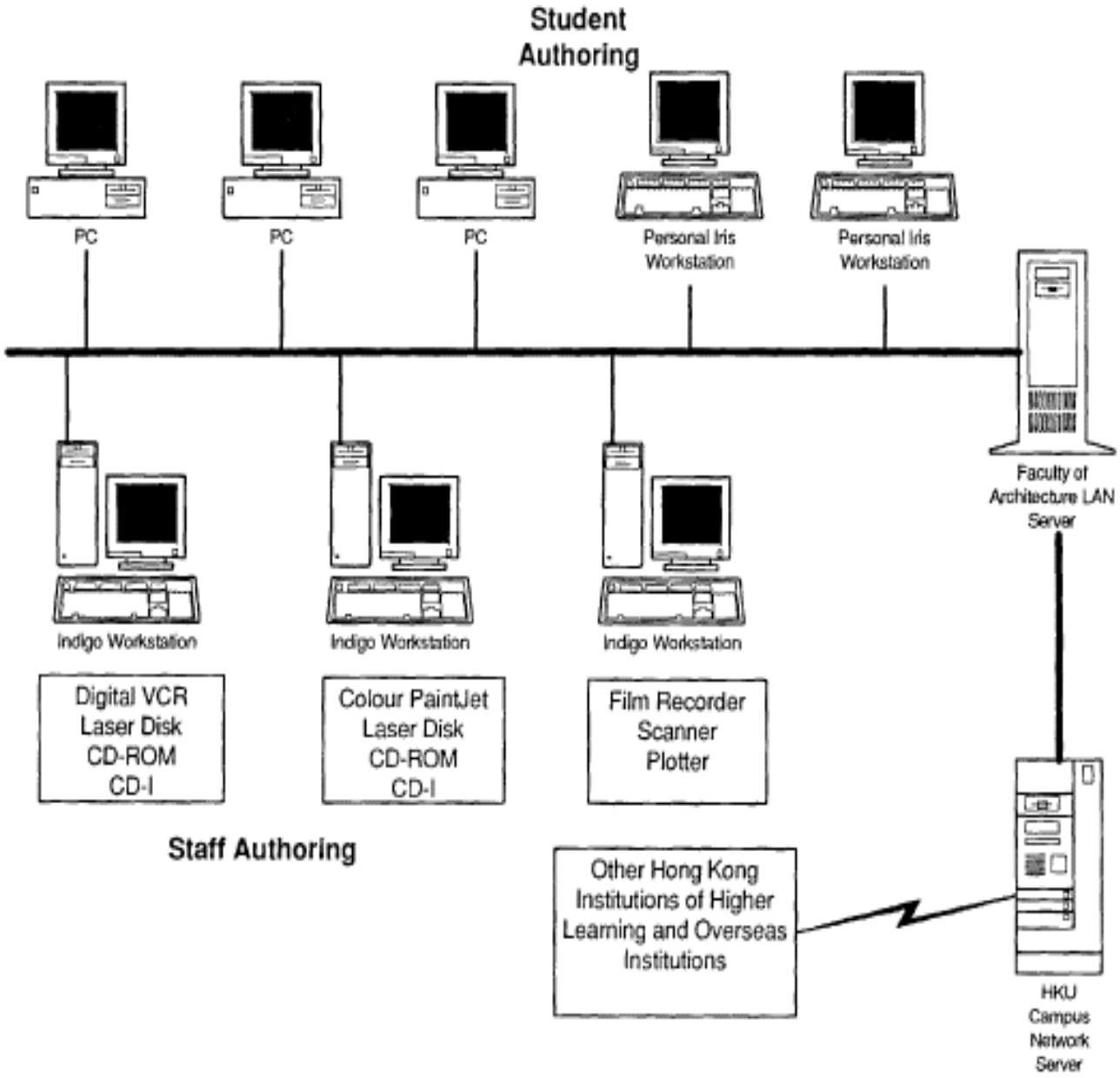
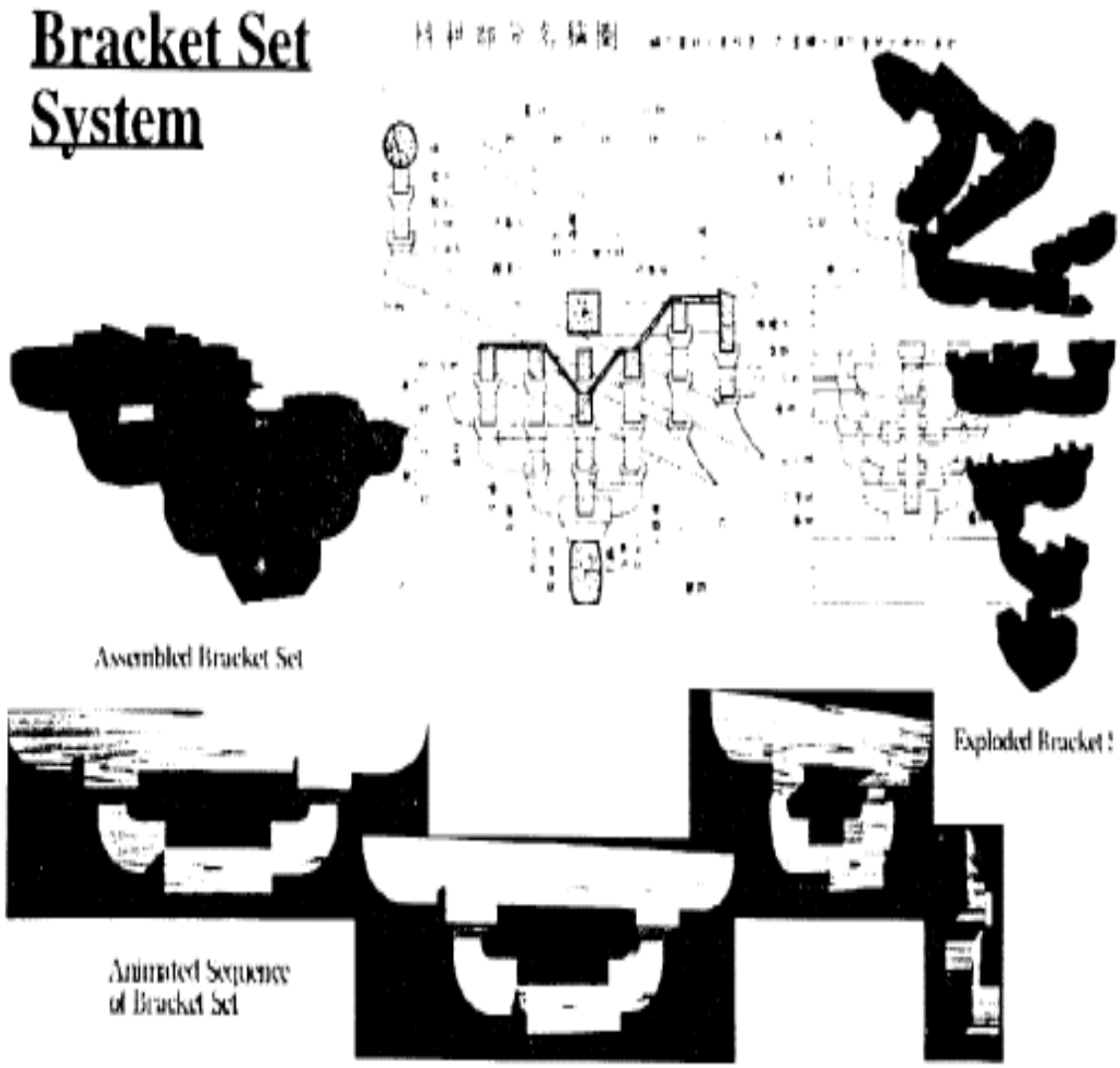


