

TEACHING BUILDING TECHNOLOGY IN THE HOME OF THE BRAVE

E. H. Tout

Teaching, other than design in an architectural school, poses a number of problems for non-design based academics. The perception that students often have, relate to ascertaining the relevance of subject content, determining priorities for attendance at lectures and tutorials, results often in lack of effort and rigour in their work. The corollary to this is, that more often than not, student design submissions do not demonstrate the application of knowledge supposedly gained in other subjects. Typically, they are unable to or do not illustrate how a design may be put together. For example in teaching Building Construction in the past, the curriculum was written over a three year programme. The subject matter went from small, to medium, to large complex buildings. It was taught removed from the Design stream. The stream was not seen as relevant by the students, and thus they did not really care about it as much as they could have. Their work displayed this sentiment. The worst thing was that they did not display a convincing knowledge about basic construction, even in their later years. The projects they were executing in Design studio were extremely unconvincing in terms of buildability and as such were seen as a missed opportunity. What is really required is an attitude of understanding how parts of a building are put together, and more importantly why they are assembled in a certain way, toward the service of an architectural aim. We are attempting to generate this attitude of how we go about doing things - and how to find out about things when we do not know enough about them. Every Building Technology unit in the stream at this University is now aligned with the current projects in Design Studio. So far this appears to be a successful strategy. Within the school there appears to be a growing culture that begins to see that ideas about how we put buildings together are ideas about Design. The Building Technology stream, which is integrated to the Design stream, is seen as being relevant, and fun. The next stage is to present these findings to as many other teachers of Building Technology and Science as we can find and discuss the results with the view of improving the results that the students can achieve, so that we may produce really good Architects that can create some great Architecture. This paper expands on the above and will include examples of student projects.

Introduction

It is the intention of this paper to describe the way Building Technology is taught in the Department of Architecture at this University. It will state a series of objectives of the Building Technology stream, the implementation of the Objectives, and show some of the results that the students have achieved. This paper will present the following ;

- What is Building Technology ?
- Previous models of teaching in this area
- A description of the “difficulties” experienced in teaching Building Technology

- A list of responses to the “ difficulties”
- A list of “honourable responses” to these
- The development of a new curriculum
- Description of the implementation
- An evaluation of outcomes via feedback and comments

What is Building Technology?

Building Technology covers building Construction, Materials and Structures. Until this semester it also covered Graphics, which has since been moved to a new stream called Design Communication, which also covers CADD. This paper will concentrate on the teaching of Building Construction.

Errol H. Tout [BArch]
Architect, Lecturer, Building Technology Controller
Curtin University of Technology, Department of Architecture
GPO Box U 1987, PERTH WA 6001

Description of previous models of teaching in this area

Previous models in this area were based on a series of lectures to build a body of knowledge, a series of case studies, submission of construction sketch books, collection of a materials information library, and an exam based lecture series.

As will be discussed later in this paper, this manner of teaching was not seen as being particularly relevant by the students, and thus the projects were not approached with as much enthusiasm and commitment as was perhaps possible, and unfortunately the work tended to reflect this.

In teaching Building Construction in the past, the curriculum was written over a three year programme. The subject matter went from small, to medium, to large complex buildings. It was taught removed from the Design stream. The stream was not seen as relevant by the students, and thus they did not really care about it. The work displayed this sentiment. The worst thing was that they did not display any knowledge about basic construction, even in their later years. The projects they were executing in Design studio were extremely unconvincing in terms of buildability.

This is not to condemn all the projects in this manner, but it was felt that it was visible (to a large number of the teaching staff) that more projects suffered this malaise than did not. A decision was made that the stream could be improved.

Based on professional experience, we were convinced that a complete, total knowledge of Building Construction was an unrealistic expectation (that takes 25 years). What is really required is an attitude of understanding how parts of a building are put together, and more importantly why they are assembled in a certain way, toward the service of an architectural aim. We are attempting to generate this attitude of how we go about doing things - and how to find out about things when we do not know enough about them.

A description of the “difficulties” experienced in teaching building technology.

