An innovative studio at The University of Nottingham informs arguments for a densification of design teaching and learning through direct, practical engagement with materials and making.

In the making: pedagogies from MARS

Graham Farmer and Michael Stacey

This paper reflects on experience gained through MARS (Making Architecture Research Studio) at the University of Nottingham.[1] It argues for a densification of design teaching and learning through a direct, practical and tactile engagement with materials and making. It sets out the pedagogical benefits of exploring and theorising the practical, combined with the value and relevance of material practices. As a methodology of design teaching it suggests a multi-level, synergistic approach to pedagogy and practice that can build key knowledge and skills while avoiding a narrowly instrumental view of architectural education and practice. A key aim of the pedagogy of the studio is the development of an empathetic imagination, as clearly articulated by William Hazlitt (1805) in *An Essay on the Principles of Human Action*:

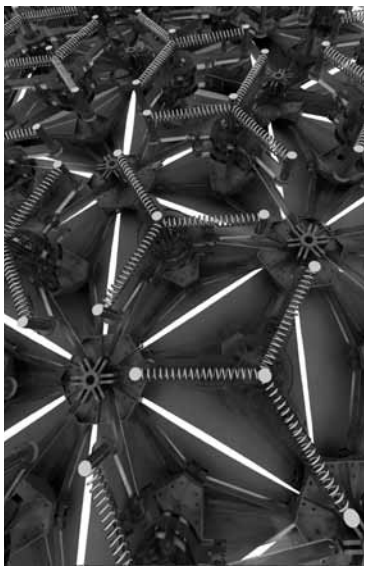
> *The imagination, by means of which alone I can anticipate future objects, or be interested in them, must carry me out of myself into the feelings of others by one and the same process by which I am thrown forward as it were into my future being.*[2]

Hazlitt argues that we share our futures and this is a key feature of humanity, that the imagined future of others is as valid as one's own imagined future. This appears to be a key skill of all designers, and particularly architects, transporting architectural discourse and practice beyond any notion of egocentric space.

The pedagogic approach of the studio is founded on our own experiences of practice combined with experiences gained through experimentation with varied forms of making in student work, including live projects, site-based constructions, prototyping, digital fabrication and craft *[1, 2]*. The recognition of the pedagogical benefits of direct material practices in architectural education is nothing new. However, for the most part, the advantages of such approaches have tended to be conceptualised around the promotion of effective use of materials, skills development, and the establishment of technical competences. While important, these understandings often underplay the revelatory, transformative, reflexive and social (empathetic) aspects of material engagement. These wider understandings of making have received more attention in other disciplinary areas and the paper draws on recent work in the field of creative practice research and pedagogy to highlight important contributions and distinctive perspectives on



1



2

1 Matthew Kidner's design thesis proposes a new agrarian infrastructure for the UK explored directly through material prototypes and 1:1 site-based constructions

2 Steve Townsend's Digital Intimacy project demonstrates a range of making and digital fabrication techniques culminating in the construction of a 1:1 operational interactive wall section which creates a responsive environment for autistic children

doi: 10.1017/S1359135513000195

https://doi.org/10.1017/S1359135513000195 Published online by Cambridge University Press

material thinking,[3] materialising pedagogies,[4] and material practice as research.[5] Each of these contributions shares a concern for an experiential mode of inquiry that, when firmly located within a research framework, can reveal insights and understandings in ways that expand our capacities for knowing.

Knowing through making

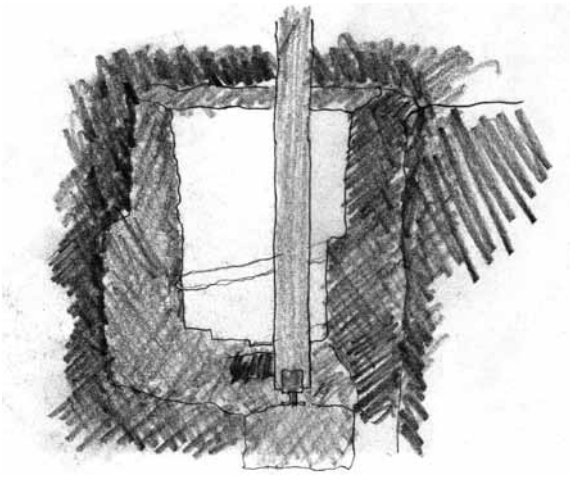
The central aim of MARS is to build inventiveness, technical competence, and confidence combined with an adaptable design approach that is responsive to specific social and physical contexts. Alan Chandler (2007) has challenged the current tendency within architectural education for knowledge to be neatly categorised, for technical understanding to be seen instrumentally as a distinct category, and for pedagogy to be shaped by the need to achieve professional compliance. In contrast, he suggests that a more fundamental challenge lies in 'equipping architects to exercise judgement and dexterity both at the design and production stages of building [...] and to define a means of operating that enhances the potential within any given situation'.[6] The studio was established by the authors, as a collaborative laboratory for exploring *learning through doing* and *research by doing* and promotes the experimental exploration of *knowing through making*. In its pedagogical approach the studio draws on John Dewey's pragmatic philosophy and his important insights on education and art as experience, together with Donald Schön's construct of reflective practice and knowing in action.

Schön's seminal work on reflective and adaptive practice highlights that professional practice routinely faces messy, problematic situations and the workaday life of the professional depends on tacit knowing-in-action.[7] From this viewpoint the design process is experimental and emergent, and is characterised by imagination, intuition and prototyping. Ambiguity is a natural part of the design process where emotion and empathy in particular are used as tools in the process, emphasising reflection-in-action and practice-based knowledge. In the creation of architecture, invention and narrative are of more importance than the resolution of problems. Often a problem on plan or in a detail is resolved by omission – by reworking the whole rather than by the application of a quick fix or a solution. In the design process the parts and the whole are simultaneously reworked, as Per Olaf Fjeld observed of Sverre Fehn's built projects and in particular his house where 'material identity supports and even influences the conceptual idea'.[8] In Fehn's words, 'material is involved in giving a dimension. It becomes a charter in the story. It has inherent rules and limits.'[9]

