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ARTICLE

Demystifying Construction

Technology in Architectural Education

Antony Wood

Abstract

Construction is often seen, among both students and staff at schools of architecture, as a distinct subject taught separately from design. It is often delivered by lectures, divorced from design studio and relying heavily on published sources. Even when it is integrated into design studio, it is often conducted as an add-on project, a separate exercise set after the design is 'finished'. This is, in the author's opinion, a flawed train of thought that is largely accountable for the increasing ill-preparation of architectural graduates for the realities of working practice and the corresponding frustration of the profession and industry who receive them. This paper presents an alternative approach to the teaching of construction in schools of architecture. Based on a model successfully implemented at the University of Nottingham, it explores the teaching methodology, learning outcomes, methods of assessment and possible implications for both schools of architecture and the profession as a whole. In doing this, it suggests a strategy to help bridge the widening divide between academia and architectural practice.

■ **Keywords** – Architecture; construction; practice; profession; teaching

INTRODUCTION: THE PROBLEM

Architectural education is in great danger, and has been for the past 20 years or so, of being hijacked by those whose real interests are words rather than buildings. (Peter Cook, in Chadwick, 2004: 6)

It often takes several years of working in architectural practice after graduation until students of architecture arrive at the realization that the assembly of materials at 1:5 scale involves the same design process, awareness and rationale as the assembly of form and space at 1:500. This is the realization that the only difference between conceptual design and construction design is one of scale. The irony with this realization is that, on many occasions during their architectural education, the same students would have undoubtedly heard that very fact from tutors – a mantra to be chanted during

construction lectures: 'detailing is no different to design'. But although most students can understand this as an abstract notion, many struggle to put it into practice. When the time comes to produce the 'construction drawings' to accompany the latest design project, most reach for the latest edition of the *Architect's Journal Working Details* (Dawson, 2003) and choose the slickest detail they think they can justify for their building. These students have simply learnt to imitate construction details as opposed to being able to apply construction principles.

Students who have learned imitation subjects have been involved in a certain process that has enabled them to acquire factual knowledge which is useful in a very limited range of situations. Much of what they have learned has no personal relevance to them (except as a form of gaining qualifications) or any connection with the real world it is supposed to explain. (Ramsden, 1992)

So why is this? Why are architectural students able to make the abstract link between the processes of conceptual and constructional design, but are unable to put it, literally, into practice? This paper – and the approach to construction teaching it contains – is based largely on the premise that this is because tutors explain the process, but very few actually demonstrate it. There is a lack of demonstration that those design discussions about the massing of a building, the way occupants move through the spaces or the visual implications of the junctions, involve the same thought processes that should be involved in considering the termination of a roof edge, how that edge might conceal a gutter, and how the constituent parts of the assembly act in symbiosis to achieve the function.

All knowledge involves the use of symbols and the making of judgements in ways that cannot be expressed in words and can only be learnt in a tradition. Accordingly, the business of acquiring knowledge of any form is therefore to a greater or lesser extent something that cannot be done simply by solitary study of the symbolic expressions of knowledge. (Hirst, 1975)

So students of architecture fail to grasp the notion that construction can be tackled from first principles, from common sense, from a blank sheet of paper and an appreciation of the result to be achieved and the palette at one's disposal. Additionally, construction lectures in many schools of architecture tend to concentrate on material properties or building elements in absentia from design, whereas construction studio asks for a product that requires appreciation of a link that is missing. So, construction as a subject becomes mystified; a skill deemed by students to be the special domain of architects with years of experience. Construction becomes detached from the design process; it becomes a separate subject, an addendum to the creation.

The form and conduct of the typical design studio today encapsulates architecture schools' entrenched isolation. Once considered an exemplar of project teaching, the studio is increasingly distanced from the real world it is intended to simulate. Technical knowledge is generally restricted to separate lectures on construction and materials. (Abel, 1998)

This, of course, is not a positive situation. Consideration of technology – structure, environmental response, construction – has to be an integral part of the design process from concept through to completion. The historical development of the role of construction in architectural education has been well documented (e.g. Carpenter, 1997). Conclusions tend towards the belief that construction cannot be learnt purely from books. It cannot be understood by the assimilation of information. It must be investigated, attempted, engaged with. It is only in the act of attempting a solution that the intricacies of the problem can be fully appreciated. This paper is concerned ultimately with the integration of technology, and construction specifically, in design. However, especially with increasing student numbers, it is not possible to reject the lecture format as a teaching medium. Rather, the following methodology explains how, in the past few academic sessions of third-year construction lectures at the University of Nottingham, both the design studio and the construction site have been brought into the lecture theatre in an attempt to demystify construction, to make it relevant to the students, to demonstrate to them the essential link to the design process.

LECTURE COURSE METHODOLOGY: LEARNING BY DOING

The methodology in the teaching approach (summarized below) is based on each lecture being centred on an exercise involving a differing building system or set of materials that the student must engage with. The intention is that, in learning by doing rather than just by listening or reading, the student will appreciate the rationale behind the assembly of elements and gain confidence to approach the detailed design of their own studio projects from first principles rather than borrowed sources. The methodology consists of seven elements:

- background – generic information on material/element issued
- sample – physical handling of material/element by students
- case study – images of material/element implementation on site
- exercise – students undertake task, produce detailed drawings

- marking – students are assessed on the value of their solutions
- feedback – author's solution is presented and analysed in detail
- reinforcement – case study construction slides are again shown.