Teaching Construction is not without challenges and difficulties. The potential obstacles could be listed as including [but certainly not limited to] the following:

- Potentially boring
- Removed from reality
- Unglamorous
- Marginalized but very important

- Lack of time to effectively get projects done to a convincing level
- At times irrelevant to student’s short term needs

Potentially boring

The attempt to capture a student’s attention with a subject is a challenge all teachers face. The subject matter of Construction could easily be seen as being perhaps not the most exciting topic in the world, especially to young students that do not yet understand the importance of the subject. They also do not understand the incredible headaches and legal implications an Architect can face if an error is made in this area. In their early years, only due to inexperience, students are not aware of how exciting it can be to watch a really well designed project achieve realisation, and that this can be fun.

Building Construction, Materials and Structures are only important to people that have to deal with problems of this nature. This statement may appear flippant but it carries a lot of truth. The point being made here is that if a person, in practice, has to solve problems of this nature, then that person is interested in that area. If these problems are on a construction site that the person in question is being paid to be involved with, and has to perhaps face the tradesperson attempting to carry out the wishes of that practitioner, then the person will be really interested in these subjects. If the sums of money involved are very, very large then the person will be very, very interested. The students are not yet in this position and so could easily get bored. The work is, at best, a hypothetical exercise and not related to the idea of money. The projects are conjectural, with no “real” result, only a grade and tutor feedback.

Paul Billington, in his book entitled ‘The Tower and the Bridge’ [Ref1] discusses quality of design and economics in the following manner.

“New ideas come along with competitive bids. The impetus of new forms comes from the need to create inexpensive structures, and this empirical fact leads to the second principle of structural art: minimum cost (economy) is an essential discipline for the creation of structural art. Economy stimulates creativity. Without the discipline of cost there can be no structural art.” [Ref 1]

Removed from reality

Students are not professionals, they are simply as their title implies - students. It needs to be said that studying Architecture is not being a practising Architect. There is a school of thought that says when a musician is practising they are inventing situations for themselves so that they may be able to deal with a situation when it arises - with ease and with grace [Ref 2]. Studying Architecture could

be said to be analogous to that situation. We are inventing situations for ourselves which will enable us to deal with them when we encounter them as professionals. This will, of course, never be totally successful, as we are not working in a situation that is driven by the dollar and all decisions are made with that in mind. Perhaps the best we can achieve is to present students with methods of dealing with issues. Another school of thought, based on conversations with practising Architects over a number of years, is that we can help students learn to ask the right (or should we say strategic) questions so that they may learn to get answers, as it would not appear a reasonable expectation that we as teachers can give them all the answers.

So, students are studying and not in the workplace where most decisions are driven by money. Thus they are not really having to face the serious consequences of decisions of Construction, Materials, and Structures. Thus the material being covered in the classes has the potential of being removed from reality and of not being that much interest to them. Thus the subject is potentially boring.

Unglamorous

The units that attract the strongest interest, and perhaps the glamour are the studio - based Design Units. These are the largest units and the students generally take the approach that they are the most important, and thus they receive their full attention. Sometimes to the detriment of other units in terms of attendance and enthusiasm.

These studio-based Design units also attract reasonably passionate teachers, who are often flamboyant, creative people that have acquired skills in “marketing” which easily translates to attracting students attention. Teachers in the Construction area, as far as this author is aware, do not often hold such a reputation.

Marginalized but very important

The construction units, in a University where development of ideas are stressed as opposed to a purely technical education, which is the realm of the Technical College, are not given an extremely large amount of the time available in a curriculum. There is only so much time available, and a lot of ground to cover for the students and they cannot spend all their time doing construction, thus the unit has the potential to be slightly marginalized. All staff recognise the importance of construction to Architects, but it is difficult to find the time required to effectively teach the material to promote what Bloom calls “Learning for Mastery.” [Ref 3]

Lack of time to effectively get projects done to a convincing level

Construction projects take a lot of time to research, develop

and execute in a convincing manner. Especially when the limited confidence of a student in this area is contemplated. The best that often happens is that the students genuinely try, but due to the lack of time available, the best they can do is bang ‘em out and hope the work is acceptable. This also never allows a student to execute a project to a level where they feel proud of what they have done, which will get them excited about doing the next project - to a higher level - and then the next one beautiful. The attempt is made to maintain the perseverance of the students as Bloom [Ref 3] describes with rewards at the end (and even partially during) the learning process.

