

Drawing + Representation; Freehand Drawing for Students of Architecture and Civil Engineering

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Abstract

Architects and Engineers draw in very particular ways, orthographic projections of plan, section and elevation, axonometric and isometric parallel projections and detail and perspective drawings. All can be used to communicate information about a given design. Though CAD applications predominate as a method for production of drawings this paper argues for the value of fluent freehand drawing ability. Through a series of workshops conducted within structures of architectural or engineering merit in Limerick City, first year engineering and architecture students are asked to produce large freehand pencil drawings. The result is increased observational skill, the use of hand-drawing as an investigative tool and the primary way to represent ideas as well as a means to understanding concepts in other modules.

Introduction

Drawing as a means to widely communicate design information has its roots in the Renaissance period. Until this time the medieval master-masons built their structures using knowledge passed on through their own guilds, designing with large scale instruments, the square and compass, but little evidence remains of any coherent attempt to draw a building comprehensively *before* construction. Occasionally scale models were produced in advance, but more usually design and construction for a given project were approximately contemporaneous activities 'as attested to by full scale working drawings etched on some church floors and walls' (Hugh McCague 2003, Horizon Journal).

Through the work of Renaissance designers and engineers such as Andrea Palladio (see Figure 1) and Filippo Brunelleschi, new drawing techniques were developed including that of linear perspective. As the methods for representing unbuilt structures became more sophisticated, and advances in printing permitted easy reproduction, it became more usual to prepare contracts before construction commenced: 'these contracts often included a drawing as an attachment in order to explain the details of the design that was expected' (Carmen Bambach, "Renaissance Drawings: Material and Function 2002) and hence the modern design and construction drawing was born.

At the present time we are witnessing another revolution in the way construction information is prepared and presented. With the increasing sophistication of software such as Building Information Modelling (BIM) and the rise of cloud computing as a means to build these models collaboratively in real-time, the technique of hand-drawing is increasingly sidelined. However as architect Norman Foster states in Will Jones' "Architects' Sketchbooks" 2011; 'I worry about students who might feel that the power of sophisticated computer equipment has somehow rendered the

humble pencil if not obsolete then certainly second rate. The pencil and computer are very similar in that they are only as good as the person driving them.'

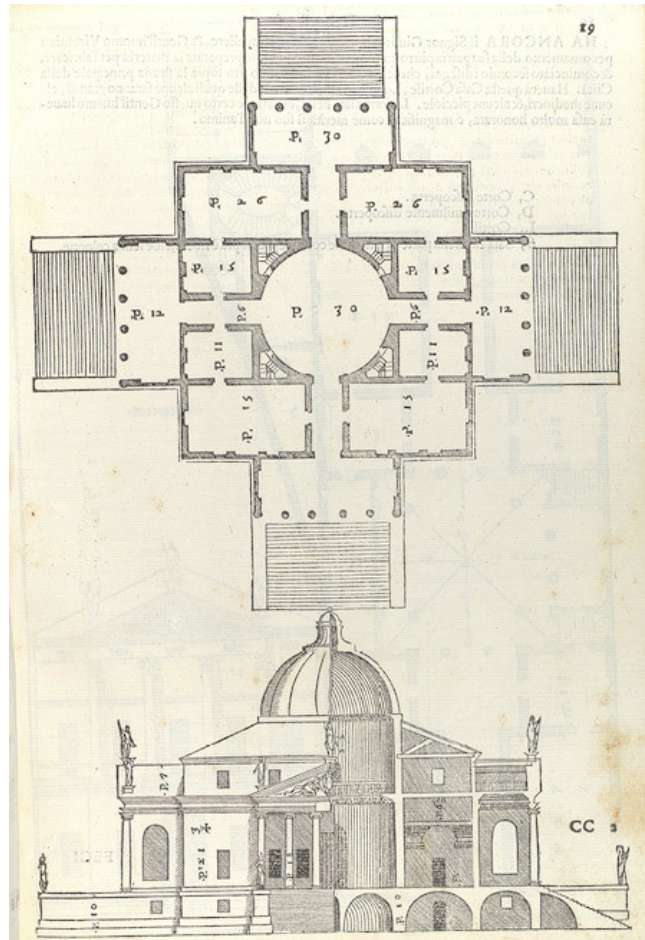


Figure 1. Plan and Section of Villa Almerico (Villa Rotonda):

From *I quattro libri dell'architettura* (book 2, page 19), 1570. Author: Andrea Palladio

At the University of Limerick (UL) we want students who can design with pencil *and* computer. As a means to acquiring skills with the latter, I believe the former is the essential first step. This paper sets out to describe the modes of teaching, learning and practice of freehand observational and design drawing to first year students of Civil Engineering and Architecture at UL. The paper argues for the value of fluent freehand drawing ability and the resultant acquired skills relating to:

- training the eye to observe and understand the assembly and dimension of structures
- the importance of line-weights, varying from bold to light depending on the use to which they are being put
- the importance of the correct scale and proportion in a drawing
- judgment of the location of horizontal and vertical section planes to show the maximum information in any given drawing
- the collateral effect of drawing ability in other modules, as sketching becomes a mode of thinking for the students.

