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# DEMYSTIFYING CONSTRUCTION; A CASE STUDY OF CONSTRUCTION TEACHING AT THE NOTTINGHAM SCHOOL OF ARCHITECTURE

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## ABSTRACT

Construction is often seen, amongst 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 which 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 A Case Study of the author's personal approach to teaching construction at third year level within the School of the Built Environment 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. It is hoped that such approaches to teaching, if more widely implemented, might help in bridging the divide between academia and architectural practice.

Keywords – architecture; construction; practice; profession; teaching

## 1.0 INTRODUCTION: THE PROBLEM

It took three years of working in architectural practice after graduation until I finally believed 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; that is, the realisation that the only difference between conceptual design and construction design is one of scale. The irony with this realisation was that, on many occasions during my architectural education, tutors had told me exactly that – a mantra to be chanted during construction lectures; ‘detailing was no different to design’. But, though I could understand it in abstract, I couldn’t put it into practice. When the time came to produce the ‘construction drawings’ to accompany the latest design project, like most other students, I reached for the latest edition of Architect’s Working Details (Dawson 2000) and chose the slickest detail that I thought I could justify for my building.

So why was this? Why was, (and, perhaps, why is), a generation of 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? I believe that, in my case, it was largely because tutors explained the process, but nobody actually showed me. Nobody demonstrated 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 process 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. I failed to grasp that construction could 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 my disposal.

Construction lectures tended to concentrate on material properties or building elements in absentia from design, and construction studio asked for a product which required appreciation of a link missing. So ‘construction’ as a subject became mystified; a skill deemed by students to be the special domain of architects with years of experience. Construction became detached from the design process; a separate subject, an addendum to the creation. I believe that, in many schools of architecture, it still is. Consideration of technology; structure, environmental response, construction, has to be an integral part of the design process from concept through to completion. Construction cannot be learnt 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 two academic sessions of third year construction lectures at Nottingham, the design studio has 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. The paper does not necessarily claim to present any new approaches to teaching. Rather, it suggests that in combining a number of established methods and increasing the level of engagement with the students, the learning experience is improved.

## **2.0 LECTURE COURSE METHODOLOGY: LEARNING BY DOING**

Each lecture of the third year construction course at Nottingham is centred upon an exercise involving a differing building system or set of materials which the student must engage with. The intention is that, in learning by doing, rather than just by looking or listening, 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.

### **2.1 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, understand it. The case study is presented in the form of slides; firstly as an object in the realisation of design (the brief, client requirements, design solution etc), then with increasing focus on the usage of the particular material / element; the construction sequence, the implications, the 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 drawings and the detail. In this way, the construction site is brought into the lecture theatre. The presentation concludes with detail(s) which are the focus of that week's exercise; both the images of its exposed construction on site, and the corresponding detail drawings.

### **2.2 Stage 2: The Exercise**

The week's exercise is next introduced (see *Fig. 1: example of a weekly exercise*). Each exercise assumes a particular 'real' scenario in an architectural office and is based upon a task undertaken by the author at some stage in his working career. The student assumes the role of an architectural assistant working in the practice and is given various pieces of information to enable the exercise, in the form of attached drawings (see *Fig. 2: example of supporting information for weekly exercise*), or dimensional information passed on from a hypothetical technical representative.

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, and that these requirements should be respected (or, at least, understood to enable conscious manipulation). Latter exercises tend to focus directly on specific scenarios and the in-depth intricacies of the corresponding details.

**Exercise 3: The Forest Shopping Experience, Nottingham – the Retail Mall.**

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 Sk 616 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 100 m 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 (Sk 616).

**Question 1:** As you can see from the section (Sk 616), 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 Sk 616), paying particular attention to the following aspects:

- How the overhang is achieved structurally.
- How the roof build-up layers are terminated.
- Interaction between the 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. 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 the box outside Antony Wood's office (ground floor, Lenton Firs House) by 12pm Noon, *Monday 28<sup>th</sup> October*. Please make sure that the work is A3 in format, dimensioned and with your name on it. Note: any tracing sheets should be photocopied before submitting.