STAGE 1: INTRODUCTION OF MATERIALS AND BUILDING ELEMENTS

The material or building element for that week's lecture and exercise is first introduced in the form of a case study of a building with which the author has been involved (and which, obviously, uses that material). Rather than the lecture programme being presented as a series of bland construction materials e.g. brick/block, composite cladding, standing seam roofing, planar glazing, etc., it is presented as a series of building types e.g. the piece of retail urban infill, the 'glossy pages' museum, the high-profile transport terminal, etc.

Information on the generic properties of the material and its use in buildings (i.e. the background information) is issued as a handout together with a sample of the material (plus items from the associated assembly e.g. fixing bracket) which is passed around the group. It is vital for the students to have an opportunity to experience the material – to touch it, test it and understand it. The case study is presented in the form of slides; first, as an object in the realization of the design (the brief, client requirements, design solution, etc.), then with increasing focus on the usage of the particular material/element i.e. the construction sequence, and the implications and peculiarities of that particular site operation. It is important that the material system is supported by images of the actual construction, to enforce the essential link between the drawings and the detail. In this way, the construction site is brought into the lecture theatre. The presentation concludes with details that are the focus of that week's exercise – both the images of its exposed construction on site and the corresponding detailed drawings.

STAGE 2: THE EXERCISE

The week's exercise is next introduced (Figure 1). Each exercise assumes a particular 'real' scenario in an architectural office and is based on a task undertaken by

the author at some stage in his practice career. The student assumes the role of an architectural assistant working in the practice and is given various pieces of information, in the form of attached drawings (Figure 2) or dimensional information passed on from a hypothetical technical representative, to enable him/her to carry out the exercise.

The objectives of the exercises change and increase in complexity each week. Early exercises are concerned primarily with appreciating that materials come with their own set of rules for usage (modular, structural, aesthetic, etc.) and that these requirements should be respected (or, at least, understood to enable conscious manipulation). Later exercises tend to focus directly on specific scenarios and the in-depth intricacies of the corresponding details.

Practically, the student completes the exercise in the day(s) following the lecture (Figure 3) and submits it for marking. Marking of the exercise is essential due to student attitudes (i.e. students only take an educational activity seriously if it is assessed – see 'Resourcing Implications' below) and forms an important part of the feedback to students that follows.

STAGE 3: FEEDBACK

The author's solution to the exercise is presented in depth at the next lecture, building up the rationale informing each decision in the assembly of the detail – functional, practical and aesthetic. The exercise-marking structure is explained, so that students understand why each mark is allocated. In attaching marks to fundamental decisions, it highlights the importance of the considerations in the detail, reinforcing the idea that each line in the drawing represents an element that is the result of a conscious, considered decision.

Once the solution to the exercise has been discussed and understood, the issues are then reinforced by presenting the same case study slides that were presented before the exercise was undertaken. Whereas before the exercise they were viewed by the students as individual images somehow contributing to the overall assembly, now each element is understood in terms of the role it fulfils and its relationship to the constituent parts around it (Figures 4 and 5). Similar details on other buildings are also shown

“DEMYSTIFYING CONSTRUCTION” Lecture Series

Exercise 3: Forest Shopping Experience, Nottingham – the Retail Mall (From Lecture 6: Standing Seam Roofing)

Now that you are getting into the retail store rationalisation for Aldi, and looking forward to extending the same detailing disciplines to the whole building (!?!), the Director pulls you off the project to assist with pressures elsewhere in the office. Another retail project is about to start on site and, unfortunately, sufficient resources have not been put into the working drawing packages. The contractor is currently screaming as the steelwork is about to arrive on site, but he has not enough information on the roof details, beyond the written specification. The Director knows that there could be a serious liability case to answer to if, as architects, you don't keep to the 'information release schedule', and thus asks you to drop everything you're working on and help out.....

The main problem is the external canopy to the shopping mall entrance, which is envisaged as a curving roof over a huge steel 'tree' structure, very much in keeping with the 'Robin Hood / Forest' shopping experience theme (sic). The structural engineer sent confirmation of the steel truss structure (composed of 90mm circular hollow sections) several months ago and this was worked up into a 1:100 sketch section which was faxed to site (see drawing *Sk616* attached). As it stands, this is the only drawing the contractor has to describe the construction of the canopy. The Director tells you to check the specification, as this should tell you all you need to know (!).

The specification section on the canopy roof reads as a *“65mm Key Bemo aluminium standing seam roofing top layer, supported by proprietary halter fixings off a 32mm profiled (trapezoidal) steel decking liner panel supported directly from the primary steel truss via 225mm Z-purlins on cleats (purlin zone = 250mm). The zone between Key Bemo roofing and top of liner panel contains 100mm rockwool fibreglass insulation compressed by the construction to approximately 83mm and a 2mm thick Butyl rubber sealant sheet acting as a vapour control layer lain on top of the liner. Curving moisture-resistant plasterboard (multi-board) fixed to the undersides of the purlins forms a ceiling”*. Fortunately, you notice, someone has sketched this construction on the office copy of the overall section which was faxed to site (see *Sk616*).

Question 1: As you can see from the section (*Sk616*), there is to be an overhang of approximately 750mm from the end of truss, and the fascia is to be a curved, 'bull-nose' profile. Sketch at 1:5 scale (on **A3** paper) this lower canopy end / gutter detail (indicated on *Sk616*), paying particular attention to the following aspects:

- How the overhang is achieved structurally.
- How the roof build-up layers are terminated.
- Interaction between gutter and roof elements (structure, standing seam roofing etc)
- How the gutter, bull-nose fascia etc are supported.
- The aesthetics of the overall detail.

