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THEORIZING THE CONSTRUCTION OF ARCHITECTURE

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ABSTRACT

The transformation of intangible ideas into tangible constructions lies at the core of architectural practice and architectural education. This is not accomplished directly but by making the mediating artifacts, mainly drawings, which others use to physically construct buildings. The profession of architecture as we know it today, that started to take shape during the Renaissance, can trace its representational origins to the practice of setting out and drawing construction on ancient and medieval building sites. Since the Renaissance and particularly during the Enlightenment, traditional practices of representation and construction were transformed into modern modes of drawing and industrialized production. Despite being currently dominated by technological thinking and the drive towards efficient production, architectural construction still has the potential to be conceived of as cosmopoiesis or world making. The key to engagement with this fertile potential does not require a rejection of digital representation or a nostalgic return to traditional methods of construction. It lies in our ability to conceive modes of representing and making buildings that are capable of shifting from the alienating to the sublime.

The aim of this thesis is to investigate conditions that would promote the (re)emergence of imaginative and meaningful construction practices in architecture. With this in mind, some current, troublesome pedagogical and professional issues in this area are examined, primarily through the lens of the philosophy and theorization of technology. Sources of inspiration for transcending the rigid bounds of rationalization and production are rare but among the most fruitful is the work of the eminent contemporary theorist Marco Frascari. Frascari engages with the corporeal, constructed dimension of architecture in an entirely non-instrumental fashion. He explores, among other things, the possibility of re-activating a metonymical relationship between human and architectural bodies based on ascribing anthropomorphic attributes to buildings. This thesis in part, traces Frascari's theoretical concerns between his well-known texts and his less well-known constructed works: his buildings. The thesis concludes with a deliberation on the relationship between construction and its representation in drawings.

THESIS CERTIFICATION

This is to certify that to the best of my knowledge, the research reported in this dissertation is my own work and is original, except where duly acknowledged. This dissertation has not been submitted previously, either in its entirety or substantially, for a higher degree or qualification at any other university or institute of higher learning.

Sam Ridgway
8.2.2010

The author acknowledges that copyright of published works on which chapters of this thesis are based (as listed below) resides with the copyright holder(s) of those works.

Ridgway, Sam. "The Representation of Construction," *Architectural Theory Review*, 14, 3 (November 2009), pp. 267-283.

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Ridgway, Sam. Drawing Construction: Reflection on the Work of Alberto Pérez-Gómez, *Architectural Theory Review*, 11, 2 (November 2006), pg. 85-100.

Ridgway, Sam, "Constructing Tales: Interview with Marco Frascari," *Architectural Theory Review,* 10, 2 (November 2005), pp. 66-88.

Ridgway, Sam. "On Common Ground: Interview with David Leatherbarrow," *Architectural Theory Review*, 9, 2 (November 2004), pp. 91-103.

Ridgway, Sam. "Construction Knowledge and The Design Studio: The Question of Integration," *Architectural Theory Review*, 8, 2 (November 2003), pp. 152-163.

ACKNOWLEDGEMENTS

Embarking on a doctoral thesis as a mid-career academic it is important to find an intellectual and supervisory environment that acknowledges both the difficulties and the opportunities that this entails. For many years I have had a relationship with likeminded colleagues at the University of Sydney and so it seemed natural that this research project should be carried out in its academic, if not its geographical environment. Choosing a supervisor at Sydney could not have been easier. Associate Professor Glen Hill always had my respect as someone who had the ability to write with remarkable clarity about very complex issues. As a supervisor he was supportive, encouraging and insightful, but also when required gave extremely forthright and concise feedback. Our long-distance relationship worked well and I am extremely appreciative of the time and effort he contributed to this project.

My candidature began just a few months prior to meeting Professor Marco Frascari and the research I subsequently carried out to trace theoretical concerns between his texts and his buildings became a major part of the thesis. This was facilitated by a three-month teaching and research appointment at Carlton University in Ottawa during the Fall Semester of 2007. I am grateful for the invitation to travel to Ottawa and for the support from the University of Adelaide that allowed this to occur. Professor Frascari has been extremely generous and helpful in allowing me access to his drawings and facilitating visits to his buildings. He has also acted as a mentor and a source of inspiration for the focus and direction of the thesis. Thanks are also due to Alberto Pérez-Gómez and David Leatherbarrow who generously agreed to be interviewed as part of this research.

Apart from those directly involved with this research there are a number of people who have encouraged and assisted me throughout my candidature. Tom Heneghan who until recently was Professor of Architecture at Sydney convinced me to enroll and was enthusiastic about the conception of construction and its pedagogy that I was developing. Adrian Snodgrass has been a constant source of inspiration and support since he supervised my masters' research. He gave me the confidence to recognize the value of my work and for this I am eternally grateful. Finally to my wife Julianne and my daughter Ruby, thank you for the love and support over the last four years that has allowed me to work towards completing the thesis.

INTRODUCTION

Towards the end of *Monsters of Architecture*, Marco Frascari, with reference to Giambattista Vico and Umberto Eco, appeals for a new understanding of architectural research in the areas of construction and design. He asks the reader to consider the propensity of current research in these areas to create a form of knowledge that can be compared to a maze, a labyrinthine network that has many choices between paths and many dead ends. Reliably navigating this forbidding territory requires a firm grip of Ariadne's instrumental thread. Research of this kind tends to produce catalogues, building codes and dictionaries that guarantee the production of safe and durable buildings. By comparison, a more discursive and imaginative, but equally labyrinthine metaphor for architectural research and the knowledge that results from it, is that of a netlike structure where all nodal points are connected. Such knowledge is not concerned with classification or with definition but like a thesaurus is "Arranged so as to Facilitate the Expression of Ideas and Assist ... in Composition."[1] This kind of labyrinthine structure, sometimes referred to as a meander, is best created and navigated through purposeful wandering. Its structure increases the possibility of connecting similar ideas, images, scholarship, art forms, theories and practices in new and often unusual ways. Frascari refers to the progeny of these unusual unions: architectural treatises, discourses, encyclopedias and projects, as monsters; extraordinary phenomena that demonstrate the union between different kinds of reality.

With the goal of exploring more meaningful and less instrumental alternatives to the current mode of teaching architectural construction, the chapters of this thesis contribute to the topography of architectural research in precisely this way. Each chapter represents a nodal point on a meander that began and has been sustained and guided by an interest in rethinking construction pedagogy. Collectively, they offer an alternative view not just of construction pedagogy but of construction itself, including, importantly for architects, its representation. Chapters were conceived and developed by following promising leads from known areas of research and scholarship towards less well-known topics. This discursive approach to research relies in large part on creating and then exploring connections with like minds, and I have

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[1] Marco Frascari, *Monsters of Architecture: Anthropomorphism in Architectural Theory*, Maryland: Rowman & Littlefield Publishers Inc., 1991, pg. 108.

certainly pursued this methodology. The interviews conducted with three leading theorists in the field that occurred early in the candidature, for example, were extremely influential in establishing focal points, many of which had not been previously obvious. In addition, the chapters that examine the theory and practice of Marco Frascari, who I consider the most influential figure in the field of alternative construction theory, resulted from meeting, interviewing and subsequently collaborating with him on this project. At first this may seem unconnected with teaching construction, but in reality, the knowledge and insights that resulted from it were central to articulating an alternative understanding of construction and architectural materiality. Without this, it would have been very difficult to offer any suggestions for reconceiving construction pedagogy.

Some of the scholarly rewards and intellectual pleasure of meandering come from exploring the same or similar topics in different contexts or viewed from different angles, and this a feature of the thesis. For example, construction and construction teaching, which are currently conceived and practiced in an almost entirely instrumental and technical fashion, are explored in several different theoretical contexts. One of these is derived, at least in part, from an understanding of the philosophy of technology, another from the discourse of architectural representation. In the profession and in academia, this is regarded as extremely unusual. The insights it provides however promote an alternative, (phenomenological) conception of architectural technology and reveal that much current construction pedagogy and practice lack credible intellectual grounding. The theorization of construction is an exploration of architecture from inside the discipline in contrast to the more usual search for meaning beyond its intellectual and professional borders.

In current construction pedagogy, students are generally taught that the conception, representation and resolution of construction are subsequent to design. Construction materials, techniques and detailing are applied to designs first conceived in the design studio. Buildings are rarely if ever imagined as constructions; they are always first designs. In this paradigm, design is the activity thought almost solely responsible for producing significant, meaningful buildings. Conversely, construction and its representation — working drawings and specifications — are portrayed as neutral tools, requiring more technical skill and knowledge than imagination or creativity. In architectural education, significantly more time is devoted to design than to construction. Construction is often characterized as unglamorous. It is usually untheorized and lacking in historical context, often taught by practice-orientated rather than

research-active staff. Construction is rarely thought of or introduced to students as generative or ontological, as part of who we are and how we reveal ourselves as technological beings.

In a modest way, my thesis sets out to theorize alternatives to this understanding of construction and construction teaching. This project is based on a conviction that the imaginative representation of construction should be a core concern of the architectural profession and of architectural education. For this to occur, construction needs to be reconceived as central to the imaginative and generative processes of design, alongside and of equal importance to the generation of a building's plan and form. In addition, the ability for construction and materiality to embody significant symbolic qualities needs to be recognized. This is an extremely difficult task since it means overturning the current instrumental *modus operandi* that became set in place during the European Enlightenment. The alternative view promotes an understanding of construction in a cultural and historical context rather than as the assembly of neutral objects through technical and industrial processes. It recognizes that the task of the architect is to transform intangible meanings and significance into tangible, constructed buildings, and that every building embodies or is a demonstration of knowledge. Through construction it is possible see the mind of the architect at work in making visible invisible ideas. Of course ultimately these ideas transcend the visible and whether we accept it or not they are also judged according to our sensory, bodily response to them. An alternative view of construction acknowledges the importance of all the senses, not just vision, in how we respond to spaces, buildings and urban environments and embraces the view that the relationship between the human and architectural body is of primary importance.

This thesis is not alone in searching for alternatives to current modes of architectural pedagogy and practice. The distinguishing feature of this project however, is that it focuses primarily on architectural materiality. This is unusual. Most architectural theorists search in areas other than construction and materiality for answers to questions concerning the current state of architectural production. In a similar vein to the consideration of construction teaching as unglamorous and construction documentation as secondary to design, theorizing architecture's material core is generally considered to be irrelevant. This has led to a situation where the core of architectural practice, the actual production of buildings, has become intellectually arid, a place colonized by all sorts of untheorized and inappropriate ideas. In contrast, the conception of construction and of construction pedagogy explored in this thesis aims to lay the foundations of a truly critical practice in relation to the core business of professional life.

Chapter Outlines

It is not possible to reconceive construction pedagogy without rethinking construction itself. This, paradoxically, requires a large amount of text-based research. I began teaching construction in the early 1990s and since that time I have explored its theoretical underpinning, through books and journal articles, and also through attending several excellent conferences, symposia and the like. Research for this thesis intensified my reading, and I began to see the literature as loosely divisible into four, interrelated and overlapping subject areas: the philosophy and theorization of technology; construction pedagogy; tectonics; and architectural representation. As a result I have organised chapter one — A Critical Review of the Literature — into four sections under these headings. These four areas of knowledge provide the intellectual substance of my attempt to question the instrumental thinking that currently dominates pedagogical and professional construction practice.

Chapter two, "Construction Knowledge and the Design Studio: The Question of Integration," sets out the existing epistemological division between construction knowledge and design. It does this by focusing on the institutionally entrenched view that in architectural education construction must be *integrated* with design. This is explored primarily with reference to official policy documents of the RAIA (AIA) and an issue of the prestigious North American publication the *Journal of Architectural Education*. The use of the word integration reveals that construction knowledge is conceived of as separate from design knowledge and skills, and must be applied, in a technical way, to designs first conceived in the design studio. This is similar to the modern understanding of theory as separable from and preceding practice. The chapter concludes by offering an alternative, more useful and historically contextualized understanding of the relationship between theory and practice based on the Greek concepts of *theoria* and *praxis*. In this view, theory (construction) participates in practice (design) rather than having to be applied or integrated with it.

Chapter three, "The Imagination of Construction," details my own attempt to teach construction and to construct a building by engaging with a phenomenological understanding of light. The theorization for this approach is based on my interpretation of the "*Lume Materiale* in the Architecture of Venice,"[2] a journal article written by Marco Frascari that I have used extensively in my construction teaching. The article considers light to be a building material, and the way architects build with light through the use of materials, textures, colours, and

[2] Marco Frascari, "The *Lume Materiale* in the Architecture of Venice", *Perspecta,* 24 (1988): pp 137-145.

shadows for example, allows a building to embody a meaningful cultural response to local light conditions. The article explores this alternative view of construction in a study of the Ca'Dario, a late medieval Venetian palace. The insights this article provides into an entirely different understanding of materiality however transcend time and place and have proved extremely effective in overturning the orthodox understanding of construction which is already firmly established in beginning students of architecture. This chapter also reveals how Frascari's ideas about *lume materiale* influenced the design of a small house in Adelaide.

Frascari's theorization of architecture in *Monsters of Architecture* and other texts, particularly his exploration of the demonstrative qualities of buildings and architectural drawings, and the metonymical relationship between human and architectural bodies is the subject of chapter four, Marco Frascari: Representation, Demonstration, and Anthropomorphism. This chapter provides the theoretical context for a discussion of Frascari's buildings in chapter five. Architectural demonstrations are, at least in part, proposed as an alternative to the growing tendency for the design of buildings to be reduced to the production of images. Construction demonstrations reveal or explore the joining or detailing of materials in meaningful ways. Demonstrations of construction celebrate and acknowledge that making buildings is also cosmopoiesis — world making. Frascari's most famous article, "The Tell-the-Tale Detail," published in 1984, is a phenomenological exploration of architectural detailing, based on the view that details, both in their virtual (drawn) and built forms, demonstrate architectural knowledge. In this article, detailing is not described as demonstration, rather, in relation to the architecture of Carlo Scarpa, as the "union of representation and function."[3] Frascari is appealing for architects to question what it is that our drawings and buildings demonstrate. This deceptively simple question can lead to many outcomes including the representation of cultural, symbolic and ethical values. In relation to this thesis, it places the translation of such intangible values into tangible constructions, at the centre of architectural practice.

Chapter five, Marco Frascari: Discursive Constructions explores how Frascari takes pleasure from performing acts of demonstration in his own critical practice. It brings to light a relatively unknown aspect of his theoretical and discursive projects, his constructed buildings, and results from original research, including: conducting interviews, visiting and photographing the buildings and collecting research material, mainly copies of original drawings. The

[3] Marco Frascari, "The Tell-the-Tale Detail," *Via* 7, (1984), pg. 29.

buildings, all renovations and additions to modest domestic buildings, are located in Philadelphia, Washington/Alexandria and Vicenza. One of the key themes traced between his texts examined in chapter four and these buildings is anthropomorphism. Architectural anthropomorphism is extensively explored in *Monsters of Architecture*, particularly the monstrous, constructed body of architecture and its relationship with the human body. The reference to monsters is interesting from a construction point of view because it refers to the joining together of different parts or elements to make a whole, although as Frascari points out, "never complete," building. The origin of parts is always evident in the final product. According to Frascari, the etymology of the word monster in fact reveals this element of its meaning as it derives from the "Latin verb *monstrare* — to show the way — which in itself, derives from *moneo* — to give guidance.[4] An alternative view of construction might encourage architects to focus on joining, not just of materials, spaces, and building parts but also the generative ideas leading to architectural representations. In this sense, architects could again begin to enjoy the pleasure of showing or demonstrating this in their buildings.

Chapter six, The Representation of Construction explores and elaborates on the possibility of creating more meaningful and sensory buildings by rethinking construction teaching in relation to architectural representation. Among other things, this means questioning the supposed neutral and technical relationship between drawings, particularly working drawings, and buildings. This relationship is based on the desire for efficiency and certainty, but its current dominance has almost completely concealed the essential need for architects to engage in symbolic, architectural representation. Because construction is always the embodiment of some form of knowledge, it is suggested that construction courses are the logical place to re-introduce some critical thinking about what architects should represent in their drawings and buildings. In this chapter, the representation of construction is placed in an historical context by referring to several historical examples and also to key texts in the area of architectural representation. It situates the origins of the architectural profession in the constructive practice of building and gives examples to illustrate the development of productive representation from the European Enlightenment. The chapter concludes with a brief examination of Building Information Modelling (BIM) a new form of productive, digital representation that reduces the production of architecture to the production of information.

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[4] Marco Frascari, "The *Lume Materiale* in the Architecture of Venice," pg. 140.

The thesis is completed with an appendix of three extensive interviews. The interviews, all conducted early in the candidature, are with David Leatherbarrow, Marco Frascari and Alberto Pérez-Gómez. The work of these eminent scholars, in particular, has played a significant role in the development and direction of this thesis. Of course the process of preparing and conducting the interviews, transcribing, editing, and then finalizing them for publication was extremely valuable as a means of developing and refining the thesis topic. David Leatherbarrow's work on the architectural mediation of industrial production in *On Common Ground* was important to my earlier research on prefabrication and the factory-made house. The interview focused on this and other issues in relation to teaching construction at the University of Pennsylvania. I interviewed Marco Frascari while he was G. Ward Truman Professor at the Washington Alexandria Architecture Centre, part of Virginia Tech. He has since taken up the Directorship of the Azrieli School of Architecture and Urbanism at the University of Carleton in Ottawa, Canada. Frascari's influence on this thesis has been profound. I first met him in 2004 although I had been working with his material, particularly "The Tell-the-Tale Detail" and the "*Lume Materiale*," for approximately ten years. This interview focuses on teaching construction although we discussed many other topics including: food and architecture; etymology and philology; proportion; Palladio; Scamozzi; and Carlo Scarpa. The interview with Alberto Pérez-Gómez was conducted in late 2005 at McGill University in Montreal. The major contribution Pérez-Gómez made to the scope and direction of this thesis is in the area of architectural representation. While I had been aware of his work for some time before interviewing him, particularly *Architecture and the Crisis of Modern Science* which had also been very influential on my earlier work, the interview focused mainly on representation. Shortly before the interview I had met him at a conference in Nottingham, where the paper he presented revisited material from *Architectural Representation and the Perspective Hinge,* a major book published in 1997. My interest in representation and a growing awareness of its importance to any discussion of architectural construction was provoked by this interview and resulted in the final chapter of the thesis, The Representation of Construction.

Inclusion of Published Material

Chapters 2, 3 and 6 of this thesis contain material that has been published in refereed journal articles titled: "Construction Knowledge and the Design Studio: The Question of Integration;"[5] "The Imagination of Construction;"[6] and "The Representation of Construction."[7] "The

[5] Sam Ridgway, "Construction Knowledge and the Design Studio: The Question of Integration," *Architectural Theory Review*, 8, 2 (November 2003), pp. 152-163.
[6] Sam Ridgway, "The Imagination of Construction," *Architectural Research Quarterly*, 3-4, 9 (2005), pp. 188-196.

Imagination of Construction" was republished as a book chapter titled *Drawing on Light*.[8] This published material has been modified to form a unified body of work that examines the thesis topic. "Construction Knowledge and the Design Studio," was originally published shortly before the PhD candidature began and material from this article has been updated and revised for inclusion in chapter 2. Three interviews that constitute a significant element of the original research for the thesis where also published and they have been included as appendices without modification.[9] Two of these interviews include a substantial introduction. A list of the original publications containing material that has been incorporated into this thesis is included in the thesis declaration.

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[7] Sam Ridgway, "The Representation of Construction," *Architectural Theory Review*, 14, 3 (November 2009), pp. 267-283.

[8] Sam Ridgway, "Drawing on Light," in Marco Frascari, Jonathan Hale, Bradley Starkey *(eds.), From Models to Drawings: On Representation in Architecture,* Routledge, 2007, pp. 219-230.

[9] Ridgway, Sam. Drawing Construction: Reflection on the Work of Alberto Pérez-Gómez, *Architectural Theory Review*, 11, 2 (November 2006), pg. 85-100. Sam Ridgway, "Constructing Tales: Interview with Marco Frascari," *Architectural Theory Review,* 10, 2 (November 2005), pp. 66-88. Sam Ridgway, "On Common Ground: Interview with David Leatherbarrow," *Architectural Theory Review*, 9, 2 (November 2004), pp. 91-103.

The Philosophy and Theorization of Technology

The philosophy and theorization of technology provides a significant portion of the critical perspective and theoretical context for this thesis. The reason for this is that it provides a means of questioning modern, instrumental and technological thinking which by-and-large dominates architectural practice and education. While building is often cited, the philosophy of technology focuses on our overwhelmingly technological modern world in general, rather than on architectural technologies in particular. From the latter part of the twentieth century most influential architectural theorists, particularly those interested in architecture's physical, material body, have been influenced by this philosophy. The work of several of these theorists has been pivotal to the development of this thesis. Their work, while not being strictly philosophy, is philosophical in nature and is therefore included in this section of the literature review. While this thesis is not a work of philosophy, I try to adopt a phenomenological, hermeneutical and ontological approach, as opposed to an objective and instrumental position to the topic.

According to Don Ihde, to "qualify as a philosophy of technology ... the philosopher must make technology a foreground phenomenon and be able to reflectively analyze it in such a way as to illuminate features of the *phenomenon of technology itself*." Ihde points out that this is a relatively recent development in philosophy, confined primarily to the twentieth century and emerging out of a "philosophical recognition of technology."[1] Ihde claims this later form of philosophy, which is less integral with the sciences, the humanities or theology and much more a critique of a particular field, a philosophy of something, is exemplified by Emmanuel Kant (1724-1804) and G.F.W Hegel (1770-1831). He writes that "[t]he system of Kant's *Critique of Pure Reason* was to become a metaphysics of science, an interpretation and critique of what had been accomplished by Newton as a 'scientist.' Philosophy had begun to differentiate itself *from* science."[2] In *Technology and the Lifeworld*, Ihde identifies and explores some of the key

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[1] Don Ihde, *Philosophy of Technology: An Introduction*, New York: Paragon House Publishers, 1993, pg.38.

[2] Don Ihde, *Philosophy of Technology*, pg. 13.

technological issues for architecture and therefore architectural pedagogy.[3] Drawing on the hermeneutic phenomenology of Heidegger and others, he challenges the notion that technologies are neutral and value-free, revealing through the use of numerous examples, that the reverse is true. In addition, through the example of cross-cultural technology exchange he illustrates how technologies are culturally embedded and are only meaningful in that context. In relation to architectural technology this helps challenge one of the central tenets of architectural high modernism that modern building technologies are, and should aim to become even more, universal and neutral.

It is interesting to note that while the philosophy of technology grew out of a need to understand technology more deeply in response to concerns about its destructive power, apart from a relatively small number of philosophers, the best known of whom are probably Jacques Ellul[4] and Herbert Marcuse,[5] the dystopic, anti-technology view is in the minority. In the main, philosophers have attempted to understand technology in its essence, not to focus only on the objects, devices and systems that form its visible and obvious manifestation. They have looked beyond and below them to the human-technology relationship and to why we have constructed the world in the way we have. In contrast to a Cartesian understanding of technologies as neutral instruments devised for some practical end, technology is reconceived as ontological, a manifestation of human being and profoundly connected to the way we see and understand the world.

While many twentieth-century philosophers have developed critiques of technology, the most influential of these is Martin Heidegger (1889-1976). It is, in particular, Heidegger's later writing that has helped determine the focus of this study both directly and indirectly through other similarly interested theorists. Two essays, "The Question Concerning Technology" (1954)[6] and "Building Dwelling Thinking" (1952)[7] heavily influenced much subsequent architectural theory and consequently my understanding of architectural technology. Without

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[3]Don Ihde, *Technology and the Lifeworld: From Garden to Earth*, Bloomington: Indiana University Press, 1990.

[4] Jacques, Ellul, *The Technological Society*, New York: Alfred A. Knopf, 1964.

[5] Herbert Marcuse, *One dimensional Man*, Boston: Beacon Books, 1968.

[6] Martin Heidegger, "The Question Concerning Technology," in *The Question Concerning Technology and Other Essays*, trans. William Lovitt, New York: Harper and Row, 1977, pp 44-35.

[7] Martin Heidegger, "Building Dwelling Thinking," in *Basic Writings from Being and Time (1927) to the Task of Thinking (1964),* translated and with an introduction by David Farrell Krell, New York: Harper and Row, 1977.

wishing to enter into a detailed discussion of the importance of Heidegger's philosophy to this study, it is its ability to offer a profoundly different, albeit intensely complex, interpretation of technology from the standard instrumental and positivist model that makes it particularly relevant. It is the essay "The Question Concerning Technology," that most directly sets out Heidegger's thoughts on technology. An often quoted example of Heidegger's challenge to orthodox thinking in relation to technology is his appeal to consider technology in its essence. He suggests that:

> the essence of technology is by no means anything technological. Thus we shall never experience our relationship to the essence of technology so long as we merely conceive and push forward the technological, put up with it, or evade it. Everywhere we remain unfree and chained to technology, whether we passionately affirm of deny it. But we are delivered over to it in the worst possible way when we regard it as something neutral; for this conception of it, to which today we particularly like to do homage, makes us utterly blind to the essence of technology.[8]

Conventional practice in architecture does not generally advocate contemplating the essence of building technologies but considers them to be controllable, neutral objects. In contrast, Heidegger raises the possibility that technology is ontological, an extension of our human nature. In the same essay, Heidegger famously states that "technology is a way of revealing,"[9] in other words, things are revealed to us through our technologically framed way of seeing. Heidegger suggests that in modernity our understanding of the earth is "enframed." The earth is encountered primarily as a "standing reserve," a vast store of resources standing ready for our use.

Ihde refers to Heidegger and the American Philosopher John Dewey as "*praxis* philosophers, that is, thinkers who found a unique kind of knowledge associated with action or patterned practices." Ihde states that "Heidegger, in response to Husserl's analysis of 'pure consciousness' produced a powerful analytic of ordinary praxis."[10] "Building Dwelling Thinking," for example, examines the relationship between building and the supposedly ordinary practice of dwelling, claiming, paradoxically, that "we do not dwell because we build, but we build and have built because we dwell, that is, because we are *dwellers*."[11] Heidegger's essay points directly to the reason we build by inverting the conventional wisdom that dwelling comes about

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[8] Martin Heidegger, "The Question Concerning Technology," pg. 4.

[9] Martin Heidegger, "The Question Concerning Technology," pg. 12.

[10] Don Ihde, *Philosophy of Technology*, pg.39.

[11] Martin Heidegger, "Building Dwelling Thinking," pg. 327.

through building reinforcing the notion that what we build should embody an interpretation of human dwelling, in particular, as it relates to place.

Karsten Harries is a philosopher who has focused in particular on a Heideggerian interpretation of architecture. In *The Ethical Function of Architecture*, Harries examines Heidegger's essay "Building Dwelling Thinking" in some detail, carefully setting out an explanation and a critique of the essay's nostalgic reference to a traditional Black Forest farm house as an example of primordial dwelling.[12] Heidegger first delivered this essay as a lecture "on Sunday morning, August 5, 1951, to an audience composed mostly of architects."[13] Harries notes that it must have been confronting to many of them, with the destruction caused by World War II still uppermost in their minds, to hear Heidegger begin to question the relationship of building and dwelling in what must have seemed a quite esoteric fashion. Within the context of a still pressing housing shortage Heidegger claimed that the need for shelter was not at all the real problem:

> However hard and bitter, however hampering and bitter, however hampering and threatening the lack of houses remains, the *real plight of dwelling* does not lie merely in a lack of houses. The real plight of dwelling is indeed older than the world wars with their destruction, older also than the increase in the world's population and the condition of the industrial workers. The real plight is this, that mortals ever search anew for the nature of dwelling, that they *must ever learn to dwell*. What if man's homelessness consisted in this, that man still does not even think of the *real* plight of dwelling as *the* plight.[14]

Heidegger does not advocate a return to the farmhouse as a means of recovering the ability to dwell but uses it to exemplify a relationship between primordial dwelling and building. Harries argues that the equation between "'dwelling' and 'residing' is called into question by Heidegger's suggestion that even among many residential buildings, 'well-planned, easy to keep, attractively cheap, open to the air, light, and sun' though they may be, hold no 'guarantee that *dwelling* occurs in them." Harries points out that while this may seem obvious; "no more than a hammer can guarantee that it will be used as a hammer can a house guarantee that people will actually reside in it," what Heidegger is trying to establish is that

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[12] Karsten Harries, *The Ethical Function of Architecture*, Cambridge, Massachusetts: The MIT Press, 1997.

[13] Karsten Harries, *The Ethical Function of Architecture*, pg. 152.

[14] Karsten Harries, *The Ethical Function of Architecture*, pg. 162. This quote is from "Building Dwelling Thinking," pg. 161, which Harries footnotes: Martin Heidegger, "Bauen Wohnen Denken," first published in *Darmstädter Gespräch Mensch und Raum* (Darmstadt: Neue Darmstädter Verlagsanstalt, 1952), pg. 72-82. Translated by Alfred Hofstadter as "Building Dwelling Thinking," in *Poetry, Language, Thought* (New York: Harper and Row, 1971), pg.145-161.

genuine dwelling differs from "mere residing, from merely inhabiting a structure or finding shelter. To dwell is to feel at home. Building allows for dwelling by granting a sense of place." Tracing back the origins of the word *bauen* (to build) Heidegger comes to the conclusion that "'to build' is said to be 'to dwell,' and 'to dwell' in turn originally meant 'to be.'" Dwelling is therefore "the basic character of human being." [15]

But what can Heidegger's essay say in relation to contemporary construction practices? Harries points out that the traditional relationship between dwelling, building and place, exemplified by the Black Forest farm house, represents a limiting of horizons and freedom that today we would find intolerable. Does the freedom to travel and choose where we live mean that we are currently unable to dwell in a traditional sense? Perhaps, but this does not negate the need to continue questioning the nature of modern dwelling and its relevance or otherwise to creating "a sense of place" through building, something often spoken of by architects. If it is true, as Heidegger suggests, that modern technology threatens our ability to dwell, and as architects we must engage with the modern technological world in order to build then the building technologies we employ have the potential to negate our attempts to make buildings in which people might dwell.

In addition to translations of Heidegger's texts, other commentaries on his work have also been influential. Albert Borgmann provides an excellent, extensive and reflective overview both of works by Heidegger and works about Heidegger in "The Question of Heidegger and Technology: A Critical Review of the Literature."[16] Michel Haar gives a direct commentary on "The Question Concerning Technology" in particular and, importantly for this study, highlights the priority Heidegger places on thought over action in helping us to see the possibility of a "saving power" inherent within technology.[17] This possibility comes about by reflecting on the ontological relationship between humans and technology. Technology is a manifestation of human desire rather than simply a collection of separate objects and systems that stand over and against us.

Adrian Snodgrass is noted for his interpretation of architecture in relation to the philosophy of technology. Over many years and through numerous publications he has used

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[15] Harries, *The Ethical Function of Architecture*, pg. 154. The quotes within the quote are from "Building Dwelling Thinking," pg. 148.

[16] Albert Borgmann with the assistance of Carl Mitcham, "The Question of Heidegger and Technology: A Critical Review of the Literature," *Philosophy Today*, 31, 2/4 (1987): 97-177.

[17] Michel Haar, *The song of the Earth: Heidegger and the Grounds of the History of Being*, trans. Reginald Lilly, Bloomington and Indianapolis: Indiana University Press, 1993.

the work of several key philosophers including Heidegger, Gadamer and Habermas, in this endeavor. His work meticulously reveals the importance of philosophy to architecture and its pedagogy. Snodgrass' most recent publication in collaboration with Richard Coyne, *Interpretation in architecture: Design as a Way of Thinking*[18] focuses on the authors' mutual interest in hermeneutics and consequently the role of interpretation in architecture. Snodgrass and Coyne argue that "interpretation is everywhere in architecture. It is the basis of architectural creation."[19] The chapter "Ethics and Practice,"[20] originally published by Snodgrass under the title "On Theorising Architectural Education,"[21] examines the contemporary relationship of theory and practice with regard to their ancient origins in the Greek concepts of *theoria* and *praxis*. Snodgrass explains that while theory is currently "thought of as providing rules for practical action,"[22] originally *praxis* was not simply the application of rules but was an activity involving ethical judgments (*phronesis*). Snodgrass questions the validity of making architectural decisions based solely on technical knowledge. He writes that a distinction can be set up:

> between practical choices made by the exercise of *phronesis* and those made on the basis of technical knowledge. Technical 'choice' is the determination, by means of pre-given rules, of the best way in which to achieve a pre-given end. The choice is made by a conscious calculation, preferably mathematical. Any consideration of the ethical and social consequences of the choice comes after the event, as an afterthought, ancillary to action.[23]

In the chapter "The Disintegrated Curriculum," Snodgrass and Coyne examine in detail the tension that exists in architectural education between knowledge they describe as conforming to the tenets of instrumentalism and calculative reason and a deconstructive, radical pedagogy that is often perceived as threatening to the rigor and status of the university. In the current paradigm, construction knowledge is the former and the design knowledge the latter. The chapter concludes with an examination of the often cited need for the integration of these different forms of knowledge and skills, suggesting problems in a curriculum are "commonly

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[18] Adrian Snodgrass and Richard Coyne, *Interpretation in Architecture: Design as a Way of Thinking*, Abingdon: Routledge, 2006.

[19] Adrian Snodgrass and Richard Coyne, *Interpretation in Architecture,* cover notes.

[20] Adrian Snodgrass and Richard Coyne, *Interpretation in Architecture,* pp 111-115.

[21] Adrian Snodgrass, "On Theorising Architectural Education," *Architectural Theory Review* 5, 2, (2000): pp 89-93.

[22] Adrian Snodgrass and Richard Coyne, *Interpretation in Architecture,* pg. 111.

[23] Adrian Snodgrass and Richard Coyne, *Interpretation in Architecture*, pg. 113.

attributed to poor integration." Snodgrass and Coyne argue, however, that commonly "subject matter is not simply poorly integrated; it is just not particularly relevant, or not taught in a way relevant to being a professional."[24] The often cited inability of students to integrate construction knowledge into their design studio projects is examined with reference to Snodgrass, Coyne, Schön, Heidegger and others in chapter two of this thesis, "Construction Knowledge and the Design Studio: The Question Of Integration." In "Design Amnesia,"[25] Snodgrass and Coyne examine attempts to integrate architectural history into the design studio. They conclude that:

> The role of history, prompted by the historian, is to strengthen remembrance by demonstrating how it contains the possible; and to widen the scope of memory, by venturing into the vast unknown territories of the past, into the landscape of oblivion, to return with understandings for present application. The historian, that is to say, acts to interpret the past for the purposes of the present; the historian translates from one to the other.[26]

This hermeneutical conception of how history might be brought into the design studio provides an excellent example of a non-instrumental relationship between theory and practice. It is also relevant to conceiving of ways to improve the currently fraught relationship between construction knowledge and the design studio.

Reconceiving this relationship requires insight into how understanding occurs and Snodgrass and Coyne explore this topic in "Architectural Hermeneutics."[27] Using our understanding of language as a means of exploring a hermeneutical model of how architectural design proceeds, they propose that "[p]rocesses of understanding are radically fundamental to all human perception, thought and action. The hermeneutical process is more basic than and prior to the use of logic, formal languages and scientific method and therefore forms the foundation of all rationality."[28] The purpose of their study is to reconceive understandings of how design and the design studio work in relation to how designing begins and proceeds from the initial "projection of a provisional image of the completed scheme."

> The projection of the first image initiates the working of the hermeneutical circle, and the design process now continues by the back-and-forth interplay between

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[24] Adrian Snodgrass and Richard Coyne, *Interpretation in Architecture,* pg. 108.

[25] Adrian Snodgrass and Richard Coyne, "Design Amnesia," in *Interpretation in Architecture*, pg. 133-146.

[26] Adrian Snodgrass and Richard Coyne, *Interpretation in Architecture,* pg.143.

[27] Adrian Snodgrass and Richard Coyne, "Architectural Hermeneutics," in *Interpretation in Architecture*, pg. 29-55.

[28] Adrian Snodgrass and Richard Coyne, *Interpretation in Architecture,* pg. 44.

> the parts and the whole. Interpretations of the parts modify the projection, which in turn plays back to modify the interpretation of the parts. This process is fluid, repetitive and continuous. It furnishes a kaleidoscope of ever-changing reflections, revisions, false starts and backtracking, leading eventually to a clarification of the projection.
>
> Designing is grounded in understanding and is nothing other than the explication of what has already been understood. This does not mean, however, that the design is predetermined, or that the process must take a preordained sequence of logical steps, nor that there is a pre-established result - the answer to the problem – and prescribed methodological steps to that result. The explication of what is already understood only unfolds when the process is fluid and retroactive. The projected task completion must be allowed to reflect back into the design situation and affect the interpretation of particulars.[29]

If we accept this hermeneutical model of design then it is important that construction knowledge forms part of the initial understandings that are thrown forward from our experience to "adumbrate the artifact in its future completion."[30] This is in contrast to the current conception of construction which predominantly defines it as set of neutral materials and elements that can be applied to a design at the appropriate time, usually after the plan and form of the building have been established. This is exacerbated by the pedagogical structure of problem-based curricula where students in design studio courses are expected to know when to ask for help in construction, structures and other so-called technical areas of knowledge.

The work of Snodgrass and Coyne offers a direction for reconceiving construction technology particularly in relation to the design studio. In the chapter "Translating Tradition," which is an expanded version of an article first published as "Translating Tradition: Technology, Heidegger's 'Letting-be,' and Japanese New Wave Architecture," the authors explore, among other things, Heidegger's notion of Letting-be.[31] They reveal that there are "ways of action and production that are not subject to the techno-rationalist enframing that Heidegger posits as hegemonic in the modern world."[32] This alternative arises from the Buddhist concepts of "letting go" or "non-grasping in which things are not asked their why but simply seen in their Suchness," combined with Heidegger's notion of Letting-be and

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[29] Adrian Snodgrass and Richard Coyne, *Interpretation in Architecture,* pg. 46.

[30] Adrian Snodgrass and Richard Coyne, *Interpretation in Architecture,* pg. 46.

[31] Adrian Snodgrass, "Translating Tradition: Technology, Heidegger's 'Letting-be,' and Japanese New Wave Architecture," Architectural Theory Review, 2, 2 (Nov. 1997): pg.83-104.

[32] Adrian Snodgrass and Richard Coyne, *Interpretation in Architecture,* pg. 217.

Gadamer's explanations of *phronesis*."[33] Snodgrass and Coyne argue that this combination counters any tendency towards:

> quiescence, acquiescence or nihilistic passivity that some might be tempted to read into Heidegger's bleak analysis of technology. They indicate that activity and creativity are not necessarily always instrumental or captive to enframing, but there are modes of doing and thinking that are free and not pre-figured by the dictates of techno-rationality.[34]

An earlier essay by Snodgrass, "Hermeneutics, Universities, and the Letting-be of Technology,"[35] sets out some of the ideas that are elaborated, expanded and augmented in *Interpretation in Architecture*. This essay specifically explores the techno-rational foundation of modern universities based on Leibniz's principle of sufficient reason, which "demands that everything must have a reason or a cause for its existence, or it is not real."[36] Snodgrass points out that whatever "its meaning might have been at the time of its coining, the term 'university' has become a 'one turning' (uni-versus) around the principle of sufficient reason." Science is the ultimate expression of techno-rational thinking in universities with its primary aim of reductively defining the real as "what can be measured and calculated mathematically to show causal relationships."[37] It was to pursue scientific and technological objectives that universities came into existence and flourished, and this brings into focus the tenuous and ambivalent place that schools of architecture have always held within them. Snodgrass points out that a scientific and technological enframing of the issues of sustainability and energy conservation, for example, conceives of the sun purely as an "energy source and thus in terms of 'sun control,' 'solar systems' and 'solar heating.'" This is in contrast to architectures of the pre-modern world which "were laid out in relationship to the movements of the sun, seen as a source of life and light and as the visible sign of the rhythmic structure of the universe." In this way buildings became part of a "mythic and ritualistic schema which connected humankind to the sun as source and sign."[38] In Heideggerian terms, this attempt to validate architecture through scientific means represents a concealing or forgetting of other equally important

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[33] Adrian Snodgrass and Richard Coyne, *Interpretation in Architecture,* pg. 213.

[34] Adrian Snodgrass and Richard Coyne, *Interpretation in Architecture,* pg. 217.

[35] Adrian Snodgrass, "Hermeneutics, Universities, and the Letting-be of Technology." Paper presented at the conference, Universities as Interpretive Communities. University of Sydney, (23-24 November 1993): pp 75-94.

[36] Adrian Snodgrass, "Hermeneutics, Universities, and the Letting-be of Technology," pg. 75.

[37] Adrian Snodgrass, "Hermeneutics, Universities, and the Letting-be of Technology," pg. 77.

[38] Adrian Snodgrass, "Hermeneutics, Universities, and the Letting-be of Technology," pg. 77.

modes of understanding, symbolic meaning for example. Snodgrass proposes a new kind of university education: a "pedagogy involving the sort of letting-be that inheres within play and other forms of *phronesis* might stand to counter techno-rationality's drive towards totalitarian sovereignty."[39]

The works of Heidegger, Ihde, Haar and Borgmann represent the primary philosophical basis and context of this thesis, while Snodgrass and Coyne provide seminal interpretations and translations of this philosophy into architectural theory. Several other theorists, working in similar ways, have also been extremely influential. These authors are difficult to understand and interpret without a basic knowledge of the philosophy that underpins their work. Two of the earliest influences on the direction of my research were: Marc Angelil's article "Technique and the Metaphysics of Science: The Rational-Irrational Element of Science-Technology within the Making of Architecture"[40] published in *The Harvard Architecture Review:* and the influential work by Alberto Pérez-Gómez, *Architecture and the Crisis of Modern Science.*[41]

Angelil's article opens up and begins to question the relationship of architecture to burgeoning scientific thinking from the sixteenth century to the present. In particular he identifies key figures and moments in this trajectory setting out for example, the dialectical relationship between the philosophy of Descartes and Vico in relation to imagination. Angelil also introduces the architect and pedagogue Jean-Nicolas-Louis Durand who is now generally understood to represent a defining moment in the shift from a traditional to a modern mode of representing and constructing buildings. Durand's key contribution in this regard was to represent buildings in a way that allowed design to be reduced to a process of combining neutral elements and forms.

Durand also represents a culmination in *Architecture and the Crisis of Modern Science.* Pérez-Gómez argues that, "[i]n the area of architectural theory and design, the stage at which *theoria* was transformed into a self-referential instrument for the control of *praxis* is best exemplified by the writing of Jean-Nicolas-Louis Durand."[42] Durand (1760-1834) taught and developed his theories at the *École Polytechnique* the French school that set in place the

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[39] Adrian Snodgrass, "Hermeneutics, Universities, and the Letting-be of Technology," pg. 83.

[40] Marc M. Angelil, "Technique and the Metaphysics of Science: The Rational-Irrational Element of Science-Technology within the Making of Architecture," *Harvard Architecture Review*, 7 (1989): 63-75.

[41] Alberto Pérez-Gómez, *Architecture and the Crisis of Modern Science*, Cambridge, Massachusetts: MIT Press, 1983.

[42] Alberto Pérez-Gómez, *Architecture and the Crisis of Modern Science*, pg. 298.

distinction between architecture and engineering. He wrote two influential theoretical works: the *Recueil et Parallèle des Edifices de Tout Genre, Anciens et Modernes* (1801), which was "a vast collection of famous, less known, and even imaginary buildings, drawn at the same scale; and the *Précis des Leçons d'Architecture* (1802), ... [which] summarized his courses at the *École Polytechnique*."[43] Durand epitomised rational, Enlightenment thinking which cast doubt on the necessity and validity of myth, fantasy and metaphor to architecture. Pérez-Gómez explains that he "no longer had, like his eighteenth-century predecessors, the capacity to accept at least the necessity of myth as a fundamental compliment of the *logos* in architectural theory ... The mathematical reason of positivism rejected metaphor as a serious and legitimate form of knowledge, and this exclusion was what Durand brought to architecture."[44]

The stated aim of *Architecture and the Crisis of Modern Science* is to reveal the historical roots of the contemporary "crisis" in architecture, a crisis that can be traced back to "two great transformations, the first of which occurred towards the end of the seventeenth century, and the second, towards the end of the eighteenth."[45] The first transformation was the questioning by philosophy and science of the "link between the human and the divine," and the second a similar questioning and uncoupling of faith and reason. Pérez-Gómez argues that:

> Faith and reason were truly divorced. Scientific thought came to be seen as the only serious and legitimate interpretation of reality, denying any need for metaphysics. Euclidean geometry was functionalized. Infinitesimal calculus was purged of its residual symbolic content. Geometry and mathematics were now purely formal disciplines, devoid of meaning, value or power except as instruments, as tools of technological intentionality.[46]

While the intellectual and epistemological trajectory of this work from early modern science to the late twentieth century is now widely understood and its aim of revealing the loss of meaning from architecture during that period acknowledged, its additional relevance to this study falls into two main categories. First, it reveals how these changes influenced, and were in turn influenced by, significant developments in architectural education, and second it traces how they affected modes of representation.

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[43] Alberto Pérez-Gómez, *Architecture and the Crisis of Modern Science*, pg. 298.

[44] Alberto Pérez-Gómez, *Architecture and the Crisis of Modern Science*, pg. 300.

[45] Alberto Pérez-Gómez, *Architecture and the Crisis of Modern Science*, pg. 10.

[46] Alberto Pérez-Gómez, *Architecture and the Crisis of Modern Science*, pg. 11.

Another of the key insights that *Architecture and the Crisis of Modern Science* offers is that changes to professional and pedagogical structures grew out of dramatic changes in epistemology, not the other way around. This is important to current educational debates in architecture. Often, problems caused by a perceived lack of integrating construction or engineering knowledge into the design studio for example, are considered to be fixable by making changes to program and course structures. But this approach fails to recognise the deeply ingrained conceptual and intellectual boundaries that exist between these two domains of knowledge.

In the same vein but at a more explicitly philosophical level is Dalibor Vesely's excellent article, "Architecture and the Question of Technology," which was first published in *Architecture Ethics and Technology* a collection of essays edited by Louise Pelletier and Alberto Pérez-Gómez.[47] Shortly after this it was republished in *Educating Architects,* another collection edited by Martin Pearce and Maggie Toy.[48] The article's appearance in these two publications, one philosophical and ethical, and the other educational, exemplifies one of the aims of my thesis: to situate a critique of construction pedagogy within a philosophical and theoretical framework. Vesely, like Snodgrass, brings his knowledge of Heideggerian philosophy to bear on the technological nature of architecture. He reveals Heidegger's concern that "traditional ways of making and creativity are slowly being absorbed into one dominant way of making and thinking ... . While some awareness of the distinction between invention, creativity, and pure production remains, it is no longer clear how this distinction should be established; that may be one of the reasons why the current debate is mostly confusing, unsatisfactory and frustrating."[49] The main problem Vesely identifies is the hegemony of instrumental thinking which reduces debate to questions of "the merit of technical efficiency vs. that of aesthetics. Even issues of cultural meaning or social and political relevance, or issues that directly affect the long-term well-being of our society, are often discussed in such simplistic terms."[50] With reference to Francis Bacon, he argues that instrumental thinking requires a particular kind of attitude to knowledge, that is

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[47] Dalibor Vesely, "Architecture and the Question of Technology," in Louise Pelletier and Alberto Pérez-Gómez (eds.), *Architecture Ethics and Technology*, Quebec: McGill-Queen's University Press, 1994, pp. 28-49.

[48] Dalibor Vesely, "Architecture and the Question of Technology," in Martin Pearce & Maggie Toy (eds.), *Educating Architects*, London: Academy Editions, 1995, pp. 44-53.

[49] Dalibor Vesely, "Architecture and the Question of Technology," *Architecture Ethics and Technology*, pg. 30.

[50] Dalibor Vesely, "Architecture and the Question of Technology," *Architecture Ethics and Technology*, pg. 30.

"knowledge as power" and that this, coupled with the will to control means "we can speak simply of a 'will to power' which as a consequence becomes a 'will to will.'"[51] This goes directly to Heidegger's contention mentioned earlier that "the essence of technology is by no means anything technological." In other words, the true origin of technology is technological thinking, the desire to control and dominate, which springs from being, and as such is ontological.

Exploring the ancient Greek notion of *techné* (making), Vesely also reveals the etymological root of technique and technology, but he does so in relation to Heidegger's contention that there is an alternative to the instrumental conception of technology. Towards the end of "The Question Concerning Technology," Heidegger writes of that alternative:

> Because the essence of technology is nothing technological, essential reflection upon technology and decisive confrontation with it must happen in a realm that is, on the one hand, akin to the essence of technology, and on the other, fundamentally different from it. Such a realm is art. [52]

Vesely points to the common origins of art and technology in *techné,* claiming that they became "differentiated later into the arts and technology as we know them today." The characteristic that perhaps led to the development of technology and instrumental thinking from *techné* is its "elevation to a priori knowledge that can be taught."[53] This is similar to the way Snodgrass links the ancient Greek concepts of *episteme* with *techné* which is how we currently link theory and practice in an instrumental fashion. Theory is a set of rules that can be carried out to achieve a practical outcome, a concept that inheres strongly within the practice and pedagogy of construction.

It is tempting to interpret Heidegger's claims about art as a kind of path to salvation from the danger of technology. In William Lovitt and Harriet Brundage Lovitt's *Modern Technology in the Heideggerian Perspective*, they include a chapter examining Heidegger's thoughts on the subject in minute detail:

> Art, in its various forms, meets us as something that both lifts us out of our ordinary milieu and confers meaning on the latter ... Whatever the art may be that has meaning for us and extends or deepens our experience, much of its appeal lies in the fact that it has been wrought by our fellow human beings. We feel somehow ennobled, in an awareness of fundamental unity, by the accomplishment of the gifted one to whom we are akin ... We think of him — and

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[51] Dalibor Vesely, "Architecture and the Question of Technology," *Architecture Ethics and Technology*, pg. 31.

[52] Martin Heidegger, "The Question Concerning Technology," pg. 35.

[53] Dalibor Vesely, "Architecture and the Question of Technology," pg. 32.

> here again the contemporary artist joins us in understanding — as one who, as artist, has somehow been laid under a necessity to create his works and who has done so with dedicated and often astonishing skill and imagination, for the purpose of providing to his fellows an insight into things that is (sic) ordinarily beyond them and of opening to them the enchanted self-awareness of environing reality that we so value for our ourselves as the chief gift of art.[54]

Lovitt and Brundage Lovitt warn however that in art Heidegger finds "manifestations of the prevailing sway of the technological that has brought modern man to exalt his own purposeful, willed achieving and to find in his own subjectivity criteria for the evaluating and carrying out of all human undertakings." To properly follow Heidegger we should focus not on "man and his doings," but on the "Being of what-is that is inherently prior to and constitutive of man, his doing, and whatever is." [55] David Kolb in *Postmodern Sophistications* offers a similar warning about the seductive desire to believe that art will save us:

> Heidegger criticized the modern world while clinging to the landscape of provincial Germany that he knew was being destroyed even as he wrote. There is a deep ambiguity about his essays on art and architecture that encourages the romantic hope that we might pierce the technological skin of our world and discover a rich dwelling still available to us ... But officially Heidegger, like Hegel, believes that in the modern world art has lost whatever power it once had. It has been reduced to the business of supplying stimuli on demand, and machines for living ... Art today cannot renew the barren modern landscape, but it can still awaken in us the sense of the withdrawn happening by which we are destined to live in the modern world. Once awakened, that sense changes our relation to the world. The change, however is not an escape. It remains an ambivalent mixture of complicity and understanding.[56]

Snodgrass counters this gloomy view of modernity by revealing that "Bernstein, borrowing Heidegger's notion of simultaneous disclosure and withdrawal, claims that Heidegger's own thinking concerning technology conceals at the same time as it reveals." Heidegger privileged thinking over action and therefore overlooked the fact that Aristotle, on whom Heidegger based his notions of *episteme* and *techné*, contrasted them with *phronesis* (practical wisdom) and *praxis* (practice). "Modern techno-rationality restricts its thinking within the limits of *episteme* and forgets *phronesis*. Heidegger, says Bernstein, is similarly forgetful." It is Gadamer who "reinstalls human actions and interactions to their rightful place, at the very centre of our

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[54] William Lovitt and Harriet Brundage Lovitt, "The Saving Role of Art," in *Modern Technology in the Heideggerian Perspective*: Volume II, Lewiston: New York, 1995, pg. 627.

[55] William Lovitt and Harriet Brundage Lovitt, *Modern Technology in the Heideggerian Perspective*, pg. 625-626.