Antony Wood

14.10.02

*Fig. 1. Example of a weekly exercise*

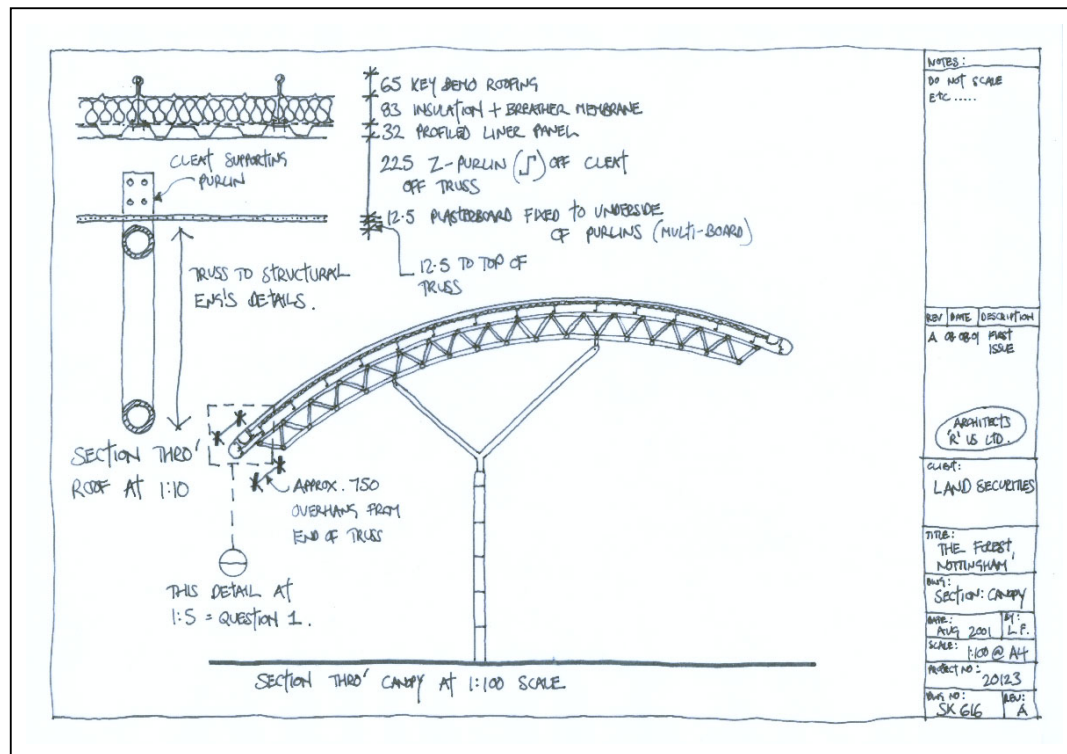


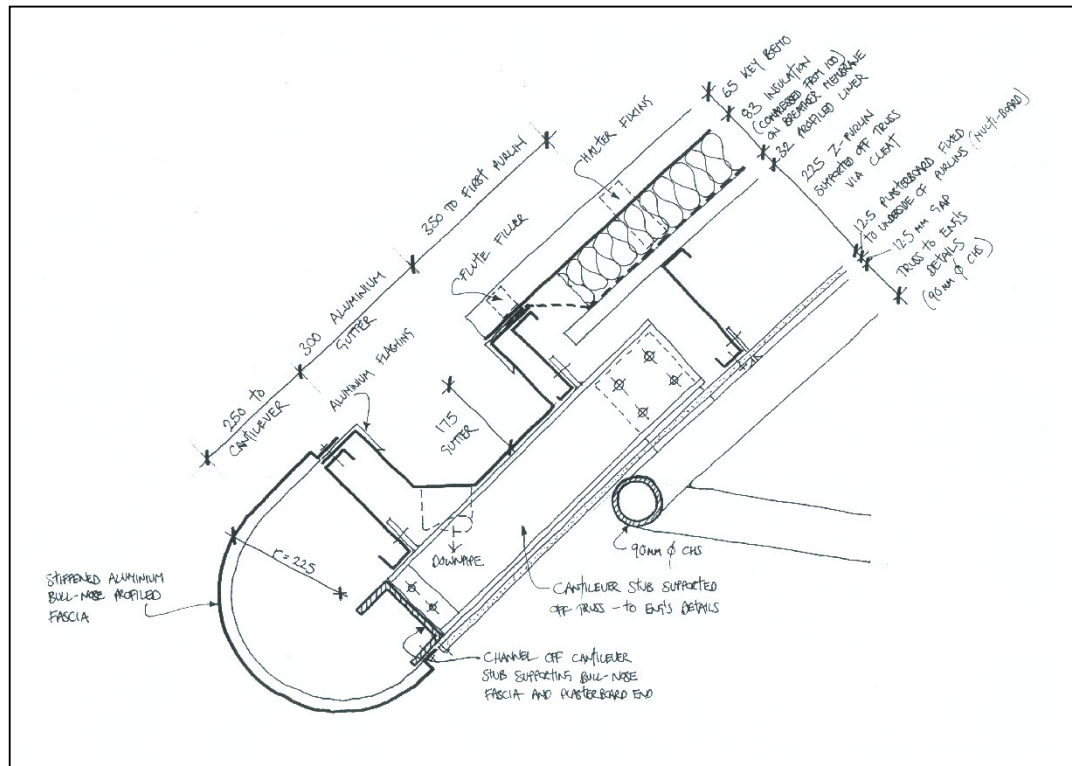
Fig. 2. Example of supporting information for weekly exercise

Practically, the student completes the exercise in the day(s) following the lecture (see Fig. 3. *Example of response to exercise*) and submits it for marking. Marking of the exercise is essential, and forms an important part of the feedback to students that follows. As academics, one of the major pressures facing us is the fact that the majority of students only take an activity seriously if it is assessed. Although the marking does not contribute directly to the assessment of the lecture course (see **3.0 Assessment**), it forms a vital part of the feedback and consequential understanding.

### 2.3 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, aesthetic. The exercise marking structure (usually out of ten) is explained, so that students understand why each mark was allocated. In attaching marks to fundamental decisions, it highlights the importance of the considerations in the detail, reinforcing that each line in the drawing represents an element which 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 which 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 (see Figs. 4 & 5). Similar details on other buildings are also shown, to reinforce the link back to the continuation of the design intent from concept through to completion.



*Fig. 3. Example of response to exercise*



*Figs. 4, 5. Example of on-site construction images reinforcing exercise learning*

## 2.4 Methodology Summary

1. Background: Generic information on material / element issued.
2. Sample: Physical handling of material / element by students.
3. Case Study: Images of material / element implementation on-site shown.
4. Exercise: Students undertake task, produce detailed drawings.
5. Marking: Students are assessed on the value of their solutions.
6. Feedback: The author's solution is presented and analysed in detail.
7. Reinforcement: The case study construction slides are again shown.

