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The novice must learn to create and interpret signs

Lines as the active impressions of the mind's work

Architectural signs: translating the linework of architecture

Chad Joseph Schwartz

In *The Thinking Hand*, Juhani Pallasmaa posits that architects, along with most designers, rarely fabricate their own design work. Instead 'they need to understand the possibilities and limits of their materials and crafts', and communicate their ideas to the specialist craftsman whose hands become the designer's surrogate hands in the execution of the work.[1] Laced into this commentary is the idea that proper communication of architectural value stems from the architect's innate knowledge of the material composition of the built environment. In past eras, before the advent of architecture as a profession, drawings were often embedded within the rituals, tools, and practices of building.[2] In our current system of architectural production, however, that is seldom the case, because drawings are now required in advance of virtually any physical act of building. As a result, Pallasmaa argues, previous rituals, tools, and practices must now be understood by the architect through design processes in order to create synergy between the distinct design and construction phases of architecture. The construction drawing must 'reveal a deep knowledge of, and affection for, the materiality of buildings, for their construction.'[3]

The question posed here, however, is not about how architects achieve this communication of knowledge, but how they develop the knowledge in the first place. As architecture students progress through their education, how do they come to understand the meaning embedded in the lines that they draw and, in turn, how do they learn to use that knowledge to become more conscious and critical of the architecture they design? This process requires the use of translation. In *Translations from Drawing to Building,* Robin Evans states: 'To translate is to convey. It is to move something without altering it.'[4] 'Architecture', he continues, 'has [...] been thought of as an attempt at maximum preservation in which both meaning and likeness are transported from idea through drawing to building with minimum loss.'[5] But delivering near lossless translation requires a great deal of understanding – for both the scribe and the translator – about architecture and its representational mediums.

Almost everything an architect generates is a representation, a signifier of information. The burgeoning knowledge base of the novice student must include lessons in creating and interpreting these signs. Each line drawn contains a myriad of information. Some traits are spatial – length, scale, position in space – and are readily digestible to most students of architecture. These characteristics are directly connected to the principles of descriptive geometry and the Cartesian grid that dominate contemporary architectural documentation. A number of scholars – Robin Evans, Marco Frascari, Daniel Willis, Sam Ridgway – have rallied against the current state of the architectural drawing due to its seemingly complete devotion to efficiency and precise physical description of the soon-to-be-built work, techniques they claim have all but eliminated the translation of the poetic ideals of architecture – processes of inhabitation, primacy of light and shadow, spatial relationships, etc. – into built form.[6] While acknowledging and empathising with this position, I propose shifting the discussion to the development of constructional consciousness in the student as he or she begins the process of learning how to design architecture. Similar to the arguments for a poetic understanding of architecture conveyed through drawing, students must also become conscious of the variety of other characteristics and conventions conveyed through the lines they draw, conventions that directly impact upon the constructability of their work. These traits, including materiality, assembly, time, cost, and precision are more difficult to visualise than those derived from spatial positioning. Yet it is the development of this consciousness that will allow students to begin to unpack their designs and better understand how their ideas can be (and perhaps will be) translated into finished architectural works.

Materiality

Lines have no mass. However, every line drawn and every object created is subject to the limits of and opportunities provided through its

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future material composition. Colour, line weight, line type, and hatching are employed in both hand-drawing and computer-aided design [CAD] programs to demonstrate material meaning. These techniques, however, can be readily modified and skewed without conscious thought of reality, allowing a drawing to present a material response that would be impossible to achieve in an actual built work. The two-dimensional representation of a building is, by its nature, flat. Indications of material thickness and layering come only through the ingenuity and knowledge of the architect.

Material character, one of the most effective tools in the development of our understanding of the poetics of space, becomes more complex with the use of Building Information Modelling [BIM] and other three-dimensional modelling software. These programs often integrate materiality through the application of mapped imagery to the surfaces of drawn objects. Sometimes aesthetically powerful, this technique can create a multitude of issues for students. In most situations, any material can be mapped onto any surface; a component shaped like a steel beam, for instance, can be mapped with an image of a brick wall creating a complete disconnect between the experience of space, the implied materiality, and the logic of construction. Students must be taught to avoid these traps, to slow down and to study the relationship between the intended materiality of their lines and the potential that the material quality can and will emerge from them. This level of consideration opens up the possibility of not just a more technically accurate drawing, but also an architect that is more conscious of material and its potential for assisting in the poetic development of space.

Assembly and fabrication

Lines miraculously stick together. The lines that students draw in their studio work or in technical assignments are not welded or mortared. They require no assembly, no joinery, no adhesives or nails. Only in limited situations do architectural drawings created in the academic environment examine the actual assembly or fabrication of space.