Method

The students participating in these Drawing & Representation (D&R) workshops are first year students of Architecture and Civil Engineering, aged eighteen years on average, the majority of whom have some experience of hardline drawing from Secondary School subjects such as Design and Communication Graphics (a subject dealing with visualizing and comprehending information presented verbally or graphically) and/or figurative drawing from Secondary School Art practice. However, freehand analytical drawing of the type taught in this module is not something with which, any of them are initially familiar.



Figure 2. Students at Work in Ardnacrusha Hydroelectric Station

The module is taught by practicing Architects and Engineers by way of fortnightly workshop, off-site from the main UL campus. The location of each workshop is within a significant building or structure in Limerick City (e.g. a medieval Cathedral, a 19th century Georgian House, the main Train Station, the local market building with contemporary tensile roof structure etc) with the particular building being the subject of the particular workshop.

The purpose of the workshop is get the students to spend time looking at a building or structure, estimate or measure how big it is, understand how it is made, why it remains standing and then represent that information graphically in the form of a freehand drawing, usually an orthographic projection; plan, section or elevation. The drawing must be very legible and differentiate the elements that are cut by a sections plane and those that are not.



Figure 3. Briefing the Students at St Mary's Cathedral (13th century), Limerick

At the outset of the visit the building/ structure is described to the students in terms of its construction, structure, programme, spatial orientation and history. Then a short sequence of slide gives the students an insight into the steps required to construct the drawing; observe, measure, note, set-out lightly and gradually build-up the drawing. The slides are effectively a very brief stop/ go animation of how the drawing might be created (typically a dozen or so slides) with a verbal description of the actions involved in each. The presentation is deliberately brief so as to not overly influence the students own work but at the same demonstrates that the complex task assigned to them can be broken into a series of simpler steps.