Tip: Enlarge the detail from the 1:100 sketch on the photocopier, and use this as a basis for the detail. Portray the elements as sloping rather than curved, for ease of drawing. Do not forget that the sketch of the roof build up (on *Sk 616*) is shown in a 90 degree different plane to your detail.

Question 2: In a rare coffee break, flipping through the drawings, it suddenly dawns on you that insulation in an external canopy should not be necessary. Why, then, is it there (in 10 words or less)?

Submission & Format

This exercise needs to be handed into (place?) by (date, time?)

The work should be to the following format:

- A3 **photocopy** – not original.
- Construction sketching technique – not computer or drawing-board drafted drawings.
- All details **fully dimensioned**.
- The **full names of all group members** clearly shown on all sheets.

FIGURE 1 Example of a weekly exercise

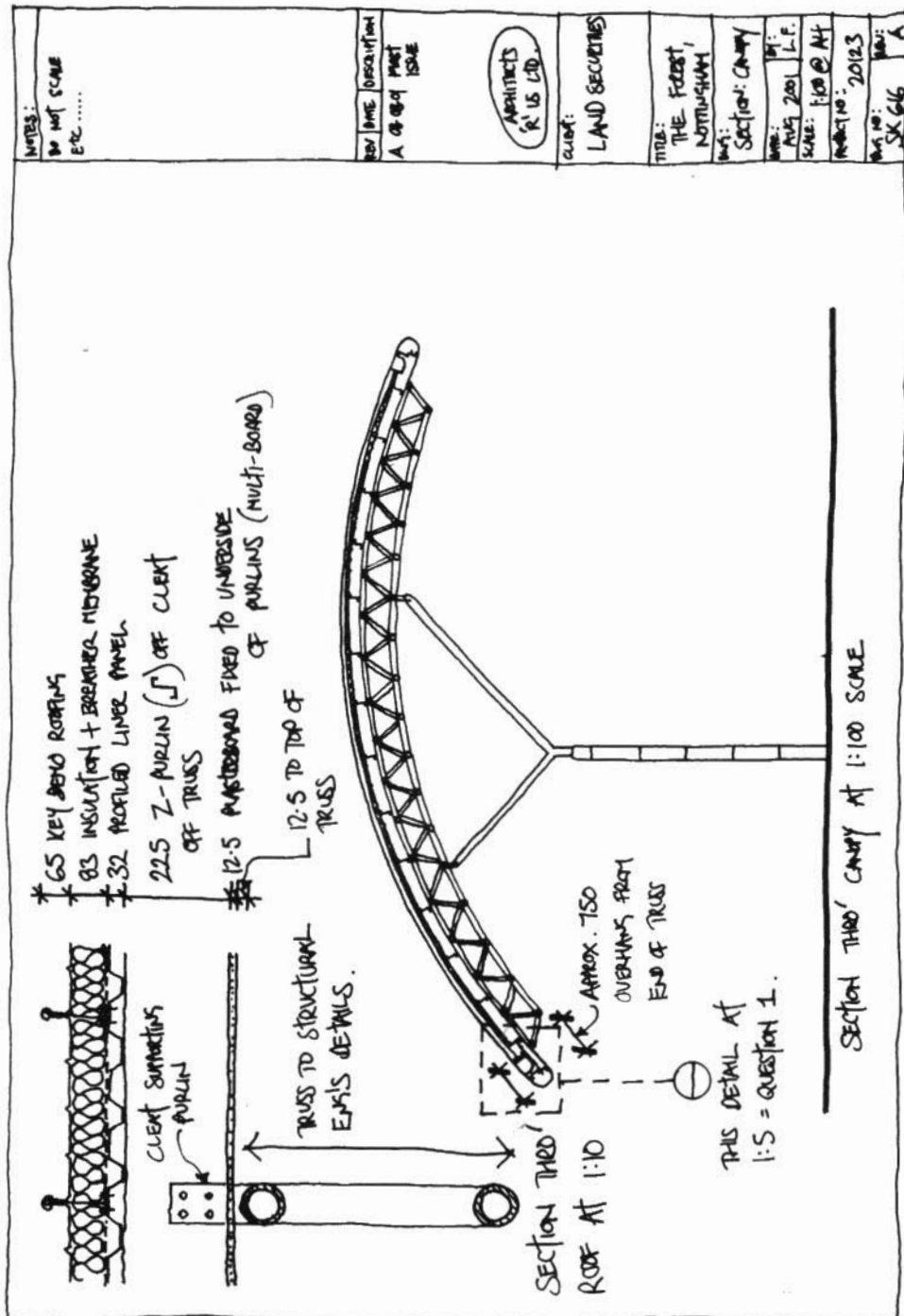


FIGURE 2 Example of supporting information for weekly exercise

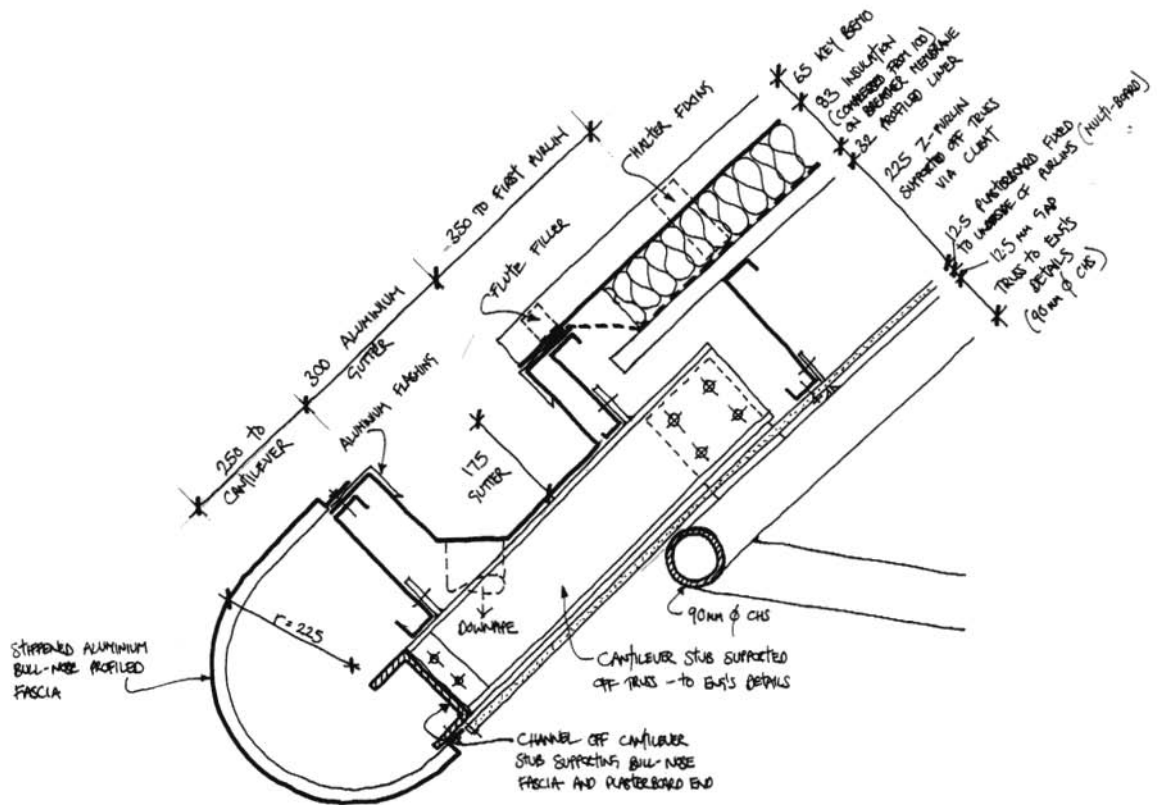


FIGURE 3 Example of response to exercise



FIGURE 4 Example of on-site construction images reinforcing exercise learning

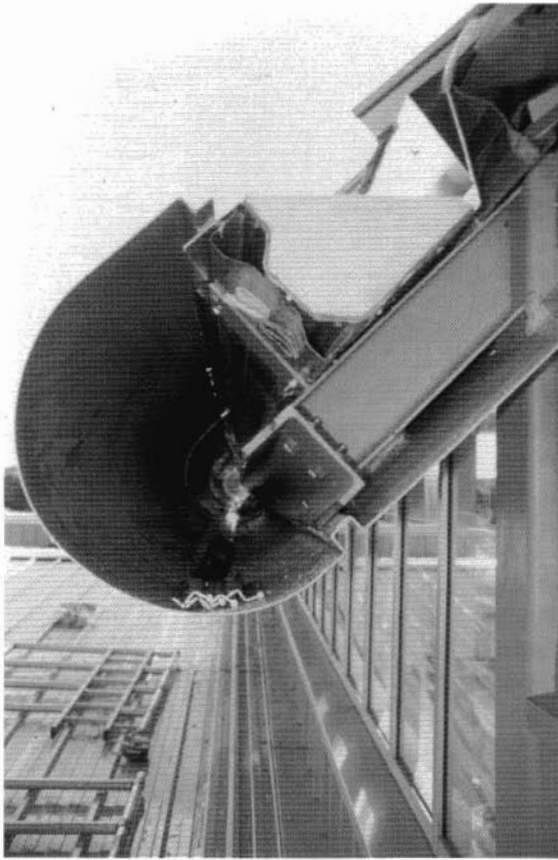


FIGURE 5 Example of on-site construction images reinforcing exercise learning

to reinforce the link back to the continuation of the design intent from concept through to completion.

COURSE ASSESSMENT

The lecture course is assessed by an end-of-session paper introducing a building design that requires rationalizing according to its construction materials and detailing in part. Most of the details are developments of the exercises already undertaken during the lecture course, thus allowing the lessons learnt during the course to be applied directly. A large part of the paper requires the student to compile a production information 'storyboard', considering the detailed information that is needed to describe the construction

of the building and how this translates into a drawing package. The finished paper is not only a collection of drawings for assessment, but also serves as a useful addition to the student portfolio for job interviews.

The actual marking of the paper adopts the same objective allocation of marks to fundamental decisions taken in the drawings as carried out in the weekly exercises. The students are also required to explain in words (briefly) why they have assembled the details as they have, to communicate the level of their understanding.

Of course, the true value of this approach to teaching construction can only really be gauged in the way that the students apply the knowledge to their own designs in studio. In third-year design studio at Nottingham we are, again, experimenting here by nestling the technology projects in the middle of design projects, rather than as an addition at the end. In requiring the student to produce structural, environmental and constructional studies during the design project, it forces the issue of technological consideration; the students cannot ignore it. The intention here is that these technological studies will help inform the design process in the latter part of the project and result in a more well-rounded design.