The lack of staff-student contact time brings about the possibility of not allowing for effective feedback from the teaching staff. The students feel they have put in the work, but do not necessarily feel they have learnt as much as they would have liked to as they have not had enough feedback on the successes and failures of the project apart from receiving a graded assessment.

At times irrelevant to students short term needs

Students, as mentioned earlier, are generally most interested in the Design units they are working on. If the subject matter of a construction lecture, for instance, has nothing to do with their current Design project, it can be quite difficult to obtain their full attention, and it can also be difficult for the students to achieve reasonable retention of the subject matter. This is, of course, an understandable attitude for students to hold, but not a desirable state for students to be in.

A list of ‘Honourable Responses’

Seeing as we are in the business of solutions, we have done the following to address these potential problems.

Boring ? No Way!

Within this teaching team there is an obstinate refusal to accept the notion that this material is boring. To overcome the potential of boredom in this unit two things are necessary;

1. Staff that are experienced, knowledgeable and passionate about the topics they teach, and;
2. The projects should have some relevance to what is of concern to the students at that point in time - the projects they are working on in Design Studio (and still be in line with the curriculum). This is based on the way projects are executed in an Architectural Practice. When Architects undertake a project they have not done before, the project will involve some research. If the Architect has to research a new material because a project is demanding the knowledge, the Architect will be very interested in it. It is the same for students, only even more so, as just about all projects will involve new information for them to master.

In this manner, projects that are of importance to the students are dealt with in terms of construction. The attempt is made, wherever possible, to support the decisions students have made in Design Studio, and it also serves to illustrate the ramifications of all the Design decisions they have made. It also illustrates that decisions about Structure, Materials and Construction are design decisions. The thrust of the units is that Design and Construction are in essence the same thing. A strong emphasis is placed on the process of decision making toward a quality project.

Glamour a plenty !

Wherever possible, the attempt is made to have staff that are interested in Design and have the knowledge and interest in speaking about Design issues as well as Construction issues - preferably at the same time. All efforts are made to achieve even gender balance. There has been a lot of success in this area.

The assignments are always exhibited. The students are made aware that their work will be scrutinised by the whole school and this helps to place the work in the public eye and lift the profile of the work in the school. It also means that students will have to take things seriously.

A genuine effort is made to make the projects as much fun as possible. This is not always so easy, and it requires staff of a certain personal physical presence to achieve it.

Time is an asterix

The lack of time to effectively get projects done to a convincing level is a really tricky problem to deal with. A solution, based on activities in practice, we have had a modicum of success with is the idea of "The Maximum Groove Workshop". The intention with this is to give the students the time to execute a Design Development project in a limited amount of time - four or five days. There are no other classes running at this stage and all the students have to work in the studio from 10 am till 6 pm on the days the workshop is run. This gives them the time to actually develop some momentum on a project. The staff are in attendance for the whole workshop, and they are at hand to field questions and advise students, which enables the students to make more rapid strides ahead and really begin to develop their projects to a much more convincing level. This is not that far removed from the Bartlett school in London [Ref 5], where the students in the second year attend a two week workshop in collaboration with Construction Management students.

At the end of the first workshop that was conducted here, the students involved in the workshop were asked to give their comments about the successes and failures of the workshop.

The response from the students surveyed was overwhelmingly positive. They felt the level of progress made on projects was very strong. Students mentioned that if they had been working at home, instead of the studio situation, and they had run into a problem they would be stuck, but at the workshop they could discuss what they were working on with a tutor, sort out the headache and then proceed.