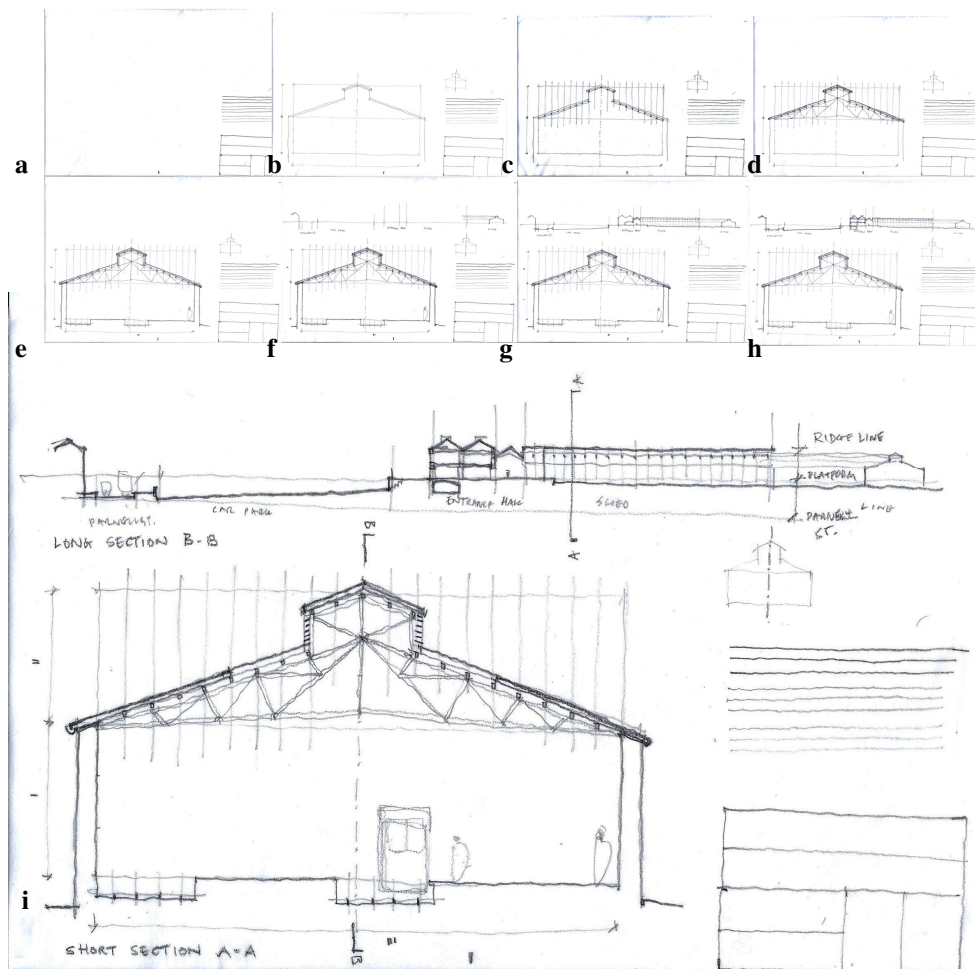
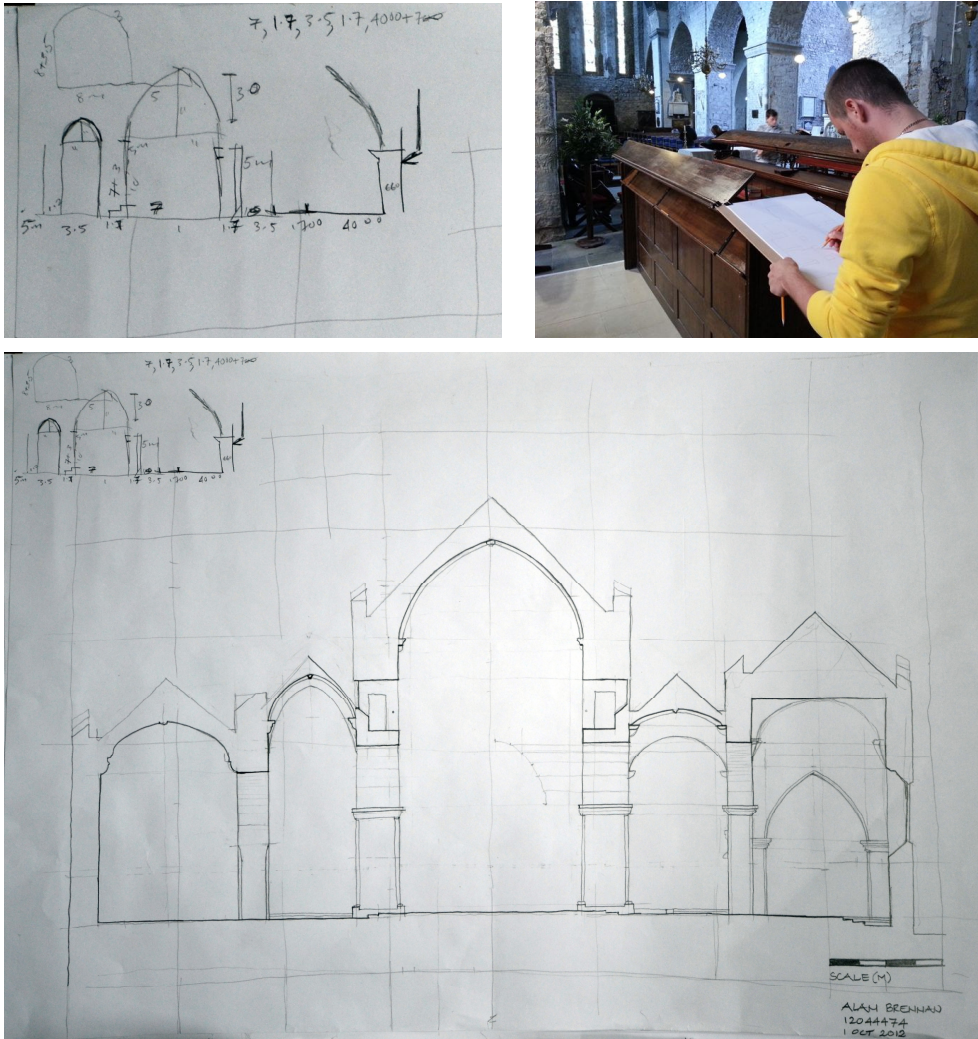


Figure 4. Series of Slides (a-i) showing sequence of hand-drawing of Train Station Sections

The students are taught to measure the space in which they find themselves by estimating by eye and by pacing and etc, and to note the results on an indicative sketch. From this initial survey they must produce a freehand plan or section or axonometric of the structure using a 3b pencil on white A2 paper, no other instruments are permitted. Following Alberti's maxim (from *On Painting*. 1436) they 'practice by drawing things large, as if equal in representation and reality. In small drawings every large weakness is easily hidden; in the large, the smallest weakness is easily seen.'