[56] David Kolb, *Postmodern Sophistications: Philosophy, Architecture and Tradition*, Chicago: The University of Chicago Press, 1990, pg. 99.

experience."[57] In *Interpretation in Architecture*, Snodgrass and Coyne argue that despite the almost total hegemony of the techno-rational kenning of theory and practice in our universities there are a few "small backwaters in which remnants of *praxis* and *theoria* still exist, albeit unwittingly, or spaces in which *theoria* and *praxis*, with their concomitants, *phronesis* and *prohairesis*, [ethical decision-making] could exist. One such backwater is the design studio."[58]

Construction Pedagogy

The origins of modern architectural education, including its division into studios supported by technical and other lectures, can be traced to the European Enlightenment and particularly to the Ecole Polytechnique, the French technical school founded immediately after the revolution. Pérez-Gómez identifies it as the "first truly technological school."[59] He writes that "unlike the atmosphere of apprenticeship, which had been geared to solving specific problems in the technical schools of the eighteenth century, the École Polytechnique advocated impersonal lectures and the notion of required subjects, which everyone had to master before specializing."[60] Architecture became relegated to a kind of sub-professional discipline, "part of the course on civil works" where it was regarded as a purely decorative activity. Apparently Napoleon despised architecture, accusing it of "ruining the state and its citizens through excessive expenditure." The Enlightenment ushered in the age of the technical expert and foremost among these where the engineers. Napoleon "mainly used engineers in his building enterprises; architects were invited to participate only when decoration was called for."[61] Nowadays it is more likely, especially in the design studio, that engineering is applied to or integrated with an architectural project but the professional schism between architecture and engineering that allows the application of one to the other can be traced to this period of the Enlightenment.

There is a large amount of literature that examines the current model of architectural educational, particularly modes of learning and teaching related to the design studio. A significant amount of this focuses on the (in)ability of students to integrate so-called technical knowledge, structures, acoustics, lighting, construction and so on, into their design projects. In relation to construction teaching, this material is often written by academics who demonstrate

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[57] Adrian Snodgrass, "Hermeneutics, Universities, and the Letting-be of Technology," pg. 81.

[58] Adrian Snodgrass and Richard Coyne, *Interpretation in Architecture,* pg. 114.

[59] Alberto Pérez-Gómez, *Architecture and the Crisis of Modern Science*, pg. 201.

[60] Alberto Pérez-Gómez, *Architecture and the Crisis of Modern Science*, pg. 278.

[61] Alberto Pérez-Gómez, *Architecture and the Crisis of Modern Science*, pg. 279.

improvements they have achieved in the way students integrate construction knowledge into their designs. A collection of six essays published in issue 51/2 of *The Journal of Architectural Education* (JAE) with the title The Pedagogy of Architectural Technology, exemplifies this approach. In the introduction, G. Goetz Schierle from the University of California states that the aim of the issue is to, "evoke a dialogue about the role of technology in architectural education and to present models of teaching technology." Of the articles presented in the issue of JAE he writes:

> integration is a central theme. Although this integration is critically important, so is a foundation of basic principles introduced in lectures or seminars — as prerequisites or corequisites to the studio — to provide the rigor and depth required for effective integration.
>
> Architecture fills human needs by technological means. The design process involves the creative integration of appropriate technology.[62]

This conceptualization of design as solving a "problem" through the integration or application of technical knowledge is often repeated in the articles that follow. As an example, "Intention, Form, and Execution: A Comprehensive Studio Curriculum,"[63] describes two new courses at the University of Maryland that grew out of a "major undergraduate and graduate curriculum revision to integrate design and technical subject matters." The two courses which are run concurrently, aim to explore the "the relationship between the conceptual and technical aspects of architectural form and its assembly." Here the authors reveal their belief that architectural form and architectural construction can be conceived separately and then brought together at some point during the design process. After a discussion about narrowing the gap between design and technology they state that the "broad lessons that these courses teach are those of integration: Students learn to synthesize seemingly impossibly diverse aesthetic and technical criteria in order to solve problems." [64]

One of the most influential critiques of this "problem solving" conceptualization of architectural education is that of Donald Schön. Interestingly, Schön's background is in philosophy, his PhD examined John Dewey's theory of inquiry. As mentioned, Don Ihde

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[62] G. Goetz Schierle, "The Pedagogy of Architectural Technology," *Journal of Architectural Education*, 51, 2, (November 1997): pg. 82-83.

[63]Carl Bovill, Amy E. Gardner, and Gregory Wiedemann, "Intention, Form, and Execution: A Comprehensive Studio Curriculum," *Journal of Architectural Education*, 51, 2, (November 1997): pp. 84-91.

[64]Carl Bovill, Amy E. Gardner, and Gregory Wiedemann, "Intention, Form, and Execution: A Comprehensive Studio Curriculum," pg. 84.

identified Dewey and Heidegger as praxis philosophers concerned with interpreting and understanding the kind of knowledge associated with "action or patterned practices."[65] Schön's major publications examine the practice and pedagogy of the professions. He argues that the current mode of professional practice is based on an instrumental model that he calls technical rationality and that this is unable to deal with the many non-technical issues that continuously confront professionals. He suggests that professional education in universities has been made to fit the epistemological model of "Technical Rationality," which is hegemonic within the modern university. Of this model he writes:

> Technical Rationality is an epistemology of practice derived from positivist philosophy, built into the very foundations of the modern research university (Shils, 1978). Technical Rationality holds that practitioners are instrumental problem solvers who select technical means best suited to particular purposes. Rigorous professional practitioners solve well-formed instrumental problems by applying theory and technique derived from systematic, preferably scientific knowledge. Medicine, law and business — Nathan Glazer's 'major professions' (Glazer 1974) — figure in this view as exemplars of professional practice.[66]

Schön explains that the status of professional education in the modern university has always been somewhat tenuous but accepted as the means by which burgeoning scientific knowledge, the core output of universities, was to be put into action for the betterment of society. The only way the professions were able to gain this status was to firmly establish that their teaching programs were based on scientific knowledge. The role of the professional was, and is, seen as putting science into practice in an instrumental and technical manner to solve practical problems and this has become essential to the functioning of our society whether it is:

> making war and defending the nation, educating our children, diagnosing and curing disease, judging and punishing those who violate the law, settling disputes, managing industry and business, designing and constructing buildings, helping those who for one reason or another are unable to fend for themselves. Our principle formal institutions -- schools, hospitals, government agencies, courts of law, armies -- are all arenas for the exercise of professional activity. We look to professionals for the definition and solution of our problems, and it is through them that we strive for social progress.[67]

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[65] Don Ihde, Philosophy of Technology, pg.39.

[66] Donald Schön, *Educating the Reflective Practitioner: Toward a new Design for Teaching and Learning in the Professions*, San Francisco: Jossey-Bass Inc., Publishers, 1987, pg. 3-4. The two authors referred to in parentheses are: E. Shils, "The Order of Learning in the United States from 1865 to 1920: The Ascendancy of the Universities," *Minerva*, 16, 2 (1978): 159-195; and Nathan Glazer, "The Schools of the Minor Professions," *Minerva*, 12, 3, (1974): pg. 346-363.

[67] Donald Schön, *The Reflective Practitioner: How Professionals Think in Action,* New York: Basic Books, Inc., Publishers, 1983, pp 3-4.

Schön's aim is to show that this model of professional education and practice is flawed and has led to a crisis of confidence in professional knowledge. He writes that:

> [t]he crisis of confidence in professional knowledge corresponds to a similar crisis in professional education. If professionals are blamed for ineffectiveness and impropriety, their schools are blamed for failing to teach the rudiments of effective and ethical practice ... Schools of engineering lose credibility because they are seen as producing narrowly trained technicians deficient in the capacity for design and wisdom to deal with dilemmas of technological development.
>
> The professional schools of the modern research university are premised on technical rationality. Their normative curriculum, first adopted in the early years of the twentieth century as the professions sought to gain prestige by establishing their schools in universities, still embodies the idea that practical competence becomes professional when its instrumental problem solving is grounded in systematic, preferably scientific knowledge. So the normative professional curriculum presents first the relevant basic science, then the relevant applied science, and finally, a practicum in which students are presumed to learn to apply research-based knowledge to the problems of everyday practice (Schein 1973).[68]

Schön claims that much of a professionals work is in fact not covered by this simplistic model and that an education based on technical rationality does nothing to prepare graduates for the "swampy lowland" of professional practice where many of the issues that must be dealt with "defy technical solutions."[69] He describes, for example, the plight of the civil engineer who knows "how to build roads suited to the conditions of the particular sites and specifications," by drawing on "knowledge of soil conditions, materials, and construction technologies to define grades, surfaces, and dimensions." When it comes to the decision about which road to build or whether to build a road at all he faces "an ill-defined mélange of topographical, financial, economic, environmental and political factors."[70] Later he writes that "[t]hese indeterminate zones of practice — uncertainty, uniqueness, and value conflict — escape the canons of technical rationality."[71]

Referring to the relationship between technical knowledge, which he refers to as applied science, and the design studio he writes, "I have not considered how the teaching of applied science might be combined with a reflective practicum. (I have an idea about it — that applied science should be taught as a mode of inquiry like and unlike the reflection-in-action of the

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[68] Donald Schön, *Educating the Reflective Practitioner*, pg. 8. The author referred to in parentheses is: E. Schein, *Professional Education*, New York: McGraw-Hill, 1973.

[69] Donald Schön, *Educating the Reflective Practitioner*, pg. 3.

[70] Donald Schön, *Educating the Reflective Practitioner*, pg. 4.

[71] Donald Schön, *Educating the Reflective Practitioner*, pg. 6

skillful practitioner —but I have only touched on it here.)"[72] In fact he holds up the architecture design studio as an exemplary pedagogical model capable of instilling a mode of professional practice that allows for reflection-in-action. Reflective practice, unlike the technical application of instrumental knowledge, acknowledges that much of what we do as professionals is based on tacit knowledge or "knowing-in-action." According to Schön, this *"professional artistry"* is sometimes revealed by professionals when they encounter "unique, uncertain, and conflicted situations of practice," and it is a:

> high-powered, esoteric variant of the more familiar sorts of competence all of us exhibit every day in countless acts of recognition, judgment and skilled performance. What is striking about both kinds of competence is that they do not depend on our being able to describe what we know how to do or even to entertain in conscious thought the knowledge our actions reveal.[73]

Because professional practice often presents us with unusual and unique challenges (this is particularly so in architecture where each new design project is unique), learning how to perform almost without thinking about it (knowing-in-action) requires the additional skill of being able to reflect or deliberate on what we are doing and this is a skill that must also be learned. Schön explains that this can occur in one of two ways:

> We may reflect *on* action, thinking back on what we have done in order to discover how our knowing-in-action may have contributed to an unexpected outcome. We may do so after the fact, in tranquility, or we may pause in the midst of action to make what Hannah Arendt (1971) calls a "stop-and-think." ... Alternatively, we may reflect in the midst of action without interrupting it. In an action-present —a period of time, variable with the context, during which we can still make a difference to the situation in hand — our thinking serves to reshape what we are doing while we are doing it. I shall say, in cases like this, that we reflect-*in*-action.[74]

Despite Schön's negative assessment of professional education, in general he holds the architecture design studio in high regard as an example of how to teach artistry or the ability to reflect-in-action to architecture students. As he says:

> the architecture studio may seem an odd choice to serve as the prototype of a reflective practicum. But architects are fundamentally concerned with designing — indeed, have as good a claim as anyone to epitomize the design professionals

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[72] Donald Schön, *Educating the Reflective Practitioner*, pg. xiii.

[73] Donald Schön, *Educating the Reflective Practitioner*, pg. 22.

[74] Donald Schön, *Educating the Reflective Practitioner*, pg. 26. The reference to Hannah Arendt is: Hannah Arendt, *The Life of the Mind*, Vol. 1: *Thinking*, San Diego, California: Harcourt Brace Jovanovich, 1971.

> — and designing, broadly conceived, is the process fundamental to the exercise of artistry in all professions.[75]

Schön goes on to describe, through his protocol studies of the design studio, a pedagogical model that Snodgrass and Coyne refer to as hermeneutical. He writes that: "[e]ven a cursory examination of the protocol studies of Donald Schön indicates that the design process he describes works according to the dynamics of the hermeneutical circle, proceeding by way of a dialogic exchange with the design situation."[76]

Schön provides an insight into why there is often tension within architectural education between so-called technical knowledge and the design studio. While architecture schools in universities conform in general to the epistemology of technical rationality, in its normal functioning the design studio operates in a reflective, hermeneutical fashion. Construction knowledge is usually conceived within the mode of technical rationality and is assumed to be based on scientific principles. The link between construction and building science helped legitimize the profession's claim to university status and within this epistemology architects "solve well-formed instrumental problems by applying theory and technique derived from systematic, preferably scientific knowledge."[77] The techno-rational model defines design as a "problem" that can be solved through the application of construction and other technical knowledge. But as Schön explains designers begin with:

> situations that are at least in part uncertain, ill defined, complex and incoherent ("messes," as Russell Ackoff, 1979, has called them), designers *construct* and impose a coherence of their own. Subsequently they discover consequences and implications of their constructions — some unintended — which they appreciate and evaluate. Analysis and criticism play critical roles within their larger process. Their designing is a web of projected moves and discovered consequences and implications, sometimes leading to reconstruction of the initial coherence — a reflective conversation with the materials of a situation.[78]

The usual technique proposed to solve the problem of students not knowing how to employ construction knowledge in the design studio is to insist that it is better integrated but as Schön, Snodgrass and Coyne reveal such a simplistic approach is unlikely to overcome the instrumental versus hermeneutical divergence that they have identified.

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[75] Donald Schön, *Educating the Reflective Practitioner*, pg. 41.

[76] Adrian Snodgrass and Richard Coyne, *Interpretation in Architecture,* pg. 45.

[77] Donald Schön, *Educating the Reflective Practitioner*, pg. 3-4.

[78] Donald Schön, *Educating the Reflective Practitioner*, pg. 42. The author referred to in parenthesis is Russell Ackoff, "The Future of Operational Research Is Past," *Journal of Operational Research Society*, 30, 2 (1979): 93-104.

Perhaps the most striking and influential example of a design school attempting to place itself on a scientific and technological footing was the Bauhaus. Although not part of a university, this school attempted to legitimize its program and curriculum through adherence to strict scientific principles. Peter Galison, who is currently a professor at Harvard in the Department of The History of Science has written a detailed account of the close relationship between the Logical Positivists of the Vienna Circle and the Bauhaus, focusing on the period between the late 1920s and the early 1930s.[79] He writes that "during this period:

> the connecting links between art and philosophy were real, not metaphorical, as artists and philosophers were bound by shared political, scientific, and programmatic concerns ... [I]t is in the later interwar years that the modernism of the Bauhaus and the Vienna Circle self-consciously reinforced each other, and in so doing began to articulate a common vision of what both called a modern "form of life."[80]

Galison argues that "to an astonishing degree, modern philosophy of science traces its heritage to the Vienna Circle, a small philosophical group comprised mostly of outsiders to philosophy that met regularly during the 1920s."[81] Members of the group came from the disciplines of the physical and social sciences, mathematics, history and engineering. "Throughout its existence:

> the Vienna Circle conceived of itself as modern and scientific, as a movement that would tear apart the stagnant, pointless inquiry that called itself philosophy. In the place of traditional philosophy the Circle wanted to erect a unified structure of science in which all knowledge — from quantum physics to Marxist sociology and Freudian psychology — would be built up from logical strings of basic experiential propositions.[82]

During the late 1920s and early 1930s, members of the Vienna Circle regularly lectured at the Dessau Bauhaus where, according to Galison, they found a receptive audience. Both groups faced off against the same threats from "the religious right, nationalist anthroposophist, *völkisch*, and Nazi opponents." In a lecture titled "Science and Life," Rudolph Carnap, a leading member of the Circle, proclaimed that "I work in science and you in visible forms; the two are only different sides of a single life." Galison labels the kind of modernism that both groups sought to instantiate as "'transparent construction,' a manifest building up from simple

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[79] Peter Galison, "Aufbau/Bauhaus: Logical Positivism and Architectural Modernism," *Critical Inquiry* 16, 4 (summer 1990): 709-752.

[80] Peter Galison, "Aufbau/Bauhaus: Logical Positivism and Architectural Modernism," pg. 711.

[81] Peter Galison, "Aufbau/Bauhaus: Logical Positivism and Architectural Modernism," pg. 713.

[82] Peter Galison, "Aufbau/Bauhaus: Logical Positivism and Architectural Modernism," pg. 713.

elements to all higher forms that would by virtue of the systematic construction program itself, guarantee the exclusion of the decorative, mystical, or metaphorical."[83] He writes that:

> the Bauhäusler hoped to use scientific principles to combine primitive color relations and basic geometrical forms to eliminate the decorative and create a new antiaesthetic aesthetic that would prize functionality. So close had the two groups come in their shared vision of modernism that, when the Bauhaus reconvened as the new Bauhaus in Chicago after fleeing the Nazis, the New Bauhaus imported the Vienna Circle's logical positivism as a fundamental component of its basic design program.[84]

Wittgenstein's *Tractatus Logico-Philosophicus*, was required reading for the Logical Positivists and Galison explains that "it is after an image of language, logic, and the world that starts at the basics and works up from there using logic alone. When complete, the structure would be without superfluity."[85] Fundamental to this kind of thinking is the belief that the design for a building or object, or a higher form of knowledge (a theory, axiom, scientific law etc.), can be created by the application of a logical or a mathematical process to its constituent parts. The neutral (value and meaning-free) nature of these constituent parts is implicit. Galison quotes Hannes Meyer, who directed the architecture department at the Dessau Bauhaus:

> Building is not an aesthetic process ... Architecture which 'continues a tradition' is historicist ... the new house is ... a product of industry and as such is the work of specialist: economists, statisticians, hygienicists, climatologists, experts in ... norms, heating techniques ... [T]he architect? He was an artist and is becoming a specialist in organization ... building is only organization: social, technical, economic, mental organization.[86]

As discussed earlier, Schön considered that technical rationality, the epistemological ground of the modern university, to be based on the philosophy of the logical positivists. While initially not part of a university, in its reincarnated life in Chicago the New Bauhaus eventually became part of the Illinois Institute of Technology and this perpetuated its influence on main stream schools of architecture around the world.

One of the significant features of the Bauhaus educational model was a core practical training in the workshops. Initially concentrated on training in the crafts, this eventually led to the well-known focus on the design of products that could be industrially produced. Under Hannes Meyer, architectural training included a significant element of experimentation with

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[83] Galison, "Aufbau/Bauhaus: Logical Positivism and Architectural Modernism," pg. 710.

[84] Peter Galison, "Aufbau/Bauhaus: Logical Positivism and Architectural Modernism," pg. 711.

[85] Peter Galison, "Aufbau/Bauhaus: Logical Positivism and Architectural Modernism," pg. 726.

[86] Peter Galison, "Aufbau/Bauhaus: Logical Positivism and Architectural Modernism," pg. 717.

building systems, the simple elements of which were intended to be mass produced. The emphasis on industrial production, or the need to make buildings appear as if they are industrially produced, is now less prominent but many schools of architecture offer courses in which students can experiment with materials in a workshop. This includes making building elements, furniture and architectural models. In some schools students actually construct a building. In *Learning by Building: Design and Construction in Architectural Education*, William Carpenter focuses on ten courses in the United States in which students construct a building.[87] Carpenter states that the book is "about craft in architectural education," and that "its central purpose is to inspire architects and students to see construction as a creative act." The book outlines:

> a brief history of construction in architectural education, examines examples of artists and architects interested in construction as part of the design process, and looks at direct ways to integrate construction studios into the architectural curriculum. We present new ideas in architectural education in designing programs that encourage building as a learning tool and use building as a catalyst for design decisions.[88]

Referring to the Bauhaus model, Carpenter argues that, "[t]he education of the architect entered the tectonic realm of study again, harking back to the medieval arts and crafts guilds and a spirit of making."[89] It is clear from this book that those students who design and construct a building gain a lot from the experience although there is a tendency for the courses in which this happens to be under theorized. As an example, the acquisition of technical skills is generally understood to enhance the ability of students to instrumentally solve design "problems" rather than giving them the opportunity to explore how architectural materiality embodies meaning. Carpenter's reference to the tectonic however is useful because this concept, as a means of describing a certain approach to architectural materiality, currently has wide currency in both the design studio and construction courses.

Tectonics

The word tectonics has two common meanings; it refers to the geology of the earth's crust, specifically to structural changes caused through movement and deformation; and in relation to this study, to a particular approach to the construction of buildings. In "Structure, Construction,

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[87]William J. Carpenter, *Learning by Building: Design and Construction in Architectural Education*, New York: Van Nostrand Reinhold, 1997.

[88]William J. Carpenter, *Learning by Building,* pg. ix-x.

[89]William J. Carpenter, *Learning by Building*, pg.7.

Tectonics," Eduard Sekler defines the term in relation to structure and construction but perhaps surprisingly, does not mention detailing:

> When a structural concept has found its implementation through construction, the visual result will affect us through certain expressive qualities which clearly have something to do with the play of forces and corresponding arrangement of parts in the building, yet cannot be described in terms of construction and structure alone. For these qualities, which are expressive of a relation of form to force, the term tectonic should be reserved.[90]

> Through tectonics the architect may make visible, in a strong statement, that intensified kind of experience, of reality which is the artist's domain — in our case the experience of forces related to forms in a building. Thus structure, the intangible concept, is realized through construction and given visual expression through tectonics.[91]

In the last few decades, the term tectonic has become something of a focal point for those seeking to find corporeal or construction-based alternatives to form and plan-based modes of signification. But the term itself and certainly the concept is much older than this and is easily traceable to the Greeks. Kenneth Frampton, one of the key architectural theorists responsible for a revived interest in the tectonic, writes in *Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture* that:

> Greek in origin, the term tectonic derives from the word *tekton*, signifying carpenter or builder. The corresponding verb is *tektainomai*. This in turn is related to the Sanskrit *taksan*, referring to the craft of carpentry and to the use of the axe. Remnants of a similar term can be found in Vedic poetry, where it again refers to carpentry. In Greek it appears in Homer, where it alludes to the art of construction in general. The poetic connotation of the term first appears in Sappho, where the *tekton*, carpenter, assumes the role of the poet. In general, the term refers to an artisan working in all hard materials except metal. In the fifth century B.C. this meaning undergoes further evolution, from something specific and physical, such as carpentry, to a more generic notion of making, involving the idea of *poesis* ... Needless to say, the role of the tekton leads eventually to the emergence of the master builder or *architekton*.[92]

Tectonic has an apparent link to the Greek word *techné,* but Frampton warns that the two terms, though related, are "etymologically distinct," *techné* being derived from the "Greek verb

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[90] Eduard Sekler, "Structure, Construction, Tectonics," in Gyorgy Kepes (ed), *Structure in Art and Science*, New York: George Braziller, 1965, pg. 89.

[91] Eduard Sekler, "Structure, Construction, Tectonics," pg. 92.

[92] Kenneth Frampton (edited by John Cava), *Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture*, Cambridge, Massachusetts: The MIT Press, 1995, pg. 3-4.

tikto, meaning to produce. This term means the simultaneous existence of both art and craft, the Greeks failing to distinguish between the two."

Robert Meagher also examines techné in his article of the same name, pointing to it as a confluence of imagination and the Promethean gift of fire. According to Meagher, Techné is:

> the conscious, willful working or reworking of matter until it becomes not only what it was not but also what it was our intention that it should become. Thus it is an instance of *techné* when we cut down a tree to make lumber for a house, or logs for a fire or paper for a book.
>
> From these admittedly commonplace examples we may derive all the essential principles of *techné*: that it is conscious, willful, materially violent, and materially productive.
>
> Under the influence of fire, flesh becomes food, wood and coal become fuel, ore becomes steel, water becomes steam; and in this process, the world becomes more inhabitable, more sustaining, and more controllable. *Techné*, in short, represents the convergence of imagination and power, of idea and fire.[93]

Meager also points out that if we look to the Greek origins of this "humanly defining activity, we find that, presiding over the activity of fabrication – the act of production encompassed by the Greek word *techné* – is the architect, the *architekton*, or 'master-producer.'"[94]

In the introduction to *Studies in Tectonic Culture*, Frampton details the meaning and origins of the term tectonic and also points to several of the key figures responsible for establishing and developing the term in architectural discourse. Perhaps one of the most influential of these was Gottfried Semper who in his *Four Elements of Architecture*, published in 1851, divided the "primordial dwelling" into:

> four basic elements: (1) the earthwork, (2) the hearth, (3) the framework/roof, and (4) the lightweight enclosing membrane. On the basis of this taxonomy Semper would classify the building crafts into two fundamental procedures: the *tectonics* of the frame, in which lightweight, linear components are assembled so as to encompass a spatial matrix, and the *stereotomics* of the earthwork, wherein mass and volume are conjointly formed through the repetitious piling up of heavy weight elements. [95]

Frampton suggests that Semper's four elements represent an "epoch-making" break with the Vitruvian triad of *utilitas, firmitas* and *venustas* and certainly they point to a taxonomy based on

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[93] Robert Meager, "Techné." *Perspecta,* 24 (1988): pg. 161.

[94] Robert Meager, "Techné." *Perspecta,* 24 (1988): pg. 159.

[95] Kenneth Frampton *Studies in Tectonic Culture*, pg. 5.

how the elements of a building are made. Frampton elaborates further on the distinction between the lightweight tectonic frame and heavy stereotomic earthwork from the Greek "*stereos*, solid, and *tomia*, to cut."

> This distinction between light and heavy reflects a more general differentiation in terms of material production, wood construction displaying an affinity for its tensile equivalent in terms of basketwork and textiles, and stonework tending towards its substitution as a compressive material by brickwork or *pisé* (rammed earth) and later by reinforced concrete.[96]

In *The Ontology of Construction*, Gevork Hartoonian similarly explores Semper's role in drawing attention to the tectonic as a mode of interpreting buildings that has had lasting influence in the academy. Hartoonian points to the origins of the four elements in the four crafts responsible for their production:

> Ceramics, carpentry, masonry, and weaving were the four industrial arts that corresponded to the four elements of architecture. The hearth, or the center, derives its forms and ideas from ceramics and metal work. The roof, mound (terrace), and enclosure were related to the skills developed in carpentry, masonry, and weaving, respectively. Of these elements, the hearth and the roof were essential parts of the earliest forms of dwelling.[97]

The importance of this interpretation of architecture lies in its return to a more fundamental and primordial reading of building based on its construction. However, it reflects a thoroughly modern way of thinking, a search for meaning rather than accepting a given, traditional meaning. Two of the most lasting features of Semper's thought are the juxtaposition of heavy and lightweight elements of construction, and a focus on the joint as the locus of architectural signification, concepts that still have currency in contemporary architectural practice. Semper traced the idea of the joint in textiles back to the knot, the basis of weaving, in turn one of the crafts he associated with the first production of walls. This could originally have been either literally carpets and fabrics or thin pieces of wood woven into a two-dimensional element much like pens for holding animals are still made in some parts of the world.

Semper's "artistic" understanding of the tectonic however, soon gave way to the forces of industrialization and the joint began to feature in modern architecture for very different reasons. It became a means of expressing the "honesty" of materials and of simulating the appearance of industrialized, factory-made building elements that could be assembled on site

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[96] Kenneth Frampton *Studies in Tectonic Culture*, pg. 5.

[97] Gevork Hartoonian, *The Ontology of Construction*, Cambridge: Cambridge University Press, 1994, pg. 20.

by workers with minimal building knowledge or skill. A fundamental part of a tectonic approach to design however is questioning and defining what constitutes architectural making — a seeking out, extending and innovating from within rather than imposing a form of production from elsewhere. In this sense the tectonic is related to the Heideggerian interpretation of techné as disclosive of primordial understandings we already have of architectural making. Semper, like many of his contemporaries was struggling with the rapid industrialization of building and his views on tectonics were effectively swamped by the modern movement's desire to neutralize the body of architecture and to subsume it within industrial production.

In his well-known article "Rappel a L'Ordre: The Case for the Tectonic,"[98] a precursor to *Studies in Tectonic Culture*, Frampton cites the need to counter the commodification of architecture epitomized by stylistic postmodernism's scenographic buildings (Venturi's decorated sheds) as the motivation to explore a tectonic approach to design. Despite the tendency towards the scenographic, Frampton suggests that:

> building remains essentially *tectonic* rather than scenographic in character and it may be argued that it is an act of construction first, rather than a discourse predicated on the surface, volume and plan, to cite the "Three Reminders to Architects", of Le Corbusier. Thus one may assert that building is ontological rather than representational in character and that built form is a presence rather than something standing for an absence. In Martin Heidegger's terminology we may think of it as a 'thing' rather than a 'sign'.[99]

Referring to both Karl Bottischer and Gottfried Semper, Frampton introduces the idea that tectonics refers to not only "a structural and material probity but also a poetics of construction ... "[100] This is important because it introduces the notion that tectonics is about more than simply revealing construction in a crude way, and that there is an element of poetry required that may be related back to the Greek concept of *poesis*, the act of making and revealing. Frampton again refers to Semper's "privileging of the joint as the primordial tectonic element as the fundamental nexus around which building comes into being, that is to say, comes to be articulated as a presence in itself," and he gently reminds us that "after Heidegger, ... inanimate objects may also evoke 'being', and that through this analogy to our own corpus, the body of a building may be perceived as though it were literally a physique."[101]

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[98] Kenneth Frampton, "*Rappel a L'Ordre*: The Case for the Tectonic," Architectural Design Profile, no. 84 (1990): pp 19-25.

[99] Kenneth Frampton, "*Rappel a L'Ordre*," pg. 20.

[100] Kenneth Frampton, "*Rappel a L'Ordre*," pg. 20.

[101] Kenneth Frampton, "Rappel a L'Ordre," pg. 22.

In addition to Kenneth Frampton the two key figures responsible for revival of the tectonic discourse are David Leatherbarrow and Marco Frascari. Both theorists examine the body of architecture from a philosophy of technology position. In *On Common Ground* for example, Leatherbarrow examines current building practice in the context of the claim by some critics of contemporary Western culture that it is "destitute or impoverished." He asks why this is so when we have to hand such an abundance of "products and so much useful information." Citing the professional architect's vast library of "brochures, samples and specification sheets describing the hundreds, even thousands of architectural materials and elements,"[102] Leatherbarrow calls into question the relationship to dwelling of this vast, industrially produced standing reserve:

> Designers can avoid thinking anew about the basic premises of dwelling experience because that sort of thinking can be assumed to have been done by specialists, the results of which are available on the market in the form of ready-made solutions.[103]

He likens contemporary architectural design to calculation, but not numerical calculation "rather, the increasingly precise estimation of results,"[104] and claims that "the increased and increasing use of ready-made solutions largely transforms design invention into choice, converting creativity into selection."[105] In a conception of design that is antithetical to the artistic or creative nature of the tectonic, he suggests that:

> Despite the designer's artistic pretensions, the business of planning what will get built has become a matter of choice and combination, at least largely so; choice and combination of elements that can be purchased but rarely invented. If originality is a race, the architect never finishes first; always ahead is the product designer. Premade products are the canon of our time.[106]

In two previous works, *On Weathering: The Life of Buildings in Time*,[107] and *Surface Architecture*[108] Leatherbarrow and Mohsen Mostafavi examine the architectural skin of

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[102] David Leatherbarrow, *On Common Ground: Architecture, Technology and Topography*, Cambridge, Massachusetts: The MIT Press, 2000, pg. 119.

[103] David Leatherbarrow, *On Common Ground: Architecture,* pg. 119.

[104] David Leatherbarrow, *On Common Ground: Architecture,* pg. 124.

[105] David Leatherbarrow, *On Common Ground: Architecture,* pg. 122.

[106] David Leatherbarrow, *On Common Ground: Architecture,* pg. 126

[107] David Leatherbarrow and Mohsen Mostafavi, *On Weathering: The Life of Buildings in Time*, Cambridge, Massachusetts: The MIT Press, 1993.

[108] David Leatherbarrow and Mohsen Mostafavi, *Surface Architecture*, Cambridge, Massachusetts: The MIT Press, 2002.

buildings. *On Weathering* reveals and focuses on the temporal nature of building through the agency of weathering from a phenomenological rather than a technical view point. Inverting two common understandings of buildings — that they persist in time and that weathering destroys finishes — the authors find instead that "no building stands forever, eventually every one falls under the influence of the elements," and that "[f]inishing ends construction, weathering constructs finishes."[109] Weathering is of course one of the key influences on tectonics, particularly the detailing of a building's skin, and this book reveals that this is far from a technical consideration only. *Surface Architecture*, published approximately ten years after *On Weathering* finds that the "ever-increasing" source of mass-produced building elements has led to many contemporary buildings representing either the "visual reflections of systems of production" or "pictorial recollections of earlier styles and motifs. The first practice mimics machine assembly — reproduction — and the second pictures an architecture based on earlier and outdated modes of construction."[110] In *Surface Architecture*, Leatherbarrow and Mostafavi dissect and examine the building façade in a great deal of detail. Their aim, at least in part, is to mediate a way forward for design that takes technology into account but does not let it dominate.

Perhaps the most well-known text dealing with architectural detailing from a phenomenological perspective is "The Tell-The-Tale Detail" published by Marco Frascari in 1984. Born in part out of frustration with the lack of construction content in the design studio at the University of Pennsylvania, Frascari explains that he wrote the "The Tell-The-Tale Detail" to explore the fact that:

> in the act of construction there are meanings and those are the fundamental meanings of architecture. The problem was that students would show a beautiful design with a lot of space, within their understanding of what space is which was within the line of modern understanding, but there was no construction. My argument is that space changes completely with the system of construction. The same dimension, the same envelope, if you build it in brick or if you build it in wood, is a different space.[111]

Frascari rarely uses the term tectonic, preferring simply construction. His article about detailing begins by diffracting the word technology into the "*techné of logos*" and then reversing the order to make the "*logos of techné*." Tracing the etymology or philology of the parts he arrives

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[109] David Leatherbarrow and Mohsen Mostafavi, *On Weathering*, pg. 5.

[110] David Leatherbarrow and Mohsen Mostafavi, *Surface Architecture*, pg. 1.

[111] Sam Ridgway, "Constructing Tales," pg. 71.

at an architectural interpretation of technology as *the making of meaning* and *the meaning of making*. Frascari considers that the "'construction and the 'construing' of architecture are both in the detail."[112] He argues that details are the "*locii* where knowledge is of an order in which the mind finds its own working that is, *logos*." Details can be generative, "a role traditionally ascribed to the plan," and that they are "much more than subordinate elements; they can be regarded as the minimal units of signification in the architectural production of meanings."[113] After a lengthy and poetic exploration of the architectural detail, Frascari concludes with an examination of the work of his teacher and mentor Carlo Scarpa, an architect who was for many years considered anomalous within the modern movement in large part because of his obsessive attention to detailing. Scarpa of course is now revered for the same reason. His buildings embody many of the qualities considered absent from much modern architecture, for example, a respect and understanding of the phenomenology of place and the traditions of building associated with place. In addition, his work displays an obvious love for architecture's corporeality. In relation to tectonics and detailing, Scarpa understood that the way a building is made is meaningful in itself and, to quote Frampton, he did not feel the need to legitimize his work in relation "some other discourse."[114] As an example of the upsurge in interest in Carlo Scarpa, *Studies in Tectonic Culture* has a lengthy and highly descriptive chapter titled "Carlo Scarpa and the Adoration of the Joint." Introducing the chapter Frampton argues that:

> The work of Carlo Scarpa (1906-1978) may be seen as a watershed in the evolution of twentieth-century architecture, not only for the emphasis that he placed upon the joint but also for his particular use of montage as a strategy for integrating heterogeneous elements. Throughout his work, the joint is treated as a kind of tectonic condensation; as an intersection embodying the whole in the part, irrespective of whether the connection in question is an articulation or a bearing or even or even an altogether larger linking component such as a stair or a bridge.[115]

I would however question whether Scapa represents a watershed for mainstream architectural practice in any significant way. If he did, it would only be during the late twentieth century and his influence appears limited. A re-emergence of interest in his work in the academy has been significant and has been led by figures such as Frascari and Frampton who have focused on the tectonic qualities of his work.

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[112] Marco Frascari, The Tell-The-Tale Detail, Via no. 7 (1984): pg. 23.

[113] Marco Frascari, The Tell-The-Tale Detail, Via no. 7 (1984): pg. 23.

[114] Kenneth Frampton *Studies in Tectonic Culture*, pg. 2.

[115] Kenneth Frampton *Studies in Tectonic Culture*, pg. 299.

A continuing theme among theorists interested in architectural tectonics is to try to position it in relation to a perceived core and periphery of pedagogy and practice. In a recent article titled "Three Aspects of Tectonic Imagination,"[116] for example, Frascari contends that:

> Even though the core of the architectural discipline is tectonic imagination, the definition of the discipline has always been done by surveying its periphery, taking for granted that, the core will become apparent and obvious as a result of the definition of its boundaries. The discourse on architecture has focused on styles, function, modernity, structures, facadism and many other peripheral components of the practice without ever singling out its focal point ... Nowadays, although the field is probably at its possible minimum dimensions, the margins are extremely indistinct and problematic. In spite of that, if the boundaries are traced in their entirety, the tectonic imagination at the heart of the field does not become substantiated or apparent. [117]

While Frascari finds the search for meaning along the discipline's periphery problematic, in contrast at ETHZ, the Swiss Federal Institute of Technology (Zurich), Marc Angélil, professor of architecture and design, with reference to Michel Foucault, proposes that defining boundaries and setting limits reveals the space "of a possible transgression."[118] Angelil and the team at ETHZ have developed a pedagogy based on a critical mode of *praxis* or experimentation. They propose a strategy that proceeds "not from the center but from the edges." At the same time it "erases edges" and "aims to encroach on boundaries" "interrogating from within and without, spiraling through potential distinctions, emerging unexpectedly into new positions."[119] Angelil challenges the notion that there is point of origin or a centre of architectural knowledge. He writes that teaching has:

> traditionally being associated with a beginning implying a point of origin from which to progress, moving gradually from anchored foundations to higher domains, in a Cartesian sense, from the simple to the complex. Such a line of development, always affixed to hierarchical structures, presupposes a center, a core knowledge delimited by disciplinary boundaries.[120]

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[116] Marco Frascari, "Three Aspects of Tectonic Imagination," *Arkitekturtidsskrift: Architectural Magazine* No. 54 (2005): pg. 9-27.

[117] Marco Frascari, "Three Aspects of Tectonic Imagination," pg. 10.

[118] Marc Angelil, *Inchoate, An Experiment in Architectural Education*, Zurich: Swiss Federal Institute of Technology (ETHZ), 2003, pg. 28. Angelil draws his quote from Michel Foucault, "*Les déviations réligieuse et le savoir medical*" (1962), in Jacques LeGoff, ed., *Hérésies et sociétés dans l'Europe pré-industrielle, Mouton*, 1968, pg. 19.

[119] Marc Angelil, *Inchoate*, pg. 28

[120] Marc Angelil, *Inchoate*, pg. 28.

This should not be taken to mean that Angelil eschews the tectonic, in fact the reverse is true. In an earlier article "Technique and the Metaphysics of Science," he argues that:

> Technology must re-address the imaginative content of production. Within architecture the act of making should go beyond the understanding of building as a purely operational necessity by which to satisfy functional requirements. The process of making should open for the production of architecture the creative and imaginative possibilities of the technical means involved in building construction. This is not to be based on a nostalgic recreation of past techniques but instead must address the poetic structure of contemporary building methods ... Within the understandings of the instruments, methods, and processes of technical understanding lies the source of poetic meaning ... Imagination reveals the spiritual and symbolic aspects of technique in a poetic act, that of making.[121]

Here we can see the genesis of the current pedagogy at ETHZ which is largely based on conceiving the architectural design process as a mode of research or experimentation. Angelil is keen to reinforce that this is based on a new understanding of architectural production or *praxis,* and reinforcing the importance of studio culture he argues that the "[t]he physical environment in which the work takes place is here of importance: imagine a crossing between a forum for debates, a library, a drafting room, a workshop, and a construction site."[122]

In addition to Angelil's book *Inchoate,* in which he and others outline the teaching experiment at ETHZ, another publication edited by its Dean, Andrea Deplazes provides a further insight into this pedagogical venture. *Constructing Architecture: Materials Processes Structures, A Handbook* is an epic construction manual, at first seemingly rather instrumental in nature but on closer inspection a work that examines and documents both the technical and the poetic nature of building. In the introduction Deplazes explains that:

> Only in conjunction with a concept does a vigorous design process ensue in which the initially isolated technical and structural fragments are at once arranged to fill a consummate, architectural body. The fragments and the whole compliment and influence each other. This is the step from construction to architecture, from assembly to tectonics.[123]

These two publications reveal the program at ETHZ to be strongly based on a critical mode of *praxis* or production conceived as design experimentation. As Angelil writes, "[e]xperimentation ... takes on the role of an operational strategy used in the production of ambiguous constructions." This praxis approach is broken down into three parts: technical *praxis*, where

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[121] Marc Angelil, "Technique and the Metaphysics of Science," pg. 75.

[122] Marc Angelil, *Inchoate*, pg. 28.

[123] Andrea Deplazes (ed.), *Constructing Architecture: Materials Processes Structures, A Handbook*, Basel: Birkhäuser, 2005, pg. 10.

the "means applied in a process have a determining effect on what is produced;" intellectual *praxis*, "[b]ased on the notion that architecture constitutes a form of discourse, theoretical investigations are an integral part of design;" and intuitive praxis, where in "addition to the technical and intellectual sites of design, the domain of creative work must be examined, that is the investment of gut feeling, reverie, and imagination — issues often isolated or neglected within education."[124]

Two further publications exemplify the recent upsurge in interest in the tectonic: Annette LeCuyer's *Radical Tectonics* and *Immaterial Ultramaterial: Architecture, Design and Materials*, edited by Toshico Mori a practicing architect and Professor in the Practice of Architecture at the Harvard University Graduate School of Design. LeCuyer examines the work of four architectural practices: Enric Miralles; Günter Behnisch; Mecanoo; and Patkau Architects. In the same vein as Leatherbarrow, she critiques architecture built from "mass-produced, standardized components," claiming that buildings have become more "homogenized, divorced from the contingencies of craft and culture. Emphasizing technique at the expense of art, the delicate equilibrium implicit in the term tectonic has been undermined."[125] Radical tectonics, which she writes "is not a style but a sensibility," offers a form of resistance to the homogenizing effects of modern industrial production:

> In contrast with the current fascination with the virtual and the tendency of architecture to look to other disciplines for theoretical underpinnings, the renewed interest in the tectonic is an affirmation that the making of the physical artifact is radical, that it is at the centre of architectural discourse and rooted in craft, culture and context.[126]

While not as heavily theorized as other works on the topic, the introductory essay lays out in clear terms a viable contemporary, tectonic approach to design. LeCuyer concludes that the projects by these architects, "who are actively being sought out to design buildings of international significance, confirm that the poetry of construction is fertile territory worthy of more intensive exploration."[127]

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[124] Marc Angelil, *Inchoate*, pg. 30.

[125] Annette LeCuyer, *Radical Tectonics: Enric Miralles, Günter Behnisch, Mecandoo, Patkau Architects*, London: Thames and Hudson, 2001, pg. 15

[126] Annette LeCuyer, *Radical Tectonics*, pg. 15-16.

[127] Annette LeCuyer, *Radical Tectonics*, pg. 22.

Mori's work takes up the question of the relationship between the development of new materials and the tectonic via an experimental research project at Harvard. Four "faculty-led groups" focused on the themes of Edge, Surface, Substance and Phenomena:

> The four groups selected for study materials commonly used for substrate and valued for their performative qualities, such as engineering boards, thin plywood, rubber, foam, felt, and aerogel. In their strange and humble neutrality, these materials act as flexible media that go through various stages of mutation and fabrication to increase use, capacity and performance.[128]

This appears to be an example of architecture searching outside its boundaries for inspiration, not in the form of intellectual stimulation but in the search for new and exciting materials. This would seem to contradict others interested in the materiality and tectonics of architecture, who often claim that architectural making has a particular quality and meaning in itself and that to introduce modes of production and materials from other industrial processes goes against the concept of the architectural tectonic. Mori includes an interview with Jacques Herzog who with his partner Pierre de Meuron has been at the forefront of the current return to materiality and corporeality. While the work of Herzog and de Meuron is tectonic in nature, it also embodies a significant element of innovative material experimentation. The silk screening onto industrial polycarbonate slabs used in the Ricola-Europe SA Production and Storage Building, is an example of this. Herzog describes this as "'inscription,' tattooing, which expresses something physical, something you relate to your body." He freely admits that in the wrong hands such new techniques, the photochemical treatment of concrete surfaces for example, has "opened up the doors for interesting applications as well as for the worst kitsch. Unfortunately it has been used for dumb projects, namely in France and Germany." In relation to another of their well-known projects, the copper clad signal boxes in Basel, he describes the innovation differently, here they "use a traditional building material, but apply it in a new way. The twisting copper bands running around the building express their inherent material qualities in a very radical and straightforward way." [129]

Finally, a two volume work must be mentioned, not because it claims to examine the tectonic but because it exhaustively and elegantly explores the way in which modern buildings were actually constructed. This is Edward Ford's *The Details of Modern Architecture*. Ford has extensively researched and sourced the original drawings of a large number of iconic modern

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[128] Toshiko Mori (ed.), *Immaterial Ultramaterial: Architecture, Design, and Materials*, New York: Harvard Design School in association with George Braziller, 2002, pg. XV.

[129] Toshiko Mori (ed.), *Immaterial Ultramaterial*, pg. 83

buildings which have been redrawn in axonometric projection. He writes that his initial intention was:

> to write a book about detailing, but I found I could not discuss details without discussing styles of building, that I could not discuss styles of building without discussing styles of architecture, and that I could not discuss any of these without discussing history.
>
> Much of what I have written about these buildings is critical. This is particularly true of the Modernists of 1920 – 1940. I did not intend to write a technical critique of Modernism or a technical defense of Postmodernism. I have tried to judge the architects on their own terms, by their own criteria; if some of them failed more than others, it is often because they attempted more. The Gamble house, the Villa Savoie, Hanna, Eames, and Farnsworth houses, and both Lovell houses were all intended and all failed to be prototypes of Modern construction.[130]

Revealing that the actual construction of iconic Modern buildings was quite different to what was claimed at the time they were built, especially when they were promoted as prototypical, is a fascinating way of allowing students to understand that construction has at least as much to do with ideology as with technical practicalities.

To become a building, an architectural project must eventually be constructed. This inevitable material embodiment of architectural ideas reveals an architect's thinking in relation to the role of construction or tectonics in the process of architectural signification. An example would be the way joints between materials are revealed or concealed, or the extent to which materiality is suppressed, accentuated or manipulated. Although not a universal rule, the materiality of traditional (pre-modern) architecture tends to contribute more to the building's presence than modern buildings where there is a tendency towards the neutrality and universality of materials. This is somewhat paradoxical since joints in traditional buildings tend towards *cosmesis* or covering rather than being left exposed. In contemporary practice, a tectonic approach to design would place construction at the forefront of the quest to produce meaningful architecture.

Representation

Just as all buildings must be constructed, all constructions must in some way be represented and the most common form of representing construction is drawing. In the field of architectural representation, there are four key figures whose work has been highly influential to the direction and content of this thesis: Alberto Pérez-Gómez; Dalibor Vesely; Marco Frascari; and

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[130] Edward R. Ford, *The Details of Modern Architecture: Volume 1*, Cambridge, Massachusetts: The MIT Press, 1990, pg. VII.

Robin Evans. All of them, in varying degrees, explore issues of representation and construction. None of them deal directly with the topic of representation and construction teaching and so this thesis, especially chapter six, "The Representation of Construction," is my small contribution to a discussion of this topic. My interest in the relationship between representation and construction was initially raised by reading of Frascari's *Monsters of Architecture: Anthropomorphism in Architectural Theory*. Chapter five of *Monsters*, titled simply Demonstrations, is a detailed elaboration of his thoughts on demonstration in architecture. Demonstrations are representations, generally drawings that reveal something about the architectural transformation taking place from invisible and intangible thoughts and ideas into visible and tangible buildings. They show architectural thought processes that transform function and practicality into symbolically meaningful, physical building fabric and space.

Frascari's inversion of the commonly held view that drawings precede buildings is a means of challenging the current instrumental orthodoxy regarding the relationship between drawings and buildings. He proposes that:

> The architectural project is based on the processes of sign transformation taking place in the translation of a building into a drawing and, visa versa, in the translation of a drawing into a building.[131]

This proposition is more fully understood by unpacking another of Frascari's enigmatic statements that a "drawing is a pre-posterous piece of architecture." The use of the word pre-posterous, like the use of monster, is unconventional. In this sense it means back-to-front. In other words Frascari is highlighting the fact that even before it is drawn a building exists in the imagination, in cultural values and conventions, in personal preferences, in words and numbers, in construction practices and rituals, in materials and industrial production, in functional requirements and so on; but it does not exist in its entirety. In this sense a drawing is literally a drawing forth. A drawing provokes a building into existence through representation. A demonstrative drawing reveals how intangible things are transformed into the representation of a building. A demonstration generally shows the generative nature of intangibles in the design process rather than their literal applicability. In this sense the drawing is "pre-posterous," it comes after the building, showing how it has been drawn from intangibility into tangibility. The commonly held view is that drawings come first and the completed building is a representation of the drawings. But as Frascari and others have pointed out, architects don't build buildings

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[131] Marco Frascari, Monsters of Architecture: Anthropomorphism in Architectural Theory, Maryland: Rowman & Littlefield Publishers, Inc., 1991, pg. 93.

they represent them. The question becomes where is the building that architects are (re)presenting? According to current convention it is a future building but Frascari draws our attention to the fact that it also exists prior to its representation. It was this revelation, born out of struggling with Frascari's text that allowed me to understand the importance of reassessing the commonly held view that a drawing, especially a construction drawing, is simply a neutral tool for transmitting information to the builder.

An interesting commentary on Frascari's proposal for architectural drawings to become demonstrations can be found in an essay by Daniel Willis, "Seven Strategies for Making Architecture," published in *The Emerald City and Other Essays on the Architectural Imagination*.[132] Willis picks up on Frascari's assertion, made during the postmodernism period, that in the present state of architectural production, "envisioning negates construction." Frascari's plea is that drawings should again become demonstrations of construction. He acknowledges that "[i]n the past, the symbolic and the instrumental representations were unified in the building, and the drawings were seen as merely instrumental representations," but he goes on to explain that:

> In the present reality, however, the union of the symbolic and instrumental representations in the building depend on their presence and union in the drawing; therefore the drawing should be a monster.[133]

Willis elaborates on what he thinks this would really mean for architects and the building industry. He argues that "[d]rawings of this type would not necessarily look like the finished building. The builder would be required to interpret the drawings, so that there would be an analogical correspondence between what was built and what was drawn."[134] This non-literal connection between buildings and drawings existed prior to the Enlightenment and requires an entirely different kind of relationship between client, architect and builder than currently exists. This would have to be built on mutual trust and respect and the architect's role would be one of producing poetic drawings and helping the builder translate these into a building. Willis cites the Japanese building industry as an example of how a relationship of this nature works in practice. In Japan, Willis points out that, "drawings are less idealized" than they are in Europe or the United States. The collaborative and "social process of building construction prevents the building from becoming conceptualized as a representation of the drawings." The architect,

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[132] Daniel, Willis, *The Emerald City and Other Essays on the Architectural Imagination*, New York: Princeton Architectural Press, 1999.

[133] Marco, Frascari, *Monsters of Architecture*, pg. 109.

[134] Daniel, Willis, *The Emerald City*, pg. 234.

builder and client work collaboratively to bring the building into existence; the drawings are a guide only. Willis' claim that the production of demonstrative drawings would mean a complete overturning of current practice is not necessarily the case. As Frascari has shown in his own modest practice, a demonstrative drawing can be subtly different from a conventional drawing and still have a quite different impact on the translation from drawing to building.