This lack of forethought for the assembly or joining of parts leads students to develop fantastic design ideas that are either extraordinarily clunky in detail or have no potential to become sound constructions in reality. As lines are put to paper or modelled in the computer, it would benefit even novice students to think through how the disparate elements of their designs could be fastened together in an actual construction. At a rudimentary level, the introduction of these considerations early in a curriculum has the potential to help architecture students to design more thoughtfully and to mitigate what could be unnecessary complications in the assembly of future built work. However, the potential latent in the architectural detail moves beyond basic construction. As elegantly stated in the works of Edward Ford and Marco Frascari,[7] the architectural detail is a locus for the poetic assembly of space. Students encouraged to investigate iteratively the potential of connections in their work will not only learn about the physical assembly of architecture but also of the role that assembly processes play in the development of the space they enclose.

Sequence

Lines occur in a vacuum. They are not subject to the external forces of the world such as gravity and temporality. As such, lines can be drawn in any order on a sheet of paper. This is equally apparent in BIM. In this realm, a wall is put up, complete with interior and exterior finishes and then a window, complete with casing, is inserted into a hole spontaneously cut into the wall. Although a great deal of information is contained within the components of a BIM model, notions of sequence – of time and place – are not among them.

As such, students should be asked to study the order of the assembly of parts inherent in almost all construction practices. This order, of course, is dependent on many factors: physical necessity and possibility, material lead times, and subcontractor scheduling being amongst the most common. Understanding the realities of lines means understanding the order in which those lines need to appear in the actual construction when translated into building materials. How are they delivered, stacked, placed, and assembled? How are they held in place while being permanently fastened? While drawing, students must reflect on sequence, time, gravity, and the nature of erecting a structure. As students mature and begin to grasp notions of sequence, they will become more aware of the existing limits of our natural and built worlds and, potentially, how to push, stretch, and bend those limits.

Cost

Lines are free. Each line drawn – or each component modelled – carries equal value to the one drawn next to it. This premise is contrasted with the vast range of costs that the represented elements bear. It is not just material value that is important though. The placement of lines also involves implied value. If a line is placed three inches from another, would the assembly cost three times as much as it would if the two lines were only placed an inch apart? If a line is drawn vertically instead of horizontally on the face of a building, how much does it increase the labour costs for installation of the system's cladding?

Frequently, cost is a non-issue in most academic curricula and it is unrealistic to expect that to change in most situations. Students, however, must be taught to resist blindly adding lines to the page and instead respect the value inherent within them. Each line can add or subtract value; each can save money for the owner or help push a project over budget.

Precision

Lines are perfect. Reality, however, is not. The computer is a miraculous tool – a 'digital system based on mathematical algorithms'[8] – but its uncompromising precision often works to the detriment of novice students who strive to design to the nearest millimetre or 1/16th of an inch. The accuracy of technology cannot be replicated by the hands of workers in the field. Certainly, digital fabrication techniques have allowed the reality of fabricated architectural work to come closer to the perfection envisaged – a trend seen for decades in product manufacturing – but, for now, the vast majority of construction still takes place on site, in the elements, on scaffolding, with imprecise tools and even more imprecise labour. Students must be taught about tolerances and about the imperfection of the construction of the built environment. As the specialisation of trades continues to grow, the tolerances between

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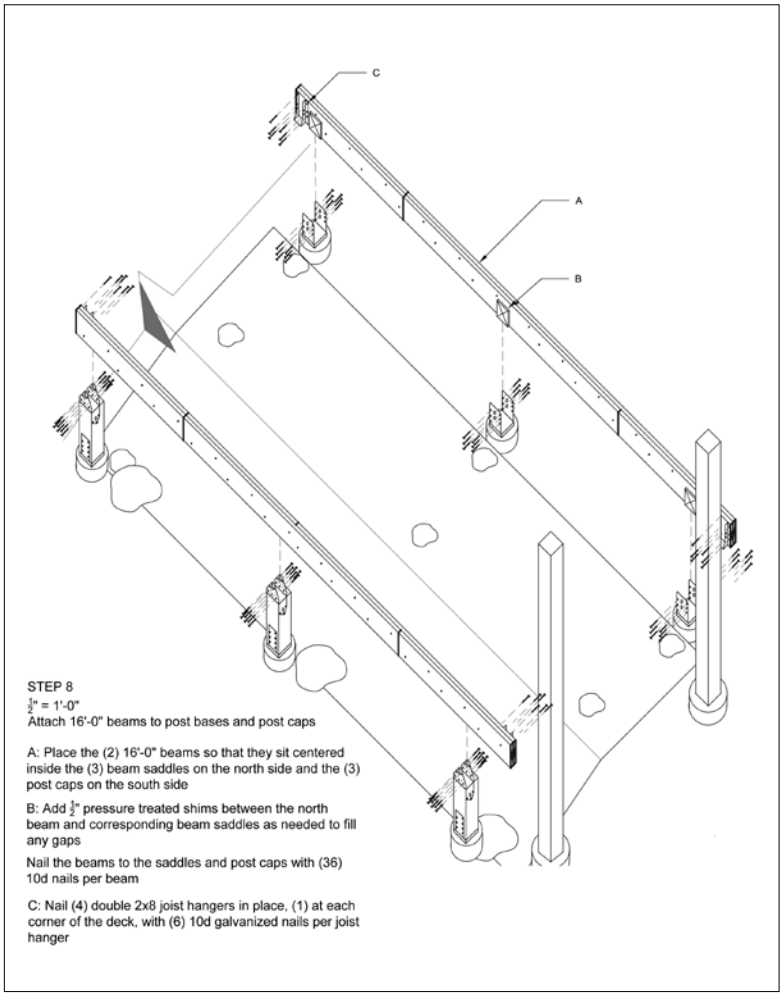
components, between lines, will only grow as well. Understanding the ramifications of precision early on will allow the student to begin to use those traits to his or her advantage, incorporating their visual and haptic impact into the design of space and into the creating of his or her drawings.