**Figure 5. Examples of Student Freehand Section Drawing
(with sketch survey notes detail at top left)**

The emphasis is initially on observation, proportion and on appreciating the physical 'work' required to measure and understand the building while improving the drawing technique. In addition the students are encouraged to become aware of drawing as a universal language and as activity requiring the use of many senses, sight, but also kinaesthesia, the ability to sense the position, location, orientation and movement of the body and its parts. Finally the knowledge learned in other taught modules, e.g. Assembly & Techniques (Building Technology), Gravity & Reaction (Structural Design) and Design Studio is used to inform the drawing and display an understanding of how the

building or structure is built up. Chris Wise, Professor of Civil Engineering Design, University College London, (from a 2009 paper titled *The World in a Pencil*) notes that 'contained within that line is a certain knowledge of how it is made. It knows about the steelyard and its workers... and shouldn't be confused with a picture; it is a shorthand for reality'.

Within the other modules there are similar drawing exercises to those described above on large format A2, A1, or multiples of A1 paper. But the students are also required to keep A4 sketchbooks containing, as well as the conventional orthographic projections, another range of notation; lecture notes, conceptual sketches, perspectives, mind maps, studies of light and shade, textures and a variety of colour renderings. In these notebooks drawing is the main investigative tool and the primary written language to represent ideas.

Informal feedback is given to the students on their individual drawings at all drawing sessions. The teaching staff circulate among their assigned students and offer constructive criticism on the drawing technique and line-quality and weight, the content of the drawing and the accuracy of the representation in terms of proportion and scale. When the drawings have begun to take shape for the majority of the cohort a break is called, and all the drawings are assembled for a short review. This part of the exercise is about provoking a peer review and using the students own successful work as exemplars for the cohort.

At a brief one to one session halfway through the semester, the students submissions are reviewed in their presence, and the strengths and weaknesses of the drawings are described. The final assessment of the drawings is done with at least two members of staff present. Ninety percent of the grade is for work submitted while the remainder are awarded for improvement and engagement by the student (the students who are weaker initially often show the most dramatic improvement).

Results

An October 2012 anonymous survey of the Y1 Civil Engineers (to which 86% of cohort responded), invited the students to respond online to ten statements relating to the module. There was unanimous agreement that the workshops had improved their drawing technique, and that the skills learned had proved useful in other modules. Some additional comments by the students were as follows: '*over the last couple of sessions I'm a lot more under control (drawing) and can now also imagine how walls, columns, roofs interact better*', and '*it has allowed me to explain my point of view more clearly in engineering mechanics*' and '*it is sometimes easier to explain by drawing than writing it in words.*'

To the statement: 'D&R has proved useful in understanding scale, how long 1m or 10m is on the ground, as a span or a vertical dimension', 83% were in agreement, with one commenting '*it has helped me to work on the family farm when building and operating machinery- it has improved my spatial awareness.*'

Despite the fact that again 83% agreed that the workshop teaching method was effective, there was indifference to a statement relating to whether feedback on their work was adequate, at the time of the survey they students had not received interim grades and this may have influenced their response.

Finally, to statements relating to the 'importance of lineweight in drawing and the requirement for a large A2 page', all were in agreement, one student commented '*anything smaller would restrict detail in the drawing*' and another; '*the way I look at it is if it is impossible to read in an office, the drawing won't even be looked at on-site*'.

Discussion

The fact that students can articulate this in the comments quoted above is I think a reasonable endorsement of the module content. One other comment from a student was as follows: '*I believe a big part of the drawing skill is speed in which you can draw. As I imagine real life situations will require quick examples in minutes as opposed to hours*'. It's a fair point that it is an unusual luxury to spend four hours on this type of drawing. The student is perhaps unaware that this the type of long exercise is required to before one can produce the invaluable short sharp drawing to which he is referring.

When the module is first introduced to the engineering students there is an initial resistance to what they perceive to be an 'art-class' and a fear that they will not be able to improve their latent drawing skills. The soft 3b pencils, large blank sheets of paper and public nature of the exercise can be intimidating. However, the survey demonstrates with only 4 no. sessions completed there is unanimous agreement on the value of the techniques that they are learning and their application to methods of thinking and learning through drawing in other areas of their coursework.

Conclusions

One of the primary strengths of the freehand drawing module is the strengthened connections between the eye, brain and hand. In the course of the 6no. four hour sessions students are forced to check and double-check the observations that they have made and meet the challenge of representing them. Also, a fluid freehand drawing ability supports the students other learning modes, and becomes for them a reflexive action when they are required to represent complex architectural or engineering concepts. The advice of Cenninio Cennini, to students is still relevant; 'Do not fail, as you go on, to draw something every day, for no matter how little it is, it will be well worth while, and it will do you a world of good' (from 'The Craftsman's Handbook' 14th c.). The concept of hand drawing as a language, immediate and universally understood, instills confidence in the student that with the humble pencil and paper all problems can be swiftly analysed, understood and ultimately resolved.

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