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Detailing Architectural Design - Learning to Detail from First, Sustainable, Principles

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ABSTRACT

Students undertaking undergraduate degree programmes in architecture and associated degrees, such as architectural technology and architectural engineering, need to develop an understanding of how and why buildings are detailed. Typically students learn to detail buildings by copying and adapting details from publications such as journals and construction technology books, from manufacturers' details and more recently from surfing the internet. The challenge with this approach is that students may fail to understand 'why' the detail is composed as it is and hence find it difficult to learn 'how' to detail buildings. Furthermore, such an approach to learning reinforces a relatively conservative approach to detailing where innovation tends to be an incremental process. The question arises as to whether such an approach is appropriate when trying to design and detail buildings that have environmentally sustainable credentials. This article describes an approach taken at Loughborough University in the UK where a new module 'Architectural Detailing' aims to develop student's skills in designing creative and environmentally sustainable architectural details. Coursework is deliberately designed with demanding performance parameters, which makes it impossible to copy topical details. Students are required to develop conceptual details from first, environmentally sustainable, principles using a simple decision support tool, and then develop these concepts into working drawings. Reflecting on the students' work, student feedback from two cohorts and reflection on the module by the author, it appears that students appreciate the link between design and production – appreciating the 'why' and the 'how' - while also developing a better understanding of sustainable design.

KEYWORDS：Architectural detailing, education, first principles, innovation, sustainability

1 INTRODUCTION

Students undertaking undergraduate degree programmes in architecture and associated degrees, such as architectural technology and architectural engineering, need to develop an understanding of how and why buildings are detailed. Typically students learn to detail buildings by copying and adapting details from publications such as journals and construction technology books, from manufacturers' details (Emmitt, 2001) and more recently from surfing the internet. The challenge with this approach is that students may fail to understand 'why' the detail is composed as it is and hence find it difficult to learn 'how' to detail buildings. Invariably the original detail becomes detached from its original context, and in many cases not entirely suited to the detailing challenge facing the student because the why question has not been fully addressed. Furthermore, such an approach to learning reinforces a relatively conservative approach to detailing where innovation tends to be an incremental process. The question arises as to whether such an approach is appropriate when trying to design and detail buildings that have environmentally sustainable credentials. A common complaint from practitioners (architects, architectural technologists, building surveyors and contractors) is that the graduates they employ are unable to detail, i.e. they have a poor understanding of the detailing process. Anecdotal reports by practitioners appear to indicate that the problem is getting worse, not better, although it is difficult to find any research that confirms or refutes these perceptions.

Within the confines of an academic institution it is common to find that students are extremely competent at presenting beautifully crafted drawings and talking about their architectural design ideals. However, when asked to be a little more specific and explain their choice of materials, and also justify why and how the detail is constructed, as a general rule the students demonstrate a lack of confidence and knowledge about architectural detailing. This helps to illustrate a gulf between design and construction knowledge. Wood (2006) has highlighted the detachment of construction technology from the design process in architectural education, echoing earlier concerns (see for example Carpenter, 1997: Cole & Cooper, 1988). Wood (2006) describes an approach taken at Nottingham University, where construction technology is taught in the studio and learning is by doing, with exercises that mimic work in the design office. Although some limitations with the method are highlighted, the article helps to demonstrate an approach that appears to work well for students of architecture. Readers more familiar with the education of architectural technology students will be familiar with a closer relationship between design and construction teaching, although the challenges remain. It would appear, on the surface at least, that academics need to improve the way in which students learn how to detail if we are to rediscover the 'art' of detailing.

The work reported in this paper illustrates an approach to learning how to detail taken at Loughborough University in the UK. The article presents reflection by the author on a module 'Architectural Detailing', which is designed to teach architectural detailing to students on an

Architectural Engineering and Design Management undergraduate programme. The coursework is deliberately designed with demanding performance parameters. Thermal performance of walls, windows and doors is set at a much higher level than that required in the current Building Regulations, which makes it impossible for the students to copy topical details. Students are required to develop conceptual details from first, environmentally sustainable, principles using simple decision support tools, and then develop these concepts into working drawings. Students are encouraged to be creative and to push the boundaries, with marks awarded for creativity as well as technical accuracy. From analysis of the coursework and discussions with the students it is evident that approaching architectural detailing from first principles helps students to appreciate the link between design and production – appreciating the 'why' and the 'how' - while also developing a better understanding of sustainable design. Initial feedback from industry has also been very positive.