It is the relationship between architectural representation and buildings that is the primary focus of *Architectural Representation and the Perspective Hinge* by Alberto Pérez-Gómez and Louise Pelletier. They examine the relationship between drawing, particularly perspective, and the design of architectural space from the seventeenth to the twentieth century. One of their key objectives is to dispel the current, popular belief that architectural representation is a neutral depiction of a future building. This is achieved by examining historical material spanning three hundred years that reveals how the representational techniques that we take for granted are in fact value-laden. Pérez-Gómez and Pelletier argue that architectural creation at the end of the second millennium is plagued by "ideological stagnation," and that to "disclose appropriate alternatives" to this we need to "acknowledge that value-laden tools of representation underlie the conception and realization of architecture."[135] They show that the various descriptive projections forming the basis of modern architectural drawings result from a geometrized and homogeneous understanding of space that "was construed as the 'real' space of human action during the nineteenth century."[136] The apotheosis of reductive and objectifying graphic techniques was descriptive geometry developed by Gaspard Monge and institutionalised as a crucial part of the curriculum at the École Polytechnique after 1795. Descriptive geometry was a graphic technique for describing three dimensional objects in space. It was entirely independent from any trade or profession; the objects it depicted were dematerialized, reduced to points in space connected by lines. The primary purpose of descriptive geometry was to "represent three-dimensional objects for technological purposes,"[137] and it was hugely important in the development of industrial technologies and for engineering.

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[135] Alberto Pérez-Gómez and Louise Pelletier, *Architectural Representation and the Perspective Hinge*, Cambridge: Massachusetts, MIT Press, 1997, pg. 3.

[136] Alberto Pérez-Gómez and Louise Pelletier, *Architectural Representation and the Perspective Hinge*, pg. 5.

[137] Alberto Pérez-Gómez and Louise Pelletier, *Architectural Representation and the Perspective Hinge*, pg. 305.

Pérez-Gómez and Pelletier's book focuses on the relationship between drawings and building in an attempt to make the reader question how this translation might become less prosaic and more poetic. Its basic premise is that since the seventeenth century, architectural representation has increasingly conformed to and become a part of a scientific and technological world view. Architectural representation has increasingly become an instrument of efficient production while the symbolic qualities of drawings and buildings have declined. This is particularly so for construction drawings which exemplify the modern drive for efficiency. The relationship between production and creativity is examined in a great deal of detail by Dalibor Vesely in *Architecture in the Age of Divided Representation: The Question of Creativity in the Shadow of Production*. In a similar fashion to Pérez-Gómez and Pelletier, he places contemporary representation in an historical context tracing the "first plausible anticipation of modernity" to the formation of Renaissance perspective.[138] One of his troubling conclusions is that instrumental, mathematical representation — representation that is essentially a tool of production — is fundamentally opposed to symbolic representation and that this is the cause of the "contemporary crisis of meaning and the general crisis in contemporary culture."[139] Vesely argues that while symbolic representation is "reconciliatory and serves as a vehicle of participatory understanding and all-encompassing meaning," productive representation is aggressive and serves as an instrument of autonomy, domination and control."[140] This is an extremely important observation for architects because it does not lay the blame nor does it suggest that the solution to the current situation is better design, but rather more appropriate representation. Vesely questions the notion that architects can bring instrumentality into harmony with symbolism, "that a balance can be established between them, that instrumentality can produce its own symbolism, or that the two can exist independently."[141] While this revelation shows the depth of the problem, it also offers hope. Representation lies at the core of architectural practice, and therefore, with an appropriate level of consideration, it may be possible for architects to conceive of changes in the way they represent buildings.

An author whose work is less polemical and who does not take a strong stand for or against current modes of representation is the late Robin Evans. Evans also explores

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[138] Dalibor Vesely, *Architecture in the Age of Divided Representation: The Question of Creativity in the Shadow of Production*, Cambridge: Massachusetts, MIT Press, 2004, pg. 6.

[139] Dalibor Vesely, *Architecture in the Age of Divided Representation*, pg. 242.

[140] Dalibor Vesely, *Architecture in the Age of Divided Representation*, pg. 356.

[141] Dalibor Vesely, *Architecture in the Age of Divided Representation: The Question of Creativity in the Shadow of Production*, pg. 242.

architectural representation in an historical context, identifying key figures and tracing links, foundations, origins and trajectories in a detailed and descriptive way. His major work, *The Projective Cast: Architecture and its Three Geometries*,[142] is an important reference in the area of architectural representation. His key premise is that architectural drawings are projections "which means that organized arrays of imaginary straight lines pass through the drawing to corresponding parts of the thing being represented by the drawing."[143] In relation to orthographic projections, the most common form of architectural drawings and the drawings almost universally used for construction drawings, Evans points out that "the projectors are not only perpendicular to the sheet of paper but also perpendicular to the major surfaces of the buildings drawn on it." This, he claims, is a "powerful, conservative, forming agency"[144] and was particularly so in relation to neoclassical architecture after the Renaissance. He argues that an "alliance had already been struck between the abstractions of orthographic projection and the fundamental organization of classical architecture."[145]

Arguably, the most significant recent development in the area of architectural representation has been brought about by the introduction of computers and computer graphics. Although computers are a relatively recent invention, the instrumental conception of architecture and architectural design that allowed them to so quickly eclipse hand drawing and manual drafting in architectural practice had begun to be installed from the Enlightenment. Robert Bruegmann's essay "The Pencil and the Electronic Sketchboard: Architectural Representation and the Computer," which appears in the same publication as "Architectural Projection" by Evans, is an insightful and relatively early examination of this topic.[146] Even before computers became widely available the aesthetic of computer graphics had already become well-known and Archigram, and others, created "computer-like" drawings by hand,

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[142] Robin Evans, *The Projective Cast: Architecture and its Three Geometries*, Cambridge, Massachusetts, MIT Press, 1995.

[143] Robin Evans, "Architectural Projection," in Eve Blau and Edward Kaufman (eds.), *Architecture and its Image: Four Centuries of Architectural Representation, Works from the Canadian Centre for Architecture*, Montreal, Canadian Centre for Architecture 1989, pg. 19.

[144] Robin Evans, "Architectural Projection," pg. 24.

[145] Robin Evans, "Architectural Projection," pg. 25.

[146] Eve Blau and Edward Kaufman (eds.), *Architecture and its Image: Four Centuries of Architectural Representation, Works from the Canadian Centre for Architecture*, Montreal, Canadian Centre for Architecture 1989. This Center for Canadian Architecture publication in which Evan's article appears is itself a significant contribution to literature concerning architectural representation. It was published in 1989 as a catalogue for an extensive exhibition of material from the CCA to celebrate the tenth anniversary of its founding.

using "the convention of the brilliantly-coloured wire-framed diagrams they would have seen in technical magazines."[147] Bruegmann points out that the initial appeal of the computer is easily understandable as it was "widely thought at the time that the use of the computer virtually guaranteed a rational approach to problem-solving." This, he claims, had been a preoccupation of architectural theorists since the mid-eighteenth century and as a result it might "well have seemed that architects had been preparing themselves to welcome such a tool for two centuries."[148] Pérez-Gómez makes a similar point when he writes that the computer is "the culmination of the objectifying mentality of modernity and it is, therefore, inherently perspectival ..."[149]

The most recent development in digital representation is Building Information Modelling (BIM) which seems to be driven by the desire for complete control of architectural projects. BIM is a further development of CAD and is the digital corollary of descriptive geometry, advancing as it does the ability to almost totally describe every physical part of a building in three dimensions at every stage of its development. Without mentioning BIM, Pérez-Gómez describes the possible directions that computer representation will take as either "towards absolute fluidity or towards further fixation and reduction." The latter is the "unfortunate result of the implementation of the technological will to power: ie. control and domination."[150] BIM appears to embody the latter. In a similar fashion to the way the introduction of CAD was proposed as a means of making the production of drawings more efficient, proponents of BIM argue that reducing the production of architecture to the production of information will make the design, documentation, construction and management of buildings better, faster and cheaper.[151]

Conclusion

An exploration of the relationship between buildings and the artifacts that mediate their production is particularly important to an exploration of architectural construction and its

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[147] Robert Bruegmann, "The Pencil and the Electronic Sketchboard: Architectural Representation and the Computer" in Eve Blau and Edward Kaufman (eds.), *Architecture and its Image: Four Centuries of Architectural Representation, Works from the Canadian Centre for Architecture*, Montreal, Canadian Centre for Architecture 1989, pg. 144.

[148] Robert Bruegmann, "The Pencil and the Electronic Sketchboard, pg. 140.

[149] Alberto Pérez-Gómez, "Questions of Representation: The Poetic Origin of Architecture," Architecture Research Quarterly, 3-4, 9 (2005): pg. 217.

[150] Alberto Pérez-Gómez, "Questions of Representation, pg. 224.

[151] *Chuck Eastman, Paul Teicholz, Rafael Sacks and Kathleen Liston,* "Managing BIM Technology in the Building Industry," http://www.aecbytes.com/viewpoint/2008/issue_35.html

pedagogy. This is especially so when the study aims to question the current way of doing things with the goal of promoting a more reflective and less instrumental mode of practice in relation to architectural construction. While it is possible to garner such a critique from literature currently circulating in the academic world it is much more difficult to find such a critical presence in the world of architectural practice. Because the literature that could foster this is unlikely to ever be widely read within the profession, its influence on the production of architecture can best be brought to bear through its introduction into construction courses in the academy. This may be difficult to achieve in the near future but the following chapters, which are all grounded in the literature referred to in this review, have this as their guiding principle.

Chapter Two

CONSTRUCTION KNOWLEDGE AND THE DESIGN STUDIO
The Question of Integration

We are bound to an epistemology of practice which leaves us at a loss to explain, or even to describe, competences to which we now give overriding importance.[1]

Donald Schön

Integration

In 2000, the Royal Australian Institute of Architects, Education Policy promoted retaining "the virtues of design studios and their potential to foster creative problem solving and knowledge integration."[2] The policy document continued:

> Through education the profession must redefine its core ideology and expand architectural thinking into broader applications. Architectural education should be directed toward the development of vigorous, adaptive minds capable of accommodating rapid change. The focus should be on the core capabilities of creative thinking and design integration – an understanding of the process of problem solving – and away from the product focus and encyclopedic learning of information. The focus should be on the context of knowledge and the relationship between knowledge in different domains. As the essence of an architectural education involves design integration, architecture courses should strive for integration of knowledge across domains thus linking the design solution to the method and context of procurement.[3]

Later, in Attachment 1, the policy outlines a list of knowledge criteria that students must be able to integrate before they can graduate from an accredited undergraduate program and it points out that "integrative skills develop in complexity over an architectural course."[4] The ten-page policy document is peppered with the word and the concept of integration, ranging from defining an architect's skills as holistic with "their ability to integrate arts, sciences and technology," to promoting a university setting for architectural education as it should "facilitate creative thinking and knowledge integration for the solution of complex, often ill-defined, problems relating to the built environment."[5] There is clear acknowledgement of "the context of knowledge," and the "relationship between knowledge in different domains," but no indication is

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[1] Donald Schön, *The Reflective Practitioner*, New York: Basic Books, Inc., 1983, pg. 21.

[2] *The Royal Australian Institute of Architects Education Policy*, endorsed by National Council, November 2000, pg. 2

[3] *RAIA Education Policy*, November 2000, pg. 2.

[4] *RAIA Education Policy*, November 2000, pg. 7.

[5] *RAIA Education Policy*, November 2000, pg. 2.

given as to what the context of construction knowledge might be or how we might assist knowledge to cross domain boundaries. It seems these questions and others, such as why architectural knowledge is currently divided in this way, are for us in the academy to ponder. The RAIA's policy document insists only that the different areas of knowledge outlined must be integrated in the design studio.

The RAIA recently changed its name to the Australian Institute of Architects (AIA) and updated its education policy. The new policy uses the word integration less often but its intent is the same. Reference to the "context of knowledge" and the "relationship between knowledge in different domains" has sadly been removed. Under the title Program Content, the new policy awkwardly states that:

> Graduates exiting from an undergraduate program shall satisfy the following criteria for each component of the framework set out below.
>
> In particular architecture students must develop the ability to integrate the range of knowledge criteria set out below. It is this ability that distinguishes architects from other providers of built environment services. Integrative skills develop in complexity over an architecture course.[6]

The first of the seven components (3.1) is titled Design Studies and Design Integration and like all of them, it is divided into the two categories of knowledge criteria, first: Awareness and Knowledge followed by Application and Synthesis. Point 3.1.2 (iv) under Application and Synthesis states that graduates must have "[a]n ability to reconcile divergent factors and integrate domains of knowledge in the creation of a design solution." Within the Awareness and Knowledge criteria for the second component, 3.2 Documentation and Technical Studies, point 3.2.1 (ii) states that graduates must have "[a]n understanding of the processes of technical design and the integration of structure, construction technologies and the services systems into a functionally effective whole." And under Application and Synthesis, it states they must have "[a]n ability to reconcile divergent factors and integrate domains of knowledge in the development of buildable solutions."

In schools of architecture, however, the apparent inability of students to integrate construction knowledge into the design studio is often a source of tension. This manifests itself through comments from studio staff concerning the lack of understanding and skill students display when asked to demonstrate how the buildings they have designed are constructed. Construction staff typically respond with exasperated accounts of the large amount of

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[6] The Australian Institute of Architects Policy on Tertiary Education of Architects – Standards for Programs in Architecture, updated 21 August 2009.

information they have dispensed and the skill students have shown in their construction courses. The problem of lack of integration is also said to exist between other so-called technical areas of instruction and design, structures, acoustics and lighting, for example. A related, though less prevalent issue, is the concern amongst design staff that construction and other technical knowledge will overly prescribe or limit creative outcomes in the design studio.

Within the profession, there is a perception that graduates are generally ill prepared for productive employment and this often centres on a lack of ability in the area of construction documentation, in particular, the ability to produce construction drawings with minimum supervision. [7] While the profession may be unhappy with this situation, there is a general understanding that some responsibility for training in this area must be shared with the schools. In the quest for greater construction skill and knowledge amongst graduates, and therefore more usefulness, professional accreditation panels often make comments and suggestions as to how this might be achieved.

The problem of integrating construction knowledge into design studios is seemingly universal and there are constant attempts within the academy, sometimes the result of pressure from the profession, to improve how this is done. The *Journal of Architectural Education (JAE),* for example, has produced several issues focusing on the question of teaching technology. The most relevant of these to this discussion is Volume 51, Number 2, published in November 1997. Introducing the issue under the title "The Pedagogy of Architectural Technology," G. Goetz Schierle, from the University of Southern California states:

> The objective of this issue is to evoke a dialogue about the role of technology in architectural education and to present models of teaching technology. The articles include models ranging from studio and seminar formats to actual construction. The integration of technology in the design process is a central theme. Although this integration is critically important, so is a foundation of basic principles introduced in lectures or seminars – as prerequisites or co-requisites to the studio – to provide the rigor and depth required for effective integration. [8]

In approximately the middle of the introduction, which first outlines how "informed intuition about technology is essential for architects," to allow architecture to fill "human needs by technological means," Schierle states that:

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[7] Ken Maher, "The Educational Contexts of the Profession's Concerns," in Desley Luscombe and Steve King (eds), *Aspects of Quality in Australian Architectural Education*, Sydney: Royal Australian Institute of Architects, New South Wales Chapter, 1995, pg.17 – 28. Maher comments on the perception within the profession that graduates are "unfit for practice."

[8] G. Goetz Schierle, "The Pedagogy of Architectural Technology," *Journal of Architectural Education*, 51, 2 (November 1997): pg 82.

> Exploration of technical issues as part of the design studio described in the following articles, is of vital importance. This must be reinforced by rigorous presentation in lectures, with emphasis on approximate methods for advanced topics. To be relevant and inspiring, lectures must introduce basic concepts in the context of real problems, rather than as isolated items. Technology must be treated as integral to design, rather than as studio support only.[9]

The final paragraph of the introduction, after an outline of the papers in the issue, states:

> The articles introduce and discuss several approaches for integrating technology with design. It is hoped that they elicit similar programs in other schools. However, such integration should be in addition to, not instead of, structured introduction of a technology foundation as an integral component of the pedagogy of architectural technology.[10]

The two predominant themes to this introduction, that there should be separate (foundational) courses in technology and that the knowledge acquired in these must then be integrated into the design studio, are discussed in all the subsequent articles in the issue. In "Architecture, Technology, and Environment," for example, Donald Watson discusses the problems that occur when "design and technology are too widely separated in the architectural curriculum."[11] Watson challenges the notion that:

> design and technology can be separate realms of inquiry and curriculum format. Architectural learning is by its nature, integrative. It connects knowledge and imagination through exploration of form and articulation of issues, informed by the means of construction within a cultural and environmental context. The ultimate measure of a curriculum is how this knowledge and imagination are brought together.[12]

Watson stresses that his "discussion defines *technology* so that it is conceived of as *a part of* architecture, rather than *apart from* it."[13] One of the first ways he proposes for achieving this is through the use of "computer-based tools that make it possible to visualise and analyse technical implications simultaneously." These new "computer visualisation tools," enable "rapid iterations between idea and testing of technical alternatives before a design takes shape." "In view of these developments, any architectural curriculum that does not integrate design and

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[9] G. Goetz Schierle, "The Pedagogy of Architectural Technology," pg 82.

[10] G. Goetz Schierle, "The Pedagogy of Architectural Technology," pg 83.

[11] Donald Watson, "Architecture, Technology, and Environment," *Journal of Architectural Education*, 51, 2 (November 1997): pg. 119.

[12] Watson, "Architecture, Technology, and Environment," pg. 119.

[13] Watson, "Architecture, Technology, and Environment," pg. 119.

technological inquiry can be considered obsolete."[14] Lamenting both the lack of "technological content and competency in the curriculum," and "advanced innovation" in university-based technology research, Watson cites two reports. First the well known 1996 report into architectural education by Boyer and Mitgang[15] which in turn cites a 1992 Centre for Construction Innovation report as saying that: "the building industry as a whole is substantially behind the times, largely because of a lack of investment in research and development." And second, a 1995 National Academy of Sciences report that finds both architects and engineers leave school "with inadequate knowledge of technology." "The committee [impaneled to write the academy's report] believes ... that technology must be integrated into the design studios."[16]

Figuring out how to integrate technology into the design studio is a consistent theme through the six papers that form "The Pedagogy of Architectural Technology" issue of JAE. Proposals are wide ranging. Edward Allen from Yale, for example, suggests a Second Studio as a means of teaching technical skills. This is based on his perception that the "information carryover from classroom teaching into studio utilization is perhaps 20 percent for the best-taught technical course, whereas ... from as-needed studio lectures ... it is at least 70 percent." [17] He suggests replacing technical support courses in structures, materials and methods of construction, and environmental controls with a second technical studio that runs concurrently with the primary design studio. Both studios may, for example, be concerned with "form, space and light." The two studios would give different "design problems" but the second studio would "greatly increase the emphasis on the simultaneous design of the technical systems of the building. The teachers in the second studio are largely the more technically orientated people on the faculty. It is important, however, that they be designers rather than (or as well as) building scientists." Within this model Allen states that "the design problem is a powerful engine that furnishes the thrust and continuity of the class." [18] Technical teaching would be provided on an "as-needed basis" with an emphasis on "the selection and configuration of technical systems as integral components of the emerging architectural

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[14] Watson, "Architecture, Technology, and Environment," pg.120.

[15] Ernest L. Boyer and Lee Mitgang, *Building Community: A New Future for Architectural Education and Practice*, New Jersey: The Carnegie Foundation For the Advancement of Teaching, 1996.

[16] National Academy of Sciences Building Research Board, *Education of Architects and Engineers for Careers in Facility Design and Construction*, Washington DC: National Academy Press, 1995, pg. 51.

[17] Edward Allen, "Second Studio: A Model for Technical Teaching," *Journal of Architectural Education*, 51, 2 (November. 1997): pg. 92-95.

[18] Edward Allen, "Second Studio: A Model for Technical Teaching," pg. 92.

design."[19] Allen gives an example of a thirteen week second studio he has taught "in the design of wood structures." Students are asked to design a "small wood building" and are given "a fairly comprehensive course in the engineering of wood structures." "The architectural program is always a simple one that eliminates distractions and focuses attention on the structure."[20]

Another paper, "Intention, Form, and Execution: A Comprehensive Studio Curriculum," by Carl Bovill, Amy E. Gardner and Gregory Wiedemann from the University of Maryland outlines a similar course structure and curriculum content.[21] As the result of a major undergraduate and graduate curriculum revision "to integrate design and technical subject matters," two new studio courses were introduced. The first "ARCH 611, Comprehensive Design Studio, entails a semester-long project exploring the relationship between conceptual and technical aspects of architectural form and its assembly." The second, "ARCH 611, Advanced Technology, is a combination studio/lecture course that focuses on the integration of building systems through the same design project." The courses, which are taught concurrently, were awarded both a University of Maryland teaching award and a National Institute of Architecture Education Honours award in 1995. Both awards "recognise the integration of issues of architectural theory, design, practice, and teaching. This integration is at the core of issues critical to the relationship between intellectual, skill-related, and practical issues." Both courses, it seems were developed in response to concerns raised by the National Architectural Accrediting Board. One of its members, John Jeronimo is quoted as saying that, "lack of integration of technical and practical knowledge into design work is probably the single most widespread area of program weakness." The authors of Intention, Form, and Execution, claim that the "educational pedagogy of the courses begins to build a bridge between the theory and practice of architecture."[22]

Perhaps the most theorized of the papers in this issue is Patricia Kucker's, "Recognizing a (Fertile) Gap," republished in *Architectural Theory Review* Volume 5 Number 2.[23] While the

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[19] Edward Allen, "Second Studio: A Model for Technical Teaching," pg. 92.

[20] Edward Allen, "Second Studio: A Model for Technical Teaching," pg. 93. .

[21] Carl Bovill, Amy E. Gardner and Gregory Wiedemann, "Intention, Form, and Execution: A Comprehensive Studio Curriculum," *Journal of Architectural Education* 51, 2 (November. 1997): pg. 84-91.

[22] Bovill, Gardner and Wiedemann, "Intention, Form, and Execution," pg.84.

[23] Patricia Kucker, "Recognising the (Fertile) Gap," *Journal of Architectural Education*, 51, 2 (November. 1997): pg. 110-118. Also published in Architectural Theory Review, 5, 2 (November. 2000): pg. 61-71.

central concern of the paper remains how to "integrate issues of technology into the beginning design studio," Kucker's description of her teaching suggests that she attempts to reconfigure the relationship between construction and design. She states, for example, that: "the studio pedagogy proposes an understanding of building technology that is conceptual, malleable, and, most significantly, a generative aspect of the design process." And later, "the goal is to develop a conceptual thinking process that identifies structured relations of technology and construction that simultaneously work to broaden and enhance formal, mechanical, experiential, and aesthetic possibilities."[24] Kucker recognizes that integration will not happen without an attempt to understand the nature of the thinking involved in design and technical activities. The gap between them becomes the object of study and thus stimulates or is fertile to ideas concerning its transcendence. The studio, Kucker explains, "presents building technology and materials as constituent components of the art of architecture, and most significant, places these issues at the core of the foundation design student's exploration of form and space."[25]

In "Students Consider Architecture's Materiality," Kelly Carlson-Reddig also describes a more theorized course in building technology. "The objective of 'Intention and Materiality' is to work with students in developing critical frameworks for understanding certain 'ethical' issues affecting architecture's materiality."[26] Students read historical and theoretical texts, write, design and make things in an attempt to "explore the subject of materiality." Interestingly, the author states that this is "not intended as a substitute for technically oriented materials courses addressing more pragmatic structural and constructional issues."[27] Instead the course examines the distinction between the "separate realms of 'theory and practice'" in itself a principle cause of the problems of integration that exist between construction knowledge (theory) and design (practice). Carlson–Reddig claims "isolation of conceptual processes from cognizant projection of their materiality necessarily limits architecture's potential richness. Efforts to understand the distance and means of bridging between these interdependent aspects of the creative process can only result in their mutual enhancement."[28] Refreshingly, there is almost no discussion of integration. This course seems to stand aside from offering

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[24] Patricia Kucker, "Recognising the (Fertile) Gap," pg. 110.

[25] Patricia Kucker, "Recognising the (Fertile) Gap," pg. 116.

[26] Kelly Carlson-Reddig, "Students Consider Architecture's Materiality," *Journal of Architectural Education* 51, 2 (November. 1997): pg. 96.

[27] Kelly Carlson-Reddig, "Students Consider Architecture's Materiality," pg. 96

[28] Kelly Carlson-Reddig, "Students Consider Architecture's Materiality," pg. 103.

instrumental solutions to the problem, instead simply asking students to question the troubled relationship between theory and practice primarily by placing it in an historical context. The author concludes: "[w]hen students ruminate on materiality, they cross boundaries; they begin to integrate thought and action related to many facets of architectural knowledge."[29]

Theory and Practice

One of the reasons integrating construction knowledge into the design studio causes continual problems and is so hard to "fix" is that they are currently on different sides of a profound epistemological division, represented respectively by theory and practice. This division does not yield to the mostly instrumental solutions detailed in *JAE* that serve only to deepen it further. More construction teaching and more pressure to show evidence of it in the design studio are unlikely to have deep or lasting effects as they fail to deal with the underlying knowledge boundaries and quite different modes of thinking in each. In *The Reflective Practitioner*, Donald Schön points out how a professional education has, since it became part of the modern university in the early twentieth century, had embedded within it a structural and conceptual division between learning basic and applied science followed by "the skills of application to real-world problems of practice."[30] This division is clearly evident in the Education Policy of the AIA which divides the knowledge criteria that graduates must satisfy in each of the seven components of an undergraduate degree into "Awareness and Knowledge" followed by "Application and Synthesis." In an obvious reference to a mathematical and scientific model of knowledge, design is conceptualized as a problem that can be solved in the design studio through the integration of technical knowledge. A design can be made whole, or integrated, through the bringing together of knowledge learned in each component of an architectural education,

Schön refers to this conceptual and structural model of knowledge as Technical Rationality and suggests that the professions would not have secured a place in the science based university system without conforming to its epistemological foundation:

> According to the model of Technical Rationality - the view of professional knowledge which has most powerfully shaped our thinking about the professions and the institutional relations of research, education and practice - professional activity consists in instrumental problem solving made rigorous by the application of scientific theory and technique. Although all occupations are concerned, on this view, with the instrumental adjustment of means to ends, only the professions

[29] Kelly Carlson-Reddig, "Students Consider Architecture's Materiality," pg. 104.

[30] Donald Schön, The Reflective Practitioner, pg. 27.

> practice rigorous technical problem solving based on specialised scientific knowledge.[31]

The steady rise of a scientific and technological world-view since the early modern science of Galileo and Copernicus is of course well documented and need not be recounted here. It is worth noting briefly, however, that it was its centrality to the philosophy of the Vienna Circle Positivists that had such a direct influence on the foundational structure of modern universities. The Positivists held that:

> The only significant statements about the world were those based on empirical observation, and all disagreements about the world could be resolved, in principle, by reference to observable facts. Propositions which were neither analytically nor empirically testable were held to have no meaning at all. They were dismissed as emotive utterance, poetry, or mere nonsense.[32]

Schön points out that for the Positivists, "practice appeared as a puzzling anomaly. Practical knowledge exists, but does not fit neatly into Positivist categories. We cannot readily treat it as a form of descriptive knowledge of the world, nor can we reduce it to the analytic schemas of logic and mathematics."[33] This created a problem, for it was the professions that were "seen as the vehicles for the application of the new sciences to the achievement of human progress."[34] Their newfound status within the university system depended on the legitimization of practical knowledge and this was solved by construing it as "knowledge of the relationship of means to ends. Given agreement about ends, the question, 'How ought I to act?' could be reduced to a merely instrumental question about the means best suited to achieve one's ends."[35] Any disagreements about the appropriate instrumental means could ultimately be decided by recourse to scientific experiment. Perhaps the professions most dramatically successful in "reliably adjusting means to ends," were medicine and engineering. The diagnosis and treatment of disease and the calculation of structures "became prototypes of the science-based, technical practice which was destined to supplant craft and artistry" which had no place in "rigorous practical knowledge."[36]

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[31] Donald Schön, The Reflective Practitioner, pg. 21.

[32] Donald Schön, The Reflective Practitioner, pg. 33.

[33] Donald Schön, The Reflective Practitioner, pg. 33.

[34] Donald Schön, The Reflective Practitioner, pg. 31.

[35] Donald Schön, The Reflective Practitioner, pg. 33.

[36] Donald Schön, The Reflective Practitioner, pg. 34.

Throughout much of the twentieth century, in many schools of architecture, the heart of the technical, theoretical stream was literally the building science laboratory. The laboratory was the symbolic place of scientific rigor and experimentation; in some schools this is still probably the case. In the dominant view of that time, building technologies, the means of achieving architectural ends, were conceived as the literal manifestation, or result of, scientific experimentation and calculation. In the case of the many building technologies that existed before this time, laboratory testing for strength, fire resistance and so on, became a means of legitimizing their use in contemporary design. There was a sense that eventually building scientists would be instrumental in developing new materials and building systems to replace traditional techniques, thus reifying the rupture with history advocated by proponents of modernism. These technical systems were to be applied to design problems in the studio. The de-centering of building science from the curricula of many schools of architecture in the late twentieth century would seem to indicate that the Positivist, techno-rational model of professional education based on the instrumental application of scientific and technical knowledge is no longer in place. It would be tempting to believe that it had been replaced with a new model based on Schön's attempts to point out the limitations of instrumental thinking and to legitimize practical (design) knowledge with its ability to deal with the often confusing, unstable and unique challenges that face the practitioner. Yet the problems of integrating technical knowledge into design projects persist and some of this at least must be attributed to an inability to reconceive technical knowledge in a way that allows it to permeate design studio boundaries.

Since Schön wrote the *Reflective Practitioner* in the early nineteen eighties it is arguable that, in step with the world outside university, rather than dissipating, techno-rational thinking has firmed its hold within schools of architecture. The commodification of education has defined graduates more and more as products who must be immediately employable and useful to the profession, and prospective students often make their choice of study based on their perceived future employability and earning capacity. To achieve this, schools must more clearly define educational outcomes in instrumental terms. In relation to construction knowledge, for example, graduates are more useful in practice if they are familiar with current industrial products and their conventional uses. While on the face of it this would seem perfectly reasonable, the uncritical application of industrial systems to a design project limits the possibility of material invention and innovation. As David Leatherbarrow points out:

> the appropriation of premade elements reduces opportunities for originality and particularity in design and specification. Moreover, this practice disguises the lack of connection between the work of building and the social and political practices that typify a given place, meaning that the cultural memory attendant to the act of building is eclipsed as well.[37]

In addition, Dalibor Vesely writes, "[t]here is a strong feeling that the multitudinous traditional ways of making and creativity are slowly being absorbed into one dominant way of making and thinking."[38] Vesely argues that while "some awareness of the distinction between invention, creativity and pure production remains, it is no longer clear how this distinction should be established."[39] In architecture as in many other areas, the dominance of "technical (instrumental) thinking" reduces debate to "the merit of technical efficiency versus that of aesthetics."[40] The shallowness of this debate, the reduction of design to aesthetics and construction to technical/instrumental means is a serious problem for the profession and represents a forgetting of complex issues such as dwelling, ethics and cultural and symbolic meaning. In *Uncommon Ground*, Leatherbarrow clearly articulates this in relation to the use of premade, industrially produced building materials and elements that are usually not designed by architects but by product designers. And as Adrian Snodgrass points out, while it is difficult to justify turning away from this techno-rational mode of practice where "theory becomes the handmaiden of quantification, and aims for the attainment of quantifiable results,"[41] it is worth considering in relation to the perceived problem of students' inability to integrate technical, theoretical knowledge into their designs in the design studio.

Theoria and Praxis

It would seem that the current problems of integrating construction and other technical knowledge into design are the manifestation of much deeper issues and cannot be successfully dealt with through structural or instrumental means alone. How then are we to reconceive construction knowledge in a manner that makes it truly enabling in the design studio? If we adopt a Heideggerian view, taking action without proper questioning only exacerbates or more firmly entangles us in an instrumental and technological worldview.

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[37] David Leatherbarrow, *Uncommon Ground: Architecture, Technology, and Topography*, Cambridge, The MIT Press, 2000, pg. 123.

[38] Dalibor Vesely, "Architecture and the Question of Technology," in Martin Pearce and Maggie Toy, (eds). *Educating Architects*, London: Academy Editions, 1993, pg.44.

[39] Dalibor Vesely, "Architecture and the Question of Technology," pg.44.

[40] Dalibor Vesely, "Architecture and the Question of Technology," pg.44.

[41] Snodgrass, "On 'Theorising Architectural Education,'" pg. 91.

Insisting students know more about industrially produced building products and systems not only limits material innovation and creativity, but it assumes that these products are made ethically, that is without unduly damaging the environment or the people involved in their production. According to Heidegger, this kind of thinking is profoundly technological.[42] We reduce the value of all things to that of a resource, or standing reserve available to be called forth for our use. We give little thought to the environmental consequences of this kind of production and are incapable of understanding our world other than as a source of materials with which to better our physical well-being.

Perhaps a good place to start reconceiving construction theory would be to consider the ancient Greek origin and meanings of theory and practice. According to Snodgrass, *praxis*, the Greek root of practice, did not mean "the application in action of rules provided in advance by theory,"[43] as it does today. What we understand as practice the Greeks called "*techne,* which is the making of something in accordance with *episteme*, 'knowledge,' and more specifically, knowledge that is consciously known, and can be directly communicated to others."[44] *Techne* was the "application of *episteme* in an act of producing something that answers to a pre-scribed need." The relationship of "*episteme* to *techne* is thus close to that which is now commonly ascribed to 'theory' and 'practice.'"[45] For the Greeks, *praxis* was not simply the means to achieve ends. Rather, it was an "activity involving judgment"[46] based on ethical decisions. *Praxis* embodies the notion that practical decisions affect others and this must be taken into account. In the techno-rational model of professional education, the scientific and technological knowledge that supposedly forms its theoretical basis is based on experimentation, calculation and empirical data and thus has no ethical dimension. Putting it into practice is more a process of technical problem solving than ethical design.

The Greeks also had a different understanding of *theoria* the root of theory. "For the Greeks *theoria* is not something that precedes *praxis*, nor is it the repository of the rules and

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[42] Martin Heidegger, "The Question Concerning Technology," in *The Question Concerning Technology and Other Essays*, trans. William Lovitt (New York: Harper and Row, 1977), pg. 4-35.

[43] Snodgrass, "On 'Theorising Architectural Education,'" pg. 89.

[44] Snodgrass, "On 'Theorising Architectural Education,'" pg. 89.

[45] Snodgrass, "On 'Theorising Architectural Education,'" pg. 89.

[46] Snodgrass, "On 'Theorising Architectural Education,'" pg. 90

principles governing action. It is, rather, a participation in practice."[47] Snodgrass refers to Gadamer who points out that the Greek word:

> *theoria* comes from *thoros*, 'spectator.' The 'spectators' were a delegation sent to a festival honouring the gods. These spectators were not merely onlookers, but took part and shared in the event. The spectators, the theorists, were participants in the rituals, and could attest to their efficacy by having taken part in them and directly experienced them.[48]

The key difference between *theoria* and theory in its modern techno-rational sense, is that "theoria did not stand apart from praxis, but participate[d] in it."[49] This kind of theoretical participation in practice is hard to achieve today because of the epistemological distance between technical knowledge based on experimentation, calculation and quantification and practice or design which at its best must deal with "complexity, uncertainty, instability, uniqueness, and value conflicts."[50] At its worst, a design may be technically competent (competent in *techne*), construction and structure for example, but, to use another Greek concept, fail to address the much larger reality of *poiesis*, poetic making, of which techne is a small part.

Snodgrass goes on to describe how the "much-maligned design studio" is a place where "remnants of *praxis* and *theoria* still exist," despite the fact that "theory and practice in the techno-rational kenning of those terms, now have almost total hegemony in our universities."[51] While the design studio does serve as a site for hermeneutical dialogue between student and tutor that is capable of transcending techno-rational constraints, it is less clear how effectively it transforms technical construction knowledge (*episteme*) into theoretical knowledge (*theoria*) that can participate in the design process. For this to happen, construction must be properly theorized and questioned, not by adding to the already large quantity of scientifically derived technical information, but in the sense of opening construction to questions of ethics, politics, philosophy, dwelling and culture. It seems clear, as Snodgrass points out, that making design

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[47] Snodgrass, "On 'Theorising Architectural Education,'" pg. 90.

[48] Snodgrass, "On 'Theorising Architectural Education,'" pg. 90.

[49] Snodgrass, "On 'Theorising Architectural Education,'" pg. 90.

[50] Donald Schön, The Reflective Practitioner, pg. 14. Schön is discussing the crisis of confidence in the professions brought about by the inability of technical experts to deal with complex situations of practice.

[51] Snodgrass, "On 'Theorising Architectural Education,'" pg. 91.

choices that are "ingrained with an understanding of responsibility and social solidarity," are not going to "come from the techno-rational approaches to pedagogy."[52]

Conclusion

It is extremely difficult to question the prevailing techno-rational approach to teaching construction. There is deep suspicion of any non-instrumental analysis or exploration of the topic based on fear that it will further erode the status of architecture in the university system and ultimately the profession as well. As a result, construction is generally still taught in a technical and instrumental fashion, that is, as a set of neutral tools that can be applied to a design independently conceived in the design studio. The problem of students not knowing how to "integrate" construction knowledge into their design studio projects is therefore usually "fixed" by providing more construction teaching and more assessable construction content in design. Attempts to make construction knowledge more useful, relevant or receivable by placing it in an historical, cultural, social, or philosophical context, to which the earlier version of the RAIA Education Policy tantalizingly alludes, are rare. Without the theorizing and questioning this generates, it will be difficult to transform construction knowledge in a way that promotes its participation in the design studio.

[52] Snodgrass, "On 'Theorising Architectural Education,'" pg. 92.

THE IMAGINATION OF CONSTRUCTION
Teaching and Constructing Lightness

Fig. 3.1 Stone Wall Detail of House in Adelaide, (2002)
Photo: Sam Ridgway

Introduction

The current division between design and construction in both the architectural profession and the academy makes it unusual to hear the word imagination used in relation to construction. Creativity and imagination are more commonly associated with design, and construction with technical proficiency, extensive knowledge of building products and economic level headedness. In schools and the profession, construction knowledge is generally applied in an instrumental fashion to designs conceived in the design studio or the director's office. Materials and techniques of construction are considered to be neutral objects and systems from which buildings are assembled and there is a tendency to rely heavily on product manufacturers to provide technical advice regarding standard detailing. In the case of large building projects the

builder is often asked to suggest materials and techniques that will achieve a result that resembles the drawings but offers substantial cost savings. It is arguable however, that the current dissatisfaction with architecture and with architects has as much to do with construction as with design. Modernism's obsession with the neutrality, universality and instrumentality of materials still haunts the profession and must in part be attributed to the way construction is taught in schools of architecture. Despite clear alternatives, construction teaching generally encourages the acquisition of technical skills demonstrated through drawing that must be then transferred or translated into the design studio. However the drawing forth of an alternative pedagogy that revitalises the imagination of construction requires us to address its current under-theorisation.

Over the past twenty five-years, Marco Frascari has played a major role in challenging the rational and instrumental view of architectural construction. Instead, he seeks to articulate an alternative understanding, grounded in the philosophy of technology that reveals materials and construction techniques to be culturally embedded and profoundly ontological. Perhaps the best-known example of this is "The Tell-the-Tale Detail,"[1] a phenomenological exploration of the role of architectural details published in 1984. Influenced by his early professional and teaching experience with Carlo Scarpa, this article was written in part as a means of introducing the idea that construction embodies the fundamental meanings of architecture, into the design studio at the University of Pennsylvania. A subsequent article, "The *Lume Materiale* in the Architecture of Venice,"[2] published in 1988, explores the spiritual dimension of construction by focusing on the Venetian phenomenon of *Lume Materiale*, literally "material light." These two articles have been crucial to the development of a less instrumental mode of construction teaching and to re-thinking the relationship between construction and design both in the design studio and in practice. It is no longer possible for me to objectify the materials and techniques of building but to see them only as extensions or revelations of our complex human nature. Embracing this view begins to distance construction and design from the realm of fashion and commodification and opens it to engage with issues of architectural technology in the widest sense of the term. This chapter outlines the central role Frascari's deliberations on *Lume Materiale* has played in both the development of an introductory construction course for students of architecture and the design of a small house in suburban Adelaide. In both, the aim

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[1] Marco Frascari, "The Tell-The-Tale Detail", *Via,* 7 (1984), 22-37.

[2] Marco Frascari, "The *Lume Materiale* in the Architecture of Venice", *Perspecta,* 24 (1988), 137-145.

has been to emphasise the important architectural objective of embodying the intangible in the tangible.

Teaching Lightness

My interest in reconceiving the currently dominant, instrumental mode of construction teaching began with research towards a Masters[3] degree during the early nineties that transformed my naïve desire to create an industrialised building system into a deeply sceptical, Heideggerian critique of these systems. My conclusion, that they represented the possible annihilation of much that is good in architecture, led me to question an architectural education that still nurtured the possibility of such technological utopias. Despite the spectacular demise of modernism and the subsequent loss of status afforded to the architectural profession, due in large part to the failings of its physical fabric, in our School, and I suspect in many others, construction was still being taught at that time in an untheorized and instrumental fashion as a set of neutral materials and techniques that could be applied to designs conceived independently in the design studio. The bifurcation of teaching into matters of design: creativity, innovation and imagination; and matters of construction: knowledge of building products, construction techniques and structures, was profound. This was reinforced by a major restructuring of the program from one five-year professional degree into two, three-year undergraduate degrees, the first dealing with theory the second with practice. This was later changed to a three plus two-year structure. Construction knowledge was largely untheorized and lacked historical, cultural, social or philosophical context. There was an understanding that construction should be taught in a linear, technical and encyclopaedic fashion starting with so-called "simple" building techniques, domestic timber framing for example, and progress to more technically complicated buildings. The notion that construction could play a generative role in design or that the material embodiment of design ideas held the key to their meaningful presence was not on the agenda.

In the mid-nineties I was appointed to the School and given the task of teaching our first-year, introductory course in construction. My aim was to theorize this knowledge so that it would become part of the way students think about design rather than a separate and technical category of skills that must be then integrated into the design studio. In this way I hoped to move considerations of materiality and corporeality from the periphery of architectural imagination (and pedagogy) to the core and to provide a means of augmenting the traditional

[3] Sam Ridgway, "The Factory-Made House: A Critique of Factory-Made Houses from the Early Twentieth Century with Reference to the Philosophy of Technology," Master of Architecture Thesis, The University of Adelaide, March 1995.

method of conceiving a building through attention to form and plan only. While the worthy goal of increasing students' knowledge in this area is common, it is usually implemented in an instrumental fashion resulting in more courses and more assessable construction content in studio projects. My approach, by contrast, was to address the supposed neutrality of materials and building techniques. Somewhat paradoxically for a course focusing on the materials of architecture, this meant beginning with theoretical texts rather than with simple building techniques, something that some of my colleagues found quite alarming. Starting with texts however, provides a very different entry point for instruction in construction, signaling that "basic" knowledge is an understanding that construction embodies significant meaning. Texts provide an immediate antidote, for example, to the facile notion that discourse concerning architectural production can be reduced to what Dalibor Vesely has described as "the merit of technical efficiency versus that of aesthetics".[4] One of the most effective pieces of writing I have found to introduce an alternative understanding of architecture's material nature to students is Marco Frascari's article "The *Lume Materiale* in the Architecture of Venice."

Published in 1988, "*Lume Materiale*" describes a phenomenological construing or interpretation of the materials of architecture, where as Frascari writes: "stones change themselves in light through architecture and architecture exists because of light." This "ontological storytelling of architectural events," depicts a method of constructing buildings from "palpable material light," (*lume materiale*), "something born in the materials of construction and imprisoned in the body of an edifice as the mind is imprisoned in the body." "A tangible essence of architecture which can be used as a touchstone for the discovery of the true nature of the substances composing a constructed world."[5] The poetic core of this article is developed from the truism that without light there is effectively no architecture and without architecture there is no light. "A mound of stones, a splendid Venetian home, a wonderful Byzantine dome, and the most extraordinary Greek temple are the same inert matter without light. Conversely, there is no light without the architectural material which makes up the constructed world."[6] Frascari's story about light as a building material centres on the Ca'Dario a Venetian Palace built by the diplomat Giovanni Dario between 1487 and 1497 (Fig. 3.2). In an inscription on the facade Dario dedicates the building to "the genius of the city" (*Urbis Genio*) thus defining it as a

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[4] Dalibor Vesely, "Architecture and the Question of Technology", In *Educating Architects*, ed. by Martin Pearce and Maggie Toy (London: Academy Editions, 1995), pg. 44.

[5] Marco Frascari, "The *Lume Materiale*", pg. 138.

[6] Marco Frascari, "The *Lume Materiale*", pg. 138.

celebration of the city rather than as a personal aggrandisement. Frascari reveals the importance of place and culture in his story about building with light by quoting a Byzantine inscription taken from the Archbishopric Chapel in Ravenna, "Light is either born here, or imprisoned, reigns here in freedom." This enigmatic inscription can be interpreted to mean that all cultures build light into their architecture differently through the use of colour, shadow, overhangs, ornament, weatherings, detailing, composition of facades, use of light reflecting or absorbing materials, interior day lighting, sun penetration, and so on. When cultures mix, as they do in Venice, Ravenna and Adelaide, architecture begins to embody this diverse revelation of *lume materiale*. It does not matter whether it is local or imported, once built-in it "reigns ... in freedom." In relation to the Ca'Dario, Frascari points out that it is a "hybrid — or 'monstrous' — building ... a combination of bold, Gothic elements, Tuscan traditions, Lombardic decorations, and Byzantine memories ... Ca'Dario is an expression of the multi-faceted culture of Venice ... an extraordinary hybrid that combines the architecture of the West and the East with the influences of Greece and Rome".[7] The article goes on to describe in detail several of the key features of the Ca'Dario including the circular stone and Venetian glass patens that "can imprison light" and the "maternal" marble skin of the upper storey made of reused *gallio antico*, a yellow marble from Numidia. In relation to these details Frascari writes that, "*lume materiale* ... is a rich substance producing a tangible built poetry out of elemental knowledge."[8]

Fig. 3.2 Ca'Dario
(Photo: Mathieu Blais)

[7] Marco Frascari, "The *Lume Materiale*", pg. 140.

[8] Marco Frascari, "The *Lume Materiale*", pg. 141.

In the context of the discussion of theorizing construction knowledge in Chapter Three, my construction course established itself as equally concerned with theory and with practice. The four journal articles that for the last several years have been the required reading for the course, of which "The *Lume Materiale"* is one, immediately establish that this is not theory in the current techno-rational sense of theory providing rules in advance of practical action.[9] Rather, it is in the ancient Greek sense of the pairing of *theoria* and *praxis*. As discussed in the previous chapter, Adrian Snodgrass points out in his article, "On Theorising Architectural Education," that for the Greeks, *theoria* did "not precede or stand apart from *praxis* but participated in it." [10] Proposing an alternative to technical construction theory based on experimentation, calculation and quantification and instead reconceiving theory in the mode of *theoria*, as construction knowledge that can participate in the design process, is the crucial and distinguishing aim of this course. Bringing to the fore the phenomenological and ontological nature of making buildings allows practical knowledge to directly inform the design process.

"The *Lume Materiale*," offers a wonderfully elegant means of allowing construction knowledge to transcend the prevailing impasse created by instrumental thinking and to participate in design. The collective revelation that beginning construction students have when reading and presenting this article during tutorial sessions is that there is, for them, a quite new and exciting way of conceiving the material presence of a building *in* and *of* light. While they often find the writing difficult, this in itself makes the eventual understandings more lasting and more influential. Its poetic and multi-layered nature allows students to work at many different levels, from issues of interior day lighting, to matters of colour, reflectance and shadows, to the more complex notion of the cultural specificity of *lume materiale*. The uniquely architectural nature of the building knowledge this article reveals, the fact that "architecture is co-existent with light," and that an "architectural presence exerts itself" through light, ingeniously correlates theory and practice. Students naturally translate theoretical notions into practical construction decisions; there is no boundary between construction knowledge and the design process. Further, students are unavoidably confronted with one of the most fundamental and continually evolving but often elusive tasks of our profession, that of embodying the intangible in built form. Frascari, for example, refers to the transformative process of spinning molten glass on a wheel

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[9] The other three journal articles are: Robert Meagher, "*Techné*", *Perspecta,* 24, (1988), 158-164; Marco Frascari, "The Tell-The-Tale Detail", *Via,* 7, (1984), 22-37; David Leatherbarrow and Mohsen Mostafavi, "On Weathering: A New Surface Out of the Tracks of Time", *Daidalos,* 43 (1992), 116-123.

[10] Adrian Snodgrass, "On Theorising Architectural Education", *Architectural Theory Review* Vol.5 No.2, (2000), 89-93 (pg. 90).

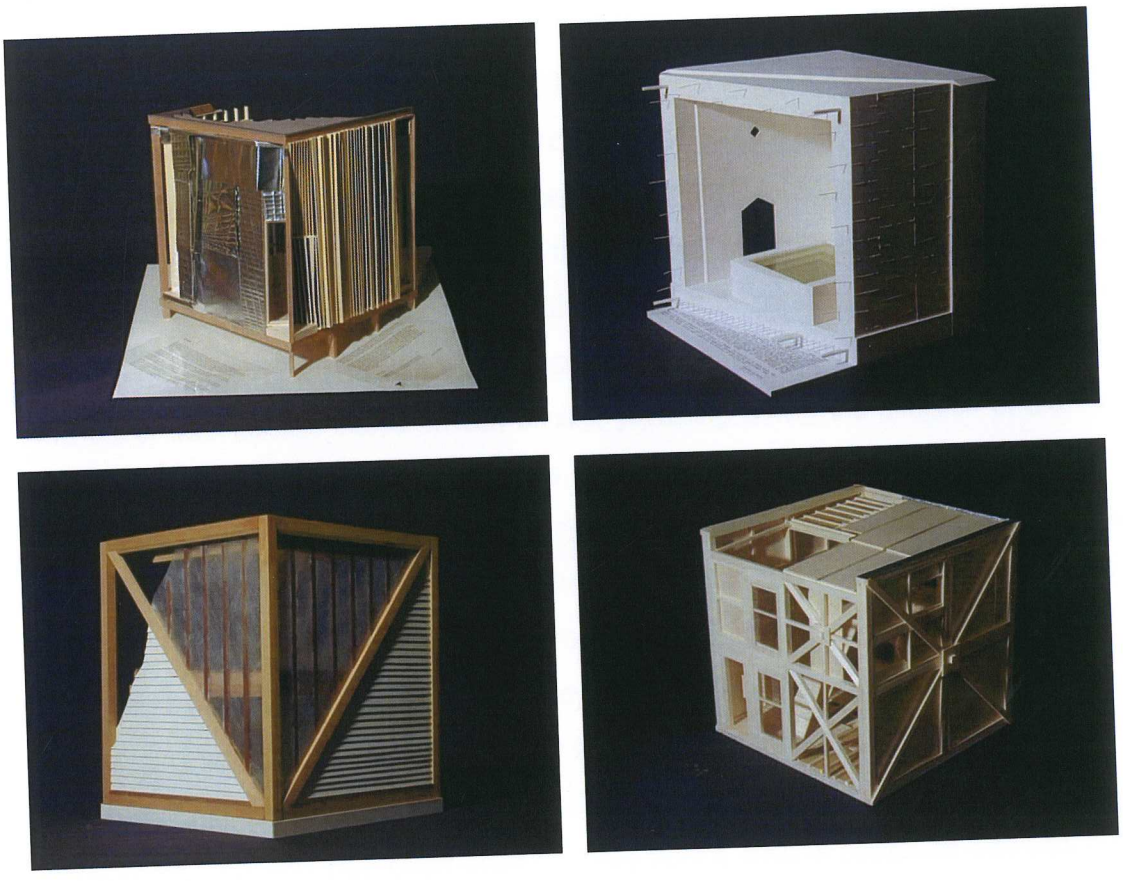
to make the circular patens that are embedded in the façade of the Ca'Dario as the casting "of a new tectonic figure" that perspicuously presents the colloidal nature of glass. These thick coloured glass elements participate actively in the "giant marble puzzle" of the building'" façade, literally trapping light and making it a "material of construction." The explicit nature of this example leads to further insights as to how other materials, details and elements, both on the façade of the Ca'Dario and other buildings, "are defined by a piercing light, which engraves their lines and sublimates them to a symbol of repose, certitude and solemnity".[11]

The major project for the course requires students to perform the seemingly paradoxical task of *designing* a *construction* that exemplifies or reveals some aspect of the theoretical material they are working with. In particular, this means an exploration of light, weathering, detailing or techné. Because all the articles are presented and discussed in tutorial groups there is often a significant cross over between the theoretical interests revealed through each model. The project is to design the construction of a 6x6x6 metre cube building and to make a model of this at the scale of 1:20 [Fig. 3.3]. This is inspired by and loosely adapted from the Cooper Union cube exercises under John Hejduk and is assessed according to how it resolves and reveals programmatic, theoretical and construction knowledge. Importantly, for the beginning student, the strict size requirement of the model removes complicated formal and planning deliberations, allowing them to focus primarily on construction. Form recedes as a background against which materiality can show up. A similarity does exist with the original exercise and that is that the form and size of the building, smaller by 40%, tends to prescribe its possible uses. Too small for a house, its simple volume is usually quickly conceived by students as a retreat, library, music room and so on. As a challenge to students to think about the relation of place and building, the constructions are site specific, the design and modeling of which is the first exercise of the course. Importantly, "The *Lume Materiale*" offers a profoundly phenomenological interpretation of Venice as the cultural, urban, luminous and ontological place of the Ca'Dario. Frascari explains that in both painting and construction, "the Venetians rejected the search for a rationalization of site in favor of a phenomenology of site".[12] A positivist interpretation of the use of the yellow Numidian marble on the building's façade, probably pillaged from sites around Venice, for example, would be that it was due to issues of site access, limited space, distance from the quarry and cost. A phenomenological interpretation might be that it was the consequence of the Venetian understanding of the

[11] Marco Frascari, "The *Lume Materiale*", pg. 143.