The studio places emphasis on working collectively to generate an informed discourse on contemporary architecture, while valuing the diversity of invention by each student. It aims to explore a critical and creative dialogue between abstraction and situation, art and architecture, technique and tactility, the analogue and the digital. Students are expected to evolve a design position through a combination of direct experience and inquisitive intuition, through critical imagination and tactile experimentation. Drawing by hand is explored as a key skill, 'used as a direct, spontaneous yet considered means to pitch construction against deconstruction, macro against micro, polished against raw, fragile against concrete'.[10] Spaces and architecture are explored using line drawing as an exploratory tool, from rapid sketching in the caves under Nottingham *[3]* to careful measured surveys, for example of Sverre Fehn's Hedmark Museum, Norway (1967–69 and 2001–05). In this case despite sub-zero temperatures, the studio prepared sketches and measured drawings of the architecture and its artefacts over a number of days *[4]*. This process of close observation culminated in an exhibition of made pieces: 1:1 fragments, scale models, construction models and material sample forming. This foundation is followed by experimental making in relation to a clearly situated year-long thesis project in which making is the primary mode of design research. The pedagogical approach of MARS is based on three interconnected themes that underpin and structure design thinking and making. These aims are: to reinforce an awareness of the embodied and integrated nature of design, to stress the importance of experimental making and to seek to encourage an empathetic outlook.



3



4

3 Cave sketch in ink by Liz Hicks

4 Sketch of the Hedmark Museum, Hamar, Norway, by Robert Atkinson

https://doi.org/10.1017/S1359135513000195 Published online by Cambridge University Press

Integrative making: engaging with situations

The principle of integration provides the methodological foundation for the practical, philosophical and pedagogical approach of the studio. Design thinking is understood to be fundamentally integrative and the ability to synthesise different kinds of knowledge and skills is crucial. Design practice operates not only on the basis of explicit and exact knowledge but also on that of tacit knowledge, and designers need to develop the ability to both recognise and integrate these different levels of abstraction simultaneously. For Dewey, who wrote extensively on craft, education and art,[11] the notion of integration was fundamental in so far as it encompassed the principle of continuity and anti-dualism as well as experience. Everything we think, do and feel is dependent on the particular context, the here and now of that particular thought, act or feeling. Central to Dewey's work was the aim of reconciling the dualisms between reason and emotion, thinking and doing, theory and practice, and, fundamentally, between body and mind. He advocated a theory of knowledge based on the principle of continuity where cognitive faculties such as conceptualisation and reasoning are seen to grow out of, and to be shaped by, our abilities to perceive things, manipulate objects, move our bodies in space, and evaluate our situation. In other words, there is continuity between concrete experiences and abstract or rational thinking. Dewey (1934) termed the process of experiential learning as 'undergoing' and suggested that knowledge generated through integrative and immersive experience provides a mode of revelation that cannot be had in any other way.

Field research

The importance of understanding architecture as a situation and as integrated experience is emphasised and reinforced in the studio by an insistence on visiting buildings as a key aspect of the learning experience. A key starting point for students in MARS over the past five years has been the design research trips to key projects by Alvar Aalto, Sverre Fehn, Sigurd Lewerentz, Jørn Utzon and Peter Zumthor, selected maker-architects whose works have helped to develop a seamless understanding of the connections between design, making, context and situation *[5]*. This follows László Moholy-Nagy's recommendation that:

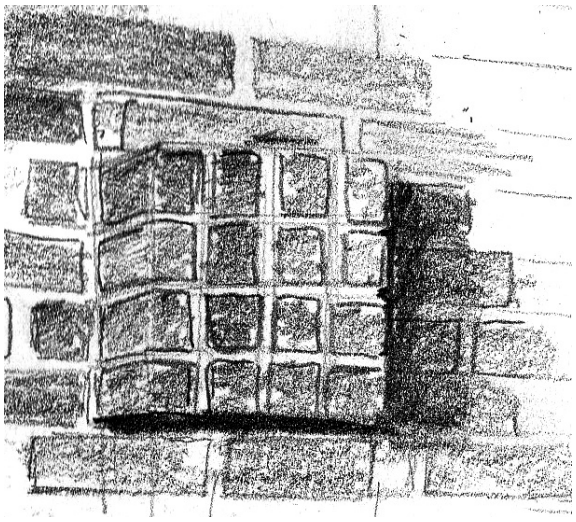
> *One can never experience art through descriptions. Explanations and analysis can serve at best as intellectual preparation. They may, however, encourage one to make direct contact with works of art.*[12]

Michael Trencher observed Aalto's response to Moholy-Nagy, 'that instead of writing about his buildings and the ideas that generated them, he would prefer that people experienced his architecture directly'. Trencher also records that: 'Theory was necessary in design, but not at the expense of the built work and the individuals and society that inhabited and used his [Aalto's] architecture.'[13]

The field research is on all occasions based on close observational drawing and measurement is essential.



5



6



7



8

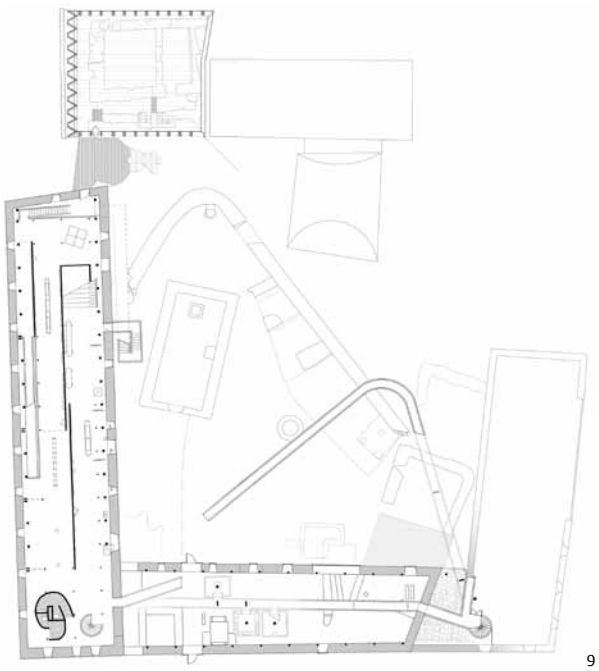
5 MARS students sketching at Hedmark Museum