2 ARCHITECTURAL DETAILING FROM FIRST PRINCIPLES

There are very few books or articles on architectural detailing that consider the process as a creative experience. Most construction technology and architectural technology books provide typical details which illustrate familiar materials and elements as standard details, usually represented via vertical and horizontal sections. A few publications have taken a slightly different approach, for example *Architectural Detailing* (Allen, 1993), *Principles of Element Design* (Rich & Dean, 1999) and *Principles of Architectural Detailing* (Emmitt, *et al*, 2004). Research undertaken at the Technical University of Istanbul in Turkey analysed these publications to see how they helped architectural students to develop architectural details (Aksu & Altum, 2009). Although their conclusions are a little critical of the prescriptive approaches contained in the books (because they are difficult for inexperienced architects to follow) they were positive concerning the philosophy underlying *Principles of Architectural Detailing*, noting its intuitive design characteristics (Aksu & Altum, 2009).

The author's first attempt at teaching architectural detailing from first principles was at Leeds Metropolitan University in the UK over a five year period from 1997 to 2003. A module called 'Detail Design' was developed for undergraduate students studying both Architectural Technology and Building Surveying. The aim was to integrate the act of detailing with a design project, with technical parameters more stringent than the then current regulations in an attempt to encourage a creative approach. Although feedback on the module was good, it was felt that a suitable framework (decision support tool) to help guide the students through the detailing process was missing.

There were plenty of complex models and evaluation approaches available, but simple guiding principles could not be found. An early version of the Basic Model of Architectural Detailing (a simple nine cell matrix) was presented by Peter Schmid at the Detail Design in Architecture conference in Leeds in 1998 (Schmid & Pa'l-Schmid, 1998). This appeared to provide a useful decision-support framework and it was introduced by the author and used in the studio by the 1999/2000 student cohort. Although it took the students some time to grasp the principles of the tool, they did use it and reported some very positive feedback. Some adjustments were made to the matrix by the author based on the student feedback, primarily to aid understanding.

The elegance of the matrix is that it allows students to find their own way around the detailing problem, and given that students like to tackle challenges in different ways this was (and remains) an attractive characteristic of the model. A small amount of analysis of the module was undertaken, looking at detailing using the Basic model and incorporating lean thinking principles (Emmitt, 2003) and investigating the amount of research that was incorporated into the module (Emmitt & West, 2003). This, together with feedback from employers indicated that the students were leaving the programme as competent detailers.

3 THE LOUGHBOROUGH APPROACH

The undergraduate degree programme Architectural Engineering and Design Management (AEDM) was launched at Loughborough University in 1999. Undergraduate students take a mix of construction management and civil engineering modules, enhanced by bespoke architectural design modules. The majority of students undertake an industrial placement after the second year, thus making a four year BSc degree programme. Following successful completion of the programme the graduates enter the construction industry as design managers, working exclusively for major contracting companies. Their job function varies between contractors, but as a generalisation their main task is concerned with managing the interface between design and production; a role that compliments that of the construction project manager. The job function involves the coordination of design and production information and the management of design changes as the building is being constructed. Design managers work closely with architects, engineers, sub-contractors and specialist suppliers to help ensure the building is constructed safely and in accordance with the specification. Design managers have an important function in overseeing and influencing the evolution of the detailed design during the construction phase, requesting changes to allow better constructability and or to save money and time. Thus it is important that the students develop an appreciation of design and in particular an appreciation of architectural detailing so that they can appreciate the implications of their decisions when dealing with coordination and requests for design changes.

Following a review of the programme and the employment of additional staff the opportunity arose to strengthen the AEDM programme with new modules. One of these was a module called ‘Architectural Detailing’ to be delivered in the final year of the programme, initially as an option to be selected from a choice of four modules. The module carries 10 credit points, from a total of 120 required for the final year. The Architectural Detailing’ module was designed to help the AEDM students understand how to detail buildings, and indirectly, the consequences of making changes to details during the construction phase. The module is assessed entirely on coursework, which is undertaken in small groups (three to four students).