[12] Marco Frascari, "The *Lume Materiale*", pg. 144.

"maternal" nature of weathered materials in the construction of a marble "*cosmesis*" to cover bare brick walls. Frascari's text is a good example of how this student project tries to distinguish itself from the notion of "homogenous space as the place of modernity" referred to by Pérez-Gómez in his introduction to the reissue of the *Education of an Architect*. This construction course attempts to begin the education of students into "someone who knows where he or she stands, becoming responsible for a personal *making* in view of the dilemmas of contemporary culture, understanding *why* one makes (and *what* one accepts as an ethical task), and not only how".[13]



[13] Alberto Pérez-Gómez, "Education of an Architect: Unravelling a point of View, 1999", introductory essay to the reissued original exhibition catalogue, *Education of an Architect: A Point of View The Cooper Union School of Art & Architecture 1964-1971*, (New York: The Montacelli Press, 1999), pg.14-19.

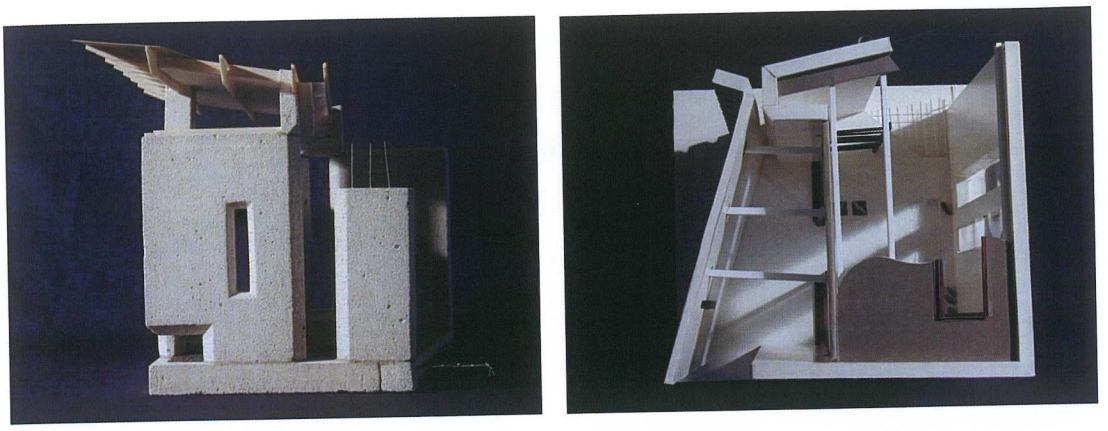


Fig. 3.3 First-Year Construction Models
Photos: Oliver Schulz

Constructing Lightness

It is in the context of devising and teaching this course that I began conceiving the design of a house for my wife and I to live in situated on a small suburban site in Adelaide. Listening to student presentations of "The *Lume Materiale"* in tutorial sessions over several years, helping tease out issues and bring the discussion back to local architectural examples, I developed a deeper understanding and appreciation of this phenomenological interpretation of light. The starting point that makes this building possible is an attempt to understand the site in terms other than the purely rational, in particular to interpret and reveal the local light conditions. In practice, it is extremely difficult to step outside a rational interpretation of site. Much of our training leads us to read sites in terms of what can be measured and calculated: orientation, dimensions, solar access based on sun angles, prevailing winds, the direction of the best views, vehicle and pedestrian access points, slope of the land and so on. Sites are also economically rationalised and the buildings designed for them conceived as commodities, the dollar value of which is known in advance of their construction. It is almost impossible not to be drawn into this cycle of commodification by producing a design that satisfies the client and the lending institution that they will get their money back when the building is sold. As architects, however, it is worthwhile contemplating how to introduce a non-instrumental reading of site phenomena into our design process that distinguishes what we do from other design professionals. This may help divert attention away from a shallow obsession with economic value only, and more successfully deal with issues of dwelling on the earth in a specific place.

From the beginning I was drawn to the site partly because of its wonderful light, especially the late afternoon, golden light that streams from the west and is particularly striking because of the site's elevation and its proximity to the nearby Adelaide Hills. While a detailed discussion of place is beyond the scope of this chapter it is worth noting that the building, in

particular its western stone wall was constructed to embody and reveal the particular local light conditions as a background against which the practices of habitation are played out. Of course it is difficult to counter the claim that it is merely pushing itself and the phenomena of the site forward in the modern sense as spectacle. It is true that it reveals the movement of the sun throughout the day and the passage of the seasonal light conditions more explicitly than a traditional house. In Heideggerian terms, however, this disclosive characteristic is "primordial" in nature. In other words, it "discloses the embodied understanding that we already have of things in the world.[14] As Frascari writes in the *Lume Materiale*: "[t]his palpable material light, however, is free to express itself, and rules the construing of architectural events posited by the material resolution of elements and the detailing of construction".[15]

As I lived nearby during the design and construction period, I visited the site often and I began to conceive the building in terms of both technical practicalities and in response to the light conditions. The initial design concept was simply to develop two, two-storey masonry facades, one to the west and one to the east that would contain and protect a more delicate, timber framed and timber clad body from the prevailing weather. The timber body is quite open to the north and therefore penetrated deeply by the winter sun. There is also a high degree of cross ventilation in the north south direction. The masonry was both a response to the suburban context of the building but also, especially in the western façade, a means of developing a paradoxical lightness. That is to create a "light construction" using heavy materials thus highlighting the true, joyful nature of lightness. This is in contrast to the current inexorable move towards lightweight buildings. To quote Frascari:

> [t]he prevailing commonplace – a theoretical doxa – is that constructions are increasingly becoming lighter. However, it is just an illusion of lightness since buildings present heavy and distressing inenarrable tales. Consequently a gentle image of architecture, an idealized tale of joyfully, lightly-conceived architectural bodies and images, is no longer the paradoxical motor of successful and delightful structures.[16]

I always imagined that the western façade facing the street and the western light would be made of stone. While all materials are revealed and transformed in light, to me, there is a special affinity between stone and light. Stone is a natural material, literally pieces of the planet

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[14] Glen Hill, "Out of Place in the Landscape: Questioning the Rhetoric of Place", In *Additions to Architectural History*, XIXth conference of the Society of Architectural Historians, Australia and New Zealand, Brisbane, (2002).

[15] Marco Frascari, "The *Lume Materiale*", pg. 137.

[16] Marco Frascari, "A Light, Six-Sided, Paradoxical Fight," *Nexus Network Journal*, 4 No. 2, (2002), 1-11. <http://www.nexusjournal.com/Frascari_v4n2.html> [accessed 7 March 2006].

that have been quarried and shaped to reveal an inner substance. Standing up a wall of stone to the light and the sun is a primal act of dwelling on the earth as much as it fulfils the need to suitably clad a suburban house. Initially, this wall was to be large blocks of purple sandstone from Macclesfield in the Adelaide Hills but this material is extremely soft and I was concerned that it did not reflect enough light. I turned therefore to a honey-coloured sandstone from Basket Range in the Adelaide Hills that had traditionally been used in houses around Adelaide for many years. The concept was still to simply cut large blocks of stone, to try to get as much colour variation as possible and to randomly lay the blocks so that the eye would be drawn to the detail of the wall as much as to its entirety. I realized later that even such a simple idea about colour variation was problematic because, as I soon learned, the stone supply industry is geared to providing as uniform (neutral) a product as possible.

Fig. 3.4 Design Sketches, Working Model and Sample Stone Blocks

Drawings and Photos: Sam Ridgway

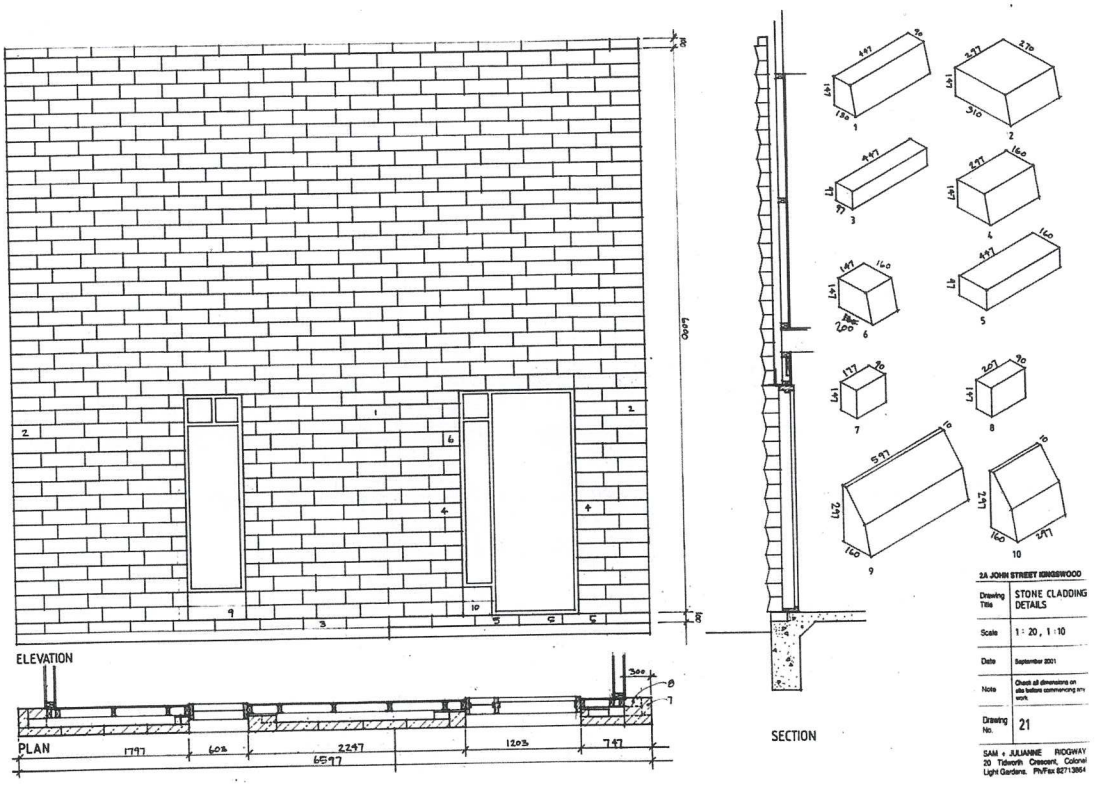

Fig. 3.5 Final, Working Drawing of Stone Façade.

Drawing: Sam Ridgway

When the time came to finally resolve the stone detailing of the western elevation, a concern I had about the scale of the blocks being too large for the building and the street encouraged me to rethink this elevation. I realized that I could enhance the light effects on the wall without creating a direct reference to classical or traditional buildings. I wanted the building to face the future and make a stand against the inane sprawl of poor quality, high energy, reproduction buildings that are appearing all over suburban Adelaide. I made a quick cardboard model and was excited with the results. I realised immediately that there was a way of achieving this detail by using a variation of an existing stone cutting technique. In relation to the reuse of stone elements in the Ca'Dario pillaged from abandoned sites around Venice, Frascari suggests that they were transformed "by technical operations proper to stone work, producing tectonic figures of wonder and ingenious variety in contrast to the purely functional aspects of the built artefact".[17] Of course fifteenth-century Venice is different to twenty-first century Adelaide, but never the less I felt that somehow this idea had translated itself across time and was capable of creating something that was very forward looking and site specific but still powerfully connected to the past. The stone for the Ca'Dario would have been cut and shaped with

[17] Marco Frascari, "The *Lume Materiale*", pg. 141.

traditional hand tools, but nowadays stone is cut primarily using water lubricated, diamond tipped oscillating and circular saws. Using these saws, it is relatively easy to cut one face of a block on an angle, either by adjusting the saw blade, or by sitting each block in an angled jig and then running it through the saw. Despite this, because it stepped outside the current practice of the cutting yard that specialised in producing reproduction facades for new houses, it caused many problems and delays.

Reflecting on this construction, I am reminded of Carlo Scarpa's statement quoted by Frascari in The Tell-the-Tale Detail that, "in architecture, there is no such thing as a good idea. There is only expression".[18] I wondered what the "expression" of this wall would be and how it would be received by the neighbourhood. I was worried that it was "a good idea" only and that its "paradoxical lightness would in fact be "inenarrable." These fears receded when I travelled to the stone cutting yard to look at the samples and knew immediately that the idea and the expression were sound. This was confirmed on the exciting day when the first 5 courses of blocks were laid. Most people understand immediately that it has something to do with light. Others see it as ripples on water; one asked if it was to become a waterfall. Several have thought the façade was made of timber which having been through the dramas and difficulties of making it out of stone initially astonished me but on reflection I welcomed this interpretation as part of a rich process of signification.

Conclusion

In this chapter I have concentrated only on a story about light. Simply put, the building and the construction course I have described reveal my attempts to stand against the prevailing technological view of building; to step aside from the off-the-shelf mentality where we are expected to create something original and creative from building products designed by product designers not architects. It is my response to the fact that we dwell on the earth in a specific location within a moving universe and it brings a critical perspective to the simplistic notion that lightweight buildings are light buildings. Most of all it is an attempt to make a joyful, serene building and to teach a construction course that faces the future while acknowledging a rich architectural past.

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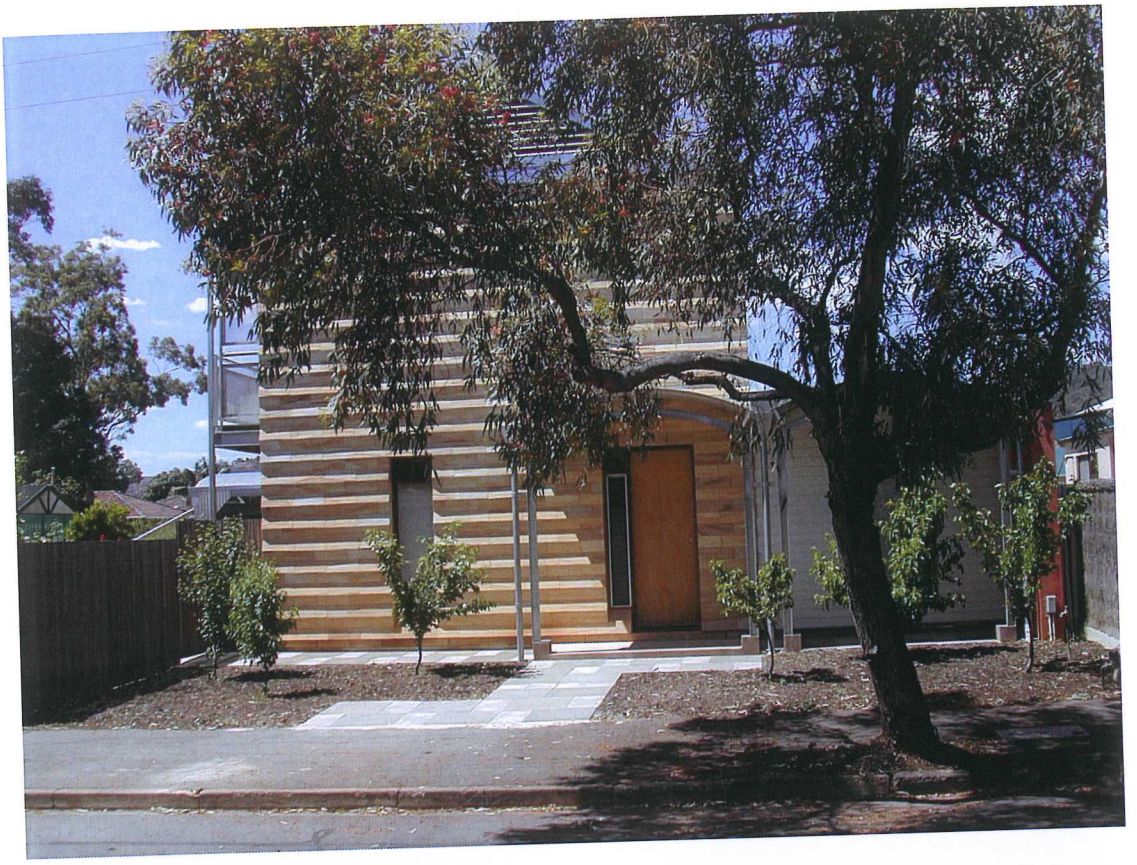
[18] Marco Frascari, "The Tell-The-Tale Detail", pg. 29.



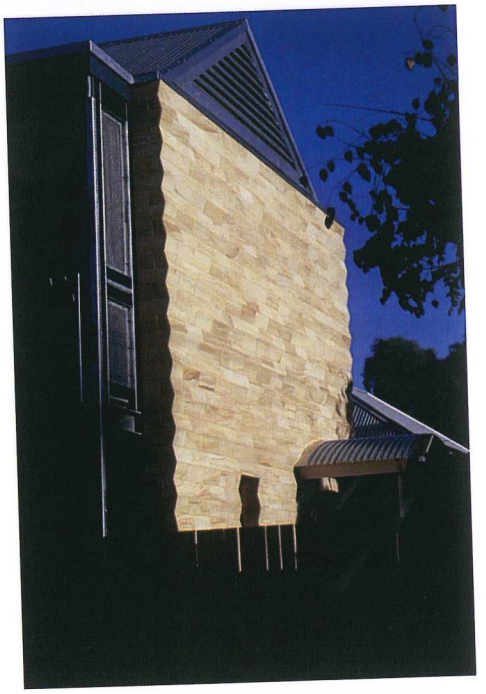


Fig. 3.6 Stone Façade at Solar Noon and Late Afternoon

Photos: Sam Ridgway

Chapter Four

MARCO FRASCARI
Representation Demonstration Anthropomorphism

Introduction

This chapter is an exegesis of Marco Frascari's major theoretical work, *Monsters of Architecture: Anthropomorphism in Architectural Theory*. The aim is to explore the theoretical environment from which three of his built projects have emerged. An investigation of these buildings is the subject of chapter five. After studying this book over several years, and after many discussions with Frascari, I have chosen to focus on three of its key theoretical themes: representation, demonstration and anthropomorphism. These three themes are central to the way he theorizes architectural construction and design, and all of them are traceable between text and building. *Monsters of Architecture* is a complex and difficult book to read, but the reward for perseverance is gaining an insight into a very different world of architectural interpretation and understanding. The reason I persevered with the book was not only for my own enjoyment and intellectual development, but in order to provide a commentary that would make the architectural intelligence it contains more accessible to others with a similar interest in challenging current architectural orthodoxies. In addition to *Monsters*, I have referred to several of his other publications, mainly journal articles, in an effort to explore these themes more widely in his work.

The curious title and subtitle of Frascari's book reveal his interest in the monstrous nature of architecture, architectural drawings and texts; and in re-establishing an understanding of the important but now neglected relationship between human and architectural corporeality. Contrary to the current, negative meaning attached to the term monster, it is important to point out that Frascari returns to a much older and more evocative interpretation. In this view, architecture monsters are positive beings, always constituted of two or more parts intelligently unified to make a new and original, but often still quite ambiguous whole. Architecture is monstrous by nature as it always involves the joining together of both material and immaterial things, often in a mode of thinking that operates like navigating from one nodal point to another in an interconnected, net-like, labyrinthine structure. The analogy Frascari uses is that of finding words and expressions in a thesaurus rather than in a dictionary. In an architectural project, joining occurs between ideas, thoughts, feelings and cultural forces, but also, in a virtual way, mainly through drawings, between physical materials, elements, forms and often

between two buildings, existing and new for example, as is the case with all but one of Frascari's buildings.

Frascari's most celebrated and often quoted work is not *Monsters of Architecture* but a journal article titled "The Tell-The-Tale Detail."[1] This article appeared early in his career while he was teaching at the University of Pennsylvania and was written out of a sense of frustration at the lack of construction knowledge evident in the design studio. It has been widely read and highly influential, mainly due to its poetic and finely crafted exploration of architectural detailing. In particular, it focuses on the generative and meaningful role detailing can play in the development of an architectural project. When it appeared in 1984 it stood in stark contrast to the central beliefs and consequent failings of both modernism and post-modernism in relation to architectural materiality: the former idealising the neutral, universal and mass produced and the latter flirting with dissimulation and irony. "The Tell-The-Tale Detail" instead reveals the depth of meaning that can be construed from the thoughtful construction of architecture. Construction is conceived as material knowledge, the central and most significant constituent of architectural practice. Joints, as revealed in "The Tell-The-Tale Detail," are always details and become the places where meaning is constructed and construed. While the construing of architectural monsters is always somewhat enigmatic ("monsters are recognizable as enigmas better left unsolved"[2]) it is possible to say that they are always architectural signs that both acknowledge and interpret the past, and also point towards the future. Detailing must always draw on and interpret the origins and existing knowledge of construction to create new details. While monsters are always joined beings, they also occur in the joints between joined elements or entities. An arch keystone is a good example of a joint between two (opposing) elements and in the past this was often signified by a monstrous carving.

Marco Frascari grew up, completed the first phase of his architectural education and for a short time practiced while immersed in the ancient, evocative and sensuous architectural environment of northern Italy, particularly Mantua and the Veneto. Frascari's Italian ancestry and extensive knowledge of classical architecture and scholarship are evident in all his written work. In addition, his well-known association with Carlo Scarpa has played an influential role in his academic and intellectual life. As he says, "[o]f course you have to realise that I grew up in the School of Scarpa. I worked for him, I studied with him, so that was part of the way I think. I

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[1] Marco Frascari, The Tell-The-Tale Detail," *Via* 7 (1984): pg. 22-37.

[2] Marco Frascari, *Monsters of Architecture: Anthropomorphism in Architectural Theory*, Maryland, Rowman & Littlefield Publishers, Inc., 1991, pg. 13.

couldn't avoid it."[3] In his article, "Architects Never Eat Your Maccheroni Without a Proper Sauce,"[4] for example, he recalls the macaronic conversations about the similar imaginative qualities required to be a good cook and a good architect at the "delightfully educative lunches at the *Gaffaro*," a restaurant near the IUAV where Scarpa would take his studio tutors for lunch on days devoted to the review of student work. In addition, he has written several articles that reveal aspects of Scarpa's work, including his use of the number eleven as a generative numerology, and several that examine his understanding of the relationship between the body and architecture revealed through drawing.[5] In "A Tradition of Architectural Figures: A Search for Vita Beata," he also traces Scarpa's influence on another architect, Valeriano Pastor in relation to the use of "body images in architectural imaging," something that evolved from Pastor's "training and collaboration with Scarpa.[6]"

Frascari's unique theorization of representation, demonstration and anthropomorphism in Monsters of Architecture and in other publications, reveals his belief that the main goal of architects should be to embody the intangible in the tangible, and to create buildings that help us to have good thoughts and happy lives. This theoretical trilogy is the basis of his appeal for architects to start thinking within architecture rather than about architecture. He believes that architects should be trained as intellectuals who practise architecture rather than as practitioners who pose as intellectuals so they can compete in the marketplace. This training would help architects understand that, in his words, "humans do not seek to spend their life in architects' spaces but in architectural spaces."[7]

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[3] Sam Ridgway, "Constructing Tales: Sam Ridgway Interviews Marco Frascari," *Architectural Theory Review* 10, 2 (November 2005), pg. 66.

[4] Marco Frascari, "Architects Never Eat Your Maccheroni Without a Proper Sauce!: A Macaronic Meditation on the Anti-Cartesian Nature of Architectural Imagination," *Nordic Journal of Architectural Research,* 2, (2003): pg. 51.

[5] Marco Frascari, "The Body and Architecture in the Drawings of Carlo Scarpa," *Res* 14 (Autumn 1987): pg. 123-142.

[6] Marco Frascari, "A Tradition of Architectural Figures: A Search for Vita Beata," in George Dodds and Robert Tavenor (eds.), *Body and Building*, Cambridge, Massachusetts: MIT Press, 2002, pg. 258-267.

[7] Marco Frascari, "The End of Architecture ?" in *The Virtue of Architecture: A 2009 Strenna*, self published book, 2009, pg. 9.

Representation: Drawing the Architectural Project

The art of architecture is based on imaginative representation.[8]

Marco Frascari, Monsters of Architecture

To begin this exploration of Frascari's views on representation we should return to Carlo Scarpa and lunch at the *Gaffaro*. In his article about pasta, Frascari recalls how Scarpa's students in the third and fourth-year design studio at IUAV learned on the School's grapevine before entering the studio that "a major change would have to take place in their design habits." This related to the way their designs were drawn, specifically, they had to change from using china ink on heavy translucent vellum to "Bristol Boards or similar material using a range of colored pencils and pens." Any use of colour to realistically render materials or to "give pseudo-effects of tri-dimensionality" was discouraged. Instead Scarpa urged his assistants to require students to use color in ways that allowed the "the drawn surface to become a glimmering receptacle of architectural desire" rather than drawings becoming "frozen mirrors denying any reflection of architectural perceptions." In Frascari's words, "a fecund account of Scarpa's request for factual lines and non-factual coloring is that architects, in tracing colored lines on paper, are not giving transparent images but synesthetic notations." Architects use drawings to "figure out dwellings that are bundles of intertwined sensory perceptions," [9] and, paradoxically, realistic depictions of buildings, in this case in relation to the use of color, are less likely to reveal or explore their multi-sensory nature. Synesthesia refers to a crossing over between the senses, "the stimulation of one sensory modality reliably causes a perception in one or more different senses."[10] In the case of architectural drawings the crossing is between vision and the other senses in particular, the tactile.

Investigating architectural drawing, drawing techniques and drawing media inevitably raises the question of the relationship between drawing and the imagination of buildings. In *Monsters of Architecture*, Frascari proposes that this relationship has changed significantly between the modern and traditional eras:

> The architectural project is based on the processes of sign transformation taking place in the translation of a building into a drawing and, visa versa, in the translation of a drawing into a building. The traditional interpretation of this translation is that an architectural drawing is a graphic representation of an

[8] Marco Frascari, *Monsters of Architecture*, pg. 90.

[9] Marco Frascari, "Architects, Never Eat Your Maccheroni Without a Proper Sauce!," Pg. 47.

[10] Marco Frascari, "Architects, Never Eat Your Maccheroni Without a Proper Sauce!," Pg. 42.

existing, or a future building. The present modern and post-modern condition of the understanding of the actors in these translations is that buildings are representations of the drawings that preceded them. In other words, in the past, architectural projects were always pre-posterous, where nowadays projects are intentionally pro-sperous.[11]

In this interpretation of the traditional relationship of drawing to building, the building always preceded the drawing. The drawing was either a measured drawing or sketch of an existing building or it was a design or construction drawing of an imagined, future building. In the latter case the architect, through the process of drawing re-presented an absent building, a building that existed in the imagination as fragments, details, feelings, schema, textures, ideas, precedents, cultural significances, functional requirements, costs and so on into a presence on paper. Imagining the building preceded the drawing and but was also provoked and developed through drawing. As Frascari writes, "the real architectural drawing does not result from a vision of the absent, but instead it provokes one."[12] A building cannot be imagined in its entirety and then drawn. The drawing is inspired and initiated by the imagination, and the embodied act of drawing partly imagined buildings is also a provocative part of the hermeneutical design process; a process that progressively reveals the building in more detail. A traditional architectural project included revealing (designing) the future building through drawing, both design and construction drawings, and then translating these drawings into a physical edifice. Drawings were conceived as analogical demonstrations of construction; a drawing was a "pre-posterous piece of architecture."[13] Preposterous here is understood in its Latin meaning of inverted, literally "having the first thing last," and drawing can be interpreted as drawing out, drawing on, or revealing imagined fragments and schema of the absent building through the literal skill and act of graphic drawing. Nowadays, drawings are generally pro-sperous; they represent only the promise of a future building and are often treated with contempt by the builder rather than being respectfully translated into a physical edifice.

Pointing to the religious and mythical origins of drawing to further explain the pre-modern translation from architectural project to drawings to construction, Frascari claims that these "traditional drawings are merely jigs and templates; they are an intermediary step of a

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[11] Marco Frascari, *Monsters of Architecture*, pg. 93.

[12] Marco Frascari, "Introduction" in Marco Frascari, Jonathan Hale and Bradley Starkey (eds.), *From Models to Drawings, Imagination and Representation in Architecture*, Routledge, 2007, pg. 7.

[13] Marco Frascari, *Monsters of Architecture*, pg. 93.

design projection, where the interpreter is the architect."[14] In the former case for the "construction of the temple on Mount Sinai, Jehovah, the divine architect, shows Moses, the mortal builder, the designs of the future sanctuary to be built and warns him '. . . and look thou make them after their patterns which was shew thee in the mount' (Exod. 25:9, 40).'" And of the latter, he cites the myth handed down by Pliny the Elder of "Diboutades tracing the shadow of her departing lovers on a wall."[15] These "[d]rawings are then pre-posterous tools," in both cases the drawing coincides with or come after the event.

From our modern perspective, the instrumental nature and small number of architectural drawings required for extremely complex building projects prior to and including the Renaissance seems initially to be at odds with the highly symbolic buildings that resulted from them. Currently the reverse is generally the case; a vast number of drawings are required to produce all buildings, even those that have negligible symbolic value. This strange inversion, suggests that the amount of technical information conveyed to the builder through drawings has little to do with the final outcome in terms of the cultural significance and meaning of a building. Medieval architecture, for example, was "*fundamentally* a constructive practice, operating through well-established traditions and geometric rules that could be applied directly on site." Very few drawings were used and the notion of drawing the entire building before construction did not exist. According to Alberto Pérez-Gómez, as late as the Renaissance, "the only drawings truly 'indispensable' for building (from a technological standpoint) were *modani* or template drawings." [16] These full-sized drawings were sometimes scribed into skim coats of plaster or onto the floor or the actual building and were used to maintain consistency in the cross-section of piers, columns, mouldings and so on. They were literally one-to-one, plan or section outlines, practical guides or jigs from which stone masons could measure to repeatedly and accurately cut pieces of stone for the building. Medieval stone masons could also use these drawings to cut the templates used in stone cutting. The final symbolic qualities of the building did not depend on their representation in drawings, rather they were embodied by the architects, masons and other craftsmen who formed the building team and they were poetically translated into the construction through rhetoric, geometrical rules and ritual acts of construction. The centrality of purpose, to interpret and represent God's will, kept these

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[14] Marco Frascari, *Monsters of Architecture*, pg. 94.

[15] Marco Frascari, *Monsters of Architecture*, pg. 94.

[16] Alberto Pérez-Gómez and Louise Pelletier, *Architectural Representation and the Perspective Hinge*, Cambridge, Massachusetts: MIT Press, 1997, pg. 7-8.

projects pressing towards their final outcomes sometimes for hundreds of years over generations of architects, masons and craftsmen.

Beginning in the Renaissance, the constructive imagining of buildings represented through analogical demonstrations, began to happen more and more on the drawing board prior to actual construction. The architectural drawing became a "preposterous" work of architecture. Frascari refers to the Italian Marxist philosopher Antonio Gramsci who suggests that "the work of art of the architect is in the project, not in the building, just as the real work of art of the writer is in the manuscript, not in the printed book."[17] To illustrate "what happens when drawings produced by architects are not demonstrations of construction," he quotes Adolph Loos who complains that:

> The art of architecture has been denigrated by the architect into a graphic art. The greatest number of jobs does not go to the person who is the builder, but to him whose work cuts the best figure on paper. And these two are opposites.[18]

Since this was written the image, "graphic art," has become increasingly ubiquitous in our daily lives. We live in an image-saturated world. For the profession of architecture the result has been that the design of buildings is often reduced to the production of images. Frascari contends however, that drawing an image, translating it into a working drawing and then into a building is dealing only with "the visible side of a technology," and he introduces the concept of a technography to highlight the difference between a conventional working drawing and a demonstration:

> conventional working drawings are scientific tools for presenting a future reality within an appearance of continuous and uniform order; they show a result, not the intent. Their Cartesian rigor deals only with the visible side of a technology; technographies deal instead with the invisible side, making tangible the real measure of architecture. Such measure is not shown in a jig, but rather in a demonstrative conception of a specific project.[19]

Frascari's suggestion is that in the current situation, (working) "drawings must become demonstrations of architecture, they have to be pro-sperous tools for the builder, not a prescription."[20] Prosperous is taken to mean promising, rather than the more well-known meaning of financially successful. To successfully translate a drawing into a building, the basis

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[17] Marco Frascari, *Monsters of Architecture*, pg. 93.

[18] Adolph Loos, "Architecture," in Precision Press (eds) *The Architecture of Adolph Loos*, London: Precision Press, 1985, pg. 105-106.

[19] Marco Frascari, *Monsters of Architecture*, pg. 102.

[20] Marco Frascari, *Monsters of Architecture*, pg. 94.

of the relationship between architect and builder should be one in which there is a mutual desire to fulfil the technological and symbolic promise of the project represented in the drawings. In pre-modern architectural projects the drawings were simple, instrumental representations and the building's symbolic qualities were embodied through construction. In contemporary practice Frascari claims that "the union of the symbolic and instrumental representations in the building depend on their presence and union in the drawing; therefore the drawing should be a monster."[21]

Understanding architectural drawings as monstrous technographies situates them within the architectural project which is conceived as a process of semiosis "an infinite process of interpretation achieved with graphic signs" in which "architects remember the past, experience the present, and anticipate the future experience of the constructed reality." Drawing on the work of the American pragmatist Charles S. Pierce, Frascari argues that drawings must become a palimpsest of "three overlapping semiotic relationships." They must be capable of showing the nature of construction so that the builder, the building management and all the other trades related to the making of buildings can "derive their interpretation in the making of the jigs and templates necessary for construction. The drawings demonstrate the technological icon." The first relationship is between "a real architectural artefact and a reflected or projected icon of it;" an existing or future building and a drawing of it. The second relationship is "between a real artefact and the instrumental icon in the mind of someone involved in a building trade related to its construction;" the real but as yet unbuilt building and the builder. The third relationship is "between the instrument icon and the formal icon within a culture;" the unbuilt building represented in the drawings and the functional building that will appear within the cultural context for which it is designed. "This palimpsest is a technography, an act of projection, a casting forward that becomes a point of projection itself."[22] A technography may be deceptively similar to a conventional working drawing, as is the case with some of Frascari's drawings, or they may be unrecognisable as such, Carlo Scarpa's drawings of the Brion Cemetery for example. According to Frascari, technographies:

> are not images of a future building, but rather they are analogical demonstrations of its construction. As Herbert Damish, has pointed out, 'an image can never replace a demonstration.' Hence technographies are the locus where construction is demonstrated and therefore represented, and by representing,

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[21] Marco Frascari, *Monsters of Architecture*, pg. 109

[22] Marco Frascari, *Monsters of Architecture*, pg. 92-95.

they rule the action of bringing into being a noncacophonous piece of architecture.[23]

To see construction drawings in this light requires a re-evaluation of the commonly held belief that they follow the design process and are simply a technical, one-to-one representation of the building. In this view, the builder only needs to follow the drawings exactly and the building will appear. The architect's role is to provide information that is "missing" from the drawings and to negotiate how much extra it will cost to include this in the contract. The second relationship in a technography, however, requires the construction drawing to be capable of developing a relationship between a "real artefact and the instrumental icon" in the mind of the builder. Ideally, construction drawings should be understood by the builder not as technical one to one representations of the building but as motivated signs. "[D]e-signs are motivated signs expressed in drawings. In drawings, 'a sign is not only something which stands for something else; it is also something that can and must be interpreted.' (Eco 1984, 46). An edifice, a nontrivial building, is the physical result of this process of interpretation." [24]

Expecting builders to engage in a relationship with the architect and their drawings in this fashion in the current techno-rational world might seem fanciful, but the translation of drawings into buildings always requires a significant element of interpretation and if this is not based on a desire to fulfil the promise of the work, to make visible the invisible, then the building process is likely to be an unhappy one. This is similar to the interpretive process required to direct a theatrical production or to conduct a musical performance. In each, the interpretation of the written document by the director or conductor is considered central to the success or failure of the outcome, and it is often discussed by audiences and critics. There is always an element of transcendence to good theatre and good music, they go beyond a simple reading of the script or score. During a well interpreted and engaging performance the distance between ourselves and the work disappears and we become immersed in the music or the theatrical performance. Such experiences in the building industry are extremely rare. Currently, its adversarial nature and the reduction of building to a technical and commercial enterprise make it difficult for architect and builder to develop a relationship based on a transcendent interpretation of the construction drawings. This kind of relationship is necessary if the construction is to capture the invisible qualities required to make it a "non-trivial" work of

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[23] Marco Frascari, *Monsters of Architecture*, pg. 105.

[24] Marco Frascari, *Monsters of Architecture*, pg. 92. The Reference is to: Umberto Eco, *Semiotics and the Philosophy of Language,* Bloomington: Indiana University Press, 1984, pg. 46.

architecture. Drawings are legal documents and instead often become a battleground where each side tries to blame the other for problems caused by perceived errors and omissions. Unfortunately our cities and suburbs are populated by trivial and alienating buildings that exemplify a design process that has by and large been reduced to image-making. Often, no architect has been involved at all, sometimes a set of drawings is produced by an architect and then handed to the builder who is instructed to get on with the job for the cheapest price. The resulting structure may resemble the drawings but has had most of the goodness sucked out of it. No architectural presence exerts itself, the facades are often flattened and the details ill-conceived.

To further explain the concept of a technography, with the aim of urging us to consider that "a productive approach to a critical architectural project is achievable only if the complexity of the technological image is preserved," Frascari continues to examine the work of Carlo Scarpa and to a lesser degree that of Mario Ridolfi:

> Scarpa's and Ridolfi's technographies are marvellous ways of writing architecture. They are the wonderful *calligrams* of technological thought, the analogical expression of the process of construction. They are visual descriptions of processes that are not visible. They are conceived not to be read by the public, but rather to carry out a demonstration of intent.[25]

The drawings of these architects do not conform to the conventions of either design or construction drawings. Glancing over them, Frascari writes, "one has the feeling of an almost indelicate and embarrassing intrusion into the architect's search for the technological measure for a specific project."[26] "The Tell-the-Tale Detail" contains a description of the way Scarpa devised his details by performing an intellectual game on the working drawings in the interface between "design and draftsmanship. That game is the matching of the construction of a representation with the construction of an edifice," and as such they "show the real nature of architectural drawings, that is, the fact that they are representations that are the results of constructions."[27] Ideally, a working drawing should not be just a diagrammatic presentation conforming to graphic standards and conventions; instead the architect should consider the drawing to be an analogy or a demonstration of construction. Scarpa's drawings contain "several layers of thought," and are extremely complex. A significant part of this complexity and consequently the pleasure architects derive from looking at them arises from feeling that it is

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[25] Marco Frascari, *Monsters of Architecture*, pg. 102.

[26] Marco Frascari, *Monsters of Architecture*, pg. 100.

[27] Marco Frascari, "The Tell-the-Tale Detail," pg. 30.

possible to actually see Scarpa's mind at work. We are confirmed in our innate belief that detailing is the core of our *metier* summed up in Frascari's statement referred to earlier that "details are then the *locii* where knowledge is of an order where the mind finds its own working, that is, *logos*."[28] This is due largely to the intricate, multi-layered yet incomplete draftsmanship often of large orthogonal plans, sections or elevations, sometimes all three, surrounded by a profusion of freehand sketches of details. The drawings also often include written comments:

> which are not only numerical and descriptive, but self-critical, ironic, and playful, without ever becoming deceptive or ambiguous. It is architectural calligraphy, a beautiful writing of construction tropes, which is concerned with the forming of uncommon figures of drawings ... Both architects deal with the construction of palimpsests exorcising the present cacotechnical reality[29]

In Scarpa's drawings there is the sense of a profound relationship between the whole building and the materials and details of which it is made. The drawings have a "twofold nature ... seeing a likeness as a basis for drawing, and/or drawing as the productive representation of an eidetic process," which is the essence of the "twofold concept of *disegno*."[30] Many drawings have an unfinished quality as if they are in transition towards a more complete and definable working drawing, something that did not happen. When a detail or element needed to be clarified or interpreted for the builder, Scarpa would often craft this on the drawing board through the development of multiple sketches and then draw the detail for the builder on site from memory, sometimes on the wall of the actual construction. In today's construction industry, it is difficult to imagine developing such a relationship with a builder or finding a client willing to support a building project that does not give the impression at least, of being completely documented before construction begins. On large projects where elements of construction are fast tracked before the completion of documentation, clients often employ a project manager or other consultants to rigidly control how the architect develops and resolves the un-drawn parts of the building. In this environment it is highly unlikely that drawing on walls, asking the builder to accept that drawings are prosperous demonstrations rather than rigid documents or that construction is a process of transcendent interpretation would be acceptable.

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[28] Marco Frascari, "The Tell-the-Tale Detail," pg. 30.

[29] Marco Frascari, *Monsters of Architecture*, pg. 102.

[30] Marco Frascari, *Monsters of Architecture*, pg. 104. The term eidetic means being able to recall or reproduce things with accuracy or clarity.

Demonstration: Making Visible the Invisible

In architectural demonstrations, the function of representation has not been separated from the representation of function [31]

Marco Frascari, *Monsters of Architecture*

Frascari's long and distinguished career in the architectural academy makes his views on demonstration especially relevant to the education of architects in general and the teaching of construction in particular. *Monsters of Architecture* grew out of his interest in the "education of the architect as an intellectual practicing architecture, rather than a practitioner posing as an intellectual in order to compete in the marketplace." It is his opinion "that it is necessary to foster a better understanding of the role of demonstration in the realm of architectural representation because it is the way the architect — as a mime — makes visible what is invisible."[32] The key to understanding what Frascari means by a demonstration is contained in the last words of this passage, which reveal his strong belief that the role of architects is to make visible, or represent, that which is invisible. A building is, or should be a tangible demonstration of intangibles and to understand how to do this in a non-trivial way requires an architect to be trained as an intellectual, someone who understands architecture as a primary rather than a secondary activity.

The demonstrations that architects, professors of architecture and their students might explore through their drawings and buildings is dealt with in great detail in *Monsters of Architecture*. Frascari's exploration and promotion of architectural demonstration focuses on the complex, interpretive relationship between buildings and drawings, the origins of which he traces to Vitruvius and his concept of arrangement. There are three kinds of arrangement according to Vitruvius, who also points out that the Greeks call these drawings *ideai* (ideas). The first is ichnography, the drawing of plans, which is based on a demonstration of laying out the "plan of a future edifice with ropes and boards on the grounds of the selected site." The second is orthography, the vertical presentation and demonstration of raising a building and the third scenography which is commonly interpreted as perspective but which Frascari claims, with reference to Daniele Barbaro, refers to a cut feature or a section, a "demonstration of the stereotomy of the building parts, an anatomical representation of building elements."[33]

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[31] Marco Frascari, *Monsters of Architecture*, pg. 90.

[32] Marco Frascari, *Monsters of Architecture*, pg. XI.

[33] Marco Frascari, *Monsters of Architecture*, pg. 95-96.

Frascari's reference to Vitruvius and to the medieval practice of stereotomy, points to his understanding of the origins of the profession of architecture in the imaginative demonstration, or drawing of construction.

Frascari's work develops a strong link between imagination and demonstration, by focusing on the deep mental process of tectonic imagination which he considers to be at "the core of the architectural discipline."[34] He criticizes architectural curricula that do not "bother to teach any basis for distinguishing between significant content and personal preference" and that casually introduce "vague collective senses of imagination without inquiring into whether they have any meaning in fact or practice."[35] He claims that the "discourse on architecture has focused on styles, functions, modernity, structures, facadism, and many other peripheral components of the practice without ever singling out the focal point."[36] In addition to becoming distracted by the boundaries or periphery of the discipline in an attempt to find meaning, Frascari believes that a lack of recognition or understanding of the imaginative and meaningful core of architectural knowledge has led to unsuccessfully trawling through other disciplines to find theoretical and generative nourishment. Losing sight of the central role of the architect, to make visible the invisible through demonstration, has resulted in "a vision of architecture as a corrupt, abstract art coping with technical and pragmatic requirements, whose theoretical basis depends for its formulation on theoretical and critical frameworks developed in other fields of human knowledge."[37]

For Frascari, one of the key differences between the architectural projects of professors and those of professionals is the way in which they engage with architectural demonstration. He believes that buildings built by professors and those produced by professional architects are fundamentally different from each other and this relates primarily to the context in which they are produced. The academic context in which a professor builds is ideally one of intellectual activity related to research and teaching. The professor builds by choice because an opportunity arises to explore ideas related to research. By contrast, the context of professional practice is the world of business, both in terms of running an office and providing a service to clients. Frascari expresses the difference as "the devising of architecture for delight

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[34] Marco Frascari, "Three Aspects of Tectonic Imagination," *Architectural Magazine B* No. 54, (2005): pg.10

[35] Marco Frascari, "Architects, Never Eat Your Maccheroni Without a Proper Sauce!," pg. 44.

[36] Marco Frascari, "Three Aspects of Tectonic Imagination," pg.10.

[37] Marco Frascari, *Monsters of Architecture*, pg. 4-5.

and the professional devising of built environments for business." In the world of business, design is conceived of as supporting the functional aspects of a project, including the production of a marketable image and the provision of "heating, ventilation and air conditioning (HVAC). Architecture is then subordinate to a more important task for which it becomes the medium." The professor, on the other hand, sees architecture as a "primary activity," that is not "subordinate to another activity." For the professor "the product is a project, not a design. For a professor, architecture exemplifies and suggests rather than determines or imposes. The professional carries out a duty, whereas the professor enjoys the pleasure of a demonstration.[38]

In general, professional architects focus on the visible side of architecture at the expense of the invisible. They tend to produce designs that are a "finished image" and then translate that image into an unambiguous building that can itself be photographed and used to increase their marketability. Professors, on the other hand, are inclined to create unfinished images "like that of the grotesque body," which is always "a body in the act of becoming."[39] The buildings of professors are more inclined to explore and demonstrate the invisible, symbolic and meaningful dimensions of architecture, something that distinguishes their buildings from professional architects and other building designers and highlights the essential but largely unrecognized value of design as research within the academy.

Monsters of Architecture was published in 1991 and in the final passage of the book Frascari writes that in "the present post-modern status of architectural production, envisioning negates construction."[40] For him this represents the severing of a fundamental architectural nexus that can be traced to the ancient Greek origins of the compound word technology, *techne* and *logos*. In a playful etymological or philological undoing of the word technology that first appeared in "The Tell-the-Tale Detail," the "Janus-like" presence of technology is revealed through the chiasm "*techne* of *logos* and *logos* of *techne*." In its best form, architecture as technology is embodied or made knowledge which comes primarily from knowledge of making. How buildings are made is central to what they mean. "Technology is the richest resource for the architectural production of meaning because it deals with both the construction (the *logos* of *techne*) and the construing (the *techne* of *logos*) of a piece of architecture." Above all else, architecture concerns the imagination of construction which must be based on the pursuit of a

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[38] Marco Frascari, *Monsters of Architecture*, pg. 31.

[39] Marco Frascari, *Monsters of Architecture*, pg. 32.

[40] Marco Frascari, *Monsters of Architecture*, pg. 108.

Vita Beata, a happy life, "architecture has to do with the reconciliation between the art of living well and the art of constructing well."[41]

To demonstrate is to show and to show the union of often disparate things through construction is to create monsters. Joining materials and elements through construction (tectonics), poetically tropes or turns them into an architectural monster, a revealing demonstration of meaningful parts unified into a whole, but never complete, building. Joints become the "places that articulate these monstrous events."[42] As discussed previously, in "The *Lume Materiale* in the Architecture of Venice," Frascari explores the Venetian phenomenon of *lume materiale* through the example of the late-gothic Venetian palace the Ca'Dario:

> The Ca'Dario is a hybrid — or "monstrous" building — building. It is a combination of bold, Gothic elements, Tuscan traditions, Lombardic decorations, and Byzantine memories. It dominates the aim of r*estituti ad pristinum*. This is the desire of a perspicuous representation of the past in the present. The "monstrous" Ca'Dario is an expression of the multi-faceted culture of Venice. It is a real monster of architecture — understood not in the sense of abnormality, but in its ethnological meaning of an extraordinary event. "Monster" derives from the Latin verb *monstrare* — to show the way — which in itself, derives from *moneo* — to give guidance. In this way, Ca'Dario is an extraordinary hybrid that combines the architecture of the West and the East with the influences of Rome and Greece. It results from a dialogue between a refined understanding of classical composition and a rich taste for the arabesque. Ca'Dario is a material representation of the Venetian enchantment with voyages and memories.[43]

Lume Materiale means material light, and Frascari's story about the Ca'Dario revolves around the idea that buildings are constructions in and of light. The monstrous nature of the building stems from the union of culturally diverse elements revealed through light that are troped into a new cultural, Venetian form through construction. These elements are brought to presence within a highly sophisticated and culturally engrained understanding of that most intangible of architectural materials; light. "Light is the alchemic catalyst of the tectonics of the constructed world."[44]

In "The Tell-The-Tale Detail," Frascari frames the practice of Carlo Scarpa, particularly his obsessive attention to detailing, as demonstration but does not name it as such. Scarpa is described as a *Magister Lundi*, a master of the game, and his buildings as "texts wherein the

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[41] Marco Frascari, *Monsters of Architecture*, pg. 4.

[42] Marco Frascari, *Monsters of Architecture*, pg. 16.

[43] Marco Frascari, "The *Lume Materiale* in the Architecture of Venice," *Perspecta* 24, (1988): pg. 140.

[44] Marco Frascari, "The *Lume Materiale*, pg. 145.

details are the minimal units of signification."[45] Referring to the theoreticians of the *architecture parlante* "architectural details are seen as words composing a sentence."[46] One of the several details used to illustrate this is the well-known high-level corner windows in the *Gipsoteca Canoviana* a generative architectural detail that forms part of a text concerned with finding a new way to naturally light a display of gypsum casts. Traditionally, the walls in a room used for this purpose would be tinted to help perception of the casts' three-dimensionality. Scarpa chose instead to wash the walls behind the figures with natural light from the corner windows and in so doing created a new interpretation of the relationship between light and building. The *Gipsoteca* windows are an excellent example of architectural demonstration, they do not simply light the casts in a functional way, there are many other methods of doing this, but their construction demonstrates the generative idea behind them. They are a perspicuous demonstration of the architectural knowledge that created them and although small in relation to the rooms they light, they allow a strong architectural presence to exert itself.

[45] Marco Frascari, "The Tell-the-Tale Detail," pg. 31.

[46] Marco Frascari, "The Tell-the-Tale Detail," pg. 24.

Anthropomorphism: Human and Architectural Bodies

Just as we think architecture with our bodies, we think our bodies through architecture.[47]

Marco Frascari, *Monsters of Architecture*

Fig. 4.1 "The Labyrinth, Here Lives the Minotaur"
Drawing: Marco Frascari

A key theoretical element of all Frascari's architectural projects, both built and unbuilt, is his understanding of, and fascination with, the relationship between human and architectural

[47] Marco Frascari, *Monsters of Architecture*, pg. 1.

bodies.(Fig. 4.1) This forms another point of distinction between his theorized projects and the commercial and professional projects generated within most contemporary professional practices. In contemporary practice the interaction between bodies and buildings has largely been reduced to considerations of physical ergonomics which is employed to create safe and efficient built environments. The symbolic qualities of buildings are these days thought to reside overwhelmingly in the visual realm rather than in their corporeality, and the bodily well-being of their occupants is reduced to considerations of physical comfort and safety. A primary function of buildings, to materialize a non-trivial relationship between human and architectural corporeality, once a significant part of the conjectural and meaningful basis of an architectural project is, with rare exceptions, no longer extant.