This twin approach in lectures and studio to technology over recent years is producing some excellent results in students' designs. It seems that students are feeling more confident about approaching construction from first principles relevant to their design, rather than irrelevant borrowing from published architects/buildings. Figures 6–8 show an example of this. This student's design involved the quite complex 'puncturing' of a massive wall element with lightweight accommodation boxes. The student worked the idea through the detailed design, developing a novel structural strategy for the wall and applying some of the lessons learnt in detailing from the lecture course directly to the design.

REFLECTION RESULTS

The results from the student exercises in the first instance often demonstrate little understanding of the issues. Some comprehend the complexities of the system they are dealing with, but few can extrapolate

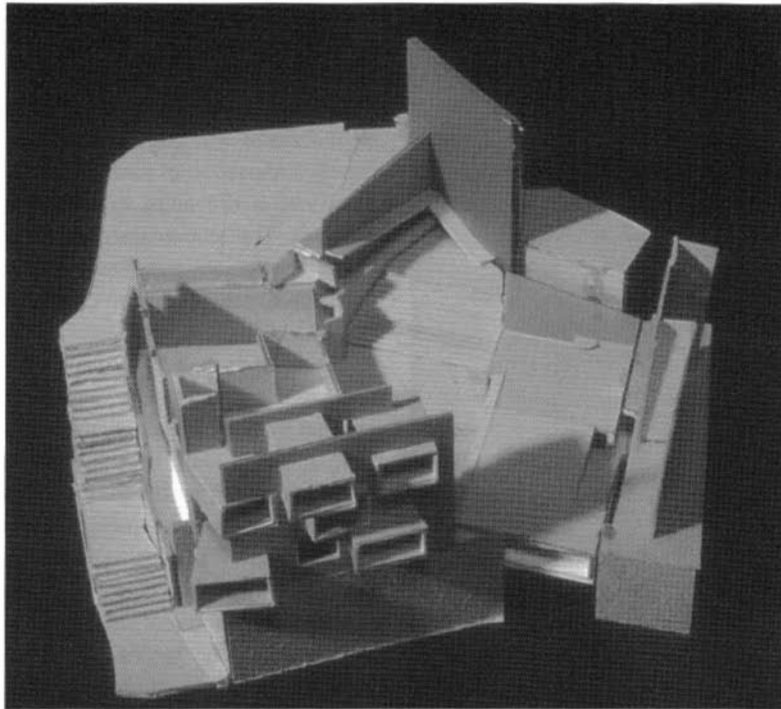


FIGURE 6 Example of student design studio work; construction being tackled from first principles, relevant to the individual design

this into a solution where all aspects of the detail are considered in unison. However, this does not really matter. It is in the understanding of the solution during the feedback session that the true value of the methodology lies. By attempting the exercise, the students have at least appreciated the problem and issues contained. Subsequently, in seeing the author's detail, the students understand the decisions leading to the solution. The detail has risen from an abstract plane; it has become relevant to them. In understanding what the different elements of the drawings represent and how they came to be in the positions they are, they understand the design at this most intricate scale; this particular construction has, hopefully, become demystified.

It is not sufficient simply to have an experience in order to learn. Without reflecting upon this experience it may quickly be forgotten or its learning

potentially lost. It is from the feelings and thoughts emerging from this reflection that generalizations or concepts can be generated... The learner must make the link between theory and action by planning for that action, carrying it out, and reflecting upon it, relating what happens back to the theory. (Gibbs, 1988)

STUDENT FEEDBACK

Feedback from the students on this particular approach to teaching construction has been extremely positive. Out of student evaluation of module (SEM) questionnaires in previous academic sessions (Figure 9), virtually all students rated every aspect of the module from five 'value' categories as either 'strongly agree' or 'agree'. In addition, a large proportion of students commented that this approach to construction teaching should be adopted in the earlier years of the course.