The first presentation of the module was in the 2007/08 academic year. Three groups of four students elected to take the option, approximately one third of the AEDM cohort. Feedback on the module was extremely positive, with the students asking for the module to be made a compulsory part of the AEDM programme. Minor alterations were made to the project brief to aid clarity and the module became a compulsory module for AEDM students from 2008/09 onwards. The second and most recent presentation of the module was in the 2008/09 academic year. Thirty students were organised into small groups of three or four students to create nine groups. Feedback from the students was very positive, consistent with the first cohort.

4 THE COURSEWORK BRIEF

The coursework brief is designed to accompany the final year design project module. A typical brief is reproduced below. Students are asked to select a part of their building design to form the basis for the development of their coursework. The first coursework assignment is submitted mid-module, the second assignment at the end of the module. Written feedback, supported with verbal feedback, is given to each group of students once the coursework has been marked and second marked by a colleague.

The client’s technical brief

Philosophy

Your client is interested in innovative (green) technologies and solutions, and has asked you to embrace the following sustainable principles in your detailed designs:

1. Use reclaimed components and materials. This includes (a) the reuse of components and materials that have been removed from a building and refurbished or reconditioned, and (b) the reuse of recycled materials in new products (recycled content building products, RCBPs).

2. Use ‘environmentally friendly’ components and materials. You will need to clearly document how you interpret the term ‘environmentally friendly’ and how the components and materials selected conform to your interpretation.

3. Use locally available and or locally made components and materials (to minimise transportation and pollution and also to support the local economy). Local is interpreted by your client as being within a 35 mile radius of Loughborough.

Technical/Performance specification

Your detailed design solutions must comply with National (e.g. Building Regulations and Codes) and European legislation where appropriate. The primary technical performance relates to the thermal performance of the external fabric of the building. Your client has stipulated a 'U' value of 0.1 (no, it is not a typographical error) for the walls (including the complete window assembly) and the roof (including any rooflights if applicable).

The window design should help to facilitate passive ventilation of the building.

The design life of the entire building is 50 years. However, the building will need to be disassembled (with minimal waste) and reassembled on a site at the other end of the campus in 10 years time. Therefore ease of disassembly, transportation and reassembly (with minimal waste) must be considered in your detailing.

Coursework

There are two elements to the coursework. The first assignment is designed to help you to develop early conceptual ideas and to justify your design approach in response to the client's criteria. This work will form the background to the second element of the coursework.

Assignment 1 (40%)

This element of the coursework comprises a precedent study and conceptual details, (the precedent study should inform the conceptual detailing), together with a PowerPoint presentation.

1.1 Precedent study (15%)

This should include good (and possibly bad) examples of similar approaches taken already, illustrated with drawings and photographs.

The report should be presented as an A4 (or A3) report (approximately 10 -12 A4 pages in length). Marks will be awarded for relevance to the client's criteria as set out above and the:

(a) Floor to wall junctions
(b) Window designs/window to wall junctions
(c) Wall to roof junctions

1.2 Conceptual details (15%)

Sketch details showing the main design concepts and philosophies for each of the three approaches above. These do not have to be to scale, they represent your initial thoughts in response to the client's criteria. For each approach a sketch plan and sketch vertical section of the following are required:

(a) Floor to wall junction
(b) Window design and window to wall junction
(c) Wall to roof junction

This should be presented as an A4 (or A3) report and include your early design sketches working with the Basic Model of Architectural Detailing (see *Principles of Architectural Detailing*). Marks will be awarded for creative solutions that meet (and/or exceed) the client's criteria.

1.3 Presentation (10%)

Each group will present their precedent study and the conceptual details as a PowerPoint presentation.

Assignment 2 (60%)

This element of the coursework comprises the final detailed design proposal and supporting information, together with a PowerPoint presentation. The coursework components outlined below should complement each other.

2.1 Written justification of the detailed design solution (5%)

This concise report should clearly explain how your detailed design proposal responds to the client's criteria. This must address the three points stated in the client's philosophy, the window design and explain how the building is to be dismantled, moved and reassembled after a ten year period. (As an approximate guide this report should be about three to four A4 sides of text).