In *Monsters of Architecture*, Frascari insists however, that "[a]rchitects can no longer do without the identification of the human body and its elements in the architectural body."[48] With reference to a quote by Tadao Ando, a key theme of the book is the "labyrinthine quality of bodies and the practice of their representation in architecture."[49] In relation to human embodiment in buildings, he claims the contemporary practice of architecture has lost its proper intellectual, conjectural, imaginative and representational core and as a result architects are playing their own private games in which, while they make all the pieces of the "theory/practice" puzzle fit together, the solutions are never-the-less solitary and solipsistic. In his article "A Tradition of Architectural Figures: A Search for *Vita Beata*," Frascari criticizes the "fashionable practices of many contemporary architects" for producing "architectural bodies without qualities." These buildings result from employing a design process "whereby prosthetic gadgets, mechanical carcasses, and perfunctory Cartesian morbid remains" supplant the time-honoured "portrayal of edifices as embodied constructs."[50] Returning to *Monsters*, he claims that "the traditional solution to the puzzle — the representation of a body within a body, a perspicuous image of the facts of architecture — is completely disregarded."[51]

> Both bodies are involved in the process of making a meaningful architecture. Sometimes they are so near that they merge; sometimes they are far apart. This tension between them allows the elaboration of a meaningful constructed world. They rule the constructing as well as the construing of architectural artifacts.

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[48] Marco Frascari, *Monsters of Architecture*, pg. 4.

[49] Marco Frascari, *Monsters of Architecture*, pg. 2.

[50] Marco Frascari, "A Tradition of Architectural Figures: A Search for Vita Beata," in George Dodds and Robert Tavenor (eds.), *Body and Building*, Cambridge, Massachusetts: MIT Press, 2002, pg. 259.

[51] Marco Frascari, *Monsters of Architecture*, pg. 5.

> This dual-body image results from an understanding of corporeality as the central focus of the architectural presence. A presence which is not only a being, but it is also a becoming. Body, perception and memory are the elements composing a growing spiral on which a true relationship [between] theory–practice should be built. This will give back to architecture its original nature of being a specific discipline with its own proper theoretical knowledge, which can be then transferred [into] the instrumental knowledge necessary to its practicing.[52]

The labyrinthine quality of bodies is a reference to both their carnal and mysterious physical form and to the intangible spirit or soul that animates them, a relationship between body and spirit that Frascari believes is equally essential in architecture. He invokes an image of the labyrinth, or more specifically two less common kinds of labyrinths, a maze and a meander, in relation to the kind of knowledge and its organization required to perform non-trivial architectural design. Unlike the original, classical labyrinth where there is only one albeit convoluted path to its centre, a maze is a confusing "mannerist invention" that requires choices between paths and some of these are dead ends. Without care and a guiding thread it is possible to spend a lifetime lost in its internal structure. A meander on the other hand is a net-like pattern of interconnected paths every crossing point is connected to every other similar point. After the Neapolitan philosopher Giambattista Vico (1668-1744), he suggests that the kind of knowledge most commonly produced by architectural research and applied to design is based on the search for "intelligible universals" and is used to produce "catalogs, codes, guidelines, or normative prescriptions." This is necessary to produce "safe and durable" buildings but does not prevent the "production of trivial designs." [53] This kind of knowledge is arranged in structures like words in a dictionary, where clarity without interpretation is required. For architects trying to develop an architectural project, navigating such structures is like navigating a maze, "No monsters are necessary in this kind of labyrinth. A maze is in itself the Minotaur; the Minotaur is the architect's trial-and-error process."[54]

In contrast, Frascari proposes that to produce non-trivial architecture, both a different kind of knowledge and a different knowledge structure are required. He suggests a "possible critical approach to architectural projects based on the use of imaginative universals. The design agenda must be grounded on a theory of image, a theory that proposes an understanding of architecture as a system of a representational knowledge resulting from

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[52] Marco Frascari, "A New Corporeality of Architecture," *Journal of Architectural Education*, 40/2 (1987): pg22.

[53] Marco Frascari, *Monsters of Architecture*, pg.106.

[54] Marco Frascari, *Monsters of Architecture*, pg.108.

technological signs." The instrumental, and technical knowledge produced by the search for intelligible universals must be "embodied in meaningful theoretical images."[55] Architects should combine theoretical and practical knowledge in their representations of architecture. As an example he cites the ancient union of the symbolic and practical importance of angles to both architecture and to navigational techniques. (Fig. 4.2) The common etymological root of the words angel and angle originate in the technique sailors used to find their bearings (angles) at sea by observing the position of stars, the home of the angels. The angels and the angles guided them safely to their destinations. In architecture and town planning, angles were equally crucial and Frascari refers to Vitruvius who discusses the symbolic and instrumental knowledge of angles used to lay out ancient cities by referring to the Hellenistic Tower of the Winds. This tower incorporated representations of the winds blowing from different cardinal points "as figures of angels." In contemporary practice, the use of unruly angles in buildings is commonplace and while sometimes related to practicalities it is often guided by personal whim and fashion rather than the attainment of symbolic qualities. In relation to the orientation of the building, its angular relationship to its site, if this is considered important at all it is invariably decided by attention of practicalities. In the case of orientation for environmental (solar) concerns this is decided by the calculation of heat gains and losses and almost never through a combination of symbolic and instrumental concerns. The relationship between the physical and psychological well-being (happiness) of the buildings occupants and its orientation is impossible to calculate and therefore considered to be secondary. However, attention to the primary, symbolic and practical relationship between human and architectural bodies contributes towards constructing well and therefore living well. In relation to orientation this may be as simple as designing to promote a happy daily and seasonal relationship between the sun and the occupants of the construction. To do this may of course require its symbolic value to override or compete with other powerful symbolism, orientation to a street frontage for example. Currently, the symbolic value of orientating a building for a correct solar relationship, including its therapeutic dimension, is negligible and therefore usually neglected.

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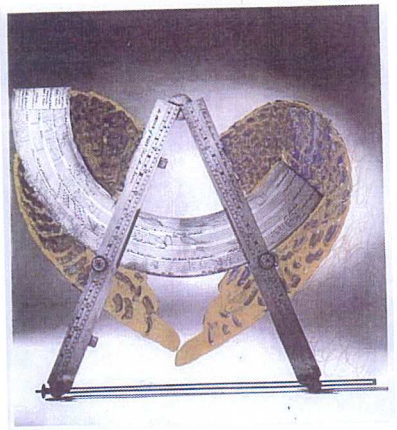
[55] Marco Frascari, *Monsters of Architecture*, pg.106.



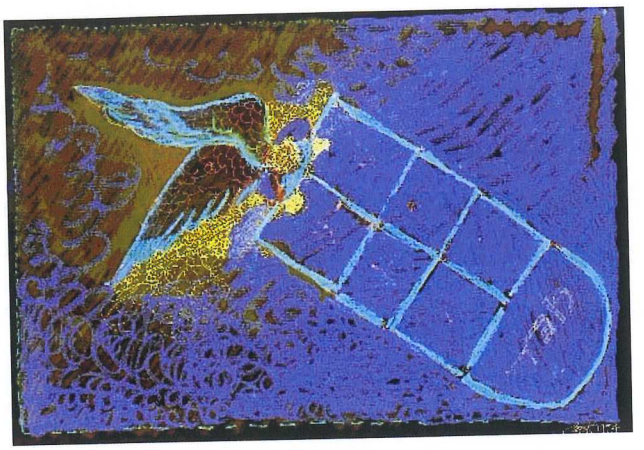


Fig. 4.2 Angels and Angles Hopping Angel
"In Architectural Demonstrations Each Angle is Dressed like an Angel"
Drawings: Marco Frascari

Architectural research that pursues the representation of symbolic attributes Frascari defines, with reference to Vico, as the search for imaginative universals. This research produces "treatises or discourses, or encyclopedias"[56] with the resulting knowledge tending to be arranged in a manner similar to synonyms in a thesaurus. The mental and graphic images form a net-like, labyrinthine structure through which it is possible to meander to gain increasing layers of meaning and knowledge. This "universe of architectural semiosis is and must be postulated as a labyrinth, a topological and a logical model for architectural production that is always an expression of an infinite process of interpretation."[57] Here topological is used in its anatomical sense, drawing on an analogy between the anatomy of the labyrinth, architecture's original body, and human anatomy as places of discourse. Crucial to the success of this imaginative mode of design in the current situation is a radical re-thinking of the importance and role of drawings in architectural production:

> Drawings must become technographies, which are graphic representations analogously related to the built world through a corporeal dimension and embodying in themselves the Janus-like presence of technology in architecture, where the techne of logos (construing) cannot be separated from the *logos* of *techne* (constructing). Drawings are specific acts of demonstration belonging to an architectural encyclopedia, which is a thesaurus of technological images.[58]

Importantly, Frascari is quite specific about the kind of "corporeal dimension" or presence he thinks should be embodied or represented in drawings and consequently in buildings, and he

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[56] Marco Frascari, *Monsters of Architecture*, pg.108.

[57] Marco Frascari, *Monsters of Architecture*, pg.105.

[58] Marco Frascari, *Monsters of Architecture*, pg.107.

highlights this by returning to the difference between the complete images produced by professionals and the demonstrations of professors. He compares the complete building images produced by professionals with the complete and idealized neoclassical representations of the human body, and the incomplete demonstrations of professors with grotesque bodies. Grotesque is taken to mean a monstrous combination of the realistic and fantastic rather than the more common meaning of ugly or distorted. The grotesque architectural body is the antithesis of buildings conceived as complete images. A grotesque building is an unfinished image, "a body in the act of becoming. It is never finished, never completed; it is continually built, continually created; and it is the principle of other's bodies." "The logic of a grotesque image ignores the smooth and impenetrable surface of the neoclassical bodies, and magnifies only the excrescences and orifices, which lead to the bodies' depths." "[T]he grotesque body swallows and is swallowed by the world. This takes place in the openings and the boundaries, and the beginning and end are closely linked and interwoven." The grotesque body is not the complete image of the metaphorical body, its boundaries are blurred often simply through the similarity of construction materials with other surrounding buildings. By contrast, the buildings of professionals are finished images that lack ambiguity. "No sign of the lower stratum or of the corporeal functions is visible in this deodorized and untouchable body image." These body images are likened to sculptures by Canova "where no part or member is shown in its carnal nature."[59]

Despite his historical knowledge of "the ascription of human characteristics and attributes to buildings and edifices,"[60] Frascari does not advocate a return to traditional methods of human embodiment in architecture but instead proposes a new anthropomorphism based on an understanding of "metonymical relations between built and human bodies." A metonymical relationship will avoid the "too simple road of isomorphism, isotropic, and metaphoric representations of the past." In other words, we should avoid being too literal in the pursuit of embodiment. The base of a building need not resemble a foot or the façade a face although both footprint and façade represent inherent qualities of the entire building as feet and faces do for humans. "In a metonymical procedure, the project of a handle results from the mould of the grasp of a hand rather than from a formal representation of the hand itself." This is not the formula for a functional answer but for "a dignifying solution,"[61] that captures intangible

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[59] Marco Frascari, *Monsters of Architecture*, pg. 32.

[60] Marco Frascari, Monsters of Architecture, pg. 1.

[61] Marco Frascari, "A New Corporeality of Architecture," pg. 22-23.

human qualities in tangible material form. The qualities, characteristics, elements and attributes of the human body become the basis for activating tectonic imagination rather than a literal translation of bodily forms or proportions into buildings. Bodily proportions for example, would not be related directly to the proportions of the plan or elevations of a building as occurred during the Renaissance or in the case of Le Corbusier's Modular. Proportion, the relationship between portions, might be represented more metonymically as the correct relationship of the many portions required to construct a dwelling for living well. This could apply equally to building elements or materials, light and heavy, for example; or to planning, the proportional relationship between spaces and their size, placement and arrangement within the building. In good design, the relationship between portions would always be fluid and adjustable in much the same way as they are in good cooking but always related to "thinking architecture with our bodies" and always achieved through constructing well.

A strategy for promoting the metonymical merging of human and architectural corporeality through the representation of human figures in architectural drawings is explored further by Frascari in his article "A Tradition of Architectural Figures: A Search for *Vita Beata*." Human figures are commonly added to drawings after the design is complete to indicate scale and to impart a sense of realism to presentation images, they a generally an afterthought. The traditional use of figures as "inaugural mechanisms of sound analogical design" is no longer part of contemporary architectural practice. Frascari proposes however that it is still possible, in fact essential, to imaginatively represent body images in the drawing of architectural projects. This is not only a means of the designer identifying more closely with the spaces and construction of the projected building, it is the conception of a "body-image" that is a "powerful and vivid animated presence" within the hermeneutical design process. "Construing architecture through body-images ensures that the imaginal force of human bodies is impressed, received, and vividly transmitted into the built environment." Outwardly, this practice results in the appearance of human figures in part or in whole in design drawings, not after the completion of the design but before or during the process. These figures become part of the imaginative generation of the project and are "brought into play to arrange buildings for *vita beata*." *Vita Beata* "the virtue of being in good spirits – is the primary scope of human existence." [62] Body images in drawings become a means of analogically relating human and architectural bodies.

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[62] Frascari, "A Tradition of Architectural Figures," pg. 259, 261.

Chapter Five

MARCO FRASCARI
Discursive Constructions

Introduction

In addition to his many theoretical texts and extensive teaching appointments, Frascari has also engaged in approximately thirty architectural projects, a small number of which have been built. While his built works can be described as modest, they are revealing when examined in relation to the theorization of architecture developed through his writing and also through his drawing. Just as drawings and theories are representations of buildings, equally buildings are representations of drawings and theories. This chapter is a study of three of Frascari's built projects that has this premise at its core. The three projects are: the Master's Apartment in the House of 1925 on the University of Pennsylvania campus in Philadelphia completed in 1985; the Casa Rossa in Vicenza, 1985-91; and the Villa Rosa on the outskirts of Alexandria, Virginia completed in 2005. All three are alterations and additions to existing buildings and they are all residences. The first is an apartment for the Master of the student residential building, the House of 1925. The second is a small house in Vicenza; and the third, a house he renovated and extended for himself and his wife Paola to live in while working at the Washington Alexandria Architecture Centre. I have also referred briefly to, and included images of, two other buildings, an early house at Roncoleva near Verona and alterations to the Arthur Ross Gallery at the University of Pennsylvania.

Carlo Scarpa's influence is quite evident in Frascari's buildings and on first impressions it would be easy to see this in simple stylistic terms, particularly in relation to the use of the stepped, ziggurat motif. This motif is very evident in his design for the re-modelled entrance to the Arthur Ross Gallery completed in 1983. (Fig's. 5.1-5.3) When I asked him about this he explained that he had been present at its birth and that this had been a formative experience in his career. One day, while working on the Castelvecchio Museum in Verona, he had been puzzling for some time over the corner detail for a corridor wall when Scarpa stopped at his drawing board and quickly drew the stepped motif, deftly revealing the layered construction of the wall and allowing more space to turn the corner. Frascari explained that the simple but ingenious way of resolving all the requirements for the detail made a lasting impression on him and that as far as he knew this was the first time it was used. Scarpa of course went on to

develop and reinterpret the detail in subsequent projects most consistently at the Brion Tomb and Chapel in *San Vito d'Altivole (Treviso).*

To gain an understanding of Frascari's built works it is necessary to enter his complex theoretical world, a world grounded in historical and philosophical knowledge that reveals his deep affection for architecture's corporeality. Through his writing and his building, Frascari often reminds us that architecture should result from a relationship between the art of living well, constructing well and thinking well, and this is the reason that architects must be trained as intellectuals not only as practitioners. Architectural theory must be embodied it is not something that can be applied. Through his writing and his architectural projects, Frascari helps point the way towards re-establishing what some of the basic constituents of a truly critical, theorized practice might be. In so doing he draws on his vast, complex knowledge of architectural history but always with the purpose of understanding how to find a way out of our current architectural aporia and to project a much happier future.

Fig. 5.1 Marco Frascari: Arthur Ross Gallery, Remodelled Entrance, Detail of New Opening through Wall (1982-1983)
Photo: Sam Ridgway

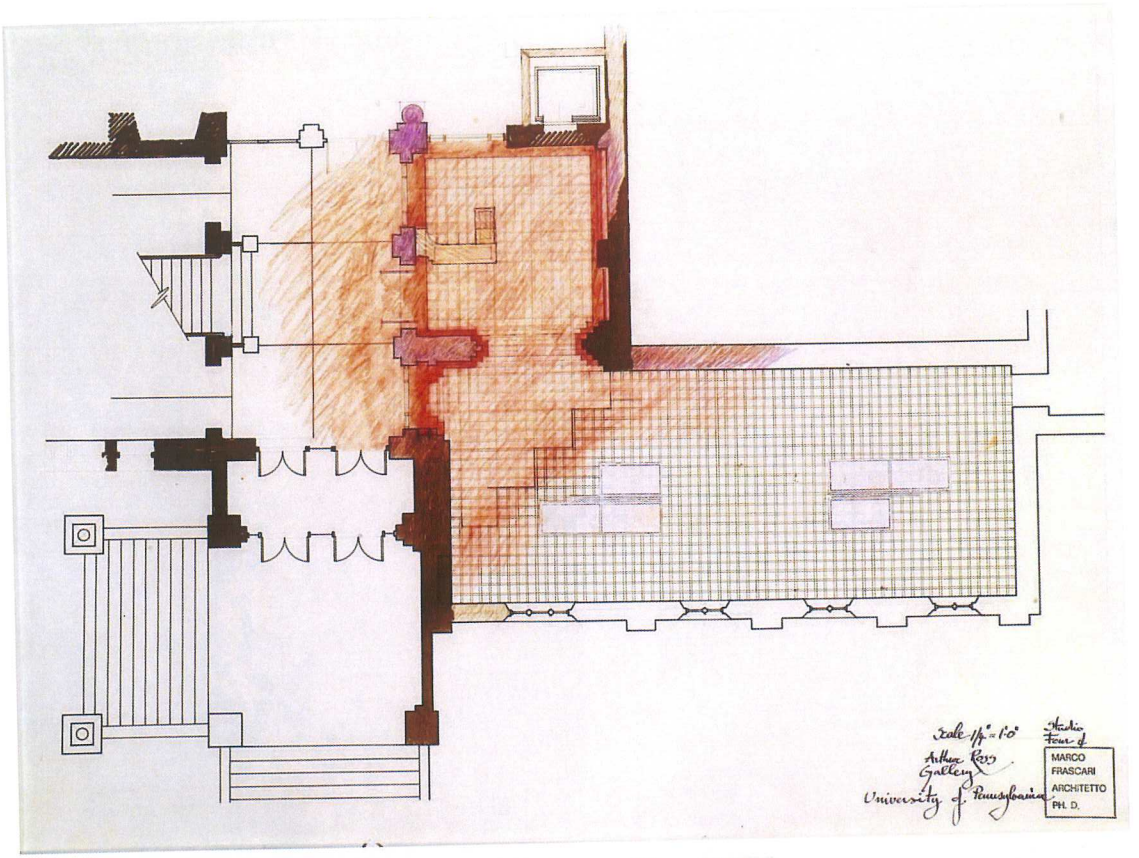

Fig. 5.2 Arthur Ross Gallery, Remodelled Entrance, Plan, (1982)
Drawing: Marco Frascari, Architectural Archive, The University of Pennsylvania

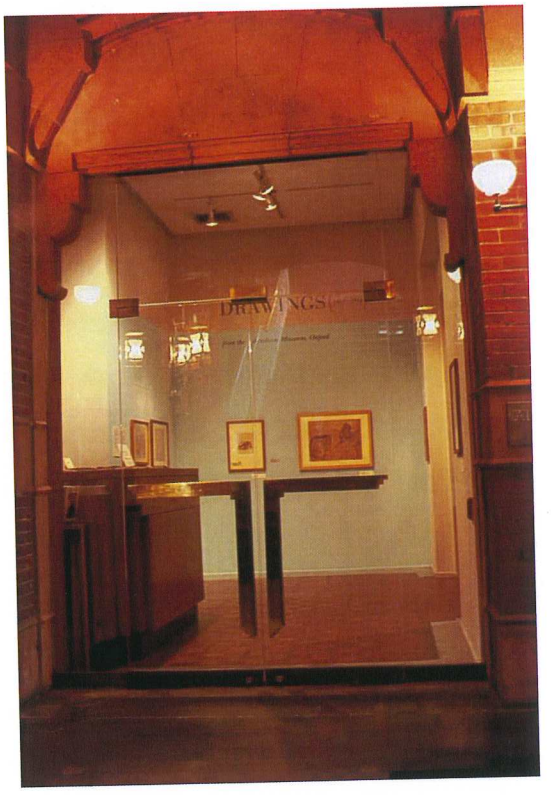

Fig. 5.3 Arthur Ross Gallery, (1982-1983)
Photos: Sam Ridgway

Master's Apartment in the House of 1925

Skylight detail
Photo: Sam Ridgway

Stair and skylight
Drawing: Cai Jun

Fig. 5.4 Master's Apartment in the House Of 1925

During his lengthy tenure at the University of Pennsylvania from 1982 to 1997, Frascari was commissioned to develop architectural projects for alterations and additions to two buildings on campus, the Arthur Ross Gallery and a student residential building, the House of 1925. The Arthur Ross Gallery project was initially quite large including a refurbishment of the gallery space, but only the new entry was constructed. The House of 1925 consisted of two phases, the creation of a new Master's Apartment contained within the top two floors of the existing building completed in 1985 and remodelling the ground floor student entry including a new lounge area in 1986.

The new Master's Apartment in the House of 1925 is a good example of the stated aim of "The Tell-The-Tale Detail" to indicate the "role of details as generators, a role traditionally ascribed to the plan." (Fig. 5.4) In the article, Frascari observes that "any architectural element defined as a detail is always a joint," [1] which can be either a material or a formal joint. A formal

[1] Marco Frascari, "The Tell-The-Tale Detail," pg. 23-24.

joint might be a connection between spaces whereas a material joint connects construction materials and elements. The first sketches of the apartment project are not plans but construction details of the proposed new skylight, stair and stair handrail. The skylight, a direct response to the lack of natural light in the existing space, became the initial generative detail for the whole design. Once the imaginative leap had been made to open the building's roof it followed that it should be situated over the stair and kitchen, to bring a vertical emphasis to the otherwise restrictive horizontality of the existing space. In plan, the skylight and stair naturally also became a formal joint between the kitchen/dining space and the living areas of the upper floor. The special quality of light flooding into the space from above engenders a quite different experience to that created when light enters a room laterally through conventional windows. This accentuates the formal joint and in a sense acts as a joint constructed of light. In the "*Lume Materiale*," we are reminded that "architecture is co-existent with light" and that light allows an "architectural presence" [2] to exert itself, something that is quite evident in this space. The location of the bookcases adjacent to the stair and skylight is probably more concerned with the practical need for light to read or select a book than the metaphorical connection between light and knowledge.

The verticality and openness created by the skylight accentuates to the body's vertical movement while traversing the stair from the darker sleeping spaces of the apartment to the lighter living areas, a reference to and an acknowledgement of, quotidian cycles and rituals. The stair also features a superimposed and enlarged stepped motif that accompanies the stringer. The same motif extends into the skylight attached to its end wall and can also be found on the partition between the kitchen and stairwell. (Fig. 5.4, 5.12) There is a generative numerology at work here developed from a relationship between the number of stair treads and risers and the enlarged stepped stringer. Numbers are a central part of Frascari's design thinking and this is explored in "The Tell-The-Tale Detail," with reference to Alberti and Scarpa. "Alberti's search for 'Beauty' is the setting of a precise relationship between the detail and the attached meaning"[3] and this is achieved through concinnity. Concinnity is finding the correct relationship between three basic requirements: number, finishing and collocation. Number refers to a system of calculating the number of elements in a building (columns, windows, doors, storeys ...) and of finding the correct relationship between them in order to build. Finishing is sometimes understood as dimensioning but it also refers to the development of

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[2] Marco Frascari, "*Lume Materiale*," pg. 138.

[3] Marco Frascari, "The Tell-The-Tale-Detail," pg. 27.

modules of measurement and proportional relationships. Collocation is the correct placing of details to achieve a composition. Frascari makes the assertion that the "'adoration of the joint' in Scarpa's architecture is a perfect realization of Alberti's concinnity." A central generative element of Scarpa's enthralling affair with detailing was his understanding of the significance of numbers. He particularly identified with the number eleven, it being the number of letters in his name. It also related to the cross sectional dimension of traditional Italian hollow tile wall construction; eleven centimetres. This is revealing, because it relates directly to a prosaic reality of construction. The hollow tiled walls are nominally ten centimetres thick but always end up thicker because of the realities of construction.[4] Scarpa used the number eleven figuratively, as pairs of columns and handrail supports for example, but also as the generating and regulating dimension of construction details. Numbers in architecture have almost completely lost their symbolic meaning, and the knowledge of numbers as bearers of meaning, often based on the numbers, dimensions and proportions of the human body, is largely forgotten. The enlarged stepping motif of the stair in the apartment is generated directly from a numerical relationship with the treads and risers of the stair. Its meaning is not literal but a matter of interpretation. The larger steps, too big for humans, nevertheless spring from the human embodiment inherent within the stair's function, their continued ascendance towards the sky into the skylight suggest, for example, a kind of transcendence from the apartment's human space and the routine of daily life.

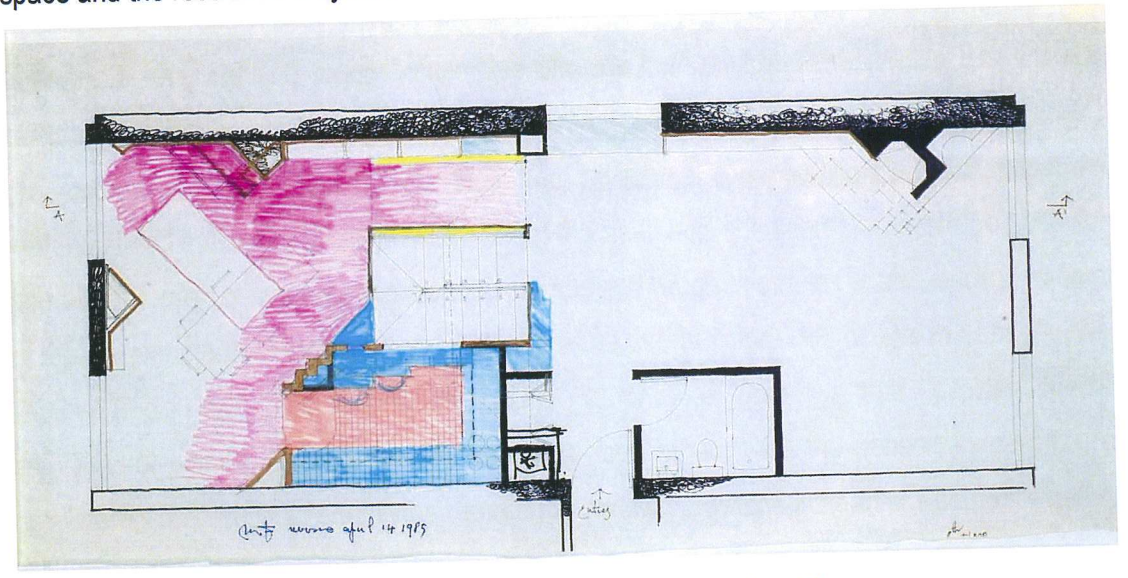

Fig. 5.5 Master's Apartment in the House of 1925, Sketch Design, Plan
Drawing: Marco Frascari, Architectural Archive, The University of Pennsylvania

[4] Marco Frascari, "A Deciphering of a Wonderful Cipher: Eleven in the Architecture of Carlo Scarpa," *OZ* 13 (1991): pp36-41. Note to describe the contents of the article.

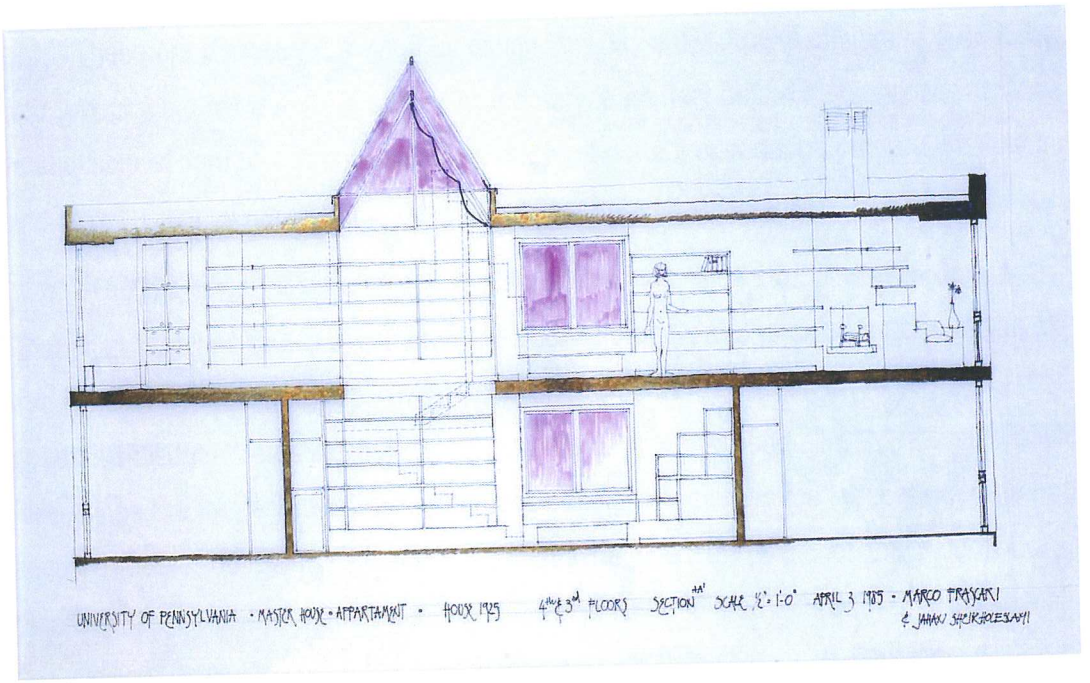

Fig. 5.6 Master's Apartment in the House of 1925, Sketch Design, Section
Drawing: Marco Frascari, Architectural Archive, The University of Pennsylvania

Although only one figure appears in the drawings for this building it should not be dismissed as token or as purely a means of showing scale, although this is one of its essential functions. Importantly, the figure is naked, a sign of the desire for a close and sensory relationship between the human and architectural body. (Fig. 5.6) The figure represents a construing of "architecture through body-image" ensuring that "the imaginal force of human bodies is impressed, received and vividly transmitted into the built environment." Within this Venetian tradition "body icons are brought into play to arrange buildings for a *vita beata*." [5] In addition to the metonymical inspiration for the stair and skylight already mentioned, this spatial and material detail embodies the characteristics of the head and shoulders, the desire to seek light and air. The project to create a multi-sensory space through this detail is also evoked in some of the developmental sketches through the unusual use of color. This occurs in both plan and section (Fig's. 5.5, 5.6) and is an attempt to produce drawings that "explore specific architectural events" by creating and exploring "synestheticly all the sensory necessities of dwelling."[6] Frascari could equally be referring to his own drawings instead of Scarpa's when he describes them as the result of a "contraposition of sweet and sour lines, fast and slow cooked color surfaces, ranging from design drawings for dining-in to construction drawings for carrying

[5] Marco Frascari, "A Tradition of Architectural Figures," pg. 261.

[6] Marco Frascari, "Architects, Never Eat Your Maccheroni Without a Proper Sauce!" pg. 47.

out."[7] These are definitely drawings for dining-in. They are a means of figuring out the sensory and topographic nature of the space. At the very least they define the sensory and functional relationship of hard to soft floor surfaces, the all important raised food preparation counter top, and the transition of natural light to the lower floor through subtle openings adjacent to the stair.

The drawings for this project reveal several more facets of Frascari's design thinking. The initial sketches reveal a generative relationship between the cross section of the skylight and the stair handrail. (Fig's. 5.7-5.9) A conversation occurs between these two elements and it appears that the interesting triangular cross section of the handrail generated the skylight's form, since the former is well defined in these sketches whereas the latter is not. The handrail section appears to be a transitional geometry between the width of the balustrade and a pleasing shape for the human hand to grip. The early colored sectional drawing reveals the final skylight design but leaves out the handrail which is finally revealed in painstaking detail in the conventional working drawings developed in conjunction with a local architect.[8] (Fig. 5.10) The final working drawings are the most detailed and conventional drawings of any of the three projects and were a requirement of the University client. This highlights an issue raised in "The Tell-The-Tale Detail," that after the industrial revolution, in a "predominantly economically motivated society" that did not consider buildings to be long-lasting cultural and social repositories, "the various building trades no longer inferred the construction of the detail from design drawings. The details were studied and resolved on the drawing boards."[9] In *Monsters of Architecture*, Frascari points out that in the present reality, "the union of the symbolic and the instrumental representations in the building depend on their presence and union in the drawing; therefore, the drawing should be a monster."[10]

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[7] Marco Frascari, "Architects, Never Eat Your Maccheroni Without a Proper Sauce!" pg. 47.

[8] The local architect who worked in partnership with Frascari to develop the working drawings was Jahan Sheikholeslami.

[9] Marco Frascari, "The Tell-The-Tale-Detail," pg. 26

[10] Marco Frascari, *Monsters of Architecture*, pg. 109.

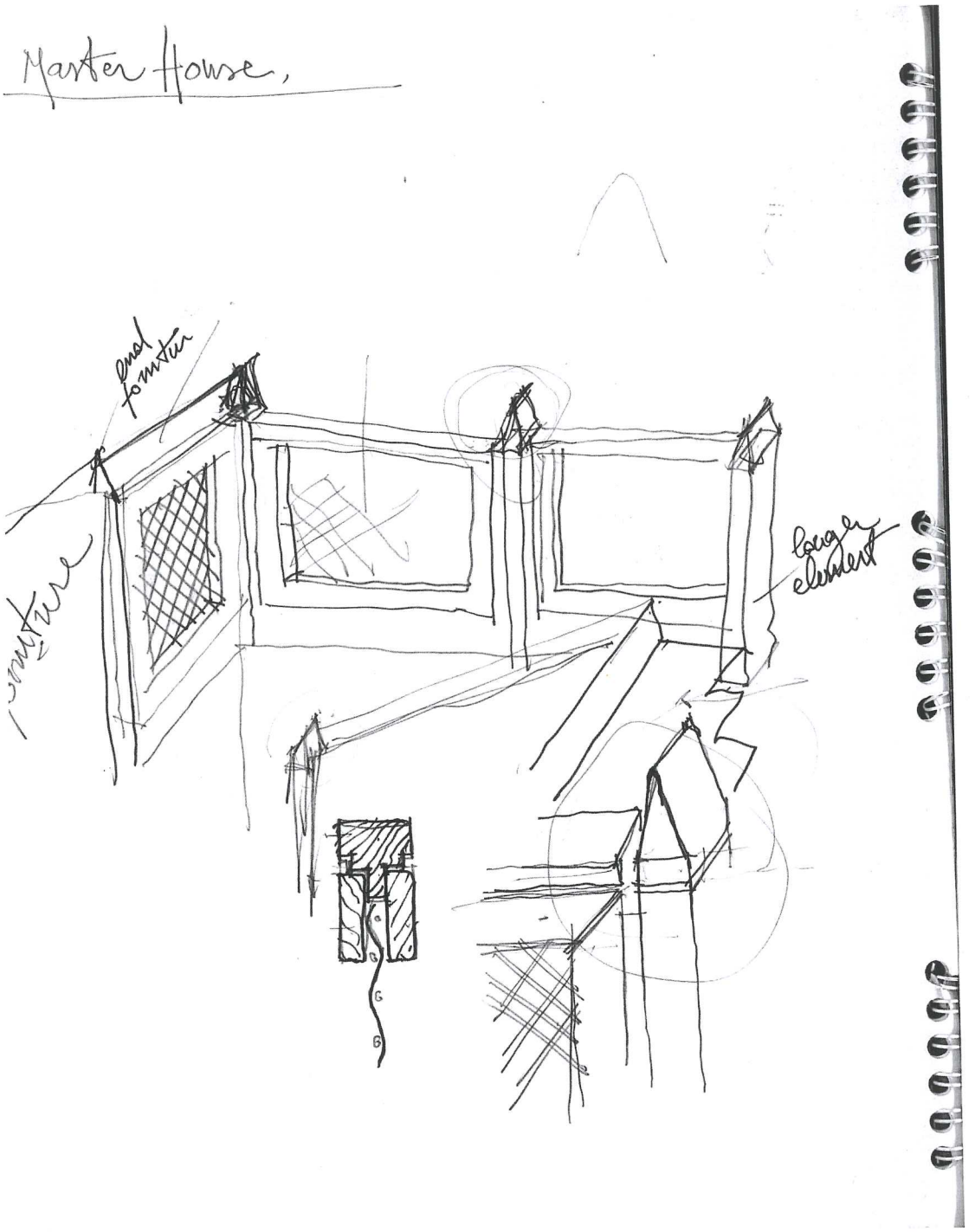

Fig. 5.7 Master's Apartment in the House of 1925, Initial Sketches of Skylight, Stair and Handrail Details

Drawing: Marco Frascari

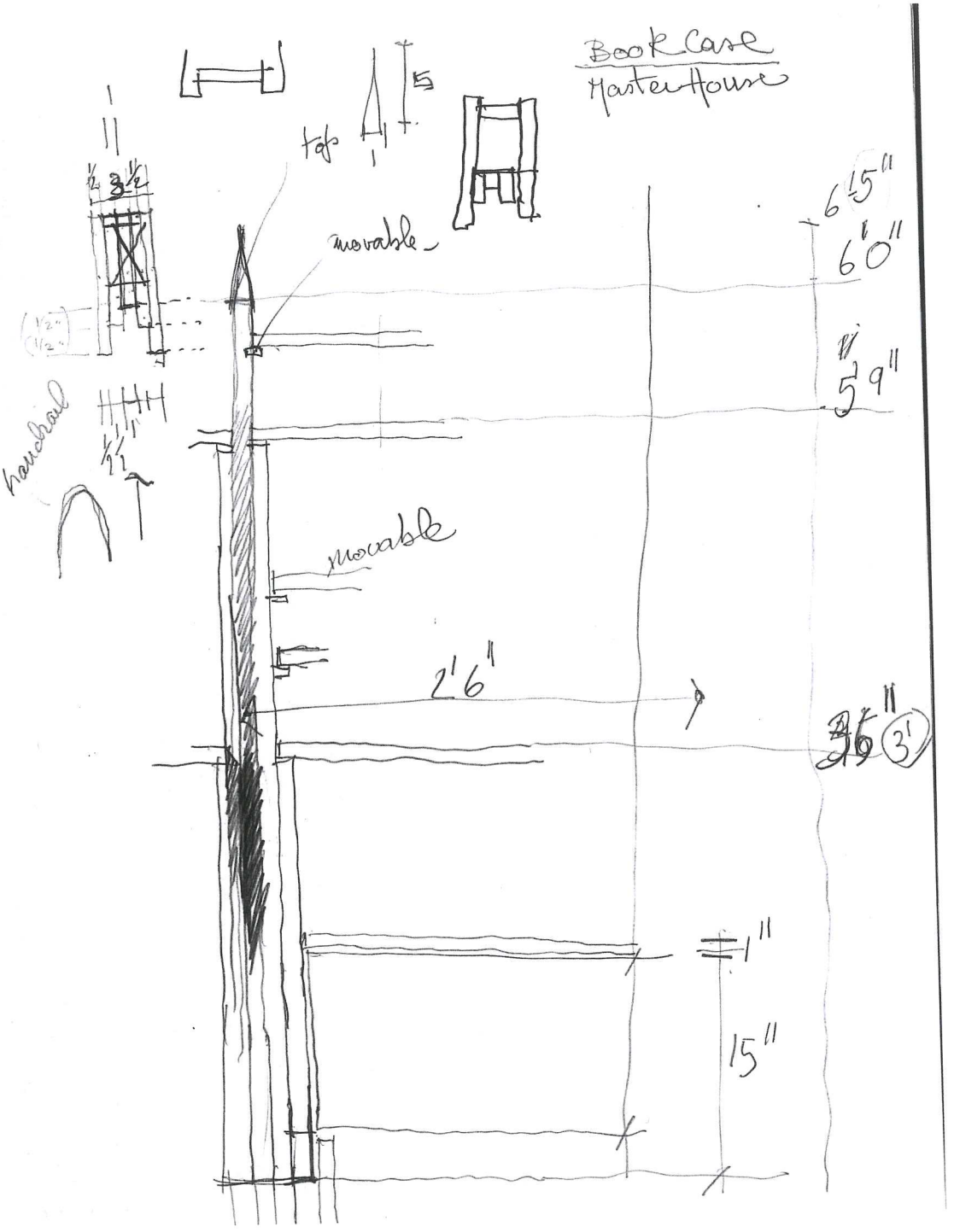

Fig. 5.8 Master's Apartment in the House of 1925, Initial Sketches of Bookcases

Drawing: Marco Frascari

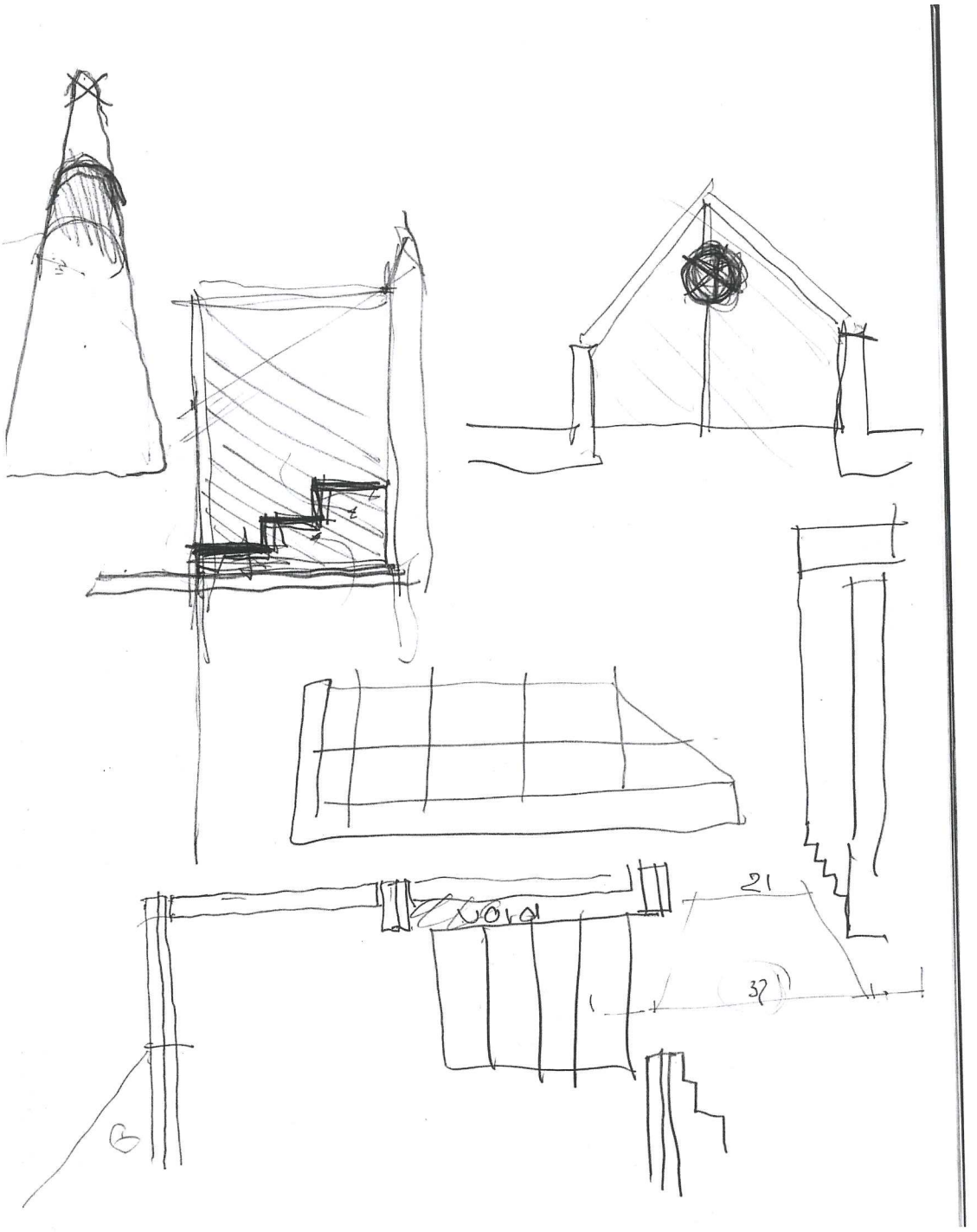

Fig. 5.9 Master's Apartment in the House of 1925, Initial Sketches of Skylight, Stair and Handrail Details

Drawing: Marco Frascari

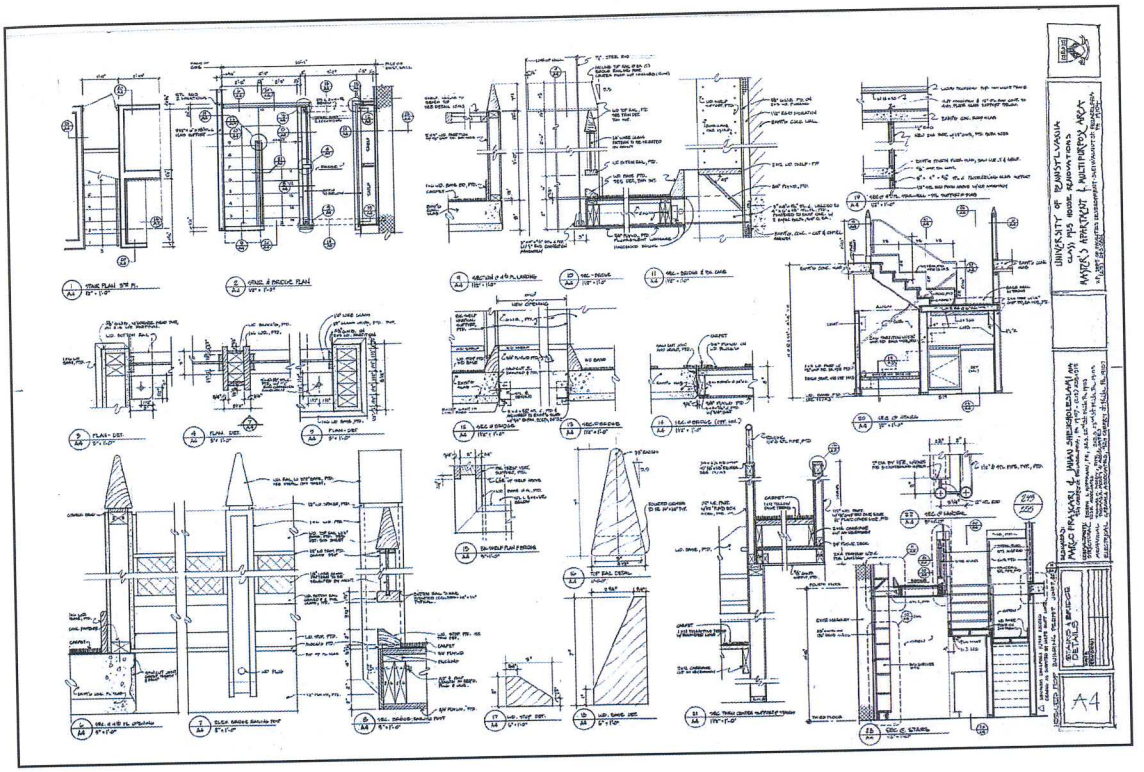

Fig. 5.10 Master's Apartment in the House of 1925, Working Drawing of Stair, Handrail and Balustrade
Drawing: Marco Frascari and Jahan Sheikholeslami

Fig. 5.11 Master's Apartment in the House of 1925, Balustrade and Bookcase Details
Photos: Sam Ridgway

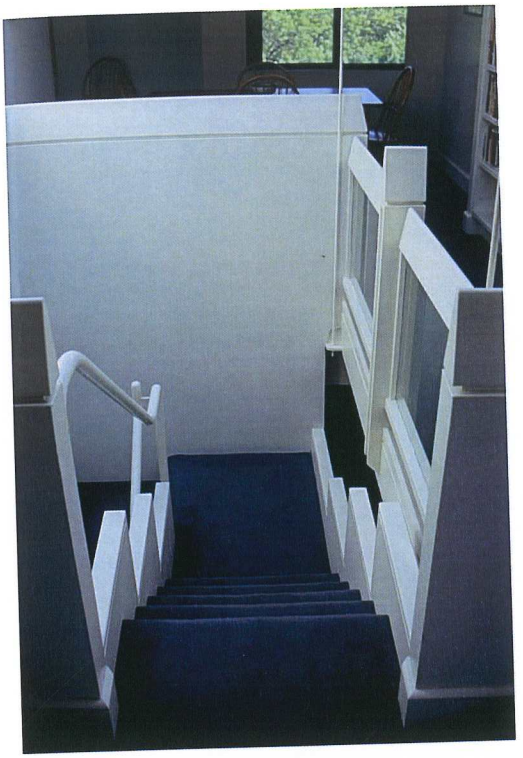

Fig. 5.12 Master's Apartment in the House of 1925, Stair, Handrail and Kitchen Partition Details
Photos: Sam Ridgway

Fig. 5.13 Casa Rossa, Dining Space
Photo: Marco Frascari

At the same time he was writing *Monsters of Architecture,* Frascari extensively renovated and extended the *Casa Rossa* (1985-91), a small house in the delightful northern Italian city of Vicenza. This house is one of two built in Italy, the other is an early work at Roncoleva (Fig. 5.20) outside Verona, although there are numerous unbuilt projects mainly sited in and around Verona. There was also a project that was partially built but sadly later demolished on the lake front at Lazise near Verona. Visiting the ancient and architecturally sensuous cities in the Veneto region including Vicenza, Verona, Venice and Mantua, it is possible to gain a sense of Frascari's early cultural and intellectual influences. Mantua, where he was born, has two Alberti churches and Vicenza is well-known as home to a significant number of buildings by Andrea

Palladio. Several of Palladio's buildings left unfinished at the time of his death, including the Teatro Olimpico, were completed by the Vincentine architect Vincenzo Scamozzi who, as Frascari points out, was also an exceptional scholar and architect in his own right. Casa Rossa is only a few hundred metres from the *Teatro Olimpico* in the centre of Vicenza, which is itself a few minutes' walk down the *Corso Andrea Palladio* from the *Piazza dei Signori* and Palladio's *Loggia Bernarda* and *Basilica*. The *Basilica* is referred to in *Monsters of Architecture* as "a canonical monster ... a colossal whale emerging over the crossing of the Cardus and Decumanus in the urban fabric of Vicenza. It is a Minotaur enclosed by Palladio-Daedalus within a labyrinth of Serlio's windows."[11] Palladio's Basilica is a grotesque building combining at least two architectural bodies into one. At the heart of the surrounding classical loggia and enclosing roof is a much older palace that was seriously damaged by fire in 1444. Palladio's genius was to successfully bring together two entirely different architectural forms and methods of construction, the medieval and the classical. He did this primarily by interpreting and developing an existing window element, the serliana, the dimensions of which could be adjusted to marry into the older medieval structure constructed of ogival arches. As Frascari points out, this transformed an indecorous construction into a "decorous building type: a basilica" so successful that even though the architectural element, the serliana, was originally invented by Serlio it became widely known as the Palladian window.

The Casa Rossa is also an architectural monster, albeit by comparison with the Basilica a miniature one, as one building is born from the union of two buildings, the existing and the new. (Fig. 5.14) The project involved gutting the existing building, re-roofing it and creating a new interior. Interestingly, the space it occupies was once a courtyard between buildings, something that was discovered during construction when the builder noted that window sills in the existing exterior walls were facing inside out. In a continual cycle of construction, an opening between buildings had over time been "swallowed by the world" becoming an internal space and the surrounding buildings demolished. Every renovation requires a degree of diagnosis and dissection of the existing building, so the sills were removed from the walls, rotated and then once again built in. The finished external skin of the building although essentially inside out, is unremarkable in its urban context. It is not a finished, discreet image but situates itself in its surroundings by means of a similarity of construction.

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[11] Marco Frascari, *Monsters of Architecture*, pg. 53.