6 Brickwork detail of St Peter's Church, Klippan, Sweden , by Ben Hopkins

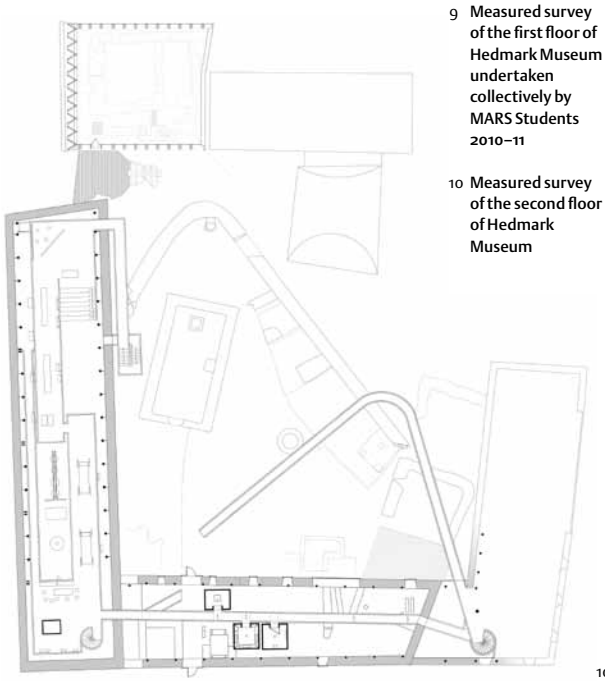
7 1:1 Making of board-marked concrete inspired by Fehn

8 Hedmark Museum, measured survey of one of the protective structures

https://doi.org/10.1017/S1359135513000195 Published online by Cambridge University Press



9



10

9 Measured survey of the first floor of Hedmark Museum undertaken collectively by MARS Students 2010–11

10 Measured survey of the second floor of Hedmark Museum

At St Peter's, Klippan (Sigurd Lewerentz, 1966), the verger was delighted on entering his church late in the afternoon to find fifteen students and their tutors silently drawing *[6]*. A further aim of the building visits is to enable students to compare their direct experiences to published texts and drawings of the projects as a way to facilitate the development of their critical thinking *[7]*. This enables them directly to experience the architecture and travel beyond the opinions of journalists or academic authors, sometimes revealing errors or omissions in earlier texts.

In 2010 the Hedmark Museum by Norwegian architect Sverre Fehn was selected for a research visit primarily for the richness of historical layering and the clarity of Fehn's architectural interventions, which span almost forty years from 1967 to 2005. Fehn describes the project:

> *My most important journey was perhaps into the past, in confrontation with the Middle Age, when I built a museum among the ruins of the Bishops' Fortress at Hamar. I realized, when working out this project, that only by manifestation of the present, you can make the past speak. If you try to run after it, you will never reach it.*[14]

The Hedmark Museum was originally a thick-walled medieval fortress immediately adjacent to Hamar Cathedral and home to the Bishop of Hamar until 1567, when a retreating Swedish Army largely demolished it by explosions and subsequent fires. In 1675 a large barn was built on the remains, incorporating parts of the old fortress into the new walls. After the nearby city of Hamar was founded in 1849, farming on the site declined until it came to an end in 1940. In 1946, the Museum of Hedmark took over the property, and this heralded the start of two decades of archaeological excavations. These excavations uncovered the forgotten medieval fortress, and a rich medieval history. In the 1960s, Per Martin Tvengsberg, a former student of Fehn, commissioned the architect to convert the old barn into a museum of medieval life. The first phase, North and West Barns were started in 1969 and completed in 1971, the South Barn was transformed into an auditorium by 1973, and the exhibitions were not completed until 1980. The protective structures were designed and built between 2001 and 2005 *[8]*. These cover sections of the medieval fortress that were not formed into part of the Storhamar Barn.

The measured survey of Hedmark was undertaken by MARS, as an act of close observation, in groups surveying specific areas of the complete museum including the external works and ruins; the exception was the auditorium which was in use. This survey of Hedmark revealed some significant anomalies in the published plans,[15] the most obvious of which is the location of the well. On the published plans this is clear of the external concrete ramp that curves across the courtyard, whereas in reality the well is tucked under this ramp. This is clearly shown on the studio's survey and is confirmed by photographic evidence *[9, 10]*. The Hedmark Museum presents to the visitor an unravelling series of layers. Like the layers of history entwined within the site, the building's fabric itself is layered. The strata of Archbishop's Palace, later barn and museum interweave to create a rich tapestry, which can be interpreted and explored if one looks closely. Just as the building is layered, so is Fehn's exhibition. Exploring the history of the Hedmark region, the artefacts are meticulously exhibited within an infrastructure of display cases, armatures and plinths, which marry steel, glass and stone. The ruins within the museum themselves become an exhibit, with concrete ramps and enclosures hovering over them as if weightless. Artefacts are displayed alongside the ruins on steel armatures projecting off the ramps. Fehn describes it as 'a "suspended museum" which will make it possible to get a grasp on history, not by means of pages in a book written with ink – but as it emerges in the world of

https://doi.org/10.1017/S1359135513000195 Published online by Cambridge University Press



11



12



13

11 Stone fragment from the Archbishop's Palace held in a steel bracket

12 Circulation ramp and in-situ board-marked concrete exhibition boxes

13 Sectional model of the Storhamar North Barn by Robert Atkinson and Matthew Alvey

archaeology'.[16] It is in the detailing of the exhibition that Fehn reveals the influence of Jean Prouvé on his work. In 1950 Fehn spent a year working in Prouvé's office in Paris after graduating as an architect from the Arts and Crafts School in Oslo. This is particularly evident in metal fittings supporting medieval glass bottles in window niches or stones suspended in space on cantilevered steel brackets *[11]*.