The response from the staff teaching in other units within the year was that the workshops had caused a lot of havoc in that students were so exhausted at the end of the workshop that they did not attend any other classes for a week. Certain Construction lecturers were not very popular. Based on this, we have not run workshops of such a large time frame. We have instead run smaller workshop studios that go for three hours over three Fridays. The outcomes were not as strong, in that the work was acceptable but not quite as exciting as before, but at least fewer ripples were caused in that the other classes were not so disrupted.

Relevant to students short and long term needs

If we can co-ordinate with the Unit Controllers, we can align the Construction assignments to be relevant to what is happening in the current Design programmes. If, for instance, the students are working on a large housing project, we can easily set an assignment to research Structural Systems that have been used by famous Architects on similar projects to that which the student has undertaken, then they can follow that up by researching cladding systems appropriate to their work.

Another example is that if the project involves a 're inhabitation' of an existing building, we can spend some time working on the material options and installation methods of the interior skin.

The development of a new curriculum

The experience of the author in ten years of practice (and of a number of other practising Architects) was the basis of re-evaluating the curriculum. It was felt, as students, that there was a lost opportunity to engage in some really interesting issues in the area of building construction and building materials. It seemed that various stimulating issues were raised in classes and then we moved quickly onto something else and the topic was never seen again. We never actually really engaged with the issues.

When emerging as a graduate, a strong reliance on others with more experience was required to keep young Architects out of trouble. Some (like the author) were very fortunate to have met some extremely patient and skilful site supervisors, some were not so lucky. The problem

was not so much a total lack of knowledge, but not knowing how to find things out that one did not know about. Graduates could not be described as being totally without skills, that is, they could draw to a reasonable level of competency.

What was wrong, was that it was never clearly explained that the decisions we make when we engage with issues of Construction, Materials, and Structures are Design decisions. The opportunities for finesse were never critically engaged. The environment for fertile discussion was never facilitated. The process of how Architects go about making those decisions was never even discussed. We learnt these processes by doing them, sometimes getting it wrong. This is a stressful and painful way to learn.

It was as though there was Design and there was Construction and they were seen as two different things. At least by the students they were.

Objectives of a new syllabus: the conceptual approach

Bloom discusses, "An educational philosophy that makes clear the author's conception of the good man (surely that should be person) and the good life can be a powerful tool in determining what educational objectives are desirable." page 12 [Ref 3].

The "good life" and the "good person" in this case are based on what the practising Architect does. This was based on professional experience over a period of ten years, and also the published views of many famous Architects.

There are a number of basic assumptions we make, and aspirations we have, as we proceed through the countryside that we call Building Technology. The idea was to present the units with the following ideas as being paramount;

1. Building Construction, Materials and Structures are Design. We approach all of these areas as Design issues. It is one of the strongest weapons in our armoury we have for making quality Architecture. The perception that Design and Construction are different things is an idea that is to be avoided at all costs.
2. Every Building Technology unit is aligned to the current Design Unit the students are engaged in. This is probably one of the most important factors in how we run these units. This means there is a co-ordination between the Design tutors and the Building Technology tutors. The students appear to learn more because the information given to them is presented at an appropriate time. It would appear futile to present information if they are not going to apply it and, perhaps more importantly, to manipulate it. The work often involves

Design Development or Working Drawings of their most recently completed Design Projects. The idea is that the students are shown that the whole process is about Design. It is all Design.

3. Really good Architects are really good in this area and bad ones aren't. Really good Architects [I don't wish to qualify this statement at this time] through history had strong knowledge and the capacity to manipulate these modes of thought and deed, to produce Architectural projects of worth. If we look at any significant Architect from Christopher Wren to Mies Van Der Rohe to Nic Grimshaw to Glenn Murcutt, it will be noticed that they all share this same trait. Thus the emphasis is placed on application of principles rather than building a large body of knowledge.
4. There is such a thing as "The Poetry of Construction" and believing that God is in the details will guarantee you a place in Heaven.
5. Building Technology is really good fun [and rather a lot of work]. Making decisions in this area of endeavour can, if approached with your head in the right space, be the most fun you can have sitting down.
6. We intend to make the Building Technology stream at Curtin University the best in the country.
7. This area is called "The Home of the Brave" so be brave. This means there is a high level of expectation for a high level of commitment from the students, and because it is demanded it is generally received.