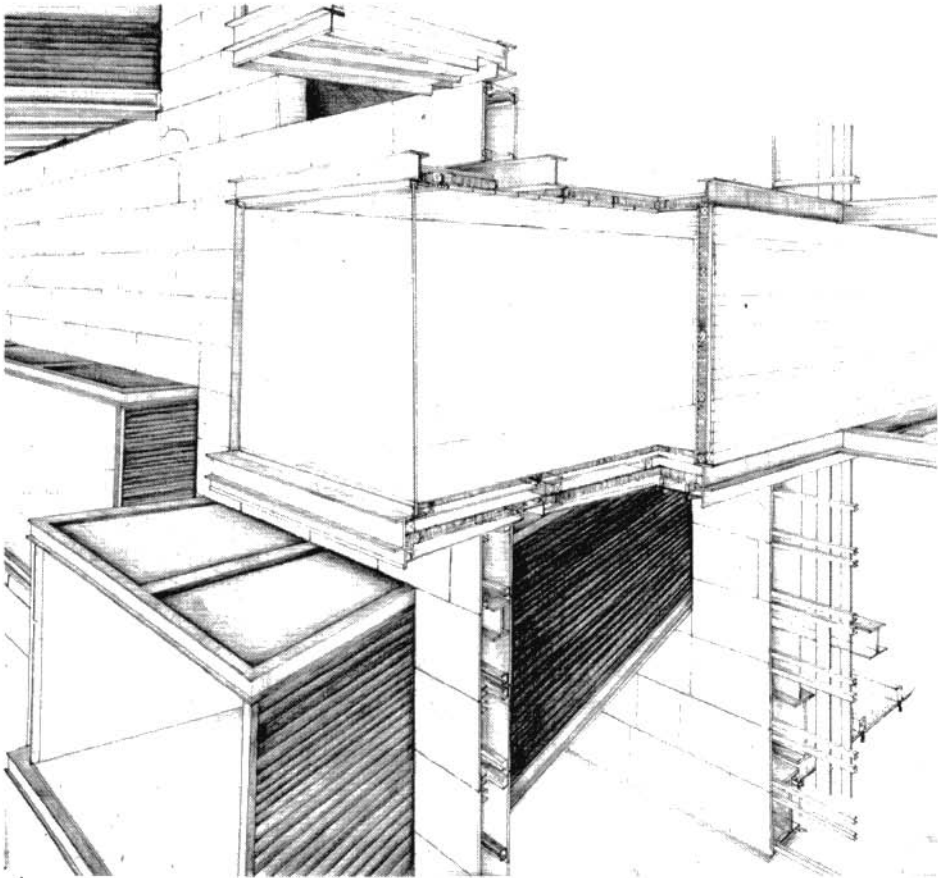


FIGURE 7 Example of student design studio work; construction being tackled from first principles, relevant to the individual design

Additional comments from the students include:

Finally, construction is taught pragmatically, realistically and vocationally in a professional manner.

A new and very much improved approach to what has previously been a rather detached subject.

The short exercises have proved to be a successful way to teach construction, much more useful than just going through things in lectures.

Great to see construction taught in such an inspirational way.

It was the first time I was actually interested in a construction lecture.

RESOURCING IMPLICATIONS

While this approach to construction teaching seems to have been successful, it is worth noting that it is resource-intensive in terms of staff input. The establishment of a course such as this requires a significant amount of time to create the weekly exercises, as well as putting the material for each weekly lecture together. Also significant in terms of resourcing, the approach can only be adopted by someone with prior practice experience to draw on (see 'Conclusion: The Way Forward?').

The most time-intensive aspect of this teaching approach, however, is the marking of the weekly exercises

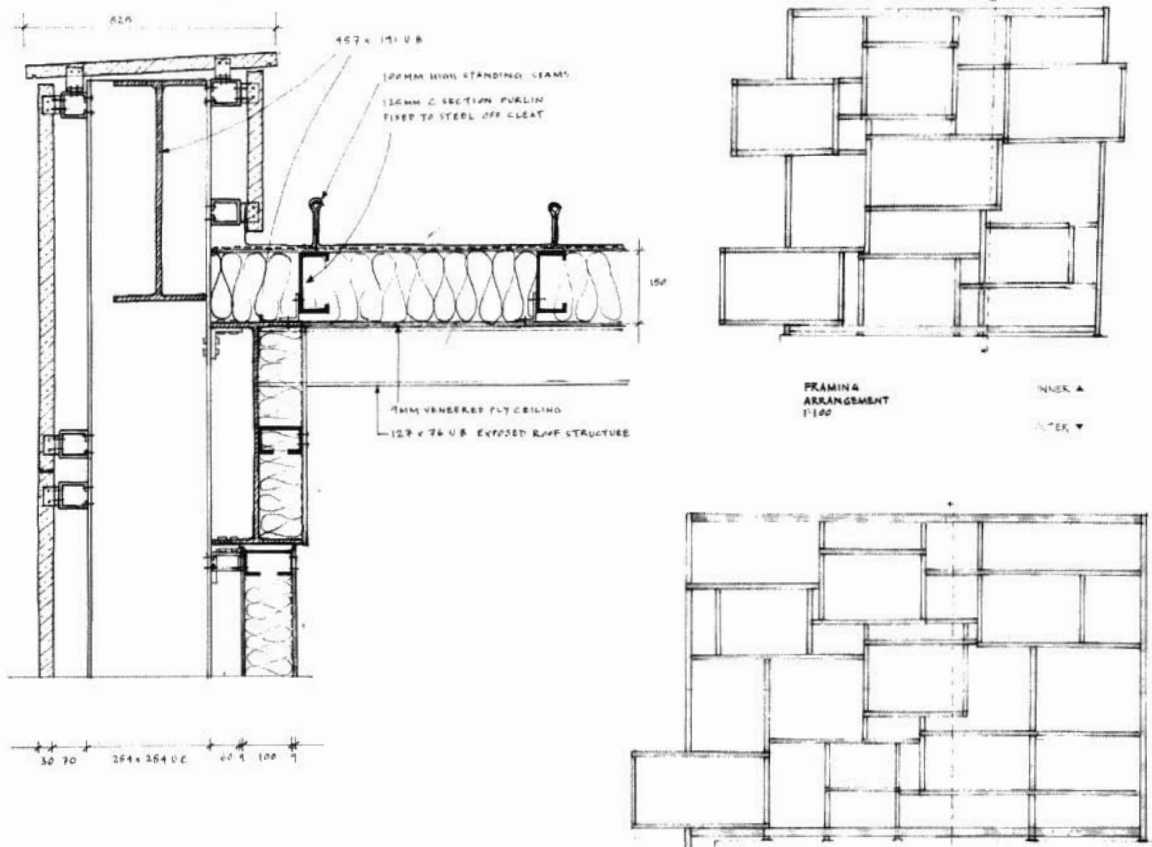


FIGURE 8 Example of student design studio work; construction being tackled from first principles, relevant to the individual design

(although this burden has been reduced somewhat this year by organizing the students to undertake the exercises in groups of four, which has the additional merit of increasing learning through collaboration).