Fehn's primary palette of materials – of concrete, glass and engineered timber – are in striking contrast to the limestone blocks from the medieval period and the seventeenth century. This contrast accentuates a sense of layers of history and serves to bring the past closer to the observer. Fehn has successfully integrated a striking piece of architecture very much of its time but one that does not compete with or distract from the historic elements of the compound – those that tell the story of the site. There is a contemplative stillness to the museum as a whole – one that is aided by the delicate natural lighting of the various spaces and the soft sounds of the wind in the landscape. Though Fehn's architecture is brutal rather than beautiful, he has created an experience that engages the attention and imagination of the visitor *[12]*. At Hedmark, Fehn consistently uses board-marked concrete and the board dimension is 100 mm whether the construction is from 1967 or 2005. Similarly he uses red oxide paint on pine timber cladding to represent the background architecture of Norway, even though the element is newly constructed in the twentieth or twenty-first centuries. Fehn reflects on the work of Knut Knutsen, who had taught him architecture, with the idea that:

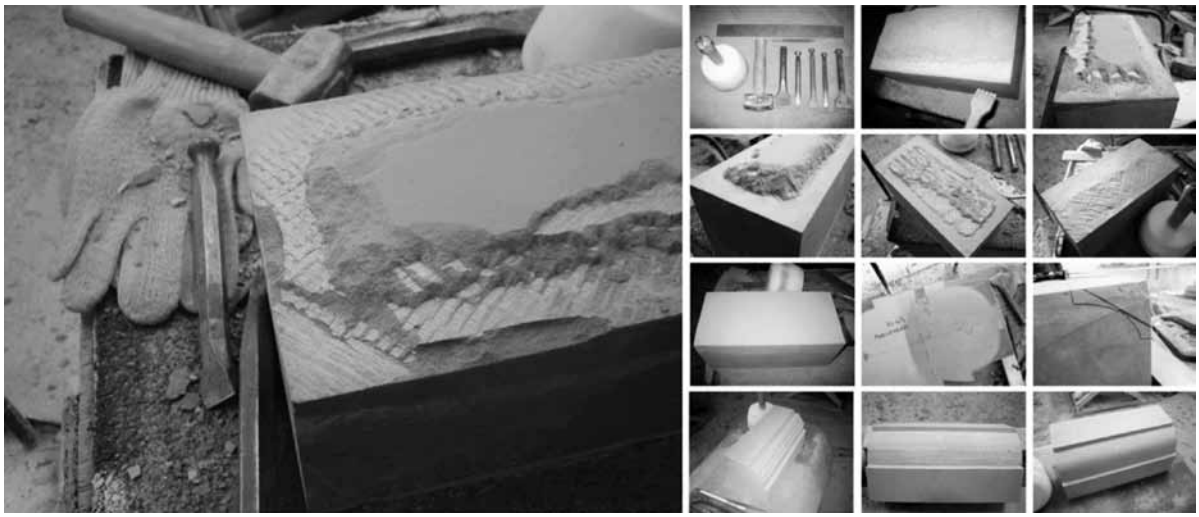
> *As an architect you scribe your tales into the sand of the earth and the language is the language of materials. In the beginning you meet materials as a challenge. You try with all your power. You force it. But the significant architects develop a dialogue with materials.*[17]

Such field studies engender a seamless interaction and holistic perception of significant works of architecture, which the studio then articulates to the rest of the school in the form of a public exhibition *[13]*.

Experimental making

The design process is characterised by experimentation by means of both facts and ideas. In the process of making, an artist actively uses material, whether brush and paint, music notes or written words, as well as emotion and thought in an experimental process of crafting the art work. In doing so, designers operate in the space between knowing and doing and use sketches and prototypes in an iterative process to arrive at a final design. Within the studio, students are challenged to work in an unfamiliar way – and with materials they may not have used or engaged with previously, including materials such as glass and metals. A key starting point is experimental and observational drawing with an understanding that we draw to make and make to draw. A practising artist, Frances Stacey, leads this element of the studio approach. David Pye (1968) has highlighted the importance of experimentation in craft by distinguishing between a 'workmanship of certainty' and a 'workmanship of risk'. In the latter, 'risk' implies 'the mental uncertainty of advancing on untrodden paths' and this is usually associated with those outcomes that we value most highly.[18] For Joseph Brodsky it is the process of working, rather than the end result, that is more important in the maker's consciousness:

https://doi.org/10.1017/S1359135513000195 Published online by Cambridge University Press



14



15

No honest craftsman or maker knows in the process of working whether he is making or creating [...] the first, the second, and the last reality for him is the work itself, the very process of working. The process takes precedence over the result, if only because the latter is impossible without the former.[19]

Although both Richard Sennett and Juhani Pallasmaa suggest that 10,000 hours of experience is necessary to become an accomplished craftsman and despite the folklore that crafts are difficult to revive,[20] our experience from the studio is that an able student can take up basket weaving or glass blowing as a new activity and display a basic competence. Often this involves the patience of established artisans such as the stonemasons at Hardwick Hall who accepted Sheldon Brown as a temporary apprentice *[14, 15]* or the craftsmen of Bristol Blue Glass who guided Anna Michael and Samantha Barclay through glass blowing *[16]*. Undertaking a stone masonry course, Richard Pulford demonstrated that a diligent architecture student has many spatial and handling skills that facilitate the making task by successfully completing the subtractive emergence of a complex stone detail – an intersecting corner ogee from a raw block – in four days *[17]*. Such engagements with traditional materials and craft skills are not nostalgic and the praxical knowledge and insight provided through such an encounter with materials, methods and tools continues to have profound relevance for current society and contemporary architecture.

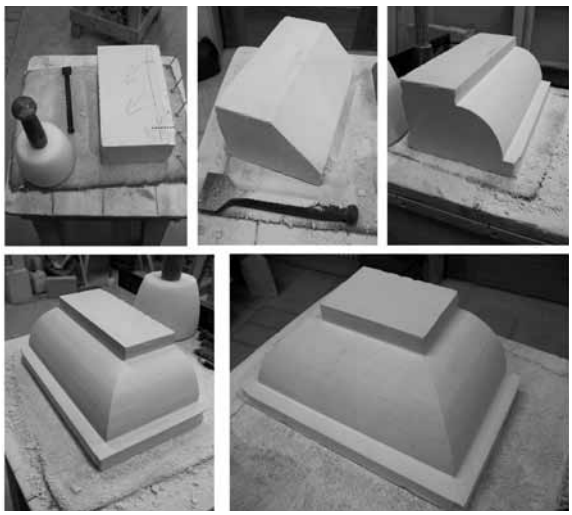
Experimentation at a variety of scales and with different media helps to emphasise and familiarise the non-linearity of the design process. It reveals a