The 'New Generation Syllabus'

In 1994 the syllabus and programme was overhauled to read in the following manner;

Building Technology 101

A conceptual unit within a foundation year. It is referred to as a foundation year because the Architecture students and the Interior Design students are together for the foundation year. This unit is unofficially referred to as "Building Construction made Hip and Cool". The three different Structural Types - Solid, Skeletal, and Surface are introduced and discussed. References are made to Mode (theory), Matter (materials) and Manner (execution). The students are introduced to the role of Construction, Materials and Structures in the Design Process. Various references Historical, International and Local are cited and discussed, in terms of Theory, Examples, Techniques and Applications.

Assignments are a whole lot of fun. Assignment 1 (Solid Construction) requires the students to construct a tower

from 1000 small timber blocks. There must be openings forming 25 percent of the surface area of the walls. Assignment 2 (Skeletal Construction) involves constructing a bridge from very fine balsa linear elements. The bridge sits on an 600 x 300 mm size base and is required to support a weight of one kilogram. Assignment 3 (Surface Construction) is a real nasty one. It is called 'The Funky Floating Thing'. Students must design and fabricate a Surface structure that is supported on four posts 150 mm high that covers an A3 board and defines a space. The Funky Floating Thing must demonstrate the principles of how Surface Construction works. Submissions always involve a three stage submission of experimental , prototype , and finished models. This mirrors the way ideas are tested in practice.

Building Technology 102

The objectives of this unit in the Construction component are to develop an understanding of the role of Construction and it's application in the Design Development process and to develop an understanding and knowledge about building parts.

The Famous Four Big Moves are introduced and discussed;

- The Idea of a Building Engaging a Site
- The Idea of a Floor System
- The Idea of a Wall System
- The Idea of a Roof System

Every attempt is made to demonstrate to the students how Architects have designed fabulous projects by understanding how these systems work.

There are two projects in the semester. The first is a model of a project by a famous architect. The student must research the project in terms of (A) The Design Concept or the Design Intent of the project, and (B) the Famous Four Big Moves, i.e. How does the Building Engage the Site, what is it's Floor System, what is it's Wall System, what is it's Roof System. The students then have to prove their understanding by making a beautiful model of the work, it must engage the notion of Finesse in the way it deals with the issues of the building. Once again the emphasis, in educational terms is placed on what Bloom calls "ability to make applications" [3].

The second major project requests the students to prepare Design Development drawings of their current Design projects. This sets them up for projects that follow in later years and sets a tone of how we operate. The students achieve some terrific results in this area.

Building Technology 201

This unit is broken up into three areas Structures, Materials and Construction. In Construction we discuss the nature of Process. We discuss Detailing, Joints, Resolution, Modules, the Idea of Skin and Frame. The Idea and Attitude [and theory] of Assembly and Making. The students are shown famous works by famous Architects and the Design Intent is discussed, we then examine how this informs the rest of the decisions made in the project and the Detailing is broken down and examined in minute detail.

Assignments are related to the projects the students are studying in the Design unit, which involves formal spatial analysis of famous architectural works. Last year it was about stadiums and the year before art galleries. The students carried out constructional analysis and then presented their work on A5 cards that describe how cool something is, we call these "Cool Cards". The next assignment involves Design Development of their Design project. The Structures assignments involve basic Structural calculations, and in Materials the students are required to acquaint themselves with the physical properties of materials and have to write about them in exams.

Building Technology 202

This unit is broken up into three areas Structures, Materials and Construction. In Construction we discuss the nature of Process of Development of an Idea, the idea of prefabrication versus on site construction, the idea of tolerance, components and installation cabinetwork, doors, windows. The Nature and Process of Development of an Idea.

The assignments vary, last year the students had to produce Design Development drawings of a small folly in the park. This year it appears they are to prepare basic Working Drawings of a small lookout they have designed on Rottneest Island.