Marking of the exercises is essential. As academics, one of the major pressures facing us is the fact that the majority of students only take an educational activity seriously if it is assessed. These students are extrinsically motivated by the level of importance perceived in a task, which is reflected in the amount the task grade contributes to their overall degree classification. Thus if an activity/exercise is not assessed, often students will give it less, if any, significance since it fails to bring a reward. The learning of these students occurs in a 'strategic' or 'achieving' manner (Entwistle and Ramsden, 1983).

Students adapt to the requirements they perceive teachers expect of them. They usually try to please their lecturers. They do what they think will bring rewards in the systems they work in. All learners, in all educational systems and at all levels, tend to act in the same way. (Ramsden, 1992)

This attitude towards marking (or the perceived value of parts of an educational course in terms of its contribution to a qualification classification rather than actual learning) influences what Ramsden (1992) has termed 'surface' and 'deep' approaches to learning. A 'surface' approach to construction learning involves the copying of previously published details without regard for appropriateness or understanding of content, or the memorizing of information from lectures for

SET Questionnaire

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Student Evaluation of Teaching

Mr Antony Wood
Construction Design 3
K1CCD3
Lecture
University Park



Built Environment Session 02/03

This questionnaire is part of a continuing effort by the University to improve teaching and promote learning. Your responses are anonymous and will feed directly into plans for teaching enhancement and staff development.
Answers to Sections A and B are analysed by the University. Please answer all the questions in these sections either by ticking the category which best reflects your view or by ticking Not Applicable (N/A).
Section C is your opportunity to provide feedback in your own words and is returned to your teacher.

A: Fixed Questions Set by the University

		Yes <input checked="" type="checkbox"/> 1 <input checked="" type="checkbox"/> 1	No <input type="checkbox"/> 2 <input type="checkbox"/> 2		
1	Is this module compulsory for you?				
2	I have attended at least 80% of the sessions timetabled for me with this teacher				
		N/A	Strongly Agree	Agree	Neutral
					Disagree
					Strongly Disagree
3	The teacher was an able communicator	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
4	The teacher retained my interest	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
5	The teacher was approachable	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
6	Sessions were paced appropriately	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4
7	Overall, this teacher assisted my learning	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4

B: Questions Selected by the School

		N/A	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
GEN011	The teacher makes good use of examples and illustrations	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6
GEN014	The teacher emphasizes key points	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6
GEN021	The teacher sets high standards	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6
GEN039	The teacher seemed to know the subject well	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6
GEN042	I have been encouraged to take responsibility for my own learning	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6
GEN067	The teacher points out links to previous topics we have discussed	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6
GEN090	Although difficult, I understood this subject in the end	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6
GEN104	The overall subject matter was developed logically	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6
MAT005	The handouts helped me to understand the material	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6
MAT007	The teacher made good use of audiovisual materials	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6
MAT034	I used a textbook(s) in addition to lecture notes	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6
VOC002	I have learned the relevance of this subject to my future profession	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6
GEN013	The teacher structures the material well	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6
GEN019	The teacher points out links to other subjects	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6
GEN036	The teacher gave explanations which were clear	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6
GEN049	The teacher is available for consultation	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6
GEN051	My ability to work independently has improved	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6
GEN086	In this module I was encouraged to think	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6
GEN043	The teacher makes good use of class time	<input type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5	<input type="checkbox"/> 6

FIGURE 9 Example of student feedback on teaching approach

regurgitation, again without much understanding. The author believes that the approach outlined in this paper encourages a 'deep' approach to learning, which is borne out in both the quality of the work produced by the students and their employability as architectural graduates.

THE CASE FOR PRACTICE: COMPLIANCE OR CONTESTATION?

Architectural academics are not the only ones concerned with the lack of ability of students to integrate technology into design. If anything, the profession and the building industry are even more vociferous in these concerns (Rashleigh, 2001) and are increasingly calling into question the preparation of graduates for the commercial and practical realities of working practice.

Practitioners are expressing disappointment, if not outright disgust, about how well students are trained for the profession... While no one expects graduates to detail expertly or manage a project on their first day on the job, practitioners observe that many graduates have little awareness or appreciation of these skills, among scores of others important for the creation of architecture. (Crosbie, 1995)

This raises the question of whether we should be preparing students for the realities of working practice at all? An important debate across the higher education spectrum is what Rowland (2001) has termed the question of 'compliance or contestation' in tertiary education – should we be training graduates in accordance with the skills that the 'real' world of commerce or industry requires of them or should we be fostering in them a more personal line of development, giving them the opportunity to explore and nurture some of the talents that are perhaps lying latent within, which the pressures of the real world, once entered, would rarely allow? Are we here purely to prepare graduates according to the wishes of the commercial world, or should we be investing that energy in helping the students to challenge that view of the world, and challenge themselves? Certainly a curriculum obsessed with attaining skills does not seem conducive with one that fosters freedom for the student to explore, expand and experiment which are all vital components of an architectural education.

The pressure on students to perform in terms of grades is now such that most seem to rely only on exploiting their strengths, rather than developing their weaknesses. The concept of experimentation is being rejected by many students in favour of 'safe' options, in

the hope of obtaining higher grades. University seems now to be more about obtaining a qualification than an education. When the realization that what the student develops into during the education years – what he/she takes into the heart and head – is far more important than any grade on paper, an opportunity has often sadly been lost.