Implementation

It is the premise of this proposal that the best way to introduce students to these realities, to the deeper meanings embedded in their linework, is to have them construct their own designs at full scale. The process, however (at least for novice students) needs to be purposefully extended to include a series of translations from original design intent to final construction. For the past five years, classes of forty to sixty second-year Architecture and Interior Design students in an introductory technology course focussed on timber construction have been given the opportunity to undertake this challenge. The initial iterations of the project asked groups of students to build a 4'-0" wide mock-up of a single-story residence based on a given wall section. Later versions have moved the project into the community where the students have designed and built a variety of structures at a regional environmental education centre. Common to all variations has been the rigorous process of investigation and the reality that most of the students participating had never built anything prior to this exercise.

The working processes of the project emphasise translation through a series of linked exercises. After the completion of the initial design phase – whether completing the design of the wall section or creating a unique design – each group is tasked with creating a parts list from their design. Having to make a list of each component required to build the structure forces the students to interpret the lines, and to recognise their reality as representations of physical objects. This task centres on investigating the materiality of lines, understanding the reasoning behind their spacing and quantity, and acknowledging both the seen and unseen elements of a drawing. After developing the list of parts, the students are required to create an initial cost analysis of the project, which is updated throughout the semester. Assigning value to each component serves to develop an understanding of the cost of lines. Student groups frequently begin to amend their designs at this point (especially in the instances when they paying for the materials themselves) as they start to understand the financial ramifications of each line. Which are essential to the design, which are excessive, and which are completely unnecessary? This step also has the added benefit of forcing the students to go to the lumberyard or hardware store and interact with the components first hand. Lines are physically manifested, held and carried, sorted through, and variants decided upon.

Once cost is established and the parts are better understood, the next step for the students is to create a more substantial set of construction documents, establishing a revised and refined Cartesian understanding of the project. In earlier iterations, the wall section rarely needed significant additional drawings. In later versions, however, many of the constructions required a significant amount of drawings for a full description. Complementing this set of traditional drawings, the students are asked to create a storyboard sequence of the construction of their project *[1]*. Where construction documents are valuable for understanding 'the what' and 'the where' of the project (its dimensions and measures), the storyboard helps the students to understand 'the how' and 'the when' of the assembly. The storyboard is invaluable to the students as they begin to understand the sequence of construction and the processes of assembly required to actually put together their design work. Coupled with the construction documents, the students are also confronted at this stage with the necessity of exploring and understanding the joints and the process of assembly at every material intersection. This virtual exploration of the construction process is also complemented at this stage with the fabrication of detail mock-ups. This iterative process allows the students a first opportunity to engage haptically



1 Sample Storyboard Slide, spring 2016. Touch of Nature Trail Station II. Drawing created by Group 2.

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2 Project Process of Group I, in the classroom and in the field. Touch of Nature Trail Station I.



3 Built Work. Touch of Nature Trail Station I (right) and Station II (left).

the more complex moments in their design without the pressure of creating the final product on site. Here, detail can be explored through both the lens of technical understanding and poetic expression.