16

fluid combination of iterative active and reflective methods in which assumptions and preconceived ideas about design are questioned through making. In seeking to understand the industrial production of her hometown of Sheffield and the role of skilled artisans – the Little Mesters – in the production of cutlery, Rachel Lee studied the production processes currently employed by David Mellor's factory in Hathersage. She then set about producing a place setting in the basic workshop of the School of Architecture, primarily using hand tools and fabricated bosses *[18]*. As Sennett observes, 'the sense of possibility is grounded in feeling frustrated by a

https://doi.org/10.1017/S1359135513000195 Published online by Cambridge University Press



17



18



19

14 Sheldon Brown trained as a stonemason as part of his design thesis research

15 Brown's direct experience of stonemasonry resulted in a thesis project for an Institute of Masonry (section)

16 Mouth-blown glass vase by Anna Michael

17 Limestone intersecting ogee corner by Richard Pulford

18 Rachel Lee, hand shaping of the spoon bowl and final place setting

19 Anna Michael conducting physical experiments with plaster casts

tool's limits or provoked by its untested possibilities'.[21] Her research is directly embodied in the artefacts together with a greater depth of understanding and respect for the maker and making. Anna Michael's thesis focused on the retreat of the Jostedalsbreen glacier at the head of the Fjærland fiord. Entropy and erosion thus became the key themes of her work, which she explored with a series of physical experiments including suspending plaster casts in fast-flowing rivers to establish how they were eroded *[19]*. Such explorations can reveal and make sense of new/alternative ways of knowing or can help students to develop a better understanding of ideas or knowing embodied in the process of making and knowledge embodied in the object made. Experimental making can be distinguished from conscious attempts to be original through an open-ended commitment to process rather than immediate outcomes, enabling the students to be unselfconsciously inventive. This commitment to making, combined with written and drawn reflection by the students on their own experimental processes, is in essence an activation of Schön's construct of 'reflective practice' and 'knowing in action'.

Empathetic making

An empathetic imagination, as articulated by Hazlitt and cited in the introduction, is a fundamental cornerstone of our approach to studio teaching and the design development of projects. Dewey's interpretation of aesthetic experience stresses the interactive nature of the production of art works in the sense that the experience of the object of art cannot be separated from the act of making it. Equally the perception or consumption of the work of art cannot be fully separated from its production. In contrast to a spontaneous and uncontrolled activity, the artist works with the aesthetic experience of the perceiver in mind. The artist embodies himself in the attitude of the perceiver while he works.[22] This interpretation of artistic production as interactive captures well the central skill and attitude of design thinking as empathetic, always attempting to see and experience the situation from the vantage point of the user. Creative work calls for a double perspective: one needs to focus simultaneously on the world and on oneself, the external space and one's inner mental space. Dewey saw the dual role of education as cultivating the human abilities of imagination and empathy.

Clara Byrne's *Traces at 76 Dean Street* can be read as an embodiment of empathetic making: from the experimental burning of timber in order to understand the destruction by fire of a Georgian terrace house in Soho, to the careful sticking-together of this ruin as a space for recovery from drug abuse *[20, 21]*. Winner of the SPAB 2012 Philip Webb Award, the judges' citation states: 'Clara's sensitive proposal to convert the fragile shell of the building to provide a supportive and contemplative environment for a recovering addict connected No. 76 explicitly to Soho's past'.[23]

https://doi.org/10.1017/S1359135513000195 Published online by Cambridge University Press



20



21

According to Pallasmaa, who quotes Aulis Blomstedt: 'The capacity to imagine situations of life is a more important talent for an architect than the gift of fantasizing space.'[24] This can be interpreted as an application of Hazlitt's idea of the empathetic imagination as the wellspring of human life and key to the creation of architecture. In the process of sketching and prototyping – in the physicality of making – the architect or student of architecture is interacting with the dynamic potential of a project, implicitly exploring the unknown, and seeking to realise a narrative arc and serve the client well with an architecture that travels beyond the merely functional and instead offers a fusion of the technical and cultural: an architecture that can be read on many levels or just enjoyed.

The growing practical as well as mental distance between the architect's studio and the construction site – the dislocation that characterises much of contemporary construction – arises partly from the fact that, unlike most artists and craftsmen, the architect works on a product that is some distance away from the final reality. An architect rarely works on the final construction; his attentions are focused on an intermediate phase, usually a set of drawings, where all too often the final drawing in their mind 'is' the final building. The critical difference is that the drawing has a visual appearance largely divorced from texture and scale, both of which can have a considerable influence on the impact of the final product, the building itself. There is also rarely direct contact with any of the materials specified for its construction. The impact of texture is often lost when moving from a small representation to a large execution. To really gain an understanding for a material and its scale you have to work with it directly at 1:1. On the other hand, architectural detail that seems suitably intricate on a drawing can look exaggerated and childish when expanded to the final size. Some see digital design and digital fabrication as the means of bridging this divide, as explored by Michael Stacey in *Searching For Excellence* (2007) and *Digital Craft* (2012).[25] Fehn is reported to have taken to drawing at 1:1 as a response to the use of computers in his practice. Fjeld suggests that after the introduction of drawing with computers 'some of the immediacy of his working method was perhaps modified, and to compensate he drew in a 1:1 scale on his old office blackboard'.[26] The challenge of communicating the constructive intent of an imagined architecture using conventional drawings, produced by hand or with a computer, has been described by Robin Evans (1997) as an act of translation:

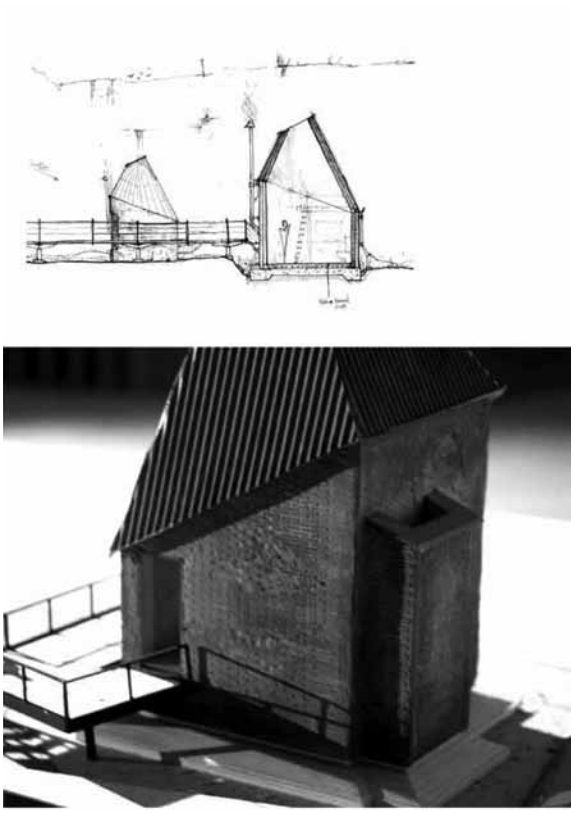
> *To translate is to convey, it is to move something without altering it. But when translating across languages, it does not seem to have the same continuity and unity; things get bent, broken or lost on the way. Something similar would appear to occur in architecture between drawing and building.*[27]