So should we be training students primarily for the job that many of them (but by no means all) will eventually be doing, or should we be helping them to develop personally in directions that may not even be architectural? In academia, the response to the accusation of irrelevance to the profession usually manifests itself in the retort that university is not there to replicate practice; that the architectural office is the proper place for training and that university is concerned primarily with helping students attain a higher level of philosophical understanding – certainly in terms of design appreciation – perhaps before the ravages of a career in architecture whittles away the ideal. Many schools of architecture thus place little emphasis on the teaching of construction technology, instead focusing on design concepts, aesthetics and the theory of architecture, leaving the practitioner to teach the necessary technical skills required to design buildings in the real world. This debate about the direction of architectural education has manifested itself in the consideration of whether architecture is a 'discipline' or a 'profession', an 'intellectual pursuit' or a 'vocation' (Crosbie, 1995).

I do not see, however, why these two visions of architecture (or, more specifically, the graduate) have to be necessarily at odds; why one has to be to the detriment of the other. What seems to be missing from the argument is an element of perspective. Would, for example, teaching construction to students following the methodology outlined above – with the dual purpose of helping them to understand the essential link of construction to the design process as well as helping them to prepare for practice – really dampen down their ambition, or somehow corrupt their ability to appreciate the beauty of the philosophy of design? For those that believe that the approach to construction teaching outlined above is indicative of a retreat to the philosophical dark ages, it should perhaps be pointed out that this particular construction course constitutes approximately 8% of the third year; more

than 50% of the overall course is still focused on design studio.

CONCLUSIONS: THE WAY FORWARD?

The pressures on the content of the architectural curriculum (keeping pace with the practice of architecture where responsibilities seem to be increasing exponentially) are now so great that we cannot afford to lose the opportunities proffered to us by each element of it. We need to be excellent at each element that we teach, be it philosophy or construction, history or building services. Each course needs to be crafted to maximize its contribution to the student's learning.

Curricula should be designed in order to present students with experience of architecture as an integrated form of knowledge, in contrast to the present practice of planning additive collections of courses which provide different and uncoordinated fragments of knowledge. (Abel, 1981)

In construction, certainly if the ranks of architectural professions are to be believed, we are not achieving that. So, why not? If the teaching of construction is elementary and methodologies such as those outlined above have been known for years, why, as schools of architecture, are we failing to implement them? This paper does not pretend to be revolutionary as an approach to teaching construction in schools of architecture. Presenting specific drawn details and reinforcing this with images of on-site operations, or providing physical material samples for students to experience is not a new concept, nor is the idea of encouraging learning through problem-based exercises. But, somehow, these – and other – methods of relevant construction teaching must be getting lost, since architectural students generally seem unable to adequately incorporate technology in their designs.

I believe that a significant factor in this is the lack of actual building experience among architectural academics. A prerequisite for the teaching of construction is the prior experience of building buildings. This brings us back to the problem that opened this paper; tutors can explain the theoretical links between construction and design, but very few can actually demonstrate why details are put together in the way they are.

Professional education consists of passing on a body of knowledge and skills. Students ... need to be inducted to the discipline in a special way – by direct learning over the drawingboard from people who have themselves designed and put up buildings, and can pass on their skills. (Davey, 1989)

The gap between academia and practice is widening. Each week, a legion of practitioners enters our schools of architecture to assist in part-time teaching but, from academia, this interchange is not reciprocated. Due to pressures imposed on us by structures of higher education such as the Research Assessment Exercise (RAE), the number of academics involved in the building of buildings is very small. And thus, construction and other subject areas are taught by academics with little relevant experience, or perhaps experience garnered so long ago that it is all but irrelevant.

One of the areas for concern must be the continued drift away from institutions' teaching of technology. The colleges have got to shift the focus of teaching by having tutors with experience and interest [in these areas]. There are some heads of school who do not have a sufficient understanding of practice. (RIBA Vice-President for Education, Paul Hyett, in Booth, 2000)

This lies at the crux of the problem and it is here that we need to address it, coupled with creating courses that maximize the learning potential. It will not be easy. Pressures on both academics and practitioners are such that a retreat into their own world, to cope with those pressures, is increasingly inevitable. But we need to foster greater links between the two strands that constitute architecture in this country – a greater dialogue, more cross-over, increased collaboration.

In a similar way that all practitioners are required to undertake continuing professional development (CPD) during their careers, perhaps all academics – and especially those involved in the teaching of construction and related areas – should be required to spend periods in practice, on site, etc.; a kind of reverse CPD.

An idea similar to this has been implemented by Kingston's School of Surveying and Architecture and

Landscape. The programme 'Learning to Work: Working to Learn' encourages teaching staff to take a two-week sabbatical in an architects' practice where they will shadow a particular member of staff, sit in on relevant meetings and visit sites. The programme aims to act as both a refresher course for academics who may have grown rusty about current practice issues and as an ideas source for promoting teaching within the school with more relevance to practice. The scheme has proved popular, with 16 academic staff involved and five architectural practices providing the necessary experience (Williams, 2000). The idea of the Architecture Professional and Educational Centre (APEC) has also been suggested, providing a place for communication and collaboration between academia, practice and the community (Musgrove, 1978).

There will be many ways of achieving closer collaboration, but the dialogue has to improve. We need a greater understanding of what the other does and a retreat from the insecurities that leave no option but to 'fight the corner'. Both academia and practice need a greater common ground for the benefit of the graduates who are the future of architecture in the UK.

Ultimately, more radical educational and administrative solutions will be required to bring architecture schools in line with cutting-edge practice. Most important, cooperative links with industry and practice need to be recognized, not as a restriction on creative freedom ... but as a means of helping students and staff alike to master the skills which make such freedom possible. (Abel, 1998)

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