Fig. 5.14 Casa Rossa, Construction and Finished Facade
Photos: Marco Frascari and Sam Ridgway

During the final stages of construction, or shortly after the completion of this building, Frascari produced a retrospective interpretation of its construction in three graphic panels that reveal some of his thinking about the project. (Fig's. 5.15-5.17) The isometric drawings at the centre of one panel depict a kind of renaissance anatomical study of the new building's entrails, with their enclosing flesh and skin removed. A correlation between the human and architectural body is highlighted by photos that surround the drawings showing parts of the building under construction. Most of the shots are taken from unusual, almost indelicate angles, looking along beams or directly upwards into the buildings voids and crevices in an attempt to reveal the buildings "lower stratum" and "corporeal functions," something that professionals tend to disguise rather than accentuate. The photos and drawings also allude to the generative and meaningful role of construction and detailing; "the construction of imagination and the imagination of construction."[12] Despite the fact that the drawings show no construction detailing in the conventional sense and were made after the building was completed, it is evident that a link is being made between drawings depicting the imaginative generation of the building and its construction. Most of the photos show the messy construction of details and are connected with subtle lines to the anatomical drawing of the building. The belief that tectonic imagination is, or should be, central to the design process seems clear. In *Monsters* he states that:

> Buildings are texts whose architectural potentialities can be read by bringing to light the roots of the imagery of human thought. This process is based on the

[12] Marco Frascari, AHRA conference abstract 11.05

> construing of details, an anatomical procedure that singles out the meaning of the bodies of buildings through a reasoning based on an understanding of the parts of construction.[13]

Metonymically, the soft curved plan and form of the bathroom wall and attached stair (Fig. 5.19) derive from the interior forms of the human body and this element together with the slightly irregular existing exterior wall inspired the new plan for the *piano nobile* and mezzanine. From an inscription on the mezzanine plan it appears Frascari also considers that he has placed himself in the building, proposing that architecture is biographical, "an embodiment of the self in building." To counter the urge to make this egotistical, he inscribes the following on the mezzanine floor plan:

> Architecture is the *locus* of the reconciliation of the art of living well with the art of constructing well the essence of architectural thinking is eluding the trap of envisioning a DREAM ARCHITECTURE as a conceit of selfish and egotistical desires.

The plans of the Casa Rossa that appear on the graphic panels play a somewhat different role in this retrospective technography. In an article he published in 1989, Frascari highlights the plan as "one of architecture's most puzzling enigmas." With reference to Vitruvius, the article "Ichnography: The Topical Enigma of Architectural Plans", extols the extraordinary ability of architects to imagine a building by tracing its plan. Ichnography (*ichnographia*) the drawing of plans, from the Greek "*ichnos* = foot-sole and *graphos* = writing/drawing" is a topical procedure, the making of an architectural place. According to Vitruvius ichnography is the first of three "arrangements" required to make a "fit assemblage of details." the other two are "orthography (elevation) and scenography (perspective)." Arrangement is a critical constituent of good architecture. Inscribing a plan on paper is not the "functional result of descriptive geometry" but a topographical demonstration, analogous to setting out the construction of a building on site with "ropes and boards".

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[13] Marco Frascari, *Monsters of Architecture*, pg. 12.

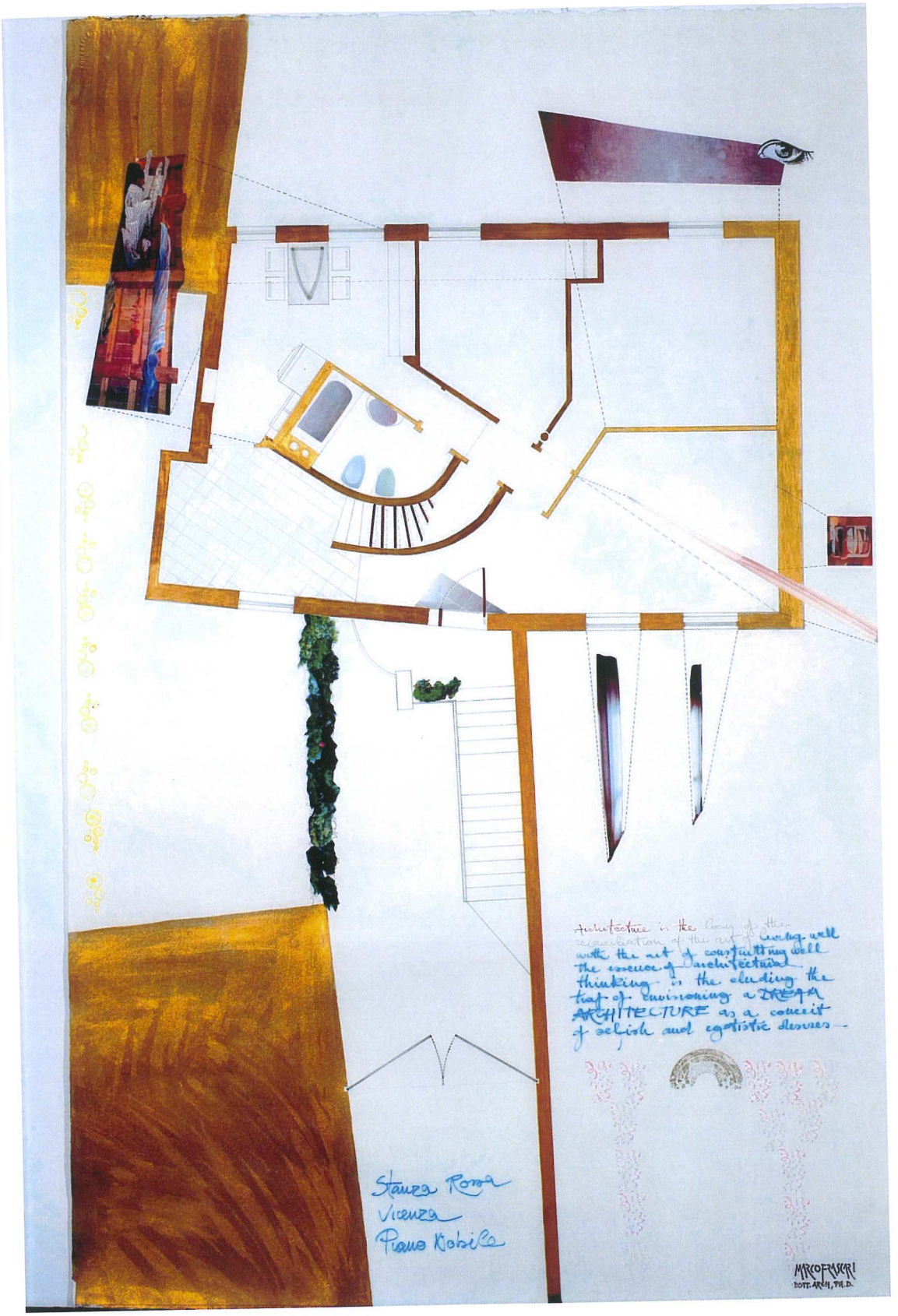

Fig. 5.15 Casa Rossa, Post-Construction Technography, Piano Nobile
Drawing: Marco Frascari, Architectural Archive, The University of Pennsylvania

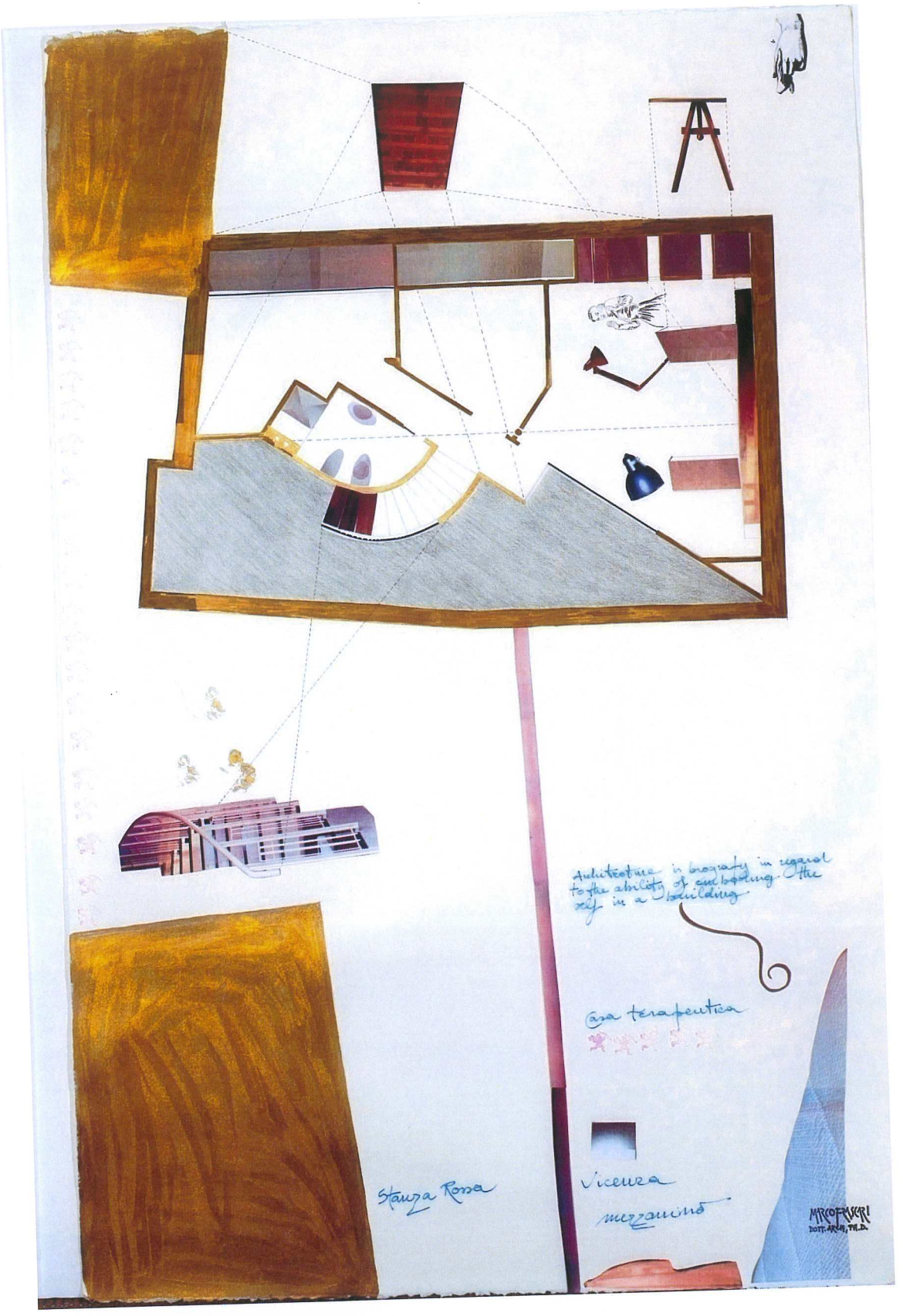

Fig. 5.16 Casa Rossa, Post-Construction Technography, Mezzanine Plan
Drawing: Marco Frascari, Architectural Archive, The University of Pennsylvania

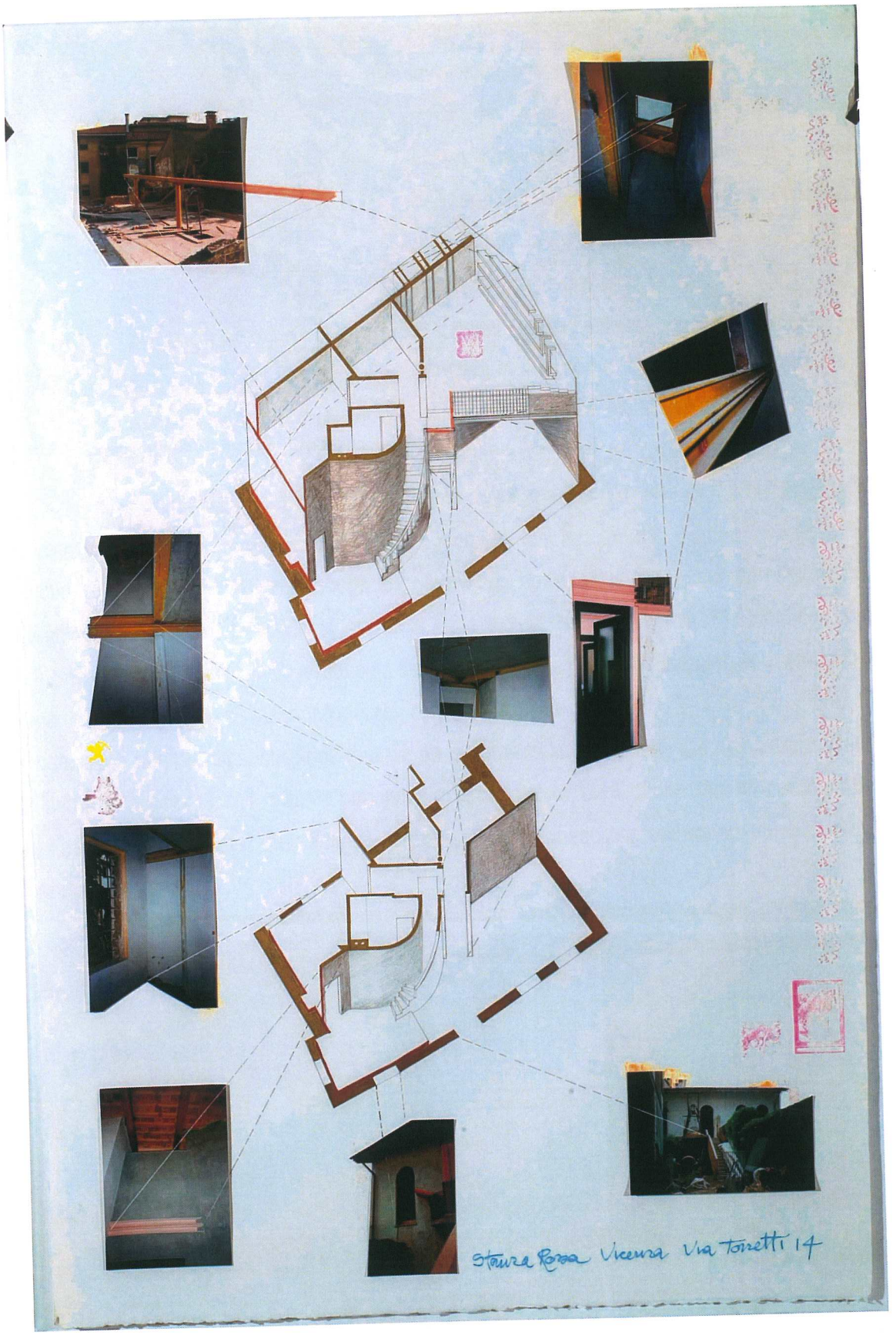

Fig. 5.17 Casa Rossa, Post-Construction Technography, Anatomical Study
Drawing: Marco Frascari, Architectural Archive, The University of Pennsylvania

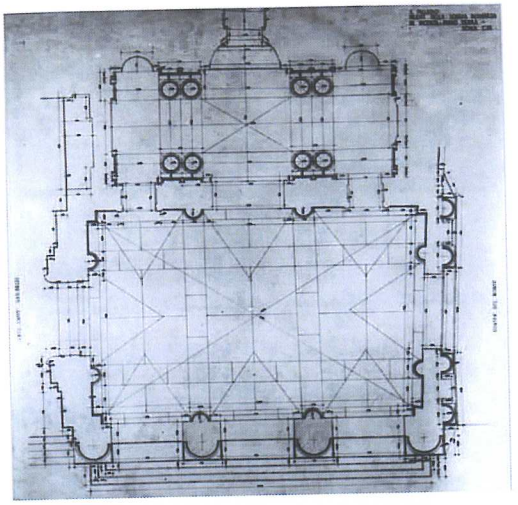

Fig. 5.18 Loggia Bernarda Andrea Palladio
http://en.wikipedia.org/wiki/Palazzo_del_Capitaniato

Plans demonstrate and represent some of the invisible aspects of a building that can otherwise never be seen. "The content of the plan incorporates that which is present in the visible building, but which is itself invisible." Through plans, architects represent three dimensional extensions of walls with two dimensional marks on paper in a "topological game" where the function of the rooms *"become self evident in the composition of the* plan." A plan is not only a representation of a building but is also generative; it "produces it poetically." Most people never see a drawn plan of the buildings they occupy and therefore the poetic or generative geometry that has brought it into existence is not visible to them. Its invisibility poetic or otherwise, however is an extremely significant, meaningful element of the building and to a large extent determines how it is inhabited and understood. "It is in this poetic dimension that the enigmatic beauty of the plan lies, embodied most powerfully in the plans produced by Renaissance architects."[14] Like the plans of renaissance and classical buildings that we have come to know so well, the plans of the Casa Rossa that appear on the graphic panels were produced retrospectively after its construction and allow us to reflect on their enigmatic quality and the poetic and anthropomorphic thinking that inspired them.

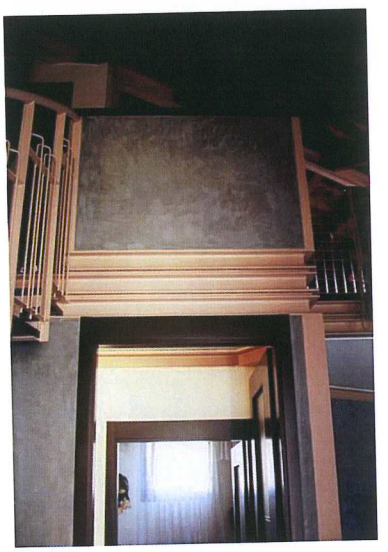

Fig. 5.19 Casa Rossa, Bathroom Wall and Stair Detail

Photos: Marco Frascari and Sam Ridgway

[14] Marco Frascari, "Ichnography: The Topical Enigma of Architectural Plans," *Terrazzo* 3 (1989): pg. 125-126.

Fig. 5.20 House at Roncoleva, Fireplace, Entry Stairs and Deck
Photos: Sam Ridgway

Fig. 5.21 Villa Rosa, Kitchen
Photo: Marco Frascari

From 1997 until he moved to Ottawa to take up the directorship of the School of Architecture at Carleton University in 2005, Frascari was G. Truman Ward Professor of Architecture at the Washington, Alexandria Architecture Center (WAAC), an off campus College site of Virginia Tech. During his tenure at the WAAC he purchased a small timber framed house on the outskirts of Alexandria and transformed it into the Villa Rosa. Despite the fact that this construction took place in the highly commercialised North American building industry, the working drawings for the Villa Rosa exemplify and explore the idea of a technography, the writing or drawing of architectural technology. Unlike Scarpa's drawings, these are recognizable as conventional working drawings, in fact their deceptive ordinariness tends to obscure further insights they offer into the relationship between working drawings and construction. When Frascari introduces the term technography in *Monsters,* a term he is reviving in anglicized form the term *tecnografia* used by Lodoli to "define a correct use of

representation in the practice of architectural technology,"[15] he adds a footnote that could well describe these drawings. The key point of the note in relation to the demonstration of construction, is that we should produce drawings that are "an imitation of the act ... rather than through an imitation of the object," a demonstration rather than an image.

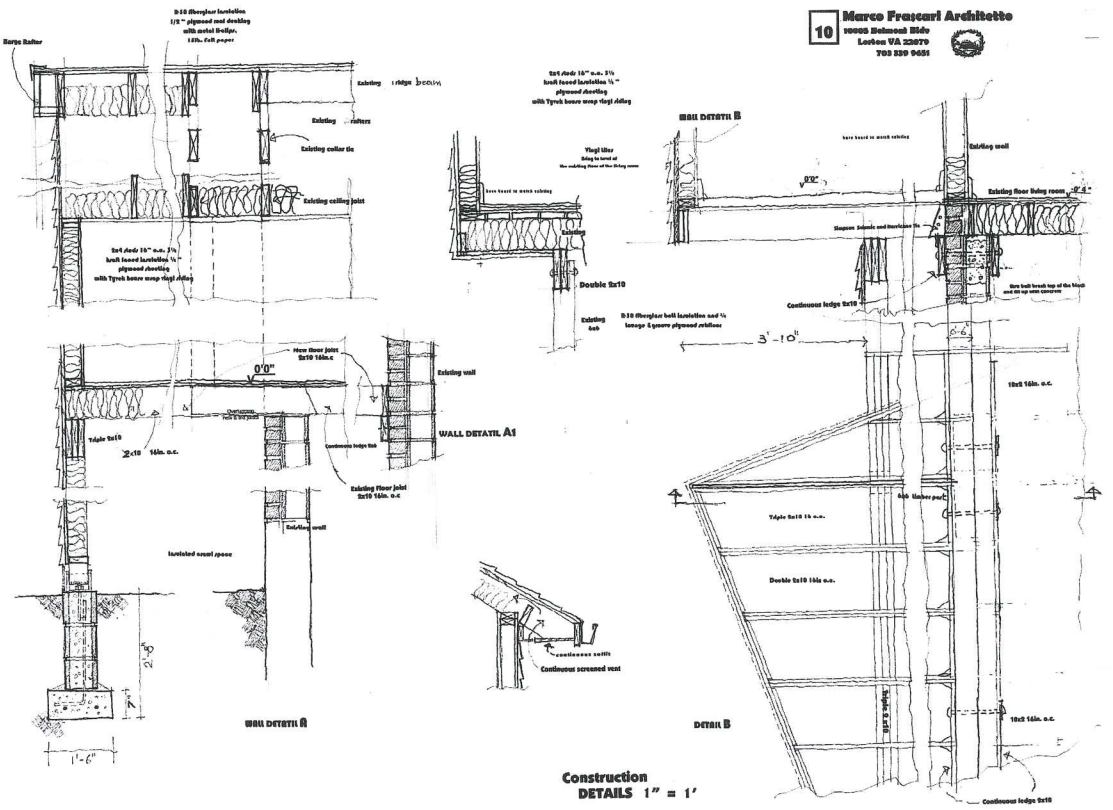

Fig. 5.22 Villa Rosa, Working Drawing
Drawing: Marco Frascari

The first thing to note about the drawings is that they are hand-drawn without the use of a straightedge. (Fig. 5.22) This immediately sets them apart from hand-drawings drawn with a straightedge and drawings produced with CAD. Construction is demonstrated through an analogical, graphic procedure on the drawing board. These drawings are a technography, a palimpsest of technological icons comprised of three overlapping semiotic relationships. The first between the drawing and the building (both the existing building and the yet to be built additions); the second between the drawing and the builder; and the third between the drawing and its cultural context and inhabitants. "Displayed as a whole, the palimpsest of the

[15] Marco Frascari, *Monsters of Architecture*, pg. 95.

technological icons is the matrix of the representational theories of the constructed world."[16] The primary purpose of this is so the builder, the builder's management and all the trades can understand the construction of the proposed new work in context of the existing building's construction. The drawings are perhaps most palimpsest-like in their relationship with the architectural artefact. They reveal the merging of the existing and new architectural bodies to produce one monstrous body. An overlapping of technological icons is evident in the analogical relationship between the wobbly hand drawings, the imprecise existing timber-framed building and the proposed new construction that is both interpretive and precise. This is significant for both the drawing/building relationship and the drawing/builder relationship, in the latter case the drawings also demonstrate the act of construction through the graphic depiction of materials and details.

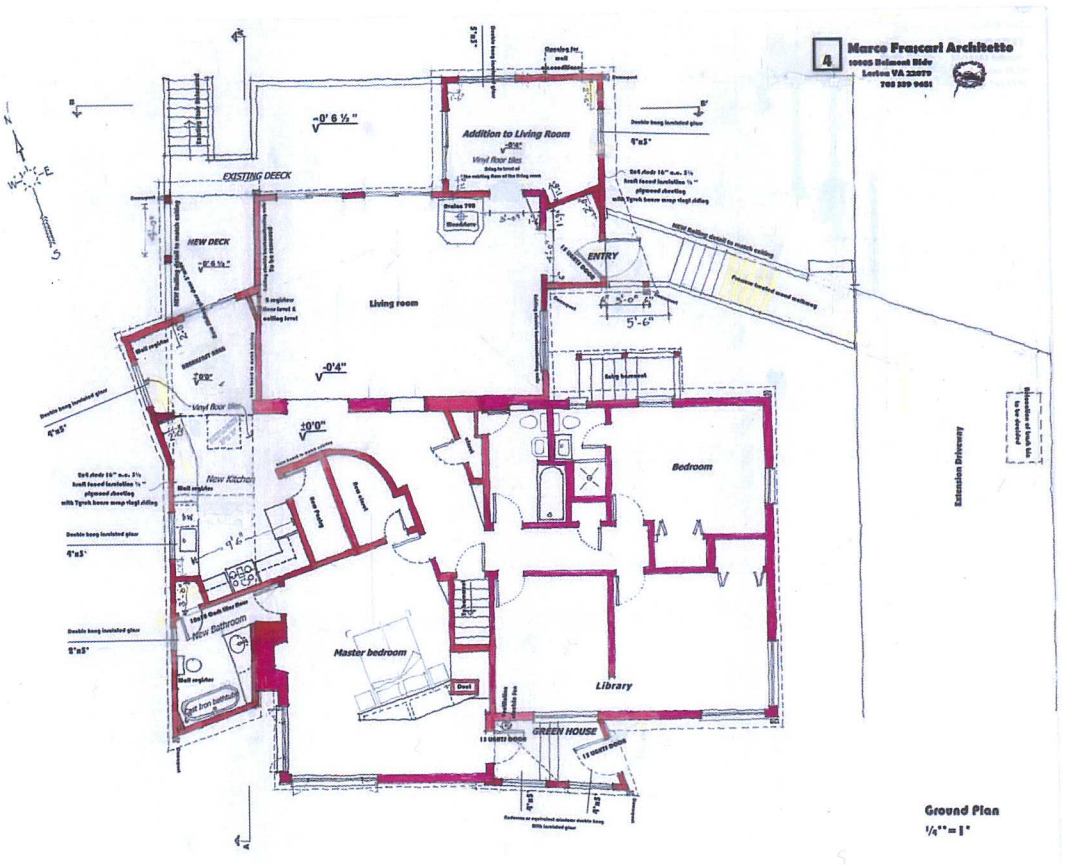

Fig. 5.23 Villa Rosa, Working Drawing, Plan
Drawing: Marco Frascari

There are some quite obvious signs to the builder that the drawings for the Villa Rosa stand for something more and must be interpreted. The floor plans, for example are rendered in dark

[16] Marco Frascari, *Monsters of Architecture*, pg. 95

pink felt tipped pen. (Fig. 5.23) Another instance of an overlapping semiosis occurs between the builder's interpretation of the drawings and the way the design of the building has taken account of its relationship with the human bodies of its future occupants. As a sign and as a design projection that, in the pursuit of happiness, this building is concerned with the relationship between the human and architectural body, a drawing of a naked human body is transposed into the working drawings. (Fig. 5.24)

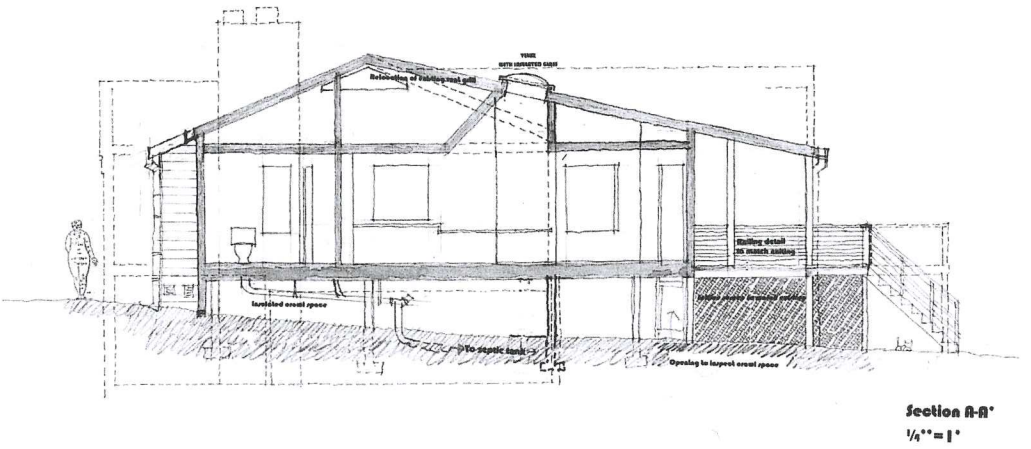

Fig. 5.24 Villa Rosa, Working Drawing, Section with Albrecht Durer Figure
Drawing: Marco Frascari

This is unusual and performs not only the important objective of giving scale but is part of the "infinite process of interpretation" that allows the builder to understand the nature of the construction. The naked figure, a meticulous measured drawing of a female body by Albrecht Dürer, one of a series showing various body shapes of both sexes, is placed outside the building on the elevations and sections and is a sign that this is primarily an internal renovation to clothe the body; a second skin. The figure helps to make the drawing promising, a prosperous, and tangible demonstration of "the real measure of architecture." In a passage in *Monsters of Architecture* that discusses the function of architecture in relation to Lodoli's dictum "Let Representation be functional," Frascari, referring to Merleau-Ponty, points to the primary (functional) relationship between "the live human body" and the "constructing of architectural images."

> *Architecture is in the world of the visible. This means that the bodies of architecture surround our bodies and architecture and the human body are one*

in front of the other and between the two there is "not a frontier, but a contact surface." (Merleau-Ponty 1968, 271) [17]

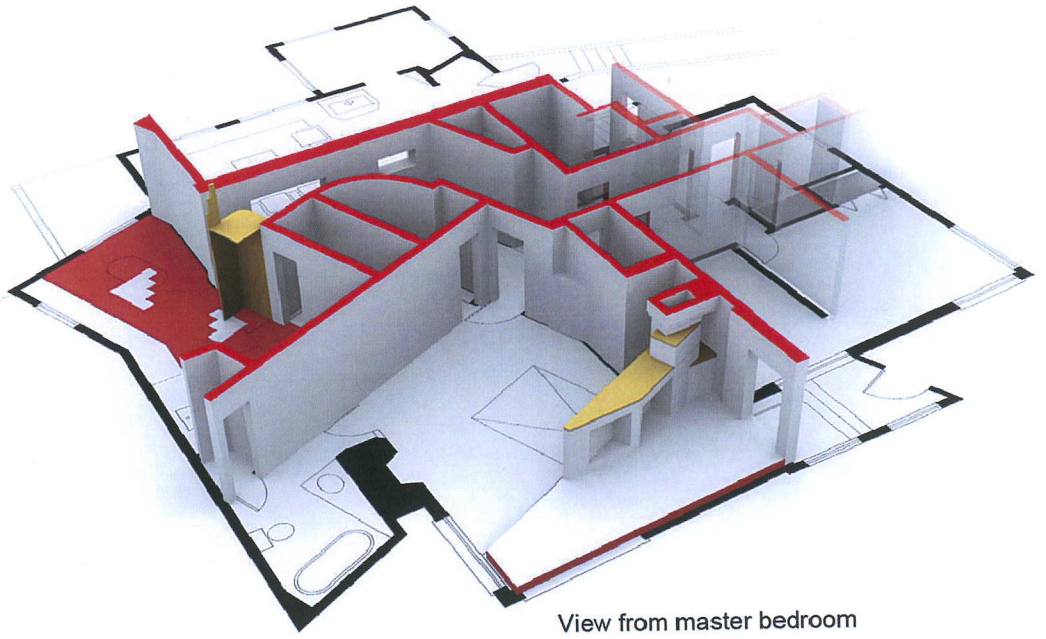

Fig. 5.25 Villa Rosa, Kitchen Addition Hinged Around Air Conditioning Duct
Drawing: Cai Jun

[17] Marco Frascari, *Monsters of Architecture*, pg.33.

Fig. 5.26 Villa Rosa, Bedroom
Photo: Marco Frascari

> Despite the present limitations on the use of the body in architectural projects, the process of embodiment takes place in both the constructed world and in the drawings that are necessary to accomplish the construction. The task of professors and professionals of architecture is to recognize these corporeal presences and make them tangible in their academic and professional works.[18]

In this building, as in the Casa Rossa, the generative curved wall detail appears. In both, it relates to the body's softness and curves, acting as a strong means of breaking from the rectilinear. In this building it acts as a gentle formal joint between the existing and new parts of the building indicating the hinged opening up of the plan pivoted around the immovable air conditioning duct in the master bedroom which in turn generates the added on kitchen and extra bathroom. (Fig. 5.25, 5.26) To reiterate the distinction between buildings of professors and professionals based on how their buildings embody the characteristics of human bodies, this building is a grotesque image rejecting the "smooth and impenetrable" surfaces of the neoclassical body and magnifying the "excrescences and orifices which lead to the body's depths. The outward and inward details are merged." The kitchen and bathroom addition is an excrescence, a growth that protrudes from the original body of the building highlighting its

[18] Marco Frascari, *Monsters of Architecture*, pg. 4.

monstrous nature. It is a "chiasm expressing two bodies in a single one,"[19] from one body another is generated and born. For Frascari a building can only really call itself a work of architecture if it addresses the basic functional requirement of forming a happy relationship with the human body and this can only be done though the embodiment of human attributes and characteristics.

[19] Marco Frascari, Monsters of Architecture, pg. 35.

THE REPRESENTATION OF CONSTRUCTION

Fig. 6.1 Peter Zumthor, Saint Benedict Chapel (1989), Sumvitg Switzerland, Ceiling Detail
Photo: Sam Ridgway

Introduction

Representation refers to the presentation of one thing (the signified) in or by another (the signifier). One thing is presented *again* in another. The world of architecture is a world of representation. Architects do not build buildings; they represent them, mainly through drawings, models, words and numbers. In turn, buildings are also interpretations or representations of these mediating instruments and artefacts that precede their construction. Intentionally or otherwise, drawings and buildings also represent many other things. In what follows, drawings and buildings are considered to be the result of both productive and symbolic representations. In other words, drawings and buildings are made according to prevailing conventions of production while at the same time seeking to satisfy the human need to embody symbolic meaning. In the search for improved ways of teaching architectural construction, exploring the relationship between drawings, particularly working drawings, and buildings is

crucial. A study of this nature unavoidably sheds light on questions of symbolic and productive representation, questions that are central to architectural pedagogy and practice.

In the west, both the relationship between drawings and buildings, and between symbolic and productive representation, have changed considerably over time, and these changes are intimately connected to the development of the profession of architecture as we know it today. The origin of architectural practice in the representation of buildings is considered to have emerged in the ancient world in the space that formed between the idea of a building and its actual, physical construction. The most common mediating artefact between idea and building was drawing. In addition to constructing buildings according to custom and tradition, builders began to make drawings that could be used to guide construction. The making of these drawings is thought to have been highly ritualized, prophetic and culturally embedded, and rarely, if ever, conceived of as the result of personal will as is the case today. Drawings were often extremely practical, template drawings for example, which were used to make templates for marking out the position of cuts required to shape building stones. Despite their practical nature however, these drawings embodied or represented a concentrated symbolic content and were not simply neutral instruments of production.

Unlike their pre-modern ancestors, modern working drawings are commonly considered to be an entirely neutral and instrumental means of transmitting construction information to the builder. While several kinds of representation techniques are used in the design of buildings, including hand sketches on paper, physical models, texts and various forms of digital media, working drawings are predominantly a collection of two-dimensional orthographic projections at different scales, now almost universally produced at a computer work station using a form of CAD software. Alberto Pérez-Gómez writes that in current practice, construction drawings "are expected to be absolutely unambiguous to avoid possible (mis)interpretations, and to function as efficient neutral instruments devoid of inherent value other than their capacity for accurate transcription." It is on this basis that both the CAD skills and the orthographic drawing techniques required to create working drawings are usually taught to students in construction courses. In his article "Questions of Representation: The Poetic Origins of Architecture," Pérez-Gómez argues however, that the representational tools underlying "the conception and realization of architecture" are "value-laden," and that acknowledging this is the first crucial step to overcoming the current "ideological stagnation plaguing most architectural creation." [1]

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[1] Alberto Pérez-Gómez, "Questions of Representation: The Poetic Origins of Architecture," *Architectural Research Quarterly*, 9, 3/4 (2005): pg. 217.

Pre-Modern Representation: The Temple of Apollo at Didyma

The link between drawing and building is probably prehistoric, originating in marking out building plans directly on site with lines scratched into the soil, later becoming string lines, pegs and boards. Even more basic set outs might have involved stepping out the plan and scuffing the soil with a foot or stick. This practice is still very much an early part of envisioning a building in relation to its site. The origin of architectural drawing in building practice can still be seen even when builders use sophisticated surveying equipment to mark out a building plan with paint and pegs onto a site before construction can begin. In the western architectural tradition, the initial separation between construction and representation can be traced to ancient Greece where the creation of representations of buildings — drawings, models, or texts for example — started to become a separate activity from physical construction. To reinforce the important link between drawing — the defining activity of architects — and building, it is worth stating the obvious, that the profession of architecture grew out of the practice of building, not the other way around. In the West, the profession of architecture has its origins in the imaginative, symbolic and practical representation of constructions. The building project began to include the creation of architectural representations, mainly drawings, which were used to guide the construction of buildings.

Prior to and including much of the Renaissance, the number of architectural drawings required to construct buildings was extremely small and most were still embedded in the construction process. There are ancient and medieval examples of drawings scribed directly onto the surfaces of buildings as a means of guiding the builders and of ensuring continuity of construction, sometimes over several centuries. The Greek temple of Apollo at Didyma in southwest Turkey for example has the outlines of columns, column bases, lintels, and drawings defining the slight incline of walls scratched directly into its stone surfaces. The stone appears to have been first covered with red chalk to highlight the scribed line and to allow for corrections. These drawings were accurate full-sized templates from which dimensions and the shape of elements could be taken directly. The reason they are still visible is that, despite being intermittently constructed over 600 years from about 334 B.C., the temple was never finished, so the drawings were not removed in a final polishing of the walls.

In addition to these drawings scratched into the lower walls of the *adytum* (the inner sanctum of the temple), the upper face of each horizontal layer of the stepped temple base is engraved with fine lines marking out alignments, set outs, axes and sometimes plan details of the next layer of construction. As the temple grew, each preceding layer of set-out drawings

was covered over, but as the temple was never completed some markings were left exposed. According to Lothar Haselberger, the archaeologist who investigated these tracings, the accurate, final position of temple walls and columns, under construction when building finally ceased, have been set out on the top layer of the wall surrounding the temple nucleus. Haselberger surmises that "design" drawings of the temple were made before construction began on materials that have not survived, and he names the "architects" of its design as Paionios and Daphnis. It is unclear what role they or their drawings played as the drawings on the *adytum* walls were made approximately 80 years after ground for the temple was first broken, when they would have been long dead. What does seem clear is that drawings for guiding the temple's construction were part of the construction process and not conceived in advance. Those who incised the drawings would probably have used similar, if not the same tools and measuring instruments as the craftsmen working on the temple. Despite their simple and practical nature these drawings were representations of an intensely sacred and religious nature and probably derived in a highly ritualized fashion.

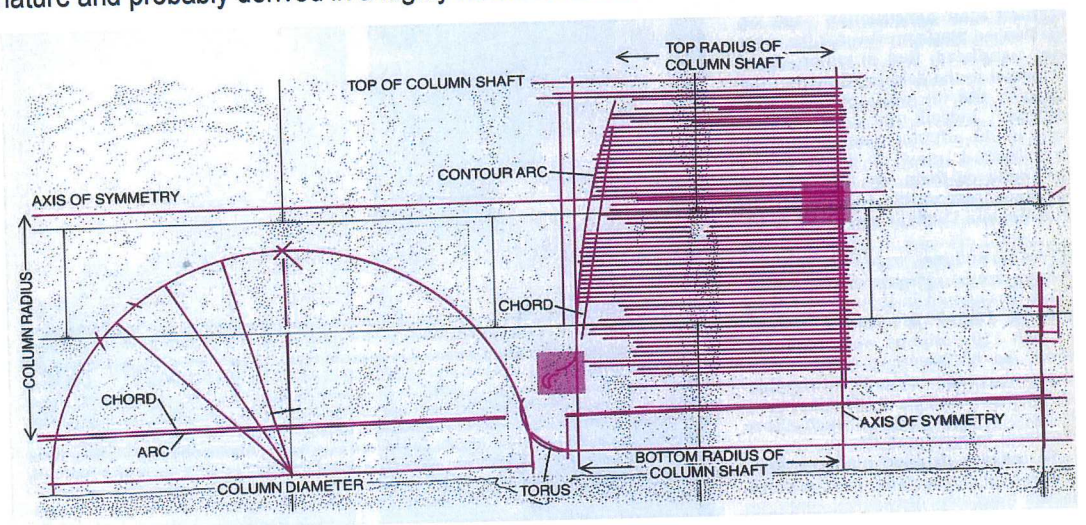

Fig. 6.2 "THREE OVERLAPPING DRAWINGS can be made out from the incised lines on a temple wall (*colored lines*). These drawings specify the shape of the column shaft and base: two vertical cross sections of the column (one of which is drawn on its side) and a horizontal section through the shaft. The upright vertical section is scaled in the vertical dimension to one-sixteenth the actual size; all the other drawings are full-scale. The joints between the marble blocks of the wall (*black lines*) are also shown. Each drawing was meant to depict half of the structure it represents; the other half is simply its mirror image. Only the top fourth of the recumbent full-scale section of the column shaft is shown. The arc below the chord outlines the nearly imperceptible curvature of the shaft's contour. The diagrammatic horizontal cross section of the shaft includes three divisions that fix the spacing for the 24 flutes around the shaft's circumference. Each closely spaced parallel line in the third drawing represents one Greek foot in length along the column shaft. In this compressed version the convex contour of the column can be clearly seen. The varying radial dimensions of the shaft could be measured off this drawing directly."

Source: Lothar Haselberger, "The Construction Plans for the Temple of Apollo at Didyma," *Scientific American*, (December 1985), pg. 120.

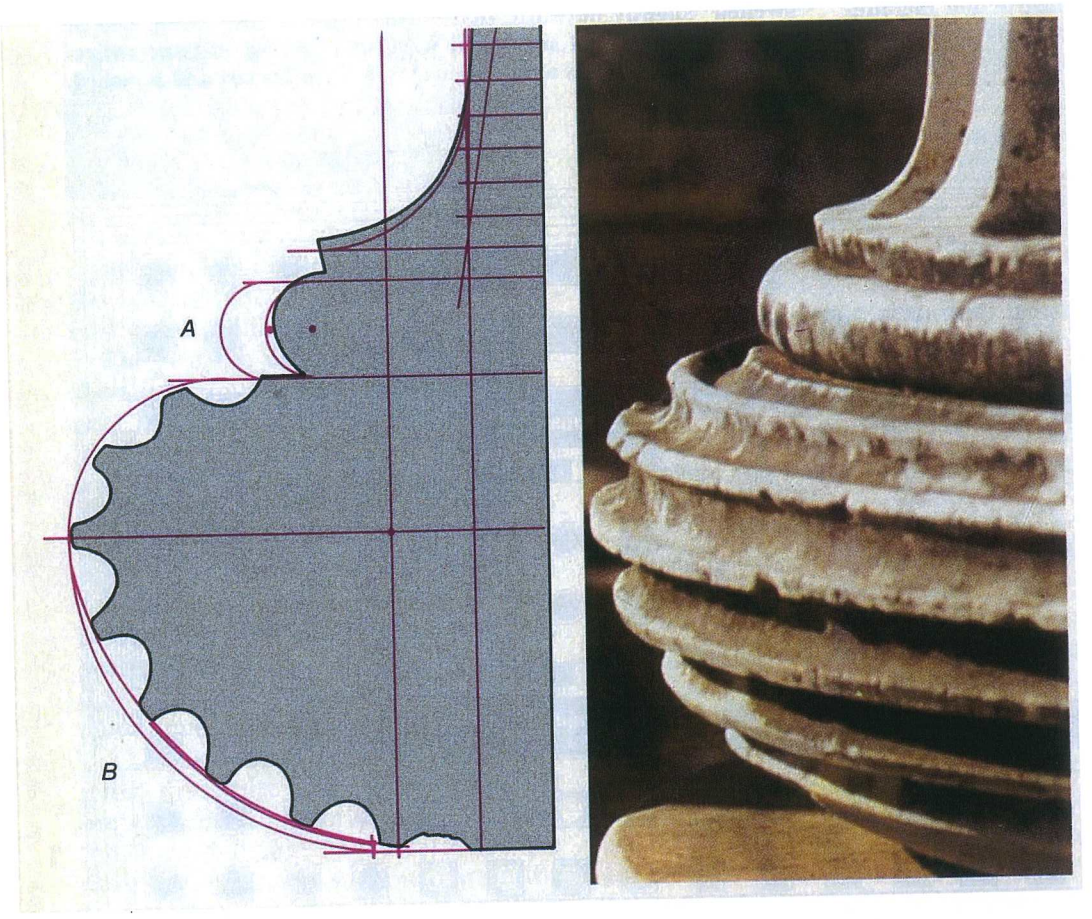

Fig. 6.3 "PLANNED AND ACTUAL COLUMN BASE can be compared in profile. The shaded outline (*left*) is a scaled cross-sectional diagram of the base of a temple column (*photograph at right*). The inscribed lines on the adytum wall are drawn here (*color*) to the same scale as the section insofar as they are visible or can be reliably reconstructed by extending visible lines. Disregarding what appear to be "first tries" at a base design, the match is close. The re-drawing of the semicircular moulding (*A*) and of the protruding curve below it (*B*) indicates that the sketches on the wall were drafts, the final versions of which were then executed."

Source: Lothar Haselberger, "The Construction Plans for the Temple of Apollo at Didyma," *Scientific American*, (December 1985), pg. 118.

Stereotomy

The construction of buildings in the Egyptian, ancient and medieval world had at its core the art of cutting pieces of stone and timber so that they would fit tightly and accurately together. This is often referred to as stereotomy from the Greek *stereos*, (solid) and *tomia*, (to cut). It seems likely that the origins of architectural representation lie in practices like stereotomy. The example of Didyma reveals the close and interconnected relationship between the drawing (designing), and construction of the temple; the building being drawn onto the stone from which it was made. This is true of both the overall design including the plan, and the design and construction of the building's individual pieces. The geometry of Greek and Roman buildings was relatively straight-forward and, although mathematically theorized by Euclid, it is likely masons of the ancient world relied on a working knowledge of geometrical techniques rather

than on knowledge of mathematical theory, to make their drawings and their buildings. In *Roman Building: Materials and Techniques*, Jean-Pierre Adam writes that the "Romans hardly used anything but perfect, segmental and flat arches, these last being in reality lintels made of voussoirs."[2] The geometrical knowledge and techniques required for drawing and cutting the stone voussoirs of arches based on semicircles, or for hemispherical domes, is relatively simple and was perfected by the Roman masons. (Fig. 6.4, 6.5) This constructive geometry combined with the traditional craft skills of the masons were at least partially embodied in the tools for measuring, cutting and laying stone. The tools used by Roman stone masons were remarkably similar to those used up until the introduction of mechanization in the relatively recent past and included: the straight edge, stringline, compass (dividers), squares (including levelling squares), plumb lines, and a variety of cutting and shaping implements (mallets, chisels, punches and cutting hammers). (Fig. 6.6) As the temple of Apollo reveals, it is likely that the same tools used for constructing the building were also used to draw onto its stone surfaces and that some of these tools and drawing techniques formed the basis for the development of architectural drawing.

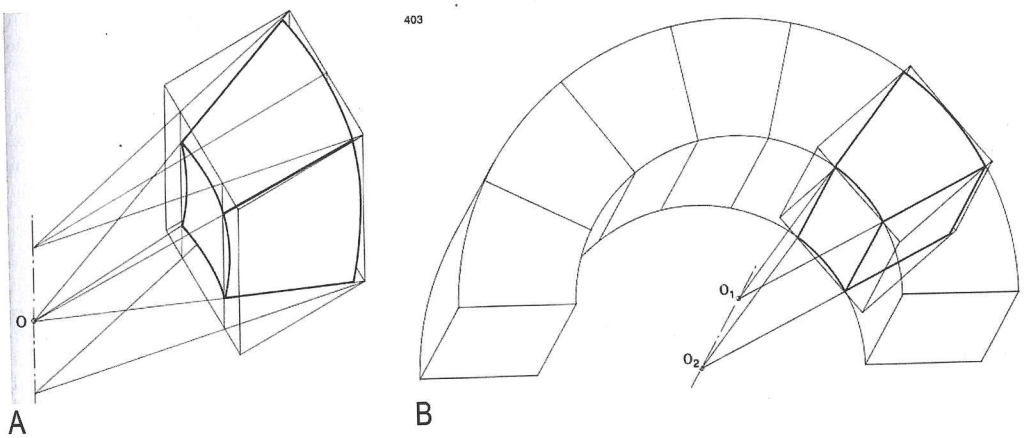

Fig. 6.4 (A) An axonometric projection of the voussoir of a hemispherical dome. All the edges of the voussoirs converge towards a single centre, O. (B) An axonometric projection of a voussoir in a perfect arch, starting with a rectangular shape.

Source: Jean-Pierre Adam, *Roman Building: Materials & Techniques*, London: B.T. Batsford, 1994, pg. 169.

[2] Jean-Pierre Adam, *Roman Building: Materials & Techniques*, London: B.T. Batsford, 1994, pg. 168.

Fig. 6.5 "triple arch with a rough extrados of opus quadratum. The irregular extrados is visually corrected by a sharp projecting archivolt springing from the band of the impost. Monumental gateway of Patara , second century, Lycia."

Source: Jean-Pierre Adam, *Roman Building: Materials & Techniques*, London: B.T. Batsford, 1994, pg. 169.

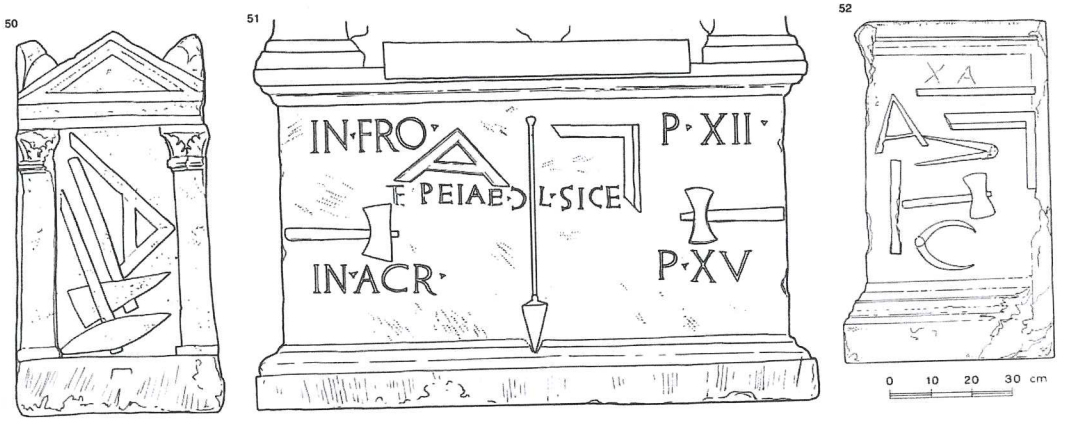

Fig. 6.6 "Funerary relief of a stone-mason, with the representation of a square, a stone-mason's hammer (or kivel) and a scabbling hammer. (Musée de Berry, Bourges; JPA.)

The base of a funerary monument on which are shown, from left to right: a mallet; a levelling square; a plumb line; a square; and a double bladed stone-hammer. (Museo della Civiltà Romana, room LII; JPA.)

Stone-mason's cippus showing: a foot without gradations (29.6cm long); a levelling square; a square; a compass; a maul or a bladed stone-hammer and callipers. (Capitoline Museum; JPA)"

Source: Jean-Pierre Adam, *Roman Building: Materials & Techniques*, London: B.T. Batsford, 1994, pg. 33.