### 3.0 RESULTS / ASSESSMENT

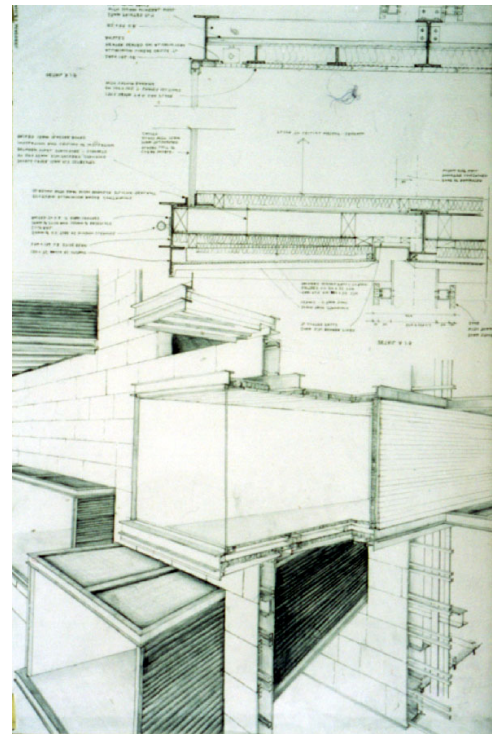
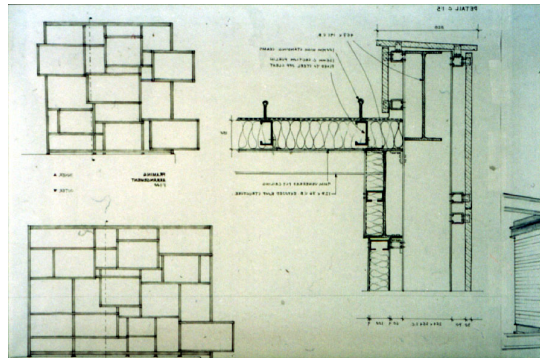
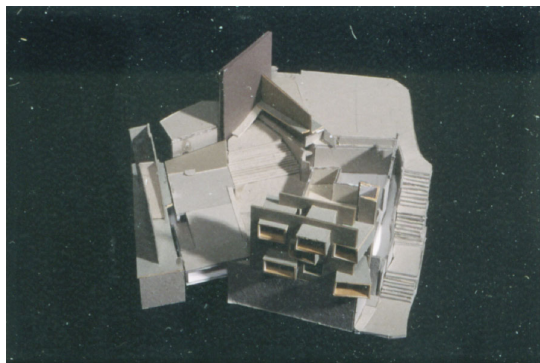
The results from the student exercises in the first instance demonstrate little understanding of the issues. Some comprehend the complexities of the system they are dealing with, but few can extrapolate this into a solution where all aspects of the detail are considered in unison. However, this does 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, been demystified.

The lecture course is assessed by an end-of-session paper introducing a building design which requires rationalising 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 then, but also serves as a useful addition to the student portfolio for job interviews.

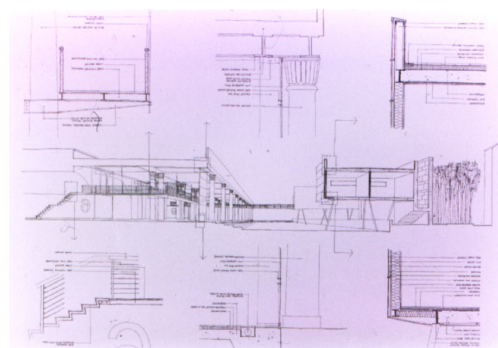
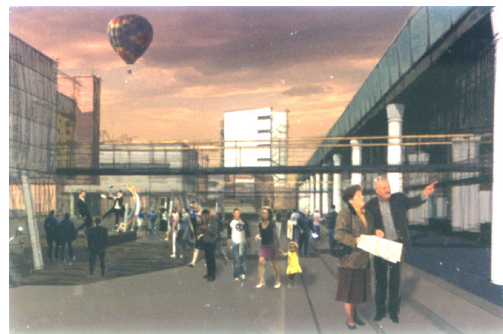
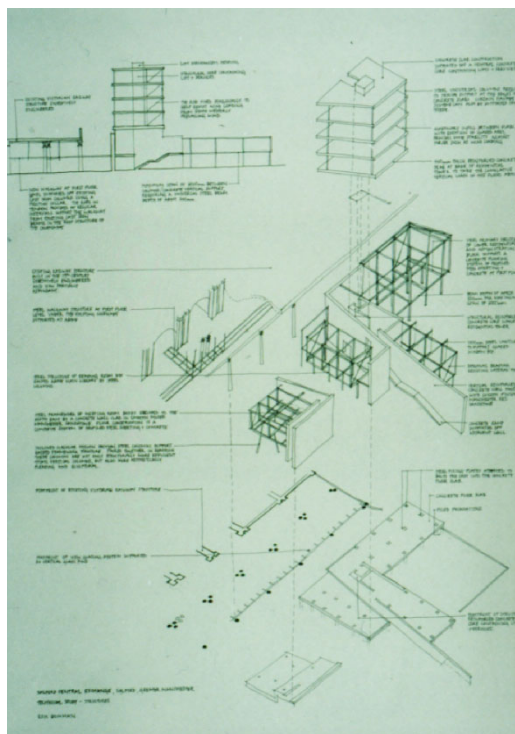
The actual marking of the paper adopts the same objective allocation of marks to fundamental decisions taken in the drawings as per the weekly exercises e.g. the paper consisting of a total of ten details, with marks out of ten for each detail totalling one hundred percent. The students are also required 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 addendum 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. It is still early days of course, but this twin approach in lectures and studio to technology over the past two 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. (see *Figs. 6-11. Examples of student design studio work*).