In these terms a design studio should be generating skilful *translators* steeped in the discipline of architecture. This is the great potential benefit to a student committing him or herself to making. It enables them to engage directly with the performative qualities of a range of materials while also providing a direct means of understanding the language of architecture. Christopher Dalton spent a complete semester studying the art of Japanese joinery. Beginning with no woodworking skills, he mastered the production by hand of complex wood-joining techniques that have a cultural tradition stretching back millennia *[22]*. A key skill is patience and an understanding that smaller scale operations and micro-iterations of refining technique and

https://doi.org/10.1017/S1359135513000195 Published online by Cambridge University Press



22



24



23

20 Clara Byrne, *Traces of 76 Dean Street* explored through experimental burning of timber

21 *Traces of 76 Dean Street*, interior space

22 Chris Dalton's fabrication of a Japanese hip rafter joint

23 Andrew Tindale, *(By) Product Landscape*, fabrication of moss briquette

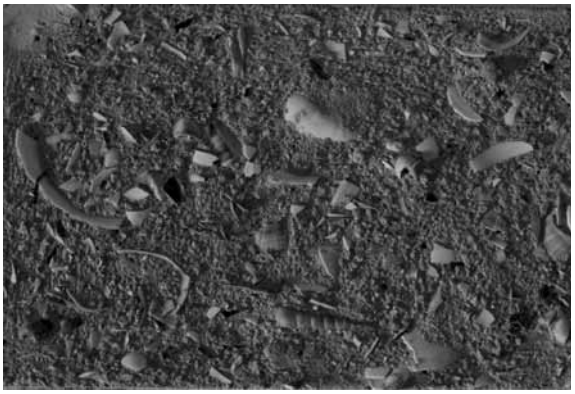
24 *(By) Product Landscape*, proposed workers' lodge

25 *(By) Product Landscape*, extension of the Monsal Trail

26 Jess Atkinson Evans, *Heterotopian Landscape*, concrete casting



25



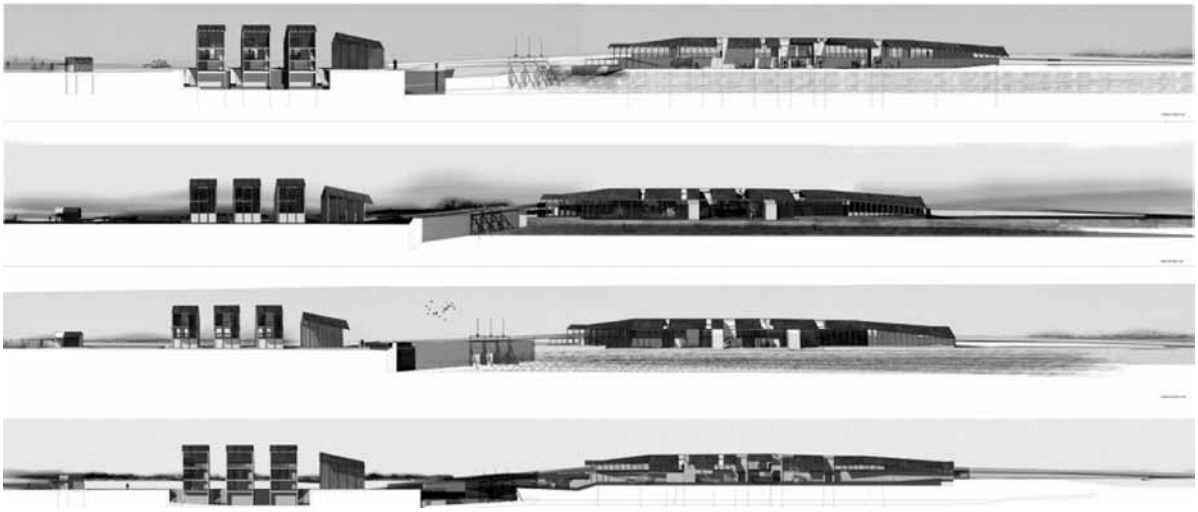
26

artefact replicate and mirror the wider process of design. As Pallasmaa suggests:

> *Mastering one craft personally helps the designer and architect to grasp the nuances of other crafts and, before all, to respect the special skill and experience of the craftsman executing his design.*[28]

In our experience, reflexivity in the making process involves not only a focus on the made piece, but also a positioning in relation to other fields that can invoke both a questioning and affirmation of one's own established design knowledge. This 'relationality' of making-based research provides students with a connection to other practices and practitioners and a means to both reflect on, and to ground, their own agency within a wider socio-cultural context.[29]

https://doi.org/10.1017/S1359135513000195 Published online by Cambridge University Press



27 *Heterotopian Landscape*, infrastructure for the fishing community of Beauduc

The experience of MARS also shows that it is possible to reinvigorate earlier craft traditions and make these available to contemporary society. Most designers rarely themselves make the objects they design. Consequently, 'they need to understand the possibilities and limits of the materials and crafts, and communicate their ideas and intentions to the specialist, whose hands become the designer's surrogate hands in the execution of the work'.[30] Architectural education has generally reproduced and reinforced this dislocation – and commonly a student's only engagement with 'technology' constitutes replicating 'snapshot' details found in architectural periodicals or textbooks at 1:5, many of which are over edited or quite simply incorrect. While the notion of integration in design literatures tends to stay at the abstract level of descriptions of designer skills and 'mind-sets', for integration to happen in practice it also has to happen at the level of experience. An engagement with making is empowering and provides students with the confidence to transcend the instrumentality that is often associated with post-rationalised technical studies. It also adds traction to a design process, as can be seen in Andrew Tindale's moss briquette for his thesis *(By) Product Landscape*, a self-generated process formed by growing moss into a building component, a humble brick *[23]*. This thesis proposed a new productive landscape in a disused Derbyshire stone quarry, which engaged with the sublime and bridged the dichotomy between tourists and workers in a situated human ecology *[24, 25]*. Jess Atkinson-Evans' material experiments in casting concrete with site-specific aggregates *[26]* became the basis of a thesis which is in essence an embodiment of the fluxing landscape and culture of the Camargue explored through a proposal for a temporal fishing village that is transformed season to season *[27]*.