Medieval Construction

A similar kind of construction-embedded drawing was used in medieval construction. Frascari writes that "full-sized details were drawn onto a skimming of plaster of Paris on the floor of the 'tracing house', or carved into the stone paving in the secondary parts of the building."[3] (Fig. 6.7) Pérez-Gómez and Pelletier, referring to the late medieval and Renaissance practice of template making, indicate that "as late as the Renaissance, ... the only drawings truly 'indispensable' for building (from a technological standpoint) were *modani* or template drawings . . ." They also point out that medieval architects "did not conceive of a *whole building*" and that during the Middle Ages, the notion of scale was unknown. Building was fundamentally a "*constructive* practice," that operated through "well-established traditions and geometric rules that could be applied directly on site."[4] A key difference between classical and medieval buildings, especially religious buildings, was the complexity of their geometry. As medieval cathedrals became increasingly complex, the knowledge and skills of the masons, while similar to Roman masons in relation to actual stone cutting, became more and more geometrically sophisticated. According to Sergio Louis Sanabria, while the Romans did develop the intersecting groin vault, they "avoided stereotomic computations" through the use of "mass concrete and brick that were shaped with temporary wooden formwork. Using thick mortar joints, one can rely on formwork definition even in cut stone vaults." Using a definition of stereotomy that is limited to the precise cutting of compound shapes in stone, Sanabria writes that "among the earliest buildings exhibiting stereotomic skills is the theatre at Philippolis in Syria with groin vaults executed in cut stone." More complex stereotomic skills arise seven centuries later at the end of the 10th century A.D. "in stellar rib vaults built in the expansion of the Friday Mosque of Córdoba under al-Hakim II. The vaults, with up to three arches intersecting at compound angles, exhibit precisely cut bosses shaped as irregular polyhedra."[5]

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[3] Marco Frascari, "A Reflection on Paper and its Virtues," in Marco Frascari, Jonathan Hale and Bradley Starkey (eds), *From Models to Drawings: Imagination and Representation in Architecture,* Routledge, 2007. pg. 25.

[4] Alberto Pérez-Gómez and Louise Pelletier, *Architectural Representation and the Perspective Hinge*, Cambridge Massachusetts: MIT Press, 1997, pg. 7,8.

[5] Sergio Louis Sanabria, "From Gothic to Renaissance Stereotomy: The Design Methods of Philibert de l'Orme and Alonzo de Vandelvira," *Technology and Culture*, 30, 2 (April, 1989): pg. 267.

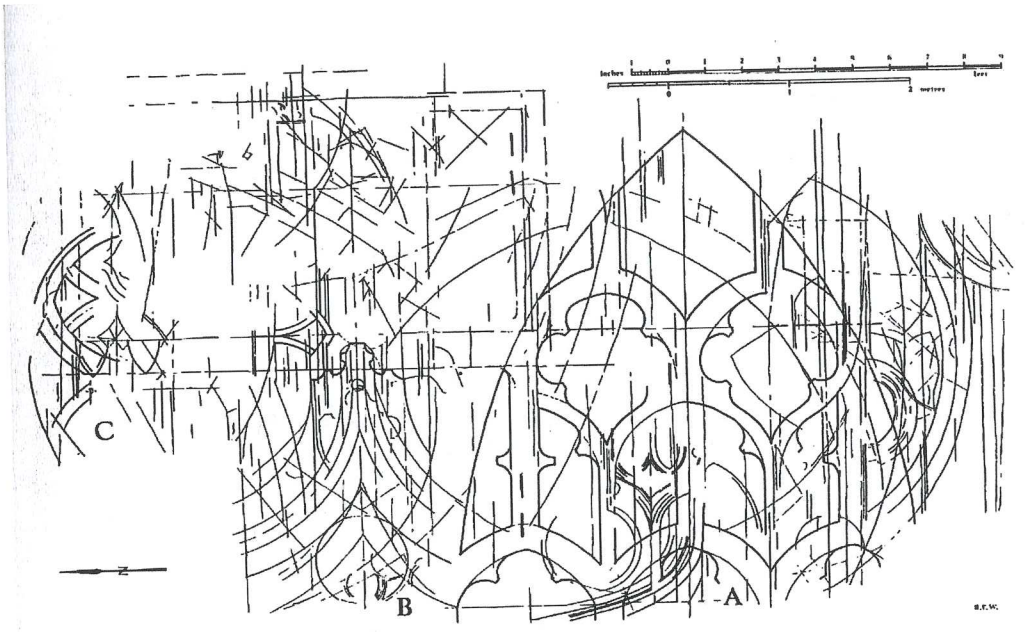
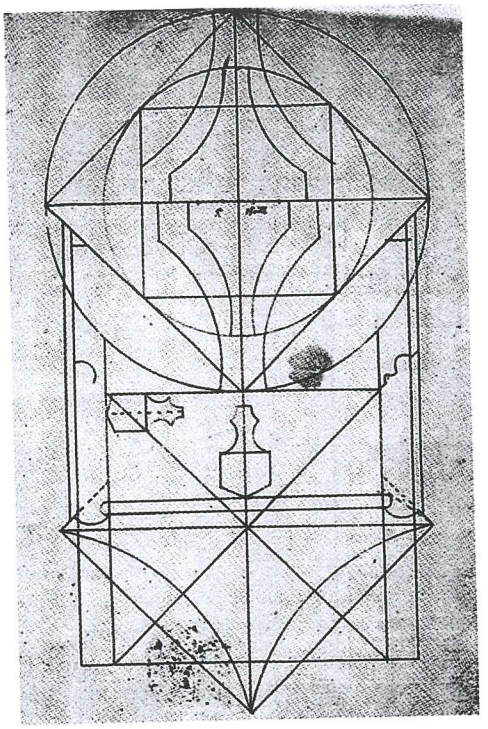
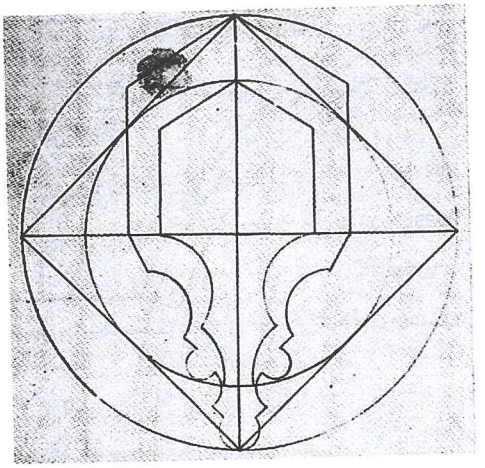


Fig. I. Drawings on the plaster tracing-floor, dating from *c.* 1360–*c.*1500
(drawing: A.R. Whittaker)

Fig. 6.7 Source: J. H. Harvey, "The Tracing Floor of York Minster," in Lyn T. Courtenay (ed.), *The Engineering of Medieval Cathedrals: Volume 1*, Ashgate Publishing, 1997, pg. 85.

The complicated, sacred geometries of medieval religious buildings encouraged the development of sophisticated construction techniques, particularly related to the accurate cutting of complex three-dimensional pieces of stone. The ability to predict the shape of stone pieces before lifting them to their final position in the building required a method of accurately drawing each face of the element at full size and then transferring that geometrical diagram onto pre-prepared, flat surfaces of the otherwise uncut stone block. (Fig. 6.11) These drawings are the modani or template drawings referred to by Pérez-Gómez and Pelletier (Fig. 6.8) and were used to accurately mark out and cut the wooden and later thin metal templates for the masons. (Fig. 6.10) They are an intermediate step between the tracing of full-sized part elevations, column plan details, window tracery, fan vaulting, and so on, and the cutting of their stone components. Although extremely practical in nature, template drawings and templates themselves represent the desire to understand and to reveal geometry as part of God's creation. Each stone the masons cut and therefore every element of the building became an embodiment of the sacred and part of God's house on earth.





10. Templates for Vault Ribs and Window Mullions in Lechlers "Instructions". (Cologne, Historisches Archiv, Hs. Wf. 276, fol. 41.)*

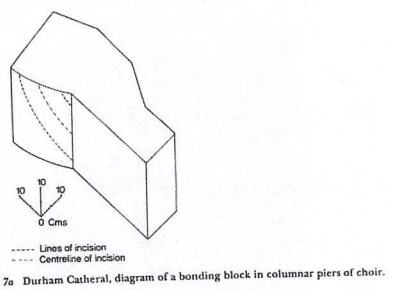
11. Templates for Transverse Ribs and Crossribs in Lechler's "Instructions". (Cologne, Historisches Archiv, Hs. Wf. 276, fol. 42.)*

Fig. 6.8 Template drawings for vault ribs, window mullions, transverse ribs and cross ribs from the "Instructions" written in 1516 by the German master mason Lorenz Lechler for his son Moritz. The geometry and scale for the large cross rib (left) is derived from two squares, one rotated 45 degrees to produce two squares of equal size which were "diagonally placed over the corners of each other." The size of the squares is derived from the width of the choir wall. In this case one side of the square is one third the width of the wall.

(Source: Lon R. Shelby and R. Mark, "Late Gothic Structural Design in the 'Instruction' of Lorenz Lechler," in Lynn T. Courtenay (ed.), *The Engineering of Medieval Cathedrals*, Ashgate Publishing Limited, 1997, pg.101.)

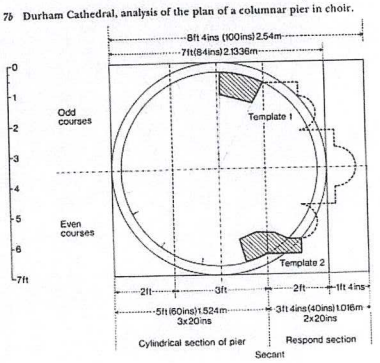
The minimal, practical and construction-embedded drawings associated with highly symbolic classical and medieval building practice are in complete contrast to the vast number of exhaustively descriptive, orthogonal working drawings produced in contemporary architectural projects. While there are many other differences between modern and pre-modern drawings, reflecting over four centuries of developments in scientific and technological thinking, the major difference is representational. The ancient and medieval examples are practical instruments that represent deeply cultural, religious and sacred meanings and values. Drawings are a means of revealing, defining and translating these into built form. On the other hand, the representational nature of modern working drawings is overwhelmingly instrumental and productive. The symbolic or meaningful value of the drawings themselves and buildings they depict is usually difficult to identify. It would seem that, even though comparing across two very

different eras, there is an inverse relationship between the symbolic qualities of buildings and the amount of drawings required to construct them.



7a Durham Catheral, diagram of a bonding block in columnar piers of choir.

7b Durham Cathedral, analysis of the plan of a columnar pier in choir.



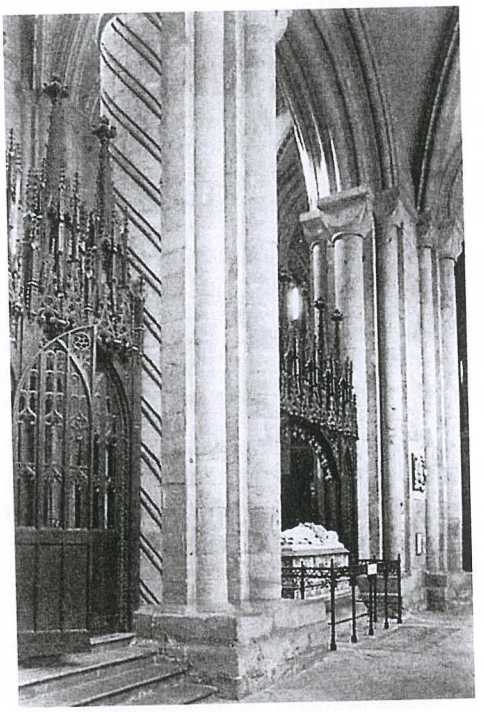
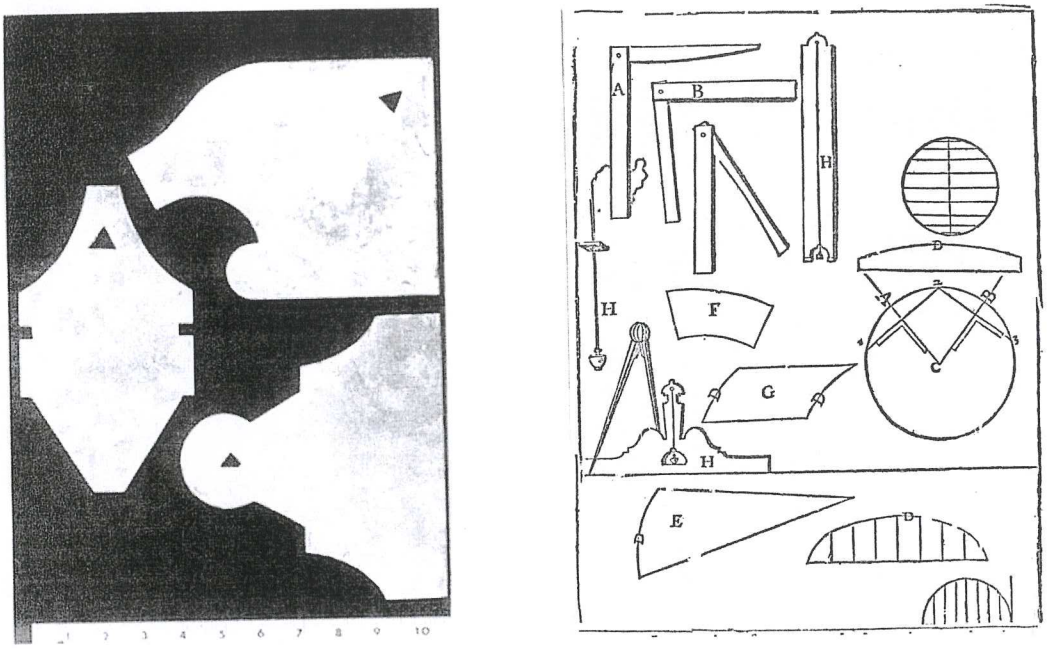


Fig. 6.9 Drawings showing the complex construction of the four incised choir piers of Durham cathedral (1093-1104). Each pier consists of a cylindrical part and a respond. The number and the precision of the blocks required for each pier including the incised spiral which was carved before the blocks were laid, meant a high degree of planning by the master mason which was translated into a series of templates used by the masons to cut he blocks.

(Source: Jean Bony, "The Stonework of the first Durham Master," in Lyn T. Courtenay (ed.), *The Engineering of the Medieval Cathedrals*, Ashgate Publishing Limited, 1997, pg.125,126.)



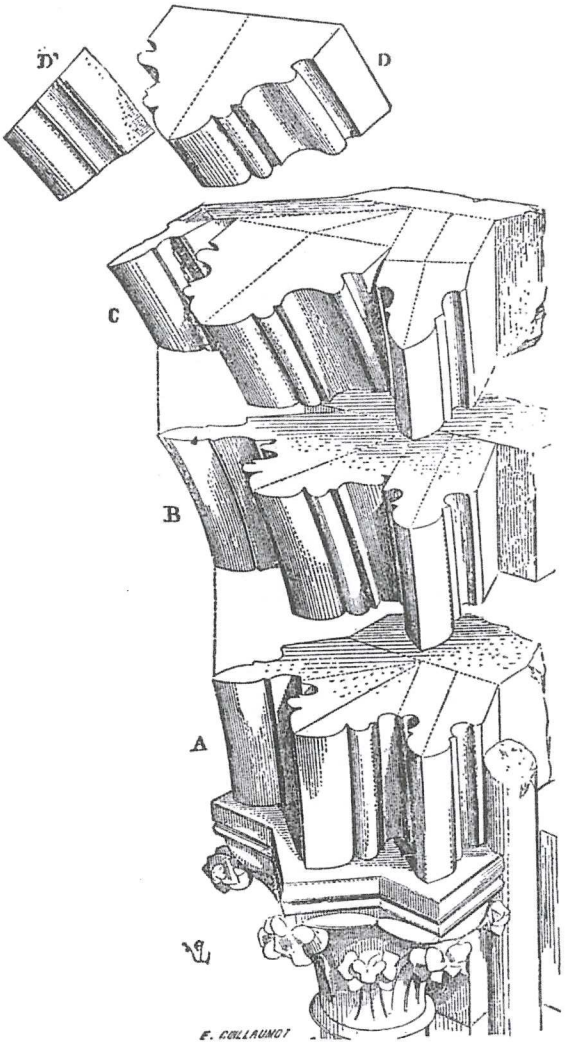
A B

Fig.6.10 (A) "Mason's templates cut from zinc sheets at the Bath and Portland Stone Company, Bath, England."

(Source: Lon R. Shelby, "Medieval Mason's Templates," *Journal of the Society of Architectural Historians*, 30, 2 (May, 1971): pg. 141.)

(B) Illustration from Book III of the renaissance architect and scholar Philibert de L'Orme's L'Architecture (1564) showing some of the "instruments that pertain to the art" of making geometric cuts "which should be known by architects and master masons to direct the cutting of stones for any purpose required." They are very similar to those used by ancient masons (Fig. 3) but with the addition of the (simple) templates (F and G).

(Source: Sergio Luis Sanabria, *The evolution of the Late Transformations of the Gothic Mensuration System: Volume II, Appendices*, Michigan: UMI Dissertation Information Service, 1984, pg. 142.)



29. *Viollet-le-Duc's Drawing of the Tas-de-Charge*

This is an exploded view of a tas-de-charge of but three courses, A, B, and C, with normal voussoirs for the transverse and a diagonal rib shown at D and D′ respectively. The beds of the tas-de-charge blocks are horizontal; only the top of the highest block has the rib portions finished in planes which slope at an angle normal to the curve of each rib. In the lower right is the stump of a column shaft that would normally continue upward to the spring of the wall arch, some distance above the capital that marks the spring of the transverse and diagonal ribs. It may be seen that the lateral face of the tas-de-charge blocks continues back to the clerestory wall in the plane of the diagonal rib's side (as indicated more fully in 26 C), thus allowing the vaulting shaft of the wall rib to continue upward in a vertical direction. In the lower blocks, A and B, the mutual absorption of the lateral mouldings of the ribs is evident; only at the top, in D and D′, have the rib profiles become completely free and disentangled from each other.

Fig. 6.11 Viollet-le-Duc's drawing shows the stereotomy of one element of a medieval church, the *Tas-de-Charge*, the base or springing point for a fan vault. Templates were used to guide the accurate cutting of each stone before it was lifted into place.

(Source: John Fitchen, *The Construction of Gothic Cathedrals: A Study of Medieval Vault Erection*, Oxford: The Clarendon Press, 1961, pg. 76.)

Modern Construction Drawings: Descriptive Geometry

In *Architecture and the Crisis of Modern Science,* Pérez-Gómez describes the moment in the late Enlightenment when he believes renaissance and post-renaissance architectural thinking coalesced into a mathematical and purely instrumental method for "accurately" describing three-dimensional objects in two-dimensions:

> The last decade of the eighteenth century also witnessed the appearance of a mathematical discipline in which Euclidean geometry became truly functionalized, that is, reduced to the realm of algebraic analysis. This was Gaspard Monge's *Géométrie Descriptive* (1795), which was studied by students of the École Polytechnique and which represented the first possibility of an effective and precise mathematical description of reality:[6]

Monge was a "military engineer, mathematician, and practical scientist who rose to prominence during the French Revolution, and who, favoured by Napoleon, was able to push through a radical reform of technical education."[7] Importantly, he co-founded the École Polytechnique in 1795, where he also taught descriptive geometry "which became a crucial tool for modern engineering and architecture."[8] Descriptive geometry allows for the accurate physical description of objects in space, defining them as a set of coordinates relative to the X, Y and Z axes. Monge believed that "a popularization of scientific methods and outlook was imperative for the advancement of industry" and that his own work was "a basis for the new *ars fabricandi* of technology, the 'theory' of the new breed of engineers, whose only purpose was to make production more efficient."[9]

During the late Enlightenment, the *École Polytechnique* became the educational institution responsible for providing a highly rationalized and instrumental form of professional training, particularly for engineers and architects, and has been an extremely influential model for modern architectural education. The French Enlightenment saw the rise of the technical expert, and Monge stressed that "everyone should know the theory and applications of descriptive geometry." Architecture suffered under this representational paradigm and engineering flourished through a prolonged period of historical revivalism. According to Pérez-

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[6] Alberto Pérez-Gómez, *Architecture and the Crisis of Modern Science*, Cambridge Massachusetts: MIT Press, 1983, pg. 279.

[7] Robin Evans, "Architectural Projection," in Eve Blau and Edward Kaufman (eds.), *Architecture and its Image: Four Centuries of Architectural Representation, Works from the Collection of the Canadian Centre for Architecture,* Canadian Centre for Architecture, 1989, pg. 28.

[8] Pérez-Gómez and Pelletier, *Architectural Representation and the Perspective Hinge,* pg.135.

[9] Pérez-Gómez, *Architecture and the Crisis of Modern Science,* pg.280.

Gómez, architects were reduced to developing the decorative elements of buildings. Engineers were responsible for their construction. The power of descriptive geometry to physically describe three dimensional buildings and their construction elements in two dimensions overcame "with a considerable degree of success, the limitations endemic to a lack of practical, immediate knowledge of building techniques. The architect could now dictate to the carpenter or mason, even if his familiarity with the crafts was practically nil."[10]

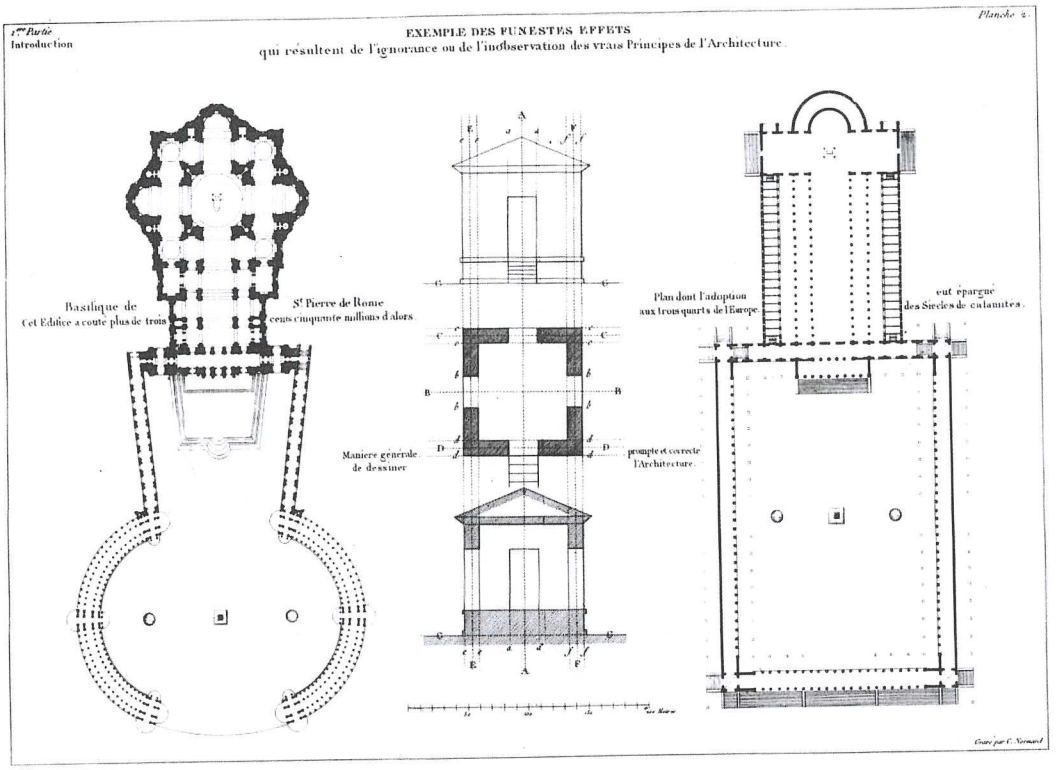

Fig. 6.12 A plate from J.-N.-L. Durand's *Précis des Leçons d'Architecture* (1819).
"Durand's demonstration of the 'correct and effective way to design,' illustrated in the centre of the plate, shows the precise coordination of the plan, section, and elevation, the 'set' that constitutes the 'objective idea' of a whole building. The comparison between the plans of the pre-Renaissance Basilica of St. Peter in Rome and the modern building from the sixteenth century purports to show the 'calamitous effects' evident in the modern example, resulting from the lack of observation of the 'true principles of architecture,' ultimately epitomized by descriptive geometry." [11]

In itself, the ability to accurately represent three dimensional objects in two dimensional drawings does not appear to be such a detrimental development for architecture. The point Pérez-Gómez, Pelletier, Vesely, and to a lesser extent Robin Evans, are making about these

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[10] Pérez-Gómez, *Architecture and the Crisis of Modern Science,* pg. 289.

[11] Alberto Pérez-Gómez and Louise Pelletier, *Architectural Representation and the Perspective Hinge*, pg. 5.

drawing techniques is not that they are inherently harmful to architecture, but that they represent a particularly mathematical, scientific and technological understanding of buildings (and of reality) that excluded questions of symbolic meaning. In this sense the development of descriptive geometry represents the triumph of form over substance that has dominated the production of architecture ever since.

It is the French architect Jean-Nicolas-Louis Durand (1760-1834) who is now commonly considered to be the figure most responsible for the setting-in-place of this reductionist approach to architectural design. Durand also taught at the *École Polytechnique* and wrote two influential theoretical works: the *Recueil et Parallèle des Edifices de Tout Genre, Anciens et Modernes* (1801) (Referee and rules for Buildings of all Types, Old and New); and the *Précis des Leçons d'Architecture* (1802) (A Concise Course in Architecture). (Fig. 6.12) The former is a collection of real and imaginary buildings drawn in plan and elevation and all at the same scale and the latter is a summary of his course at the *École Polytechnique*. Pérez-Gómez and Pelletier claim that the "process of creation prevalent in architecture today" where a "conventional set of projections, at various scales ... adds up to a complete, objective idea of a building" can be traced to Durand:

> The descriptive sets of projections that we take for granted operate in a geometrized, homogeneous space that was construed as the "real" space of human action during the nineteenth century. Our implicit trust in the application of a scientific methodology to architecture derives from techniques prescribed by Jacques-Nicolas-Louis Durand ... For him, descriptive geometry was the modus operandi of the architect. Although descriptive geometry promoted simplistic objectification, this projective tool is a complex product of a philosophical tradition and technological worldview that defines the European nineteenth century and leads to our own "world order."[12]

In *Architecture in the Age of Divided Representation*, Dalibor Vesely argues that the end of the eighteenth century saw the growing influence of modern science on architecture and the "elevation of *technē* [technical production] to a universal, self-sufficient instrumentality." He points out that during the "Napoleonic period, particularly in institutions such as the *École Polytechnique,* architecture was taught — probably for the first time — as a science."

> The problematic influence of science on the rest of architectural knowledge — that is, on experience, tradition, and the primary conditions of design — is characteristic of the eighteenth century. Apart from the specific influence of geometry, stereotomy, mechanics, theory of materials, and so on, a less visible but even more powerful influence was exercised by the new style of thinking —

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[12] Pérez-Gómez and Pelletier, *Architectural Representation and the Perspective Hinge*, pg. 5.

> which appeared in the fascination with encyclopedism, taxonomies, comparative studies, different kinds of measured observations, and the like. This fascination with everything supporting the desire for autonomy, certainty, and power is a key to a deeper understanding of the growing sway of modern science at the end of the eighteenth century.[13]

In "The Pencil and the Electronic Sketchboard: Architectural Representation and the Computer," Robert Bruegmann writes that in architecture, the most complete "outgrowth of and logical corollary to the work of scientists and philosophers of the Enlightenment," is found in the works of Jean-Nicolas-Louis Durand. "From at least the mid-eighteenth century one of the preoccupations of architectural theorists had been the elimination of the irrational and the personal in favour of a universally applicable system of principles and rules based on absolute certainties." In relation to the introduction of the computer into architectural practice in the late twentieth century, he believes that "architects had been preparing themselves to welcome such a tool for two centuries." The exactitude of computers in relation to the processing of information, which is ultimately broken down into digital units, would finally eliminate all "imprecise or subjective factors." It was thought that the production of architecture could be reduced to performing computational operations on precisely selected and organized data. The computer "should be able to bring to design the certainty and order that appeared to characterize physics or mathematics."

Durand's design method reduced architectural production to the selection and combination of building forms and elements, rejecting "both personal expression and the appeal to any transcendant authorities such as Nature, divine proportions, ideal prototypes, or absolute standards of beauty to which virtually all previous architecture in the western tradition referred."[14] Computers are perfectly suited to this reductionist understanding of architectural production, as has been evident in courses in computer aided design for many years. In the "Introduction" to *The Electronic Design Studio*, for example, William Mitchell writes that "[d]esign is the computation of shape information that is needed to guide fabrication or

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[13] Dalibor Vesely, *Architecture in the Age of Divided Representation: The Question of Creativity in the Shadow of Production*, Cambridge, Massachusetts: MIT Press, 2004, pg. 242.

[14] Robert Bruegmann, "The Pencil and Electronic Sketchboard: Architectural Representation and the Computer," in Eve Blau and Edward Kaufman, (eds), *Architecture and its Image: Four Centuries of Architectural Representation, Works From the Collection of the Canadian Centre for Architecture*, Canadian Centre for Architecture, distributed by MIT Press, 1989, pg. 141.

construction of an artifact."[15] Design is considered to be little more than the ability to describe the shape of buildings and building elements so they could be accurately fabricated. In this sense, both construction and design have been reduced to the purely instrumental and productive.

The analogical relationship between drawing and building with its origins in traditional building where drawing was embedded in the rituals, tools and practices of building, has been replaced by a digital system based on mathematical algorithms. The primary reason for the introduction of digital drawing into architectural offices was to make the production of working drawings more efficient, not to address the lack of symbolic substance in architecture. The descriptive abstract for "Questions of Representation" suggests that CAD, in particular its precision, may be seen as the "apotheosis" of the trajectory of descriptive geometry as a "generative architectural idea."[16] Relegating the drafting of construction drawings to a secondary, technical position in the profession is not new, but CAD has exacerbated this problem, turning the production of drawings into unimaginative labour. Pedagogically, it has become increasingly difficult to correlate construction drawing and construction knowledge. By construction knowledge I mean knowledge of the evocative power and symbolic potential of proper, imaginative construction thinking. Frascari suggests that:

> [t]he new electronic imaging prevents imagining, and resulting representations promote acts of merely logical 'thinking about architecture' rather than bringing architects, contractors, clients and critics to think *within* architecture.[17]

Modern construction drawings represent the domination of the desire for efficient production over symbolic content. This applies to the efficient production of both drawings and buildings, and has become increasingly obvious through the use of digital media to produce construction drawings and the (at this stage still occasional) use of these digital drawings to robotically fabricate building elements using compatible software. In a resurgence of the modernist utopian ideal of factory-made buildings, there is widespread belief that this direct link between digital representations of building elements and their robotic fabrication will increase, and that this is good thing for architecture and for architects. Robotic fabrication neatly encapsulates the

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[15] William Mitchell, "Introduction," in Malcolm McCullough, William Mitchell and Patrick Purcell (eds), *The Electronic Design Studio: Architectural Knowledge and Media in the Computer Age*, The MIT Press, 1990, pg. 1.

[16] Pérez-Gómez, "Questions of Representation," pg. 217.

[17] Marco Frascari, "Introduction," in Marco Frascari, Jonathan Hale and Bradley Starkey (eds), *From Models to Drawings: Imagination and Representation in Architecture,* Routledge, 2007. pg. 2.

desire for efficient production and demands that architects continue to aim for working drawings that are as "accurate" as possible so that construction can be reduced to a straightforward business transaction. To this end, the drawings must display both a kind of Cartesian exactitude and technical neutrality; the builder's task is to literally transcribe the drawings to construct the building.

If buildings are also representations of drawings, which in a literal sense must be the case in this production-driven form of representation, it is not surprising that buildings resulting from such drawings struggle to embody any meaningful symbolic qualities other than those thought to be associated with production itself. Architects and builders have become locked into a system of commodification that demands the increasingly efficient production of buildings. Construction drawings are conceived of as the technological means of accomplishing this. Working drawings are instrumental representations that reduce the construction of buildings to the single parameter of determining the most efficient, cost effective means of production. The over-riding motivation for this is to increase architectural marketability by producing a commodity that, while it might cost more than a building built without architectural involvement, is ultimately worth more in the marketplace.

In contrast to its supposed neutrality, the modern working drawing is in reality an extremely powerful tool of production that reveals the dominance of scientific and technological representation over an extremely weakened and almost imperceptible symbolic presence. In *Architecture in the Age of Divided Representation*, Vesely argues that the production of architecture is currently dominated by scientific and technological thinking, which is concerned primarily with the instrumental, reductionist and mathematical representation of reality. He writes that there "is little doubt that both technology and modern science are motivated by the same interest — the domination of reality and the will to power." It is becoming increasingly clear that the limited view of reality he identifies has profoundly influenced the production of architecture. For Vesely, "the instrumental representation of reality is part of the essence of modern technology," and "symbolic and instrumental representation are inevitably deeply opposed. While the former is reconciliatory and serves as a vehicle of participation, understanding, and global meaning, the latter is aggressive and serves as an instrument of autonomy, domination, and control. They also share the same construction of reality that leads to 'productive' knowledge." Later he writes:

> It is unfortunate that this fundamental conflict has not been recognized as the main source of the contemporary crisis of meaning and of the general crisis in

> contemporary culture. In disciplines such as architecture, most believe, even today, that instrumentality can be brought into harmony with symbolism, that a balance can be established between them, that instrumentality can produce its own symbolism, or that the two can exist independently. The absurdity of such a belief becomes clear in view of an earlier tradition which understood precisely that *instrumentality* (*techné*) must always be subordinate to symbolic representation (*poiēsis*), because *technē* refers only to a small segment of reality, while *poiēsis* refers to reality as a whole.[18]

In current architectural and building practice, the instrumental and productive nature of representation appears to be largely unchallenged. In addition, the recent much acclaimed appearance of BIM (Building Information Modelling), the next generation of powerful, digital design and documentation software, suggests a lack of recognition of Pérez-Gómez and Pelletier's insight mentioned earlier, that "value-laden tools of representation underlie the conception and realization of architecture."[19]

Building Information Modelling (BIM)

BIM represents a further and decisive development in the drive for efficiency in architectural production. BIM is a form of information drafting that is being advocated by software manufacturers, building developers, governments and many architects. BIM will make possible a cybernetic link between industrial production and construction that will enable architecture to be fully commodified. In a paper titled "Managing BIM Technology in the Building Industry" four of its proponents, *Chuck Eastman, Paul Teicholz, Rafael Sacks and Kathleen Liston* claim that BIM will allow "clash-free design, inherently consistent drawing sets and excellent visualization of the building design, during design, fabrication and erection." These "grand improvements," will "resolve some of the recurring problems and wasteful practices that architects and contractors have been putting up with in current practice." The authors consider that these "evolutionary" attributes of BIM are just the beginning and that this digital technology offers much "larger impacts" that will "transform many aspects of the AEC [architecture, engineering, construction] industry." "BIM invites strategic re-thinking of processes and production to achieve the three-part goal of better, faster and cheaper buildings." These are defined as:

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[18] Vesely, *Architecture in the Age of Divided Representation*, pg. 241, 242.

[19] Pérez-Gómez and Pelletier, ", *Architectural Representation and the Perspective Hinge*," pg. 3.

Better: more knowledge about the building earlier in the life cycle regarding cost, energy use, organizational performance, 3D visualization by all members of the project team (including the owner)

Faster: ability to use construction and fabrication knowledge during design, ability for greater use of off-site fabrication, ability to use product information earlier in design and in procurement planning

Cheaper: much better coordination of project team using the model as source of decision-making and planning, faster procurement, greater use of fabricated components from global sources, fewer owner changes because of better understanding of the building and how it will function for its users, fewer errors, omissions and claims, use of "as built" model for facility management. [20]

At the core of BIM is sophisticated software that turns each drawing into a collection of parametric, digital, information models that automatically interact with each other. Instead of the pretence of digital drafting simply trying to emulate hand drafting, CAD has metamorphosed into BIM an entirely informational representation of all building elements including structure and services. Inputs and outputs from the system can be non-graphic, drawings can be converted into numerical quantities, and standard elements or manufacturers details can be implanted. The parametric interaction of information packages or models means that quantitative parameters set by structural engineers or air conditioning consultants, for example, can be powerfully deterministic within the "design" process. There will be near-spontaneous, electronic feedback between requirements for construction, structure and services.

The reduction of architecture to information requires rigid standardisation of ready-made industrial building materials and elements, as well as drafting conventions and software, so they are transferable between architects, consultants, fabricators, manufacturers and building owners. Efficiency requires ultimate control, one of the recurrent post-Enlightenment obsessions of the architectural profession and building industry. Within this technological enframing of architecture, control is a vital ingredient, and BIM offers the prospect of control at every stage of a building project. Control is portrayed as the magical, missing ingredient that architects, builders and building owners have been searching for throughout the modern era to perfect the design, documentation, construction and management of their buildings. What we might think of as architectural qualities — the embodiment of symbolic values and content, invisible qualities made visible — are likely to be pushed even further to the periphery of architectural practice. Vesely writes:

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[20] *Chuck Eastman, Paul Teicholz, Rafael Sacks and Kathleen Liston,* "Managing BIM Technology in the Building Industry," http://www.aecbytes.com/viewpoint/2008/issue_35.html

> Architecture has been confronted with the possibility of design based on no more than an understanding of form, formal purpose, material, and technique, whose simplicity and intrinsic poverty are complemented by an unprecedented complexity of personal intentions and formalizations. We have moved deep into the instrumental realm of production.[21]

Building Information Modelling is still a relatively new phenomenon and not yet widely used in the profession. There is however, an air of inevitability about its imminent and widespread uptake by the "AEC industry." To keep pace with the profession and to retain their professional accreditation, architecture schools must also engage with, and teach, this powerful new form of digital representation. Instead of simply supplying graduates proficient in BIM (and CAD); architectural academics could use the appearance of these digital systems as a stimulus for reflecting on the complex and important question of architectural representation. This could become an opportunity to explore the relationship between construction and drawing as the basis for construction pedagogy. Without this, according to Pérez-Gómez, we fail to address the possibility that "[d]igital media merely provide much more powerful tools to continue with ways of conceiving and making architecture that have already failed."[22]

(Re)Drawing Architectural Technology

No doubt there are many strategies that could help mitigate the effects of productive representation in architecture. My suggestions are intended for those who teach construction and may all be related in one way or another to architectural drawing. They are inspired by Frascari's suggestion that we need to rethink how we draw architectural technology. As previously discussed, he centres his strategy on a form of drawing called a technography:

> With the term technography, I am reviving, in anglicized form, *tecnografia*, a term devised by Lodoli to define a correct use of representation in the practice of architectural technology.[23]

A technography is in reality a different way of *thinking* about the relationship between a (working) drawing and a future building. It embodies an understanding that a non-trivial work of architecture is only achievable if symbolic and instrumental representations are both present in the drawing. The question becomes, what are the symbolic qualities we are trying to embody in our buildings and how would we represent them in drawings? The most obvious and pertinent

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[21] Vesely, *Architecture in the Age of Divided Representation*, pg. 248.

[22] Sam Ridgway, "Drawing Construction: Reflections on the Work of Alberto Pérez-Gómez," *Architectural Theory Review*, 11, 2 (November 2006).

[23] Marco Frascari, *Monsters of Architecture: Anthropomorphism in Architectural Theory*, Maryland: Rowman & Littlefield Publishers, 1991, pg. 95.

answer for a construction drawing is that it must reveal a deep knowledge of, and affection for, the materiality of buildings, for their construction. For Frascari, an "architectural project is based on the processes of sign transformation taking place in the translation of a building into a drawing and, visa versa, in the translation of a drawing into a building."[24] In an analogical sense, architectural drawings should be demonstrations of constructions, not simply Cartesian, technical lines showing edges, corners and joints, but following the logic of drawings, to reveal both the symbolic and instrumental representations of the future building. As Frascari writes, "[i]n his/her drawings, the architect's pursuit in conceiving and constructing architecture is to make visible what is invisible."[25] The fact that any of this could be considered contentious indicates the extent to which architects have become alienated from the heart of their profession. Exploring the possibilities for symbolic representation could in fact provide a basis for revitalising construction pedagogy with minimum controversy.

Part of any technography must be an acknowledgement of the historical context of construction knowledge. This is not only so we can better understand our rich architectural ancestry, but because it re-establishes a connection with the origins of our profession in building. Our obsession with efficient production has required architects to acquire an extreme form of amnesia in relation to modes of architectural production that existed prior to the eighteenth century. As Frascari writes:

> If we have to understand architecture – to think within architecture rather than about architecture – then we have to understand something of the mechanism that drives representational thoughts, otherwise we are condemned to watch in despair as the architectural worlds created in the past continue to slip further and further away from our awareness and beyond our intellectual capabilities.[26]

Thinking within architecture requires us to acknowledge and re-establish the symbolic representational power of construction as the core of the profession. This cannot be done without questioning the domination of current pedagogy and practice by productive representation. Reflecting on the origins and historical context of the profession and understanding that CAD and BIM have their roots in the reductive representational practice of descriptive geometry is one way of encouraging this kind of questioning and consequent critical practice.

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[24] Frascari, *Monsters of Architecture,* pg. 93.

[25] Frascari, *Monsters of Architecture,* pg. 92.

[26] Frascari, "Introduction," *From Models to Drawings*, pg. 7.

In many schools of architecture and in the profession, the ability to drive CAD software now substitutes for proper knowledge of construction. The representation of this increasingly deterministic digital means of producing drawings in the resulting building is, however, not well understood. Digital media have obscured the analogical relationship between constructing a building and constructing a drawing and encouraged experimentation with building shapes and forms without regard for how they will be constructed. Daniel Willis, in his essay "The Impact of the Computer on Architectural Practice," observes that traditionally, the materials of construction were regionally derived and a building's shape was "always conceived in negotiation with the tendencies of the dominant building method."

> Now, particularly with the assistance of CAD, architects can conceive novel compositions without regard for the method of their construction, leaving it to engineers, 'production architects,' and other technicians to project these shapes onto mute substances. There is seldom anything cunning or clever about these assemblies, and their connections are usually kept hidden, so as not to interfere with the purity of the sculptural composition. The tilted wall has been disembodied into a shape-sign unconnected to the manner of its construction, and the freedom granted by the computer to compose with unconventional shapes has helped to accelerate the extinction of authentic details. [27]

The application of digital media to architectural production has encouraged the curious combination of unconventional building shapes with clumsily modified conventional construction techniques. The reduction of design to the description of form has led inevitably to formal experimentation and digital media provides this activity with a powerful, legitimizing tool. Rather than providing any generative basis for design, construction merely follows in a subordinate role.

As discussed, one of Frascari's strategies for overturning the contemporary practice of productive representation is to reconceive architectural drawings and buildings as demonstrations. In this sense, representation and demonstration are similar, although the act of demonstrating something in drawings and buildings suggests a more direct, even functional outcome. As Frascari states, "[i]n architectural demonstrations, the function of representation has not been separated from the representation of function."[28] In an architectural demonstration, the symbolic function of buildings is not separated from their practical function. The symbolic and practical are one and the same thing. A demonstrative drawing may or may not be easy or straightforward to understand or interpret. It may, for example, graphically

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[27] Daniel Willis, "Seven Strategies for Making Architecture," in *The Emerald City and Other Essays on the Architectural Imagination*, New York: Princeton Architectural Press, 1999, pg. 284.

[28] Frascari, *Monsters of Architecture*, pg. 90.

demonstrate a union of the poetic and the practical aspects of construction, rather than representing poetic construction in a purely technical way. Such graphic demonstrations are signs that must be interpreted by the client and builder and this changes the nature of the relationship as it requires the negotiation of a mutual understanding of outcomes which may not be possible to describe instrumentally. The business relationship between the architect, client and builder, which is based largely on contract drawings that have become legal documents, is of course easier to comprehend and manage if it stays on technical ground.

In the seventh of his "Seven Strategies for Making Architecture," Willis explores what he thinks it would mean for architectural production if Frascari's "radical" proposal that drawings should be demonstrations was to become a reality:

> [C]ontemporary architects, given their inability to control the production of buildings, should challenge the purely instrumental role of construction drawings, striving to produce drawings that are demonstrations of poetic building. If the professional practice of architecture demands that buildings are now representations of drawings, the only way to insure poetic building is to make poetic drawings.[29]

These technographic or monstrous drawings, monstrous as we have seen because they show the union of unlikely things, would be quite different to conventional construction drawings. Details "would not be miniature projected representations of an imagined building and they would follow the logic of drawings, not buildings. They would represent the built detail symbolically, in addition to instrumentally, so that, in Frascari's words, 'each angle is an angel.'"[30]

Willis concludes his strategy with an outline of what he considers to be the radical nature of Frascari's proposal for architects to produce technographic drawings. He writes that most of the "conventions of building production in First World countries would be overturned if his suggestions were implemented." There would be no working drawings, and therefore no competitive bidding other than in countries like Japan where cultural forces make this possible.[31] Building approvals could not happen in advance and no two builders working with

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[29] Willis, "Seven Strategies for Making Architecture," pg. 233.

[30] Willis, "Seven Strategies for Making Architecture," pg. 233

[31] Willis details this in Strategy One, referring to the extremely ritualized and socialized nature of Japanese building production, the key to which is mutual trust between the architect, builder and client. He writes that "even though Japanese firms use the same sorts of instrumental drawings as their American counterparts, the social process of building construction prevents the building from becoming conceptualized as a representation of the drawings." The final construction results from an interpretive collaboration between the architect, builder and component manufacturers.

the same design "would be likely to build the same structure." Lending institutions and clients would have to "trust the architect's judgement to a far greater extent than is presently the case," meaning that architects would be chosen on the basis of "proven reputation," rather than "star power or lower fees." A close relationship between architect and builder would mean that architects would restrict their "practices to specific regions, or to specialize by climate, or building system, or particular theme, rather than strictly by building function."[32] Here Willis refers to Scarpa's "preference to practice in the Veneto region as an 'architect of spoils,' or Fay Jones's practice based on constructing artificial forests." And for all this to occur it would mean that "living and dwelling well were elevated once more to higher status than the accumulation of capital. Drawings and from them buildings would have to become convivial tools again."[33] As we have seen, one of the most well-known examples of technographic drawings are those produced by Carlo Scarpa, an architect with whom Frascari had a long association. In Scarpa's practice the resolution of details often happened on the building site and involved an imaginative and interpretive collaboration between Scarpa and his builders to construct a "non-trivial edifice."

An important element of a technography is that it resists the neutral depiction of construction. This requires drawing to be reconceived as the production of signs that must be interpreted rather than as the neutral, one-to-one production of construction diagrams. While construction itself should be the main representational depiction, the inclusion of unconventional signs on working drawings is something that can challenge instrumentality. As discussed earlier, in his own practice Frascari often uses an image of the human body on working drawings as a sign to the builder that one of the primary functions of a building is to accommodate the sensory human body. Through the use of such signs, it may be possible to develop a relationship with the builder that embraces a corporeal understanding of the construction; the building as a body. Scarpa used many human figures in his drawings, developing a metonymical relationship between building and body based on common attributes. The inclusion of figures as metonymical signs is not something that can be applied to the drawing, but must come out of changing attitudes to the body/building relationship. For students of architecture there is an understandable feeling of awkwardness about such strategies based on how they might be perceived by the client and builder. There is generally a strong sense of needing to conform to what is perceived as the "correct" way of doing things in

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[32] Willis, "Seven Strategies for Making Architecture," pg. 235.

[33] Willis, "Seven Strategies for Making Architecture," pg. 236.

the profession. As a pedagogical tool however this offers a way of understanding the theoretical nature of construction and may be effective in challenging the purely instrumental nature of working drawings.

The dramatic overturning of current practice suggested by Willis might seem utopian, but making achievable changes within the current system could nevertheless be encouraged. Frascari has certainly done this in his own modest architectural practice. The key to fundamental change is changing the way architects are trained, and this means increasing the intellectual and critical skills of graduates as a basis for continual development and exploration throughout their careers. Without this, young architects, especially if they join large practices, may be quickly overwhelmed by the pressures of professional life. Beginning architects can only act differently if they understand more about the nature and origins of their profession. One way of encouraging this is to continually question modes of representation, in particular, the relationship between drawing and building.

Conclusion

The lack of symbolic representation in architecture is a vacuum into which all sorts of strange and inappropriate things have been sucked. A step towards addressing this is simply to ask: what does this (future) building represent? This immediately opens up the drawing/building relationship for deliberation and inevitably changes the nature of a drawing, whether it is a design or a construction drawing. It does not necessarily mean a radical departure from current modes of drawing. As can be seen from the classical and medieval examples, instrumental or practical representation is not inherently antithetical to symbolic representation. It has become questionable because it has come to represent only efficient production and resulted in the creation of a built environment that many people find alienating and distressing. If construction courses can become a place where the relationship between symbolic and productive representation are bought into question, then it seems sensible to begin with the most productive form of architectural representation and the most common vehicle for teaching construction, the construction drawing.

This thesis results from a number of years of research on the (unglamorous) subject of architectural construction. It also draws on my experience of teaching construction, particularly to first year students, and of teaching design in the design studio. Prior to becoming an academic I practiced as an architect, and since becoming an academic I have designed several experimental houses. Two of these I have at least partially built myself, the remainder of the work being completed by subcontractors. In this sense the thesis is very different from a one produced by a candidate not long finished their professional degree; an early career researcher. Its main differences in this regard lie in the development of the critique that is brought to bear on the material and the breadth of literature and experience that have influenced the writing. A substantial part of the thesis is comprised of work that has been published during the candidature.

In essence, the thesis argues for the practice and pedagogy of construction to have a rigorous intellectual grounding. This is proposed as a means of countering the hegemonic dominance of instrumental thinking and the relentless drive for efficiency that currently rules the production of architecture. It is argued that the untheorized teaching and practice of construction is as much a part of the current architectural malaise as poor design. In fact it is suggested that the conceptual separation of design and construction in both pedagogy and practice is both symptomatic of the lack of intellectual qualities and rigor within the discipline and also a root cause of its dysfunction. The thesis promotes the view that a more ethical and meaningful way of making buildings might be found by promoting a phenomenological, hermeneutical, and ontological approach to their conception and production. This requires architects and pedagogues to be capable of conceiving of buildings in ways other than instrumental analysis and production, where design is a problem to be solved. The thesis gives several examples of how this might be achieved. One example is found in the discussion of light as a construction material, particularly the unmeasurable, cultural and phenomenological understandings of the relationship between buildings and light. Another example is Frascari's theorization of the abundant possibilities for developing a metonymical relationship between human and architectural bodies based on common attributes. This is based, in part, on the

meanings we attribute to buildings and the way we relate to them based on senses other than vision.

Despite concerns raised by Dalibor Vesely that discourse surrounding the dominance of instrumentality and production has focused on the misguided belief that instrumentality can be brought into harmony with production or that instrumentality can "produce its own symbolism" or even that the two can exist independently, I believe that there is a way forward. This way is through a re-conception of construction as a significant repository and source of architectural meaning. This naturally requires the current understanding of construction as neutral and technical to be questioned and this can only be achieved through a theorized approach to construction teaching. As previously mentioned, other contemporary theorists in architecture and related disciplines have similar objectives to those detailed in this thesis. This work distinguishes itself from them by focusing on architecture's materiality, its construction. The lens through which this material is examined is primarily that of the philosophy and theorization of technology although a closely affiliated theorization of architectural representation is also employed in this task.

Vesely's characterization of architecture as a primarily instrumental representation that excludes symbolic representation prompts a critique and an appraisal of the role of representation in architectural production. Despite revealing itself as being at the heart of our professional and intellectual metier, in practice this topic is almost entirely untheorized. The representation of construction is particularly impoverished in this regard. The continual striving towards and need for an accurate, one to one relationship between drawing and building, for example, is generally considered to be axiomatic and beyond question. The relatively recent explosion in the quantity of construction drawings required to physically make a building has resulted from this utopian and technological understanding of construction. By examining several traditional examples, this thesis highlights the coincident loss of symbolic value of buildings with the dramatic rise in construction drawings in the modern era. By reflecting on traditional modes of construction requiring very few, if any drawings, it questions our obsession with production at the expense of meaning.

Finally, the suggestion is made that far from being merely places where the technical aspects of constructing buildings are taught in a neutral way, courses in construction could become the sites of intellectual debate concerning the material nature of buildings. The representations students make of construction, whether by hand or with digital media could then begin to reflect a renewed understanding of, and desire for buildings to embody and

reveal architectural knowledge. This would mean engaging with such topics as the relationship between building and dwelling; ethical construction; the translation of intangible cultural requirements into tangible buildings; the relationship between architectural and human bodies; the monstrous, joined, nature of buildings; and how to appropriately represent architectural technology; to name just a few. In this way construction and construction teaching would become central to the imaginative and generative process of architectural production.