*Figs 6-8. Example of student design studio work; construction being tackled from first principles, relevant to the individual design.*



*Figs 9-11. Example of student design studio work; construction being tackled from first principles, relevant to the individual design.*

## **4.0 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 last academic session, virtually all students rated every aspect of the module from 6 'value' categories as either 'excellent' or 'very good'. Additional comments from the students included:

'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'.

## **5.0 THE CASE FOR PRACTICE: COMPLIANCE OR CONTESTATION?**

It is not only architectural academics that are concerned with the ability of students to integrate technology in design. On the contrary, it is perhaps the profession and building industry that are the more vociferous in these concerns, and are increasingly calling the preparation of graduates for the commercial and practical realities of working practice into question (Rashleigh 2001).

This raises the question of whether we actually should be preparing students for the realities of working practice. An important debate across the higher education spectrum is what Rowland has termed the question of "Compliance or Contestation" in tertiary education (Rowland 2001); whether we should be training graduates in accordance with the skills that the 'real' world of commerce or industry require of them, or whether we should be fostering in them a more personal line of development; giving them 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 challenge that view of the world; challenge themselves? Certainly a curriculum obsessed with attaining skills does not seem conducive with one that fosters freedom for the student to explore, expand, experiment – 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 realisation 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 which may not even be architectural? In academia, the response to the accusation of irrelevance from 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.

I do not see, however, why these two visions of the graduate have to be necessarily at odds; why one has to be at 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 understand the essential link of construction to the design process but also in helping them 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; the course overall is still focussed with 50% or more on design studio.

## **6.0 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) is now so great that we cannot afford to lose the opportunity 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 maximise its contribution to the student's learning.

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 has already stated that it does not pretend to be especially 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, neither 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 that a pre-requisite for teaching in this way is the prior experience of having built buildings, and that is an experience that many academics do not have. It is back to the original problem that I experienced in my own education; the tutors could explain the theoretical links between construction and the design process, but very few of them could actually show me why details were put together in the way they were.

The gap between academia and practice is widening. Each week, a legion of practitioners enter 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 RAE, the number of academics involved in the building of buildings is very small. And thus, construction – and other subject areas – is taught by academics with little relevant experience, or perhaps experience garnered so long ago that it is all but irrelevant.

This lies at the crux of the problem, and it is here that we need to address it, as well as creating courses which maximise 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 periodic periods in practice, on site etc; a kind of reverse-CPD if you like (could we call it DPC?).

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 which leave no option but to 'fight the corner'. Both academia and practice need a greater common ground – in the vested interests of the graduates who are the future of architecture in the UK.

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