Doing good work: towards an ethics of making

A concern for empathy and integration and a meaningful dialogue with materials extends beyond a mere understanding of technology and establishes a working method that should provide a foundation for subsequent careers beyond education. However, this also depends on imparting what Sennett (2008) highlights as the key characteristic of craft – namely the desire to do a job well for its own sake – as a template for living. According to Sennett, the carpenter, lab technician, and conductor are all craftsmen because they are dedicated to good work for its own sake. Theirs is practical activity, but their labour is not simply a means to another end: 'Every good craftsman conducts a dialogue between concrete practices and thinking; this dialogue evolves into sustaining habits.'[31] This vocational view of craft as a process of making self-identity and citizenship echoes Dewey's view that skill is not only a way of making things but also as a way of making people.[32]

The three abilities that are the foundation of craftsmanship: to localise, to question and to open up, clearly have wider relevance to architecture. The first involves making a matter concrete, the second, reflecting on its qualities, the third, expanding its sense. The carpenter establishes the peculiar grain of a single piece of wood, looking for detail; he or she turns the wood over and over, pondering how the pattern on the surface might reflect the structure hidden underneath; then he or she decides how the grain can be brought out if, for example, he or she uses a metal solvent rather than standard wood varnish. To deploy these capabilities the brain needs to process visual, aural, tactile and language-symbol information simultaneously. Henry Moore when carving a wooden sculpture would push the grain to its limits despite the sharpness of his chisel. The needs of the form pushed him to the very limits of carpentry, and of joinery practice. For Pallasmaa, 'the work of the craftsman implies collaboration with his material. Instead of imposing a preconceived idea or shape, he needs to listen to his material.'[33] The self-respect that people can earn by being good craftsmen does not come easily. To

https://doi.org/10.1017/S1359135513000195 Published online by Cambridge University Press

develop skill requires a good measure of experiment and questioning; mechanical practice alone seldom enables people to improve their skills. Too often we imagine good work itself as success built, economically and efficiently, upon success. Developing skill is more arduous and erratic than this. But most people have it in them to become good craftsmen, possessing latent capabilities that need to be unlocked, in part by engaging in material-based risk taking. They have the capacities to become better at, and more involved in, what they do – the abilities to localise, question and open up problems and opportunities that can result, eventually, in good work. Sennett observes: 'craftwork depends on curiosity, it tempers obsession; craftwork turns the craftsman outward'.[34]

Conclusions

This paper has explored the link between thinking and making, suggesting that drawing, sketching and making by hand should be an essential part of every architecture student's education. We began by setting out the need to explore a new relationship with materials in architectural education – one that extends beyond purely visual or instrumental understandings to see them as part of a network of forces and actions of which we are seamlessly part. Architectural education must explore materials in this way if it is to promote their responsible and sustainable use, to respect the potentiality of new and old materials, and to reach an understanding of how materials may be productive in experiential, spatial and social terms. This approach accepts that 'materials can only be understood (and even defined) within the terms of a specific discourse and in relation to when, where and how they are produced and used.'[35] Rather than viewing the role of architectural education as the training of professionals furnished with a narrow technical understanding and versed only in the current needs of practice – or, alternatively, inventing ever more sophisticated philosophies to criticise this aim – we should be theorising the kinds of practice that might help to address the key issues of the design of architecture and the built environment now and in the future. A reconnection with materials and the means of production may help to reinvigorate both architectural education and practice and it is our intention to equip current students with the research and critical thinking skills that will enable them to engage positively with praxis now and into the future.

We have suggested that a direct engagement with materials and making provides a key to rethinking the conditions of possibility of architectural pedagogy; and we have argued that understanding with hands and eyes operates in a different register than the assumed theoretical-cognitive engagement that seems to typify contemporary teaching and academic research. However, in placing emphasis on the insight that is gained through making we do not seek to promote a predominantly skills and techniques based programme for architectural education and we are certainly not arguing in favour of artisan rather than industrial based production. Our aim is to encourage and promote careful, reflexive and considered dealings with the material reality of architecture in the broadest possible sense. This suggests an alternative ethic to that of mastery and a different engagement from the formalist and instrumentalist constructs of technology, tools and materials that are too often prevalent within contemporary architectural pedagogy. This paper proposes that students – future architects – should become good translators who are inventive within the culture and discipline of architecture, empowered by sympathetic imaginations and material knowledge to create architecture informed with a common humanity, thus contributing to human well-being.