This process, as I argued before, serves to deepen the students' understanding of their design work and their drawings of the work. After the task submissions are approved by the faculty, the process culminates in building the resultant design on site *[2,3]*. In this phase of the project, all the lessons converge. Lines are hammered and sawed, bolted and screwed, and, in a couple of instances, carried a quarter of a mile down a narrow path into the forest. Lines become real and a consciousness activates in the students. They will never see the lines they draw in the same way again. Here, the impact of precision becomes apparent as the students try to live up to the impossible constraints provided by their computer-generated documents. Inevitably, changes are made, joints are simplified, and the work is built. The final task is to document this process through a photo narrative and a set of red-lined, as-built documents which illuminate where learned reality differed from initial assumptions: moments of clarity.

Concluding thoughts

'Drawing in architecture is not done after nature, but prior to construction; it is not so much produced by reflection on the reality outside the drawing, as productive of a reality that will end up outside the drawing.'[9] As lines almost always occur prior to construction now, they have the potential to impact the architecture they represent. This impact is certainly felt in the poetic understanding of space or, as proposed by many others, the lack thereof. The lines, however, also have the potential to influence the efficiency and effectiveness of the process of building construction and the resulting product. As a result, we need to urge our students to engage the lines they draw and 'occup[y] the very structure that the lines of the drawing represent'.[10]

In 'The Representation of Construction', Sam Ridgway critiques the construction education delivered to students in both academe and the profession, stating that the ability to successfully navigate architectural software is often seen as an

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appropriate substitute for knowledge about the construction of our built environment.[11] This project and this article have followed another avenue, immersing second-year students in the realities of fabricating a (small) architecture project.

Ultimately successful,[12] this exercise is not without its struggles. The project is very demanding of the students' time and requires a highly coordinated and relatively complex environment to function properly. It is also expensive to build at full scale, both with respect to the cost of materials and the cost of the graduate assistants required to help monitor the construction site(s). At times, when grant funding has not been available, the students have had to buy the materials themselves. And, of course, when working with a client and in the field, the project is at the mercy of the schedules of others, which can create a significant issue with completing work in the timeframe of a semester. But, despite the issues, there is no substitute for the immersive learning experience of this design/build endeavour.

Through this process, the students are introduced to the reality of the lines used to create their initial drawings. Slowly, they pull apart and unpack their work, investigating its embedded qualities. It is this intimacy with lines that students of architecture must embrace. To know the lines drawn is to understand their qualities and the impact that those qualities can have on the practice of architecture. Drawing is not just a means of recording but a discussion, a dialogue, a conversation between architect and architecture. Drawing must be an engaged process. When drawing a line, the mind must not be centred on points A and B but on the physical, and sometimes metaphysical, presence created between them. 'Lines are material, spatial, cultural and temporal.'[13] They are complex manifestations of our ideas. They are not passive. Lines are, instead, the active impressions of the mind's work.

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Notes

1. Juhani Pallasmaa, *The Thinking Hand: Existential and Embodied Wisdom in Architecture* (Chichester: John Wiley & Sons, 2009), p. 63.
2. Sam Ridgway, 'The Representation of Construction', in *Architectural Theory Review*, 14:3 (2009), pp. 267–83.
3. Ibid., p. 278.
4. Robin Evans, *Translations from Drawing to Building and Other Essays* (Cambridge, MA: The MIT Press, 1997), p. 154.
5. Ibid., p. 181.
6. Marco Frascari, *Eleven Exercises in the Art of Architectural Drawing: Slow Food for the Architect's Imagination* (New York: Routledge, 2011); Daniel Willis, *The Emerald City and Other Essays on the Architectural Imagination* (New York: Princeton Architectural Press, 1999); Evans, *Translations from Drawing to Building and Other Essays*; Ridgway, 'The Representation of Construction'.
7. Most prominently, Marco Frascari, 'The Tell-the-Tale Detail', in *Theorizing a New Agenda for Architecture: An Anthology of Architectural Theory 1965–1995*, ed. by Kate Nesbitt (New York: Princeton Architectural Press, 1996) and Edward Ford, *The Architectural Detail* (New York: Princeton Architectural Press, 2011).
8. Ridgway, 'The Representation of Construction', p. 275.
9. Evans, *Translations from Drawing to Building*, p. 165.
10. Pallasmaa, *The Thinking Hand*, p. 59.
11. Ridgway, 'The Representation of Construction', p. 279.
12. Over the past five years, students have anonymously rated the course and the learning experience very highly – at an average of 4.76 out of 5.0 or 95%. The significant number of students have also written in the same evaluations about the positive, albeit demanding and stressful, experience of the project and have praised it for delivering on the core lessons promised. More recently, a group of graduates back at the University to deliver a lecture on construction management who participated in the project and are now working in the architecture and construction fields, stated that this project was one of the best learning experiences they had in the programme and that it helped to both solidify their passion for the industry and establish their professional goals.
13. Frascari, *Eleven Exercises in the Art of Architectural Drawing*, p. 103.

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