Fig. 1 The LAN System in the Department of Architecture, HKU

The multimedia system has been developed by using the UNIX based operating system of the SGI, C++ and "Showcase" and "Inventor" software packages [4]. The 3D models have been developed by using OOM techniques with specifically defined scene graphs to ensure compatibility of the models. This consistency in nomenclature is essential for cross-listing of objects and it enables comparison, substitutions or superimposition of comparable elements as required. A number of translators and routines have been developed within Inventor to permit the use of sound and video techniques together with text files, surface rendering files and animation routines.



Two levels of authoring are permitted by the system - the first is that of the staff-authoring and data is on a protected level accessible to the students but not able to be modified by them. The second level of authoring is for the students themselves and they are able to create their own multimedia files. These files are

structured within an agreed format to ensure compatibility and are checked by staff for relevance and correctness before being assimilated into the protected data-base.

The major advantage of this arrangement is that much of the information that is collected by the students is able to be retained and used for future research or projects rather than being lost or misfiled as is the case with current student projects in most Architecture schools. In addition the information is stored in an easily retrievable form and subsequent students may enhance the existing data, add new sections, or under controlled conditions, update or modify complete sections of the data-base. By this methodology substantial holdings can be built up rapidly and the accumulation process is also a very positive teaching technique.

Periodic surveys of the data-base, which at this stage is held in "soft" form on a harddisk, will determine which information can be transferred to a "hard" form by the use of CD ROM disks [5]. These CDs will form the basic self-learning units for students and will provide a ready reference system for studio projects and for future research. An interim step of producing disks that are capable of write-once read- many-times was considered but the set-up costs for this stage preclude it at this time.