Notes

1. MARS is a final year, Part 2 studio in the Department of Architecture and Built Environment at the University of Nottingham. It was founded in 2008 by the authors, following earlier collaborative teaching at Part 2. Graham Farmer remains a critic for MARS, and runs a thematically related studio at Newcastle University – Thinking and Making.
2. William Hazlitt, *An Essay on the Principles of Human Action* (1805), facsimile reprint (Gainsville, FL: Scholars' Facsimiles & Reprints, 1969), p. 3.
3. Paul Carter, *Material Thinking* (Melbourne: Melbourne University Press, 2004).
4. Barbara Bolt, 'Materializing Pedagogies', *Working Papers in Art and Design*, 4 (2006), <http://www.herts.ac.uk/artdes/research/papers/wpades/vol4/bbfull.html> [accessed 1 April 2013].
5. *Practice as Research: Approaches to Creative Arts Enquiry*, ed. by Estelle Barrett and Barbara Bolt (London: I. B. Tauris, 2009).
6. Alan Chandler, 'A Philosophy of Engagement: Developing a Strategic Ability through Direct Engagement with Material, Process and Collective Action', in *Material Matters: Architecture and Material Practice*, ed. by Katie Lloyd Thomas (Oxon: Routledge, 2007), pp. 115–24 (p. 116).
7. Donald Schön, *The Reflective Practitioner: How Professionals Think in Action* (Aldershot: Ashgate, 1996).
8. Per Olaf Fjeld, *Sverre Fehn: The Pattern of Thoughts* (New York: Monacelli, 2009), p. 99.
9. Ibid., p. 68.
10. 'Frances Stacey', in *Jerwood Drawing Prize 2009*, ed. by Anita Taylor and Siobhán Kneale (London: Jerwood Visual Arts, 2009), p. 130.
11. See for example John Dewey, *Art as Experience* (New York: Minton, Balch, 1934); John Dewey, *Experience and Education* (New York: Collier Books, 1938); John Dewey, *Democracy and Education: An Introduction to the Philosophy of Education* (New York: MacMillan, 1916).
12. László Moholy-Nagy, *The New Vision*, 1928, fourth revised edition, and *Abstract of an Artist*, trans. by Daphne M. Hoffman (New York: Wittenborn, 1947), p. 12. *The New Vision* was originally published in 1928-29 as *Von Material zu Architecture* (From Material to Architecture). Moholy-Nagy observed in the foreword: 'my lectures at the Bauhaus, Weimar and Dessau 1923–1928 form the basis of the book'.
13. Michael Trencher, *The Alvar Aalto Guide*

https://doi.org/10.1017/S1359135513000195 Published online by Cambridge University Press

(New York: Princeton Architectural Press, 1996), p. 23.
14. Sverre Fehn, 'Every Man Is an Architect: Pritzker Prize Acceptance Speech, 1997', in *Sverre Fehn: Projects and Reflections*, ed. by Ingerid Helsing Almaas (Oslo: Norske Arkitekters Landsforbund, 2009), p. 57.
15. As published in: Fjeld, p. 119; *Sverre Fehn: Projects and Reflections*, pp. 26–27; and *Architect Sverre Fehn: Intuition, Reflection, Construction*, ed. by Marianne Yvenes, Eva Madshus and Peter Cripps (Oslo: National Museum of Art, Architecture and Design, 2008), p. 94. All of these published plans are in essence the same.
16. Sverre Fehn, in Leif Knutsen, *The Museum Guide*, 16 July 1986.
17. Sverre Fehn, in the foreword to *Knut Knutsen, 1903–1969: en vandrer i norsk arkitektur*, ed. by Arne Sigmund Tvedten and Bengt Espen Knutsen (Oslo: Gyldendal, 1982), translated for the authors by Kristian Bjerre.
18. David Pye, *The Nature and Art of Workmanship* (Cambridge: Cambridge University Press, 1968), p. 24.
19. Joseph Brodsky, *On Grief and Reason* (New York: Farrar, Straus and Giroux, 1997), p. 301.
20. Richard Sennett, *The Craftsman* (London: Penguin, 2008), pp. 20, 172.
21. Ibid., pp. 209–210.
22. Dewey, *Art as Experience*.
23. The judges of SPAB 2012 Philip Webb Award were architects Patrick Dillon, Eric Parry and Nick Hirst, see <http://www.spab.org.uk/media-centre/press-releases/press-release/?ContentID=205> [accessed 1 April 2013].
24. Juhani Pallasmaa, *The Thinking Hand: Existential and Embodied Wisdom in Architecture* (Chichester: Wiley, 2009), p. 114.
25. Michael Stacey, 'Searching for Excellence: Ballingdon Bridge', *arq*, 11.3+4 (2007), 210–22; Michael Stacey, 'Digital Craft in the Making of Architecture', in *Manufacturing the Bespoke: The Making and Prototyping of Architecture*, ed. by Bob Sheil, AD Reader (Chichester: Wiley, 2012), pp. 58–77.
26. Fjeld, p. 209.
27. Robin Evans, *Translations from Drawing to Building and Other Essays* (Cambridge, MA: MIT, 1997).
28. Pallasmaa, p. 63.
29. *Practice as Research*, p. 7.
30. Pallasmaa, p. 63.
31. Sennett, p. 9.
32. Glenn Adamson, *Thinking Through Craft* (Oxford: Berg, 2007), p. 69.
33. Pallasmaa, p. 55.
34. Sennett, p. 288
35. Katie Lloyd Thomas, 'Introduction: Architecture and Material Practice', in *Material Matters*, pp. 1–12 (pp. 5–6).

Illustration credits
arq gratefully acknowledges:
Matthew Alvey, 7, 13
Robert Atkinson, 4, 7, 13
Jess Atkinson-Evans, 26, 27
Samantha Barclay, 16
Sheldon Brown, 14, 15
Clara Byrne, 20, 21
Chris Dalton, 22
Liz Hicks, 3
Ben Hopkins, 6
Matthew Kidner, 1
Rachel Lee, 18
Anna Michael, 16, 19
MARS Students 2010–11, 9, 10
Richard Pulford, 17
Michael Stacey, 5, 8, 11, 12
Andrew Tindale, 23–25
Stephen Townsend, 2

Biographies
Graham Farmer is Head of Architecture at Newcastle University where he leads the MArch design studio – Thinking and Making. Between 2004 and 2010 he was Director of the Part 2 programme at Nottingham University and was co-founder of MARS. He is a qualified architect with a background in architectural practice. His research interests include the social production of the built environment, environmental sustainability, design ethics and architectural pedagogy.

Michael Stacey is Professor of Architecture at The University of Nottingham where he leads the Architecture and Tectonics Research Group and Sixth Year Architecture studio – MARS. He is a qualified architect with an extensive track record of excellence in practice. His research interests span from the social science of human ecology via design and tectonics to new materials, making and manufacturing architecture.

Authors' addresses
Graham Farmer
School of Architecture Planning and Landscape
University of Newcastle
Newcastle upon Tyne
NE1 7RU
UK
graham.farmer@ncl.ac.uk

Prof. Michael Stacey
Department of Architecture and Built Environment
The University of Nottingham
Nottingham
NG7 2RD
UK
Michael@michaelstaceyarchitects.com

https://doi.org/10.1017/S1359135513000195 Published online by Cambridge University Press