2.2 Drawings (30%)

A set of drawings are required to describe the assembly The minimum requirements are outlined below. Additionally, 3D drawings and/or small physical scale models may also be used to help explain the assembly/disassembly. Marks will be awarded for presentation and technical accuracy.

(a) Vertical section through the building showing the main construction details and materials to be used. Scale 1:20.

(b) Vertical and horizontal (plan) sections of the following:

Ground to wall junction. Scale 1:5

Window design and window to wall junction. Scale 1:5

Wall to roof junction. Scale 1:5

2.3 'U' value calculations (5%)

'U' value calculations for (a) the wall, (b) complete window assembly and (c) the roof.

Marks will be awarded for accuracy and response to the client's technical criteria.

2.4. Written specification (in NBS format) for the wall and window assembly (10%)

A written specification is required to accurately specify the (a) wall assembly and (b) the window assembly. Both should be written as:

(a) a proprietary specification (5%), and

(b) a performance specification (5%).

Marks will be awarded for clarity, brevity and accuracy.

2.5 Presentation (10%)

Each group will present an overview of their detailed drawings as a PowerPoint presentation.

5 DECISION SUPPORT TOOLS

One of the biggest concerns voiced by the students at the start of the module was that they 'are not designers', they are learning to be design managers. Although they do undertake design project modules at all three levels of the undergraduate degree programme, there is less emphasis on design skills compared to a typical degree programme in Architecture. However, as graduate design managers the students will be making decisions concerning architectural details on a frequent basis, thus an understanding of how buildings are assembled and disassembled and the consequences in relation to the functionality and performance of the building is essential.

5.1 Delivery of the project

The module is delivered with lectures of one hour duration to introduce the main concepts followed by studio sessions of two hours duration in which the groups can seek guidance from the lecturer. The studio sessions are structured to give students some guidance through the detailing process. Two decision support tools are used, both of which are taken from *Principles of Architectural Detailing* being the basic model of architectural detailing and the nine-plus-one step procedure (see Emmitt *et al*, 2004 for a full description),.

All students are encouraged to develop their conceptual details by using a simple nine cell matrix called the basic model of architectural detailing. This decision support model is introduced and explained as part of a lecture. Students are then given guidance and tutorial support immediately after the lecture in the design studio as they undertake a small task designed to help them to start using the matrix. Students are also encouraged to use the nine-plus-one-step model. This is a structured approach to the development of architectural details. Unlike the basic model of architectural detailing this design tool is not explained to the students, but they are directed to the model as part of their structured reading and encouraged to investigate it further via their coursework. Two of the nine groups comprising the second cohort used the model, both to help develop their design ideas and also to explain the disassembly sequence of their details. This proved to be a very successful approach for the two groups.

6 ANALYSIS AND REFLECTION

Analysis of the first cohort's coursework revealed that the students had embraced the creative, intuitive and innovative aspects of the module, developing some original and creative details. None of the three groups applied commercially available technologies, but analysed these as part of their precedent studies and used the information to develop new products and details. All three groups had got very close to the demanding thermal performance, but none had achieved it. Furthermore, all three groups had embraced the concept of design for disassembly. The three groups had benefitted from quite close studio guidance and all three groups had worked in the studio and made extensive use of the studio teacher to get advice on the progress of their conceptual detailed designs.

Analysis of the second cohort's coursework revealed a tendency to try and borrow existing details from commercially available products. Three of the groups used a commercially available window that claimed a U value of under 0.1. Two of the groups had taken the window and adjusted it to suit their design (incremental innovation), while the other group had used the window without alteration (in direct conflict to the aim of the module). Four of the groups also used commercially available roof systems, one of which had substituted the metal framed system with timber and adjusted the details accordingly. Again, examples of incremental innovation.

It is unclear why these cohorts were less creative in their approach compared to the first. Some of the technologies available to the students had changed since the first delivery of the module twelve months earlier, and the demanding thermal requirements were, perhaps, a little less challenging to the second cohort. Reflecting on the students' approach in the studio it appeared that the students were less confident designers compared to the first cohort, and their response was to be relatively conservative; happy to adjust details to suit their purpose rather than starting with a blank piece of paper (or blank computer screen). Their approach could be seen as incremental innovation. Another contributing factor may be the ease with which architectural details can be downloaded from the internet (via a general search) and from manufacturers' homepages. The majority of the students had taken their placement year in industry and was familiar with certain, well-known, manufacturers and their details. It proved very difficult to try and encourage the students to look at alternative approaches, since they were keen to use materials, systems and manufacturers with which they were already familiar. This reflects research findings into the behaviour of specifiers (e.g., Emmitt & Yeomans, 2008) which found that architects tended to stick to a palette of familiar products unless forced to consider alternatives.