The Pilot Study

The first application of this multimedia prototype was carried out with students of the first year of the M.Architecture programme at the University of Hong Kong. Sixteen students agreed to undertake a test-run of the system by applying the process to a specific course viz. "Building Systems". They were divided into four groups and each was allocated the task of preparing a 3D model of a traditional Chinese temple. Four periods were chosen; Tang, Sung, Ming and Ching with the objectives of producing comparable models that could exemplify the aspects of the system previously described.

All of the students could be considered "computer literate" in as much as they were familiar with word processing, AUTOCAD, etc. Several of the group had worked at higher levels of architectural computer graphics but none of them were conversant with UNIX based systems. The general principles of the system were described to them in a seminar setting. Overviews of the system were explained and they were introduced to the operations of the SGI Indigo. Most of the group had only had previous experience of PC based systems.

A series of tutorials spanning over a total of ten hours explained the capabilities of the Showcase and Inventor software packages and after initial attempts at producing small scale objects in the form of interior furniture the students were

then asked to produce full 3D models of the temples using available measured drawings photos and slides. The average time expended by the students in the exercise was 85 hours per student and they are now completing the project to bring it to its full multi-media capabilities by the introduction of surface rendering and animation techniques. They have already incorporated text files in both English and Chinese as well as photographic files and 2D images. Sound files are also under preparation.

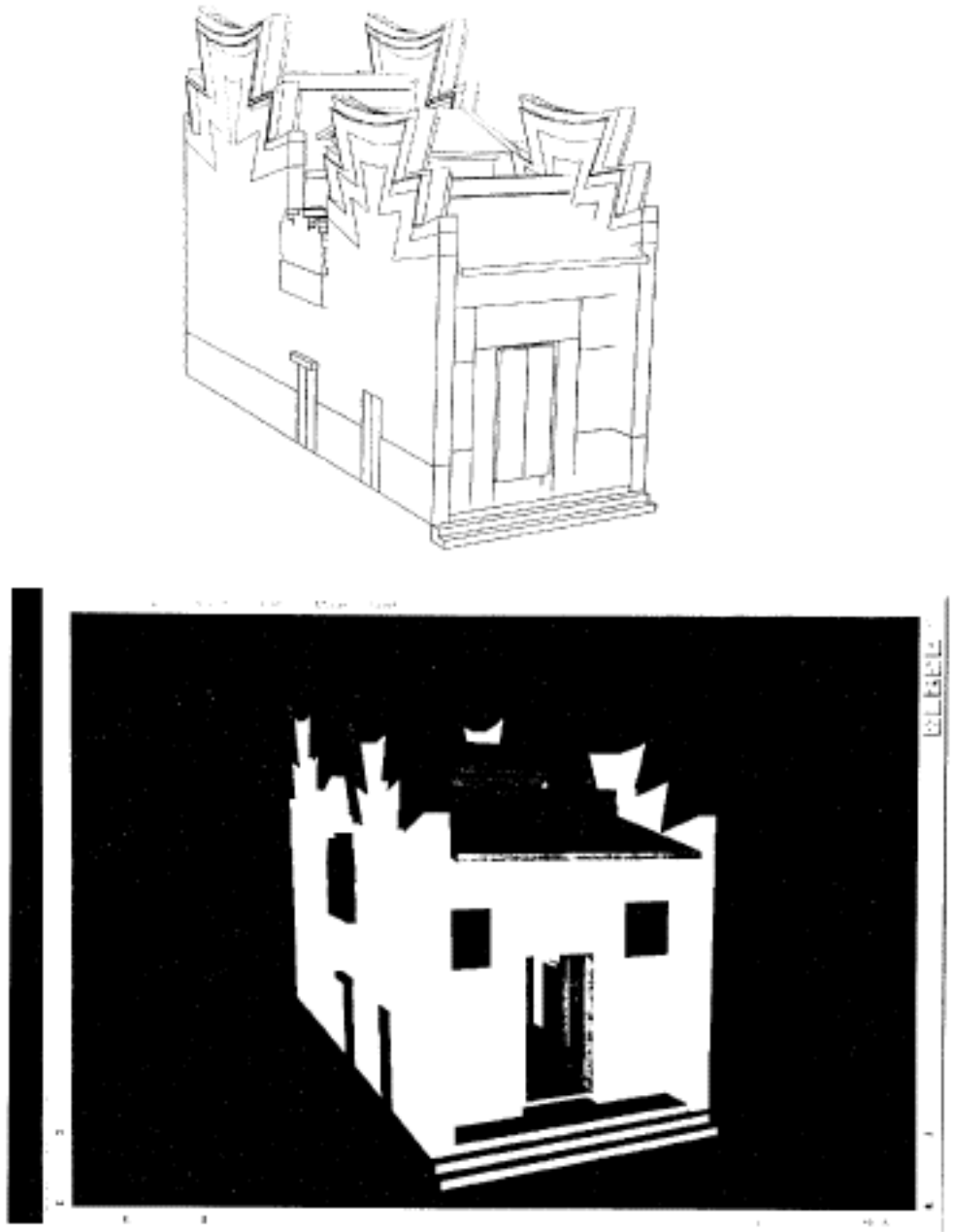
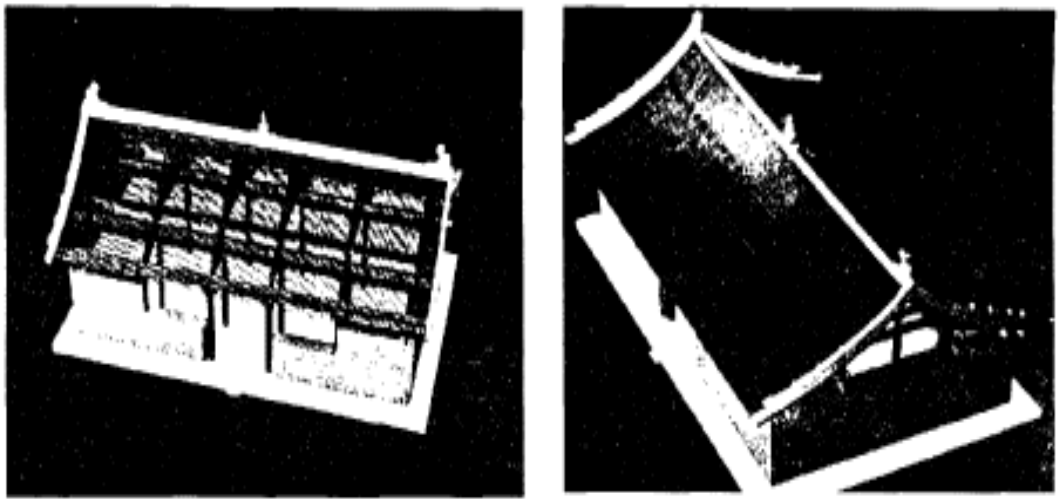