Building Technology 301

This unit is broken up into Structures and Construction. We require the students to apply their knowledge to the current Design projects that the students are involved in or have just completed. In Construction we discuss the Idea of Co-ordination of different Ideas [Consultants], the BCA, the nature and Process of Execution of an Idea. We then proceed to execute Dashing Design Development drawings of the last Design project the students undertook. We run a series of workshops where the Structures lecturer acts as a consultant to the students as they proceed with their Design development assignment. Assignments involve research into structural systems of a similar nature to the current Design programmes, analysis of Design Development carried out by famous Architects and

Engineers, assignments on how the Building Code of Australia will affect their current Design, and finally a set of absolutely convincing Design Development drawings.

Building Technology 302

This unit is divided into Specification Writing, Costing and Construction. The Construction component covers solving of complex building problems, multi-storey structural systems and claddings, fire-proofing. The final project involved the preparation of working drawings of the current design project. This is a major exercise where students are expected to demonstrate an understanding of all they have learnt in this stream over the last three years. It is surprising that very few students actually fail this.

Assignments consist of research into groovy cladding systems, working drawings of Design programmes, writing a small specification using industry based software packages of Natspec and Specpak, and exercises in building costing.

Description of the implementation

If the premise that Building Construction **IS** Design was to have credence, we realised that the Building Technology units were going to have to be aligned with what was going on in the Design units.

This meant that the information and programmes had to be presented at relevant times and in an appropriate manner so as to assist the students in what they were working on in their Design Projects. They would use what they learnt from the Building Technology lectures to enrich their own projects. This is an approach not unlike the one taken at Newcastle University [Ref 6].

Easier said than done. We have a number of co-ordination meetings with the Design staff, prior to commencement of semester. At these meetings we all outline our objectives, syllabus and programmes. The attempt was to work together, an objective that had not been achieved ever in this school, although the aspiration was said to have been there.

We called these sessions 'Show and Tell'. Some actually worked !! The third years on one occasion rioted when they felt that the Building Technology unit had not been aligned as they were promised. Whilst this was an unpleasant series of events, it showed that the students were genuinely interested in the subject. The work they finally produced displayed that aspiration as well.

Generally speaking, evaluation is Formative rather than Summative, as the nature of the projects deal with Design process. It also allows for students to see where they need to improve their thinking to promote what Bloom calls "Learning for Mastery". [Ref 3]

An evaluation of the outcomes via feedback and comments

The content of this paper could be described as a 'Works in Progress' of course development. I say this as the stream has a certain organic element to it. It must respond to a set of changing ideas, specifically the content of the Design Units.

Some of the units have been revised as it was obvious that the curriculum was overstuffed and that the subject matter was too large to be covered in that semester. The objective was then to promote deep learning of a smaller curriculum rather than spreading a large curriculum too thin.

The feedback that has been received, although no exhaustive formal survey has been undertaken at this stage, has been quite positive, both from graduates and employers. The students have been filling out regular Student Assessment of teaching in all the units. With the employers this has only been in the form of informal conversation. A number of the employers stated the ability of the graduates to take on a task and be relied on to complete the task with the minimum of supervision, that the students knowledge, though limited was of use to them in an Architectural practice.

In the "Graduate Attributes Survey" undertaken by the University's Quality Office in March 1997 [Ref 4], it was found that graduates from this University rated well in terms of knowledge of discipline and field, ability to apply this knowledge, technical capabilities, self motivation, creative ability, demonstration of initiative as well as scoring very well across the board generally [Ref 4].

Conclusion

As discussed earlier, this course is almost organic in that it must respond to the demands of a changing profession, as well as the decisions that must be made by the practising Architect, as well as responding to student's needs as they proceed through the Design Studio.

The response from the students and limited comments from practitioners has so far been of a positive nature. It is suggested that the integration of Design Studio and Building Technology has merit, but is not without problems. It is intended that the course will always be in a state of revision. But it has been said that the measure of a good repertoire is how much has been dropped from it [Ref 2].

This paper is not presented as proof as being the best or the only way of teaching this area, but rather as a form of reflective practice, and as an offering for discussion.

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