6.1 Reflection

Reflecting on the coursework and the informal comments made by the students it is evident that the module is enjoyed by the students and that they feel that it has equipped them to deal with changes to architectural details. As students enter industry the intention is to keep in contact with them and engage in a small feedback exercise to help inform future development of the module. One such recent exercise has indicated that the students are highly appreciative of the module. One design manager commented that he was unsure of the purpose of the module while at university, but now that he is in industry and working on very large projects he can appreciate that he had developed the skills to be able to deal with design changes and hence do his job effectively.

Following feedback from the students, and in response to some minor changes to the programme structure, it was decided to move the module to the first semester. This means that the module will now run alongside the design project module, thus students will be designing a conceptual building and designing details concurrently. This also means that the coursework brief will need to be adjusted to suit the concurrent nature of the two modules. Whether this will result in students adopting more or less creative approaches and solutions remains to be seen.

With regard to the future development of the module there are two issues; physical model making and the amount of information given to the students. Physical model making is not a requisite of the module, but students are encouraged to use simple model making skills to help realise and refine their conceptual details. Of the two cohorts, only one group attempted any physical model, which proved to be very beneficial to the development and refinement of their conceptual details.

The other challenge relates to the information given to the students. The approach so far has been to avoid showing the students architectural details, encouraging them to source their own and then analyse them. This approach has been criticised by the students, they want to see how a ‘good’ detail should look, i.e. they want answers, solutions, before they start, which tends to defeat the purpose of the exercise. The dilemma is that in encouraging students to develop architectural details from first principles it is necessary to limit the information given to the students, thus mitigating their desire to copy.

7 CONCLUSIONS

The material presented in this article is largely descriptive and based on the author’s self reflection. The intention is to provide an example of how creative detailing can (and could) be taught at undergraduate level on architecture and built environment programmes. Some critical reflection is included, however, the future challenge is to analyse the module in a more objective manner, perhaps via an independent research project. Other than student feedback on the module and self reflection by the author, there has been no independent analysis of the module. Questions remain as to whether or not this is the most effective way in which to educate students about architectural detailing and whether the tools used are the most appropriate.

In personal conversations with a small number of lecturers contributing to architectural technology programmes in the UK it is clear that other institutions are using some of the material from the *Principles of Architectural Detailing* book. Two universities (Derby University and the University of Central Lancashire) have reported great success by using the basic model of architectural detailing in helping their students to realise environmentally sustainable architectural details. This would tend to support some of the findings by Aksu and Altum (2009). However, further research into how students are taught architectural detailing and to what extent these skills are carried into industry is required.

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詳述建築設計 － 從首要、永續與原則當中學習詳述

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摘 要

研讀建築技術與建築工程等建築相關學系的大學生，應該要了解如何詳述建築以及詳述建築之原因。一般而言，學生學習詳述建築的方式，均透過模仿與修改期刊、建築科技書籍或是建築商之內容，近年來甚至流行用網路搜尋。這些方式所面臨的挑戰爲，學生可能不明白詳述的方式，並且認爲學習詳述建築是很困難的。此外，此種學習方式會使詳述的學習更加地保守，因爲創新是一種漸進的過程。問題在於，設計與詳述擁有永續發展環境憑證之建築時，此種方式是否恰當。本文介紹英國拉夫堡大學所採用的新詳述建築模式，以發展學生設計創意與詳述環境永續發展建築之技巧。作業的設計刻意加上性能要求參數，因此無法複製問題的細節。學生必須藉由簡單的決策工具，從首要、環境永續與原則爲基礎，進而將這些概念運用到施工圖當中。從觀察學生的作業、兩組學生的反饋以及作者對此模式的觀察當中發現，學生對於設計與生產之間的原因與方式有正面回應，同時更深入地了解永續發展的設計。

關鍵字：建築詳述，教育，首要原則，創新，永續發展。