Fig. 3 Temple System created by AutoCAD and converted to Inventor format

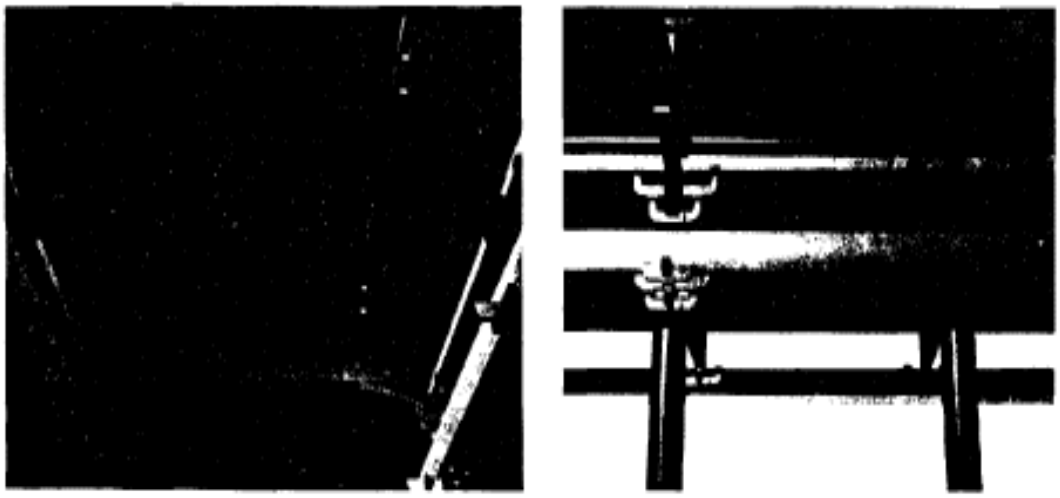
Because, of the limitations of equipment many of the elements of the 3D models were produced on standard 386 and 486 PC's by using AUTOCAD software. They were then transferred to 3D/STUDIO whilst still on the PC´s Translation programmes developed by the research team allowed the students to transform these PC based inputs to the UNIX based Inventor systems There have been some shortcomings using the PC generated files not the least of which is their large sizes. The routines for producing say a cylindrical column in AUTOCAD require a large number of points to produce a convincing circle and this problem is compounded when these are extended into the rectangular facets that then make up the cylinder proper. By the use of a simple cylinder generator in the Inventor system very sizable savings in file size can be made. Another problem that has arisen with the PC generated objects is that it is extremely difficult to determine the surfaces of the objects thus increasing the complexity of applying surface texturing. For those objects generated within the Inventor software these problems are eliminated. Although the system can accept the PC generated files it would appear that the benefits of using a low-end input are more than off-set by the difficulties in handling the increased data particularly when regenerating the images in the 3D mode.

The study indicates that the educational objectives of students producing their own integrated data-bases within a structured framework were achieved in a number of areas. The course the students were undertaking, "Building Systems", is designed to introduce them to the methods employed in producing cohesive building types, he they historical or modern. Building components, elements and systems are studied in the context of the available technology, skills and resources and the influences of climate and culture are taken into account. Special attention is paid to the methods of transportation, production and sequences of assembly as these factors are influential in forming the final product.

This course was appropriate as a test for the efficacy of the system as it integrates a wide range of topics spanning history, technology, construction, culture and aesthetics within a design paradigm. The end product is a dynamic system that can he animated to explode and assemble at will with specific attributes attached to each component or element of the model and this can he achieved in real-time. Additional information can he added at anytime and the whole system (or specific parts of it) can he re-languaged [6] to meet different students demands. Single components can he extracted for closer examination or for comparison studies and multiple windows can open other models simultaneously.



External View



Internal View

As can be seen from the above diagram the model can be viewed either internally or externally and rotation through any axis can be achieved. As students progress through the system other layers of information can be obtained by the opening of additional screen windows. The current pilot study is still in "soft" form on a storage disk and has not yet been transferred to the "hard" form of a CD-ROM. When this latter step has been achieved the normal progression of a student in a self-learning mode will be through a structured approach to a specific topic but the flexible capabilities of the CDI format mean that the student can also stop at any point, skip items that are not of interest or even enter another CD or "Soft" form in the search for a specific piece of information.

With the workstation module connected on-line there is theoretically no limit to the search that can be carried out be it on the University network, or with the

correct access codes, to overseas networks. The system is therefore in a practical sense dynamic and interactive.

Future Developments

A proposal for the development a series of Interactive Multi-media Studios interlinking the Faculty of Architecture, University of Hong Kong, the Department of Architecture, the Chinese University of Hong Kong and the Swire School of Design at the Hong Kong Polytechnic has been submitted for funding and it is envisaged that a very sizable data-base can be rapidly established covering the design fields. Further applications for this technology can be seen in Medicine (Anatomy, Orthopaedics, Sports, Medicine), Engineering (Civil, Electrical, Mechanical, Production etc.) Fine Arts, History and Geography.

Further areas of integration with continuing professional education programmes outside the University are envisaged and if these are achieved the current relationships of the Universities to the architecture profession will have to be reassessed.

The teaching and learning environments of our universities are undergoing major transformations and many of the long held traditions will have to be seriously challenged. The massive increases in accessible information have to be controlled and rationalized and this proposal offers an innovative methodology that will stimulate learning and research particularly in those fields that deal with the complexities of the three dimensions of the real world.

NOTES:

[1] Bligh : Whats the Use of lectures .....

[2] Ramsolen, Paul & Moses, Ingrid. (1992) Associations between research and teaching in Australian higher education. Higher Education 23. 273-295.

[3] "Multimedia" in this context refers to the specific five media controlled by a computer.

[4] The development work associated with this project is contained in the following papers :

a. Bradford, JW., Ng, F.F., and Will, B.F., "Multimedia CAI in Architectural Education". Paper presented to the Design Decision and Support Systems Conference, Eindhoven, July 1992.

b. Bradford, J.W., Ng, F.F., and Will, B.F., "3D Models and Hypermedia for Architectural Education". A paper presented at the ECAADE 92 Conference Barcelona, Spain, November 1992.

[5] "Soft" in this context is basically volatile data that may or may not be modified by students depending on which data is protected by a security code. Once this data has been manipulated to a level considered satisfactory by the staff certain chunks of the data can be transferred to "hard" medium of a CD ROM. Some of the data will remain in volatile form and the future users of the system will be able to draw on both sources.

[6] "Re-languaged" is a term used to explain the process of changing written text, notations and instructions from the primary language of English to a second language say, Chinese. It may be used to transform the complete system or it may be used for individual words or terms to act as a language to language dictionary/thesaurus.