APPENDICES

A CONSTRUCTION TALES: Interview with Marco Frascari

B DRAWING CONSTRUCTION: Interview with Alberto Pérez-Gómez

C ON COMMON GROUND: Interview with David Leatherbarrow

Introduction

Scanning a 2004 version of Marco Frascari's CV prior to conducting this interview made clear to me the impressive trajectory of his appointments and teaching in top architecture schools and, of course, the extent of his publications. There are approximately eighty papers and three books, with two more works in progress on topics including the relationship between food and architecture, architectural drawing, the body of architecture, semiotics, architectural synaesthesia, Carlo Scarpa and Vincent Scamozzi, to mention just a few. For me, the thread that ties this vast theoretical opus together is its poetic and finely crafted phenomenological exploration of the material nature of architecture. Arguably his most famous and influential article, "The Tell-the-Tale Detail," published in 1984 and now translated into Spanish, Japanese and Mandarin examines the architectural detail in precisely this manner. Born, as he says, "under the shadow of the dome of Alberti's *Sant'Andrea* in Mantua," educated in Venice, receiving his first degree from the *Accademia di Belle Arti* and his second a *Dottore in Architettura* from the *Instituto Universitario di Architteto di Venezia* (IUAV), and subsequently working as one of Carlo Scarpa's assistants in both teaching and in practice, it was difficult for him to avoid this approach. As he said during the interview, "Of course you have to realize that I grew up in the School of Scarpa. I worked for him I studied with him so that was part of the way I think. I couldn't avoid it." Carlo Scarpa is perhaps most well known for his obsessive attention to detailing, in other words for an understanding that construction embodies significant meaning. As Frascari notes in his writing on Scarpa's use of the number eleven, "[i]n Scarpa's buildings, the power of a tectonic imagination is the core of the architectural *métier*."[1] Scarpa's determination to give construction a voice, primarily, as Frascari writes, through "the adoration of the joint,"[2] put him at odds with mainstream modernism, which was obsessed, often in contrast to the realities of construction, with the neutrality, universality and instrumentality of materials, construction techniques and detailing. In many ways Scarpa and Frascari are two sides of the same coin, one in practice and the other in the academy. Both

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[1] Marco Frascari, "A Deciphering of a Wonderful Cipher: Eleven in the architecture of Carlo Scarpa," *OZ*, 13 (1991): pg. 38.

[2] Marco Frascari, "The Tell-the-Tale Detail," *Via* 7 (1984) pg. 29.

figures embody a powerful antidote to the jaundiced modern project in which neutrality of space and materials are the ideal. Instead, their work promotes a richness of architectural expression and insight that is embedded in the corporeal and which displays a deep understanding of its historical context.

I recorded the interview that follows in May 2004, while Frascari was G. Ward Truman Professor of Architecture at the Washington Alexandria Architecture Centre (WAAC), an off-campus College site of Virginia Tech. He has since been appointed Director of the School of Architecture at Carleton University in Ottawa. Prior to his appointment at Virginia Tech he was Professor of Architecture at the University of Pennsylvania from 1988 to 1997 and before that he taught at schools of architecture throughout North America, Canada, Europe and the UK including Columbia, Harvard, The University of Barcelona and the AA in London. After moving to the US he received his Masters at the University of Cincinnati in 1978 and his PhD at the University of Pennsylvania in 1981. The interview was recorded over several sessions and while it touches on many topics it primarily explores our common interest in construction and construction teaching. I was interested to learn, for example, that he wrote "The Tell-the-Tale Detail" soon after he began teaching at the University of Pennsylvania because he was frustrated with the lack of construction content in the design studio with students showing "a beautiful design with a lot of space ... but there was no construction." He went on to explain that the same envelope built in brick or wood are two completely different spaces. This is quite different to the usual gripe from design tutors, who expect students to demonstrate how to construct their designs by applying materials and building techniques in an instrumental fashion. Frascari believes that construction helps determine the character of a space and therefore should be thought about from the beginning. Similarly, writing "The *Lume Materiale* in the Architecture of Venice,"[3] was motivated in part by concern that while "The Tell-the-Tale Detail" was becoming a standard reference, ironically "not in construction, ... what was missing was looking to the material for its spiritual dimension, not only for its materiality." Of all Frascari's articles, "The *Lume Materiale,*" literally "material light," is perhaps the most poetic. As he writes, the expression *Lume Materiale* "is intended to point out the palpable presence of light – something born in the materials of construction and imprisoned in the body of an edifice as the mind is imprisoned in the body of a man."[4] The beginning quote, taken from Antonio

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[3] Marco Frascari, "The *Lume Materiale* in the Architecture of Venice," *Perspecta,* 24 (1988), pg. 137-145.

[4] Marco Frascari, "The *Lume Materiale,"* pg. 137.

Conti's *Prose and Poesie*, "Knowledge is the material cause of poesis," sets the tone for the article, which, even though it focuses on the late medieval, Venetian palace Ca'Dario, once again reveals Frascari's training with, and admiration for Carlo Scarpa. Dwelling on the fundamental but usually suppressed architectural truism that buildings are revealed in light and conversely light is revealed as it touches buildings, is not an attempt to give sight priority over the other senses. During the interview he explained that, "[w]hat is fundamental, is construction involves all the senses." He illustrated this by referring to an article that he started to write but never finished, in which he wanted to explore how to "design a church that makes palpable the presence of God." One of the many factors required to achieve this would be to ensure the building has the right smell and to do this would require the omission of vapour barriers during construction so that the church walls are slightly damp. As he spoke, my experience as an eighteen year old in the churches of Arrezo where I had travelled to look at the Piero della Francesca frescos, came flooding back to me and I realized that of course the smell of a building creates such a powerful and lasting impression.

One of the wonderful things about interviewing Marco was that, like all architects, when he started to discuss a building he looked around for something to draw on. I'm glad that at the time I had the presence of mind to offer my note pad for his sketches and that they can now form part an illustrated interview. I have augmented them with drawings and photos of buildings to which he referred. For example, we spoke about Palladio's additions to the medieval Basilica in Vicenza and I have included his sketch, Palladio's drawing from the *Quattro Libri*, Serlio's drawing from Book I (On Geometry) on which Palladio based his design and a photograph of the façade of the Basilica that I took in 2004. I have included these drawings and photographs to help place our discussion about the construction of the façade in context for those of you who, like me, did not really know much about this building. Like all the drawings he did for me, this one revealed a way of understanding the building that I would not otherwise have experienced and this was by describing how Palladio ingeniously married together medieval and classical construction. As he said, "[w]hat is beautiful about the Basilica is this technique. How do you bring together two technological reasons one to the other in an act of construction and it takes on a meaning and the meaning is so important that we call this window Palladiana, which is funny because the guy who invented the window is Serlio!" Prior to the interview I did not know that Frascari would reveal his thoughts through words *and* drawings, but it soon became evident that this would be his mode of delivery! The interview would not therefore be complete, nor at times make sense, without them.

During one session of the interview we looked through and discussed two large folders of Frascari's articles that we had retrieved from the WAAC library, prompted by my asking him specifically about "The Tell-the-Tale Detail," and the "*Lume Materiale*." It was a good way to gain insight into his huge range of work, both published and unpublished. This sequence begins with the article he co-authored with Livio Volpi Ghirardini[5] on proportion, which prompted the sketch of Serlio's famous drawing showing how to proportion a temple door, which in turn led to the discussion of Palladio's Basilica in Vicenza. This was followed by "Deciphering a wonderful Cipher: Eleven in the architecture of Carlo Scarpa,"[6] which reveals an otherwise hidden aspect of Scarpa's work, showing how he generated many of the details and dimensions for his buildings. Having been interested in Scarpa's buildings for years, I found this knowledge added another layer of richness and complexity to the visit I subsequently made to the Brion Family Chapel and Cemetery, one of the most consistent and highly detailed modern buildings I had ever experienced. This session of the interview ends with a discussion of the article "Tolerance or Play: Conventional Criticism or Critical Conventionalism in the Light of the Italian Retreat from the Modern Movement."[7] I have omitted short comments he made about two other articles, one dealing with the "Pneumatic Bathroom," (unpublished) and the other with "The Construction Drawings of a Blind Architect."[8] The discussion of tolerance and play is a good example of the way Frascari employs etymology and philology, which he describes as "the love of how thinking develops through the use of words," to reveal otherwise hidden meanings in the way we describe the construction of buildings. 'Tolerance,' the word used nowadays to describe allowable dimensional deviations from those shown on drawings and allowances that must be made to ensure that building elements fit together, can, of course also refer to something less than ideal, something that must be tolerated. The machine-made, modern ideal is to produce buildings elements and materials that fit together perfectly. Play, on the other hand is a word used by previous generations to describe the same phenomenon, but it evokes a more joyful and harmonious relationship between building parts. Frascari used this difference as a means of describing

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[5] Marco Frascari and Livio Volpi Ghirardini, "Contra Divinam Proportionem" *Nexus* 2: *Architecture and Mathematics*, (1998).

[6] Marco Frascari, "Deciphering of a Wonderful Cipher: Eleven in the architecture of Carlo Scarpa," *OZ*, 13, (1991).

[7] Marco Frascari "Tolerance or Play: Conventional Criticism or Critical Conventionalism in the Light of the Italian Retreat from the Modern Movement", *Mitgard* 7 (1986).

[8] Marco Frascari, "The Construction Drawings of a Blind Architect" in *On Architecture the City and Technology,* M. Angelil (ed.), Butterworth Architecture, Stoneham, 1991.

Scarpa's approach to detailing, in which, instead of attempting to hide joints or demand dimensional accuracies that could not be achieved, he designed joints that revealed a joyful union between materials and elements. During the interview, Frascari sketched some of the motifs that Scarpa used in his detailing. Later, when looking at some of his buildings, I wondered why I had never really questioned or understood these details before. Of course most people who enjoy his buildings would not know how the details were generated, and to explain this a metaphor used by Frascari about good cooking springs to mind. When served a wonderful meal often it is hard to tell exactly what the constituent flavours and ingredients are, how it has been constructed or even what method of cooking has been used. Rarely are we privy to its generative parti, we nevertheless get immense enjoyment from eating it. To be a good cook, however, it is essential to be able to analyse food cooked by others on the plate and the palette; and similarly, for the architect, it is necessary to acquire knowledge of the generative ideas, materials and techniques that make great buildings.

It was fascinating to meet and interview Marco Frascari on his then home turf in Alexandria, as I have admired his work and used his articles in my teaching and research for many years. For me, the significance of his writing lies in its ability to continually reveal the richness and complexity of the world of architectural knowledge. His writing does not eschew exterior pressures and influences on architectural practice and pedagogy but it continually reveals his deep understanding and affection for its corporeality. By concentrating on and expanding knowledge of their material nature in the most poetic and delightful manner, he opposes, as did Carlo Scarpa, any attempt to reduce buildings to functional and neutral objects.

Interview

SR: Recently I read your article "Architects Never Eat Your Maccheroni Without a Proper Sauce,[9]" and you seem to be correlating the kind of imaginative process required to make good architecture with that required to be a good cook. In relation to cooking, this means that it is hard to describe how you really make a good dish. It's got to do with a feeling for the food, of how to choose and combine ingredients and a sense of when things are cooked according to how they smell or sound rather than just following a recipe, baking times and so on.

MF: My quest in that article was to explain why Descartes fired his cook because you can't separate mind and matter in a piece of food. The cook would come to him and say, this is the recipe; I followed it exactly but it tastes really awful! My grandmother never followed a recipe completely but her cooking was very good. The same is true of construction. A good building is not the result of this perfection of mind and perfect CAD drawings that tell you down to the micrometre how big the room is. It is the result of your interaction with the builder. My grandmother would say "ok, it would take three rosaries to cook that." I would say, "What, it's not twenty minutes?" "No, it's three rosaries," and you realise that three rosaries is a very precise system of measurement. I was talking with a friend of mine who was working with photography. He said he hated the timer because in the beginning when I develop a photo it takes thirty seconds to do it. After a three-hour session in the dark room developing for thirty seconds doesn't give the same picture. Why? Because the temperature of the room goes up, the chemicals are going down, and so on. He said that he preferred to count, one thousand and one, one thousand and two and so on because after two hours in the dark room he is tired, and so he counts slower and the slowing down that resulted corresponded exactly with the extra time it took to make the pictures from the beginning of the session the same as those from the end. The same with my grandmother's cooking. Three rosaries during the winter are different to three rosaries during the summer. Three rosaries in front of the oven during the winter go slower because it's warm and you enjoy it! During the summer they go much quicker because it's too hot and you want to get the dish cooked quickly. But of course the meat was much warmer when it went inside the oven. The oven is keeping the heat much easier during the summer than during the winter and the roast comes out beautifully every time.

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[9] Marco Frascari, "Architects, Never Eat Your Maccheroni Without a Proper Sauce! A Macaronic Meditation on the Anti-Cartesian Nature of Architectural Imagination," *Nordisk Arkitekturforskning*, 2 (2003): 41-53.

SR: My mother cooked on a wood stove and it was similar to what you describe. She knew how to stoke the fire for each dish, a roast or a cake, so that it would cook perfectly. It was also different in the summer and the winter. In the summer she also would cook more quickly so that she could let the fire die down to stop the kitchen getting too hot!

MF: So this article is basically a key discussion of that issue, but it's done in a funny way and not really talking about architecture directly. I go through this dream of cooking. How is Descartes to fire his cook and I make a relationship between cooking with local food and building with local technology and of course you can keep going. The analogy works out but that is my base of thinking and that is really how do you deal with construction? Construction is a very deep mental process where you don't separate mind and matter. You cannot. So when you think a solution it is related to that material and that material gives you back the materiality of the building.

SR: One of the big issues in architectural education at the moment is Descartes' separation between mind and matter represented by the current split between design and construction. Construction has an instrumental relationship with design.

MF: Exactly. Over here we design and over there the guy gives you the construction diagrams.

SR: What originally interested me about your work was your non-instrumental, phenomenological way of conceiving the materials of construction. The "*Lume Materiale*" is perhaps an even more profound example of this than "The Tell-the Tale Detail," proposing as it does that light is a material of construction: that a building can be thought of as a construction in and of light.

MF: The question is, 'in-materiality' is 'in-the-material,' because in language the 'n' doesn't stay there but becomes an 'm,' so the word becomes 'immateriality.' But really the Latin root of that is in-materiality so if you put in a dash or just separate 'immateriality' it is 'in-materiality.' That is the issue I was discussing in "The *Lume Materiale*," that you are dealing with the immaterial but through the material. And that is the key question. In design the first thing I do is ask what is going to be the material, which is not the way we are taught architecture. You are taught to design the building and then you figure out the materials. But, if I'm going to do a brick building with steel and glass, I don't know what it looks like yet but choosing the material will give me all different levels of imagination that deal with its non-instrumental nature. The problem is that if I have a shape already then materials and structure are only instrumental. So this is basically going back to constructing archetypes. In a village, surrounding trees don't grow more than 10

feet so their beams are going to be 10 feet. And that wood will not allow the span on top of the window more than so many inches. Of course there will be slight variations because every tree is different and every builder is different. But in reality, since they had the materials before, they can reach the level of immateriality much better than thinking, '"Oh yes, this is going to be a perfect church where you feel the palpable presence of God." And you can deal with all this level of immateriality. Boloney! When you walk into a Romanesque church, they got to a level of feeling the palpable presence of God because they were dealing with the raw materials. And the materials they were looking at were, yes, of course, light, darkness, humidity.

SR: I've taught construction for ten years and I've used your articles from the beginning, since 1994. Prior to that, through research towards my Masters, I had begun to understand the really severe problems that treating construction in a purely instrumental fashion posed for architecture. I was looking for an alternative that didn't further entrench divisions between construction and design. Your articles were a way of introducing students to the relationship between construction and imagination, the meaning of materials and so on, and this is quite alien to most construction courses that I know about. I don't know what it is like in America.

MF: It's the same!

SR: The question I would like to ask relates to how this alternative view of materials might be applied or used, if that's not a too instrumental way of putting it, in construction teaching. I wanted to ask a question about the writing of, in particular, "The Tell-the-Tale Detail" and "The *Lume Materiale*," if you thought about their application in that way.

MF: Ok. Well let me tell you the story before the "Tell-the-Tale Detail." It was something I wrote as soon as I finished my PhD. I was teaching at Penn, and I was frustrated by what was going on in the studio and of course what was going on in construction. So I felt the need to say something about what; of course, Kenneth Frampton would call it tectonics, but really from my point of view it was construction. The term tectonics is fine, I don't have any problem with it. It was used because it was more fashionable. But I was really trying to explore the fact that in the act of construction there are meanings and those are the fundamental meanings of architecture. The problem was that students would show a beautiful design with a lot of space, within their understanding of what space is which was within the line of modern understanding, but there was no construction. My argument is that space changes completely with the system of construction. The same dimension, the same envelope, if you build it in brick or if you build it in wood, it is a different space. It is not the same space and that was why I wrote the "Tell-the-

Tale Detail." Of course you have to realise that I grew up in the School of Scarpa. I worked for him, I studied with him, so that was part of the way I think. I couldn't avoid it.

So that was The-Tell-the-Tale Detail." The "*Lume Materiale*" was again a reaction, because I saw the "Tell-the-Tale Detail" becoming a standard reference for many courses, not in construction, but what was missing was looking to the material for its spiritual dimension not only for its materiality. Of course, the source was Venice where I spent several years of my life, including when I was a student. So that's why I selected Ca Dario to talk about, since this is a perfect example of Venetian architecture, and behind that there is also a little bit of Ruskin and his *The Stones of Venice*. The problem is you cannot get people to read Ruskin nowadays because it is a romantic discourse. But basically Ruskin is behind "The *Lume Materiale*" because *The Stones of Venice* is dealing with the quality of the materiality of Venetian architecture. The problem is that Ruskin talks about everything and therefore it becomes a mess. So that's why I wrote "The *Lume Materiale,*" focussing on one building and one issue rather than the totality of Venice. So I was trying to get to the materials, and of course stone is a basic material in architecture, it's fundamental, and that's why I selected stone as the fundamental element. Light is the other element you reveal through stone. Of course, this is very difficult to explain. I was planning to write another article about religious architecture, but it never came about. I started it several times but I never got the time to finish it, especially because I had to figure out where to publish and it's always difficult to publish something on sacred architecture. My argument was to deal with the question of how do you design a church that makes palpable the presence of God? This is the fundamental issue of sacred architecture and the argument was going to be that the only way to do it is through construction. It's not space that does it, but the physicality of the material and how that material is put together. So my argument there was going to be that when you do the construction of the church you don't put in vapour barriers because the humidity has to be in the church, it has to smell right. The argument there was going to be against the building codes related to stopping vapour. Sure they are understandable, I don't want humidity in my bedroom, but I want humidity in a church. The question was how to design a church in such a way that the building doesn't go rotten but at the same time you have a building the construction of which is addressing all the senses and not just the visual. And that is the fundamental element.

SR: I remember a long time ago when I was eighteen going into churches in Arezzo to look at the Piero Della Francesca frescos. I'm not a religious person but I remember feeling almost

faint just walking into those spaces. There *is* something palpable there, it's so intense, the flickering candles, the frescos, the space, the stone, the sounds and the smell, it's very intense.

MF: Yes. All the senses are involved and what is fundamental is construction involves all the senses. When you are designing and figuring out how to build something you have to think which senses besides the visual should be involved and that is the key element. So the decision of how do you make a joint or how do you place the layers of material is related to the senses. It's not related to the optimised idea that you don't want humidity to go through that wall. It's completely absurd. I think a sacred stone building where you have water dripping on the walls because of condensation is perfect. Sure you will tell me it's cold. First of all, you don't stay in a church 24 hours. Only the priest does that and generally they always have a scarf around their neck and their nose is dripping, but that is an old tradition and it's part of the materiality of the church.

SR: I guess for me that's primarily what "The *Lume Materiale*" is about, the sense of sight. Trying to deal with a single sense and in my construction course that's where the revelation comes for students. They struggle and struggle with this concept, then suddenly they will begin to understand that it's about the sense of sight. All architects deal with light because they deal with shadows and colour and all of these things. I can point out the window of the classroom and ask why the architect designed the overhang in that way so the shadow does that on the façade.

MF: It's all a game of shadows, you should read my article on Scamozzi.[10]

[10] Marco Frascari, "A Secret Semiotic Skiagraphy: The Corporeal Theatre of Meanings in Vincenzo Scamozzi's Idea of Architecture," *Via,* 11 (1990).

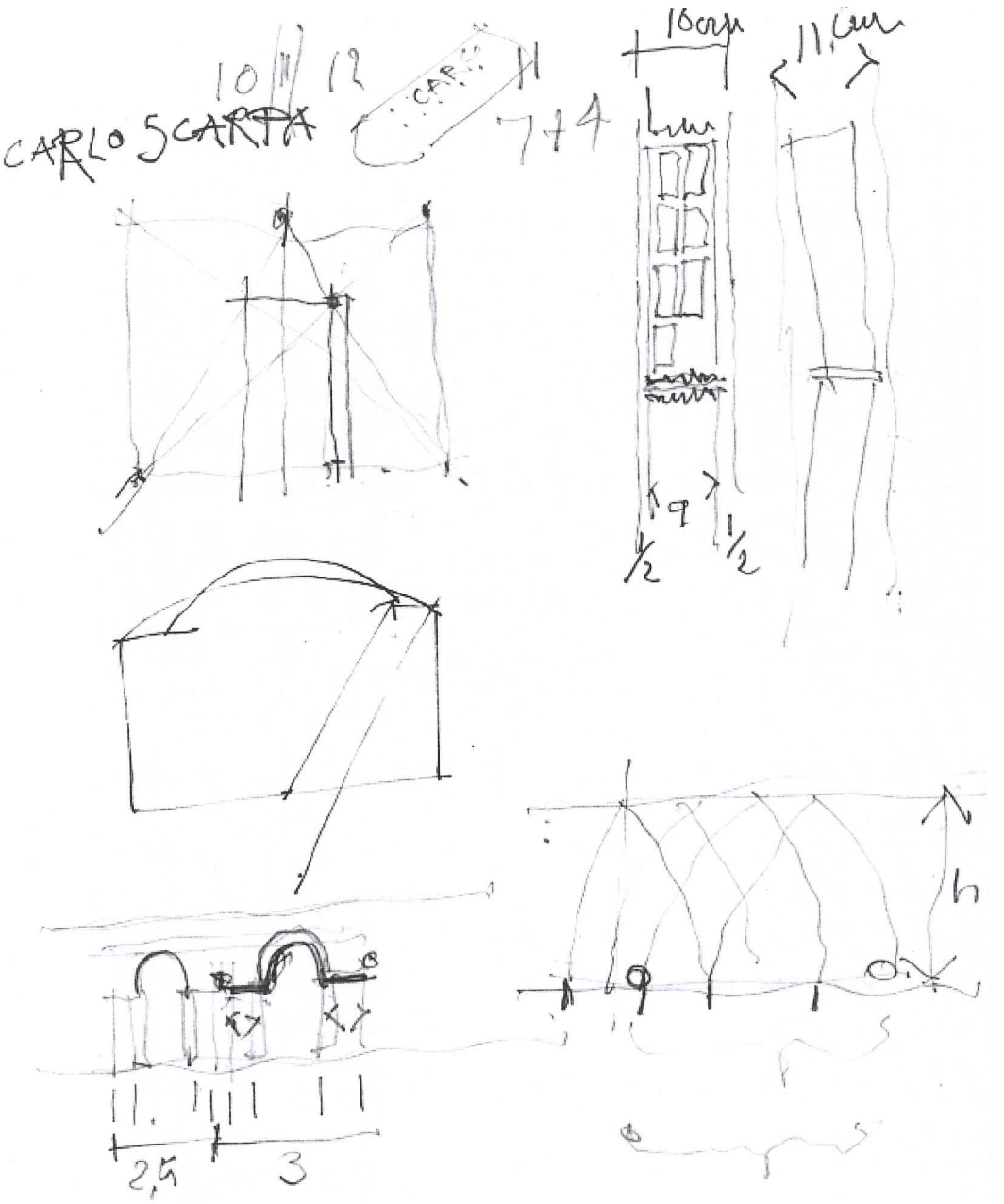


Fig. A.1 Sketches made by Marco Frascari during the interview. Clockwise from top left: Serlio's drawing showing how to proportion a temple door; Carlo Scarpa's gravestone; Italian hollow tile construction; relationship between base and height dimensions of Gothic, Ogival arches; Palladiana/Serliana; sketch of bedroom section by Sam Ridgway.

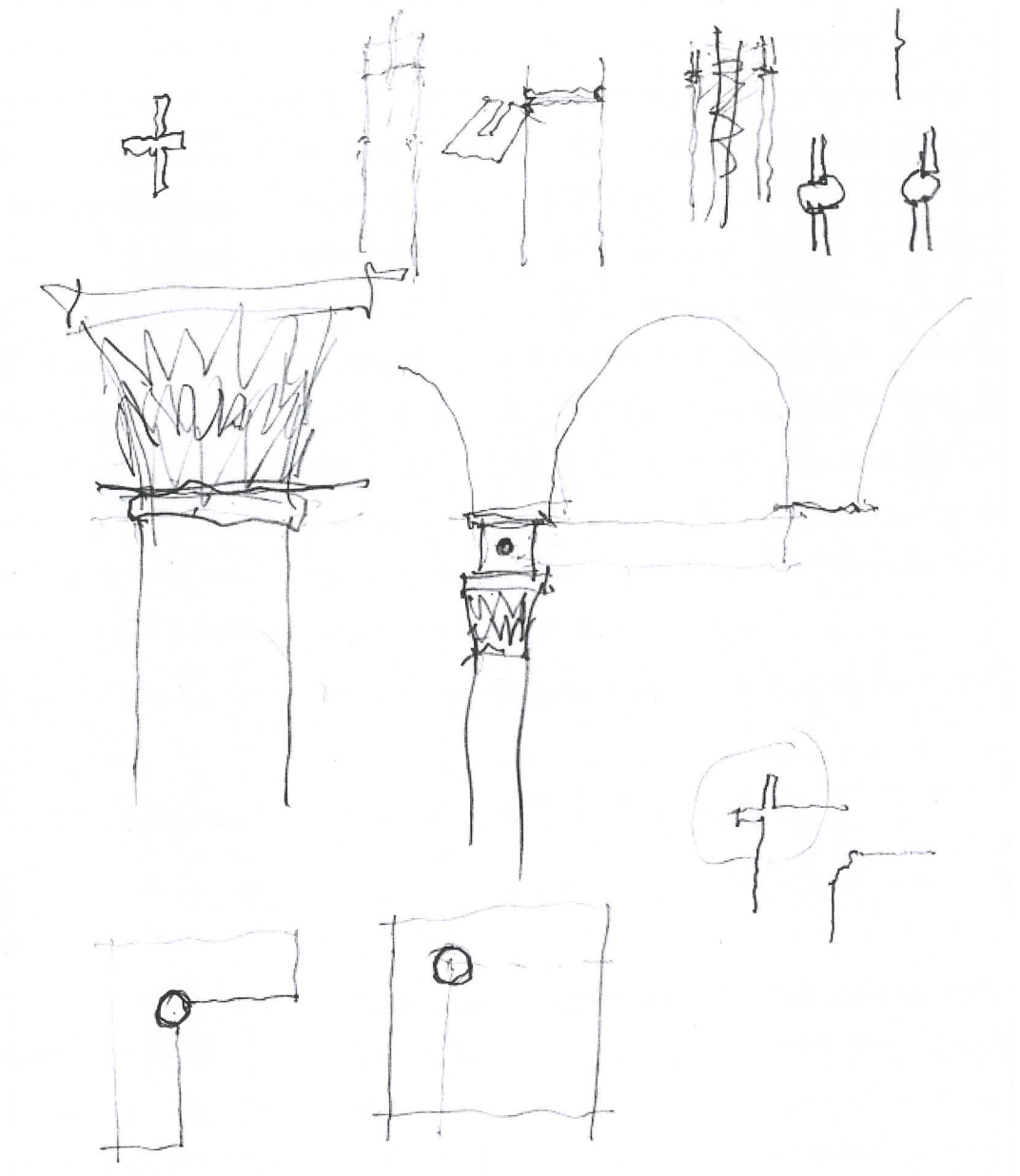


Fig. A.2 Sketches made by Marco Frascari during the interview. Clockwise from top left: diagrams of Scarpa's detailing of the joints between the formwork of concrete columns; column capital detail from Brunelleschi's church of Saint Lorenzo; genesis of Scarpa's detailing based on construction techniques; column capital showing mutola attached to column.

MF: I wrote this article "Contra Divinam Proportionem"[11] in 1998 with Livio Volpi Ghirardini.

The argument basically is that you know people in art history, they take a photograph of an

[11] Marco Frascari and Livio Volpi Ghirardini, "Contra Divinam Proportionem" *Nexus,* 2 Architecture and Mathematics"Edizioni dell'Erba, (1998).

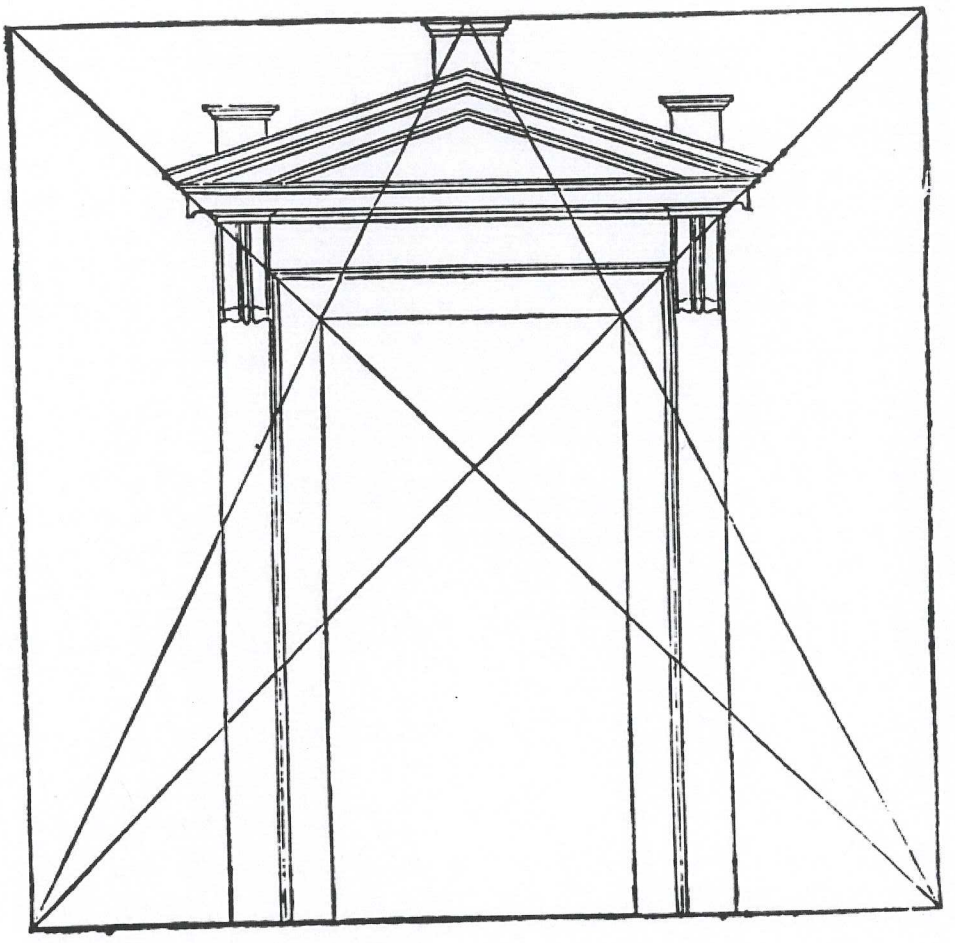
ancient building, trace lines from certain points on the façade to other points and they find the Golden Proportion. The problem that we found is how do you decide which are proportions? Proportions are the result of construction, not something that you can superimpose on top of a photograph. They relate to the builder who has a plumb line and he has to work out how to build it. I'll give you an example. There is that famous drawing of Serlio which purports to show how a door is inserted in a wall according to the proportions of the wall. (Figs.A.1, A.3) Why are these proportions important? It's very easy. The builder has begun to build the room, he hasn't put the stuff on top yet but he has to order the stones to make the door for the wall. How do I measure the stones for the door? It's very simple, I take rope and a piece of wood with a nail in it and I make the measurements for the door. Then I call my stonemason and give him the dimensions for the piece of stone! So in this article basically we are arguing that there is no such thing as golden proportion using building. It's only the proportion coming out of the making of the thing. Alberti, and basically we are looking at Alberti here, did things by the normal traditional way that builders make construction, and construction is linked to this act of measuring of the building. It has nothing to do with golden proportions!!

SR: In the Renaissance there was a lot of discussion about the harmonic proportions between the planets.

MF: Yes but the proportions they are using are the builder's proportions.

SR: So in fact the planets resonated according to how the building was built rather than the other way around.

MF: Yes and now we found all these beautiful things by taking a picture and picking up points that don't make any sense from a construction point of view! These buildings were never measured this way. They were measured so the builders could make the drums to make the column, the capital and so on, so the whole proportional system is determined by construction. There is no other way, so when you are going to measure the building, you have to measure the building in relationship to the way it's been constructed, not the way you think the proportional system fits.



Here finishes the First Book, on Geometry.

Fig. A.3 Serlio's drawing of temple door proportions.
(Source: Sebastiano Serlio on Architecture, Volume One, Book 1, On Geometry)

SR: Now that you mention it, the bedroom ceilings in my house are an example of that. I really wanted the curve to extend from wall to wall but the centre of that curve is below the floor so the builder couldn't set it out. (Fig. A.1)

MF: Exactly. No builder will do that.

SR: So in the end I made the biggest curve I could with the centre at floor level. The carpenter used a chain and a pencil to set out the curve.

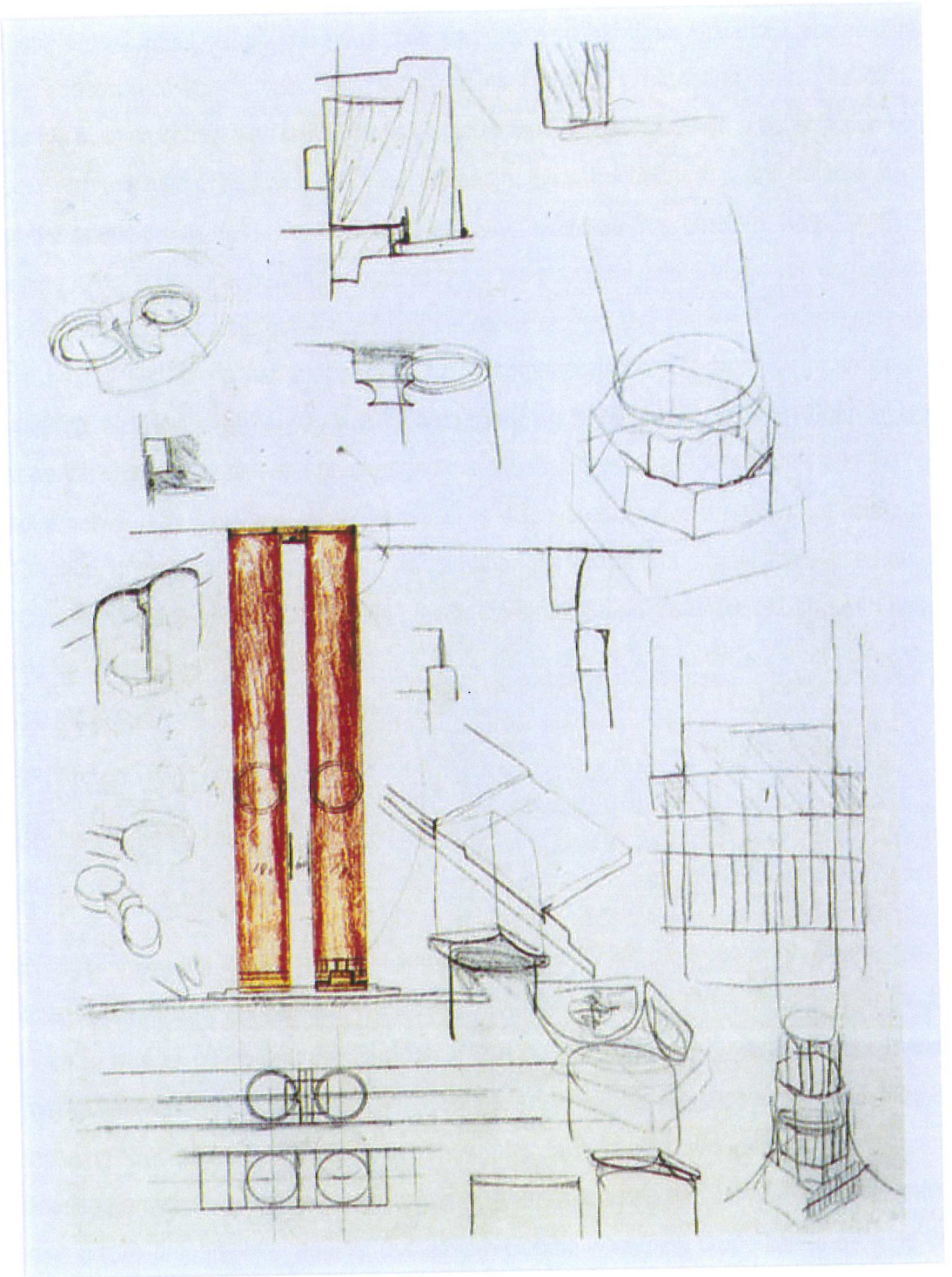


Fig. A.4 Carlo Scarpa, preliminary sketch for the twin pillars, *Banca Popolare di Verona.* (Source: Carlo Scarpa, Benedikt Taschen)

MF: Yes, you did a trick that is a classic of construction. When I explain to students why Palladio used the Serliana, which is an instruction in construction, for his arcade around the Basilica in Vicenza ... Give me your book I will draw it for you (Fig. A.1). The Basilica is built with this rhythm of arches and columns. Of course if you look in the *Four Books* (Fig. A.5),

these are all equal. When you go on site you discover that these distances are all different. The reason was very simple. This façade is applied to a pre-existing Gothic building. The Gothic building is built with ogival arches which intersect like this. From a construction point of view with this type of arch you can keep the height the same but narrow and enlarge the width of the opening (Fig. A.1). So the Gothic builders never had that problem. Now Palladio was asked to put a classical building in front of it and the structural points where you can attach this to the Gothic building are at the bottom of the ogival arches. If one opening is three metres and the next is two and a half metres you are in complete trouble because you cannot vary a classical arch in the same way without also changing its height. So what Palladio did was to keep the arches constant and he changed the dimension between the columns and the centre point between the columns. Why? Because he discovered what is a problem of construction. The story of the Basilica is that there was another guy before him that built this arcade around it and it collapsed because he couldn't relate the structural points of the existing with new. So this is a classical trick of construction. The Serliana allows you to correct every dimension if you get into trouble.

SR: And you don't notice it.

MF: No you don't. The only one who notices it …

SR: Is someone who measures it.

MF: Well if you are an architect you see it. Other people will never notice it. Goethe got very upset when he saw the Basilica. He travelled to Italy and the first thing he did when he got to Vicenza was to go to see the Basilica. When he got there he ran with his body and he immediately measured between these things and he got very upset because they kept changing. But basically Goethe didn't know how to build. He was one of these guys who theorised architecture without ever having built anything. And basically all the discussion we have *contra proportioni* is against people like Goethe who think proportion is a divine thing. The reality is brutal. You have to cope with a different system of construction. This is a Gothic system and this is a Roman system. The Roman with the arch requires that the distance between the arches has to be the same. With the Gothic system you can tilt the angle of the ogival arch every time to match the dimension of the plan without any problem.

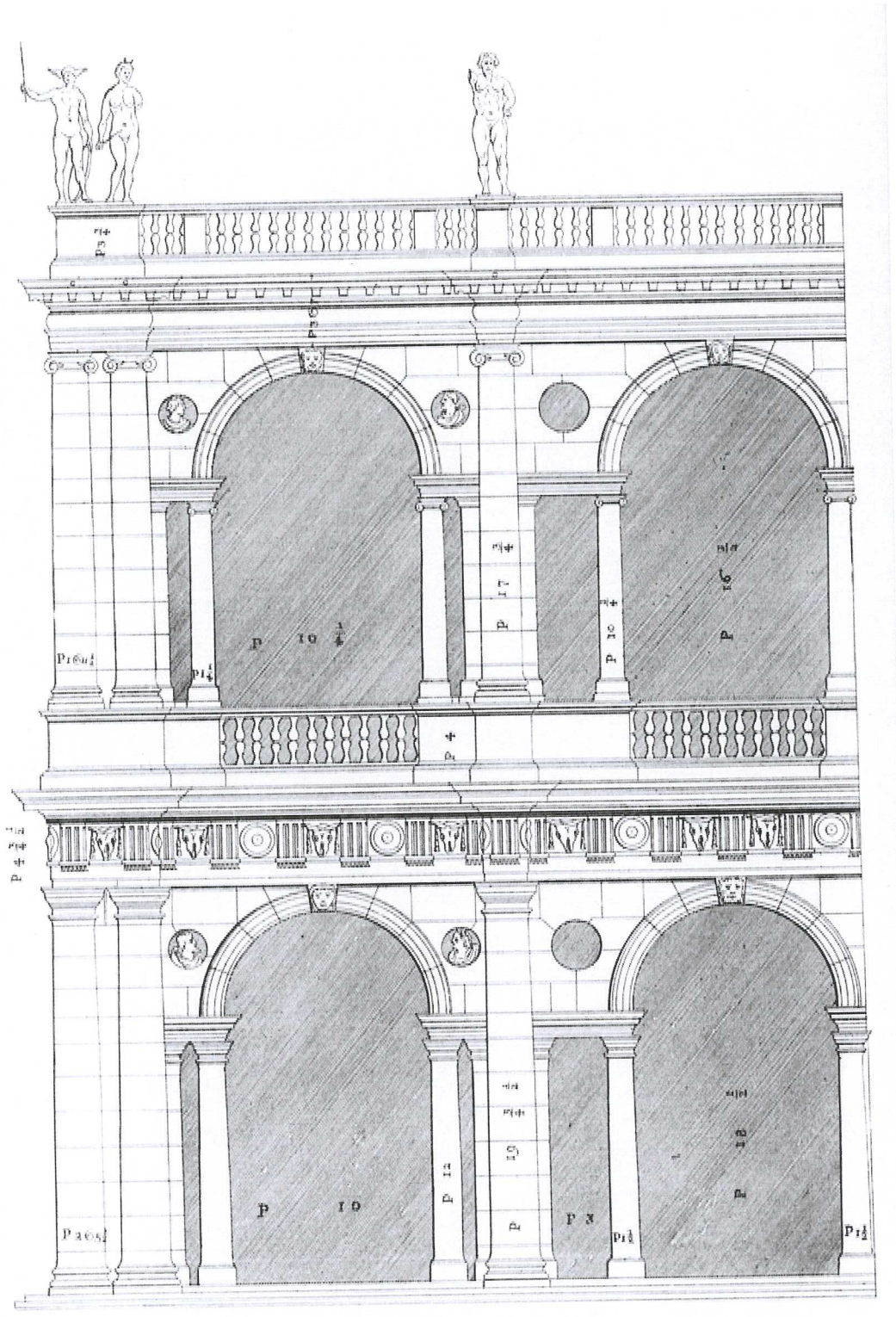


Fig. A.5 Palladio's deign for the addition of a classical arcade to a medieval basilica.
(Source: Andrea Palladio, The Four Books of Architecture, Third Book)

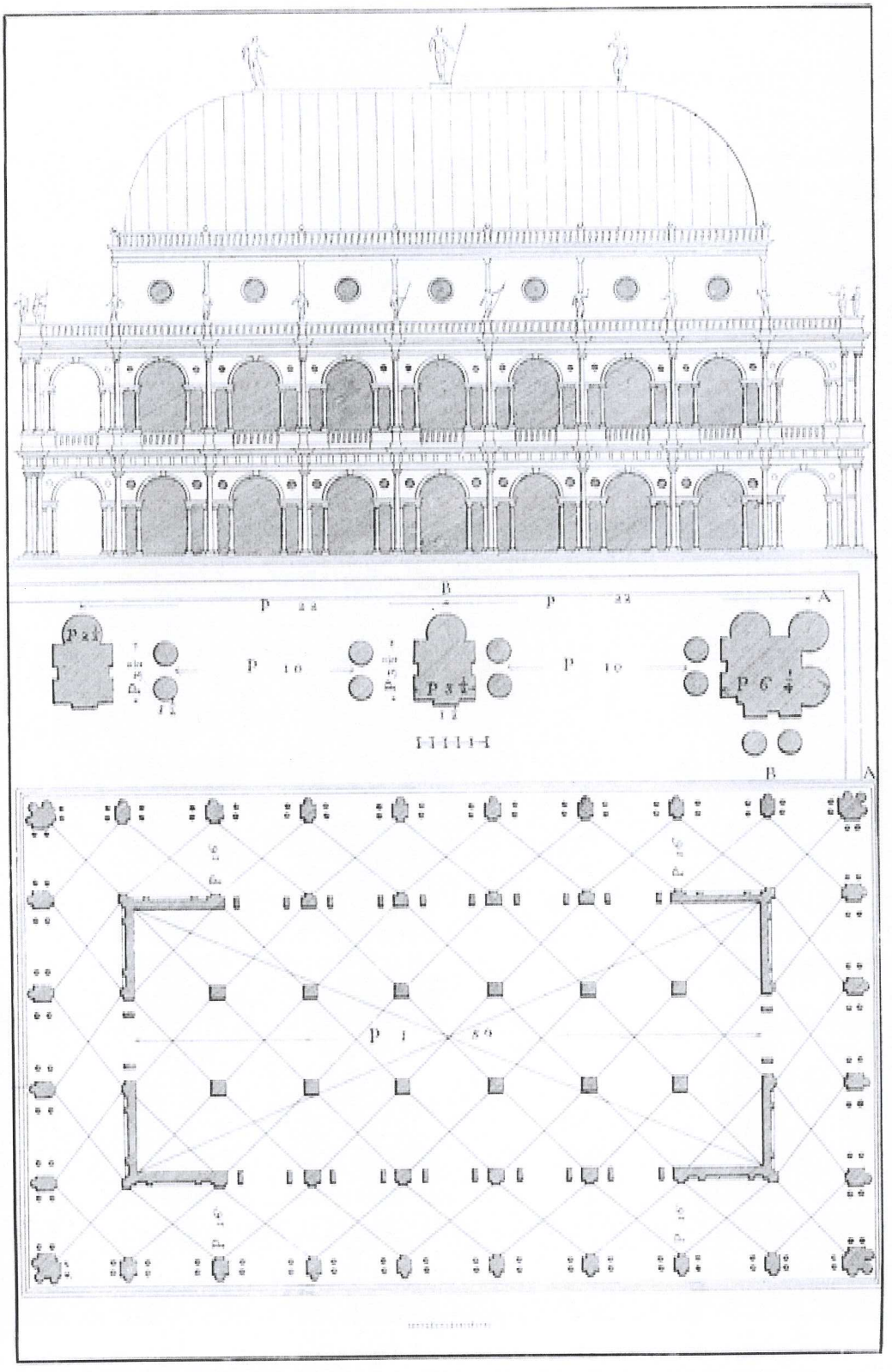


Fig. A.6 Palladio's design for the addition of a classical arcade to a medieval basilica.
(Source: Andrea Palladio, The Four Books of Architecture, Third Book)

Fig. A.7 Palladio's Basilica in Vicenza.
(Photo: Sam Ridgway)

SR: There must have been a similar situation with Brunelleschi's dome in Florence because he built a classical dome on an existing gothic base.

MF: Yes but you just look at that building and you realise that these people didn't know how to build, but the result in Vicenza is an architectural result (Fig. A.6). What is beautiful about the Basilica is this technique. Palladio brought together two technological reasons one to the other in an act of construction and it took on a meaning. And, the meaning is so important that we call this window Palladiana, which is funny because the guy who invented the window is Serlio. So some art historians called it Serliana, but it is only because they tend to give to Caesar what belongs to Caesar. But generally it is known as Palladiana because it's Palladio who made it famous through that building and probably Serlio, who also put in a proposal for the Basilica, had the same problems.

MF: Another aspect of construction is covered in this article I wrote about Scarpa's use of eleven. It was published twice; the second edition is better than the first. It' called "Deciphering of a Wonderful Cipher: Eleven in the Architecture of Carlo Scarpa,"[12] and this is again about construction and how you get the connection between construction and design. Scarpa used eleven centimetres as a basic measure. Now eleven is a very funny number. Scarpa's argument was this. Italians build internal partitions in hollow tile. If you do a wall in hollow tile the section looks something like this (Fig. A.1). I don't know if it is common in Australia. The hollow tiles are built up into a wall with mortar joints and then plastered over to finish. The standard dimension of this wall is ten centimetres but of course they never go up in a perfect plumb line. The dimensions are supposed to be a nine-centimetre tile and then half a centimetre of plaster on each side. The reality is, and I will draw it a bit exaggerated (Fig. A.1), they are always laid a little bit crooked and the plasterer compensates to make the wall true. The result is that the wall is nearly always eleven centimetres. So that is the argument of Scarpa. That is the basic module that he used. This is the reality of construction not the absurdity of a building code. So every measure is one hundred and ten millimetres or half that, fifty-five millimetres. I can tell you the measurements of every building of Scarpa's without a mistake because they are all based on eleven. You might think that a measurement looks like twenty centimetres; I can tell you that it is twenty-two. Eleven is also a funny number it is made by one and one. If you look, everything in Scarpa is double. If he does a downpipe, there are two of them. If he is doing a support for a handrail it is two pieces of metal. There are usually two supporting columns and so on (A.4, A.9). So eleven takes on this double meaning. Eleven is also an evil number by definition. It is a measure of the inferno. The only two measures

[12] Marco Frascari, "Deciphering of a Wonderful Cipher: Eleven in the architecture of Carlo Scarpa," OZ, 13 (1991): 36-41.

given by Dante in the Inferno are twenty-two miles and I think forty-four miles, both multiples of eleven. Ten is perfect, twelve is perfect, and eleven is in between. There is another funny thing; there are eleven characters in the name Carlo Scarpa. All his proportional system is based on eleven so he is embodying himself in all his buildings. Do you know the famous picture of his tomb where there are all these dots (Fig. A.7)?

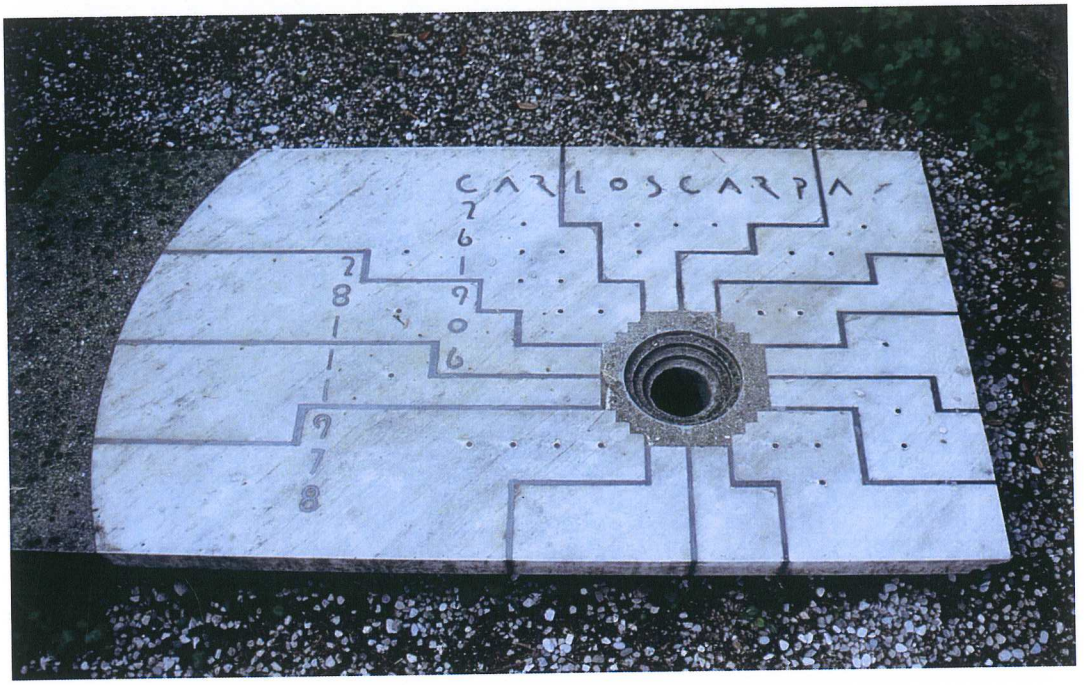


Fig. A.8 Detail of Carlo Scarpa's tomb in the Brion Cemetery (Photo: Sam Ridgway)

Fig. A.9 Carlo Scarpa Detail of Brion Family Chapel (Photo: Sam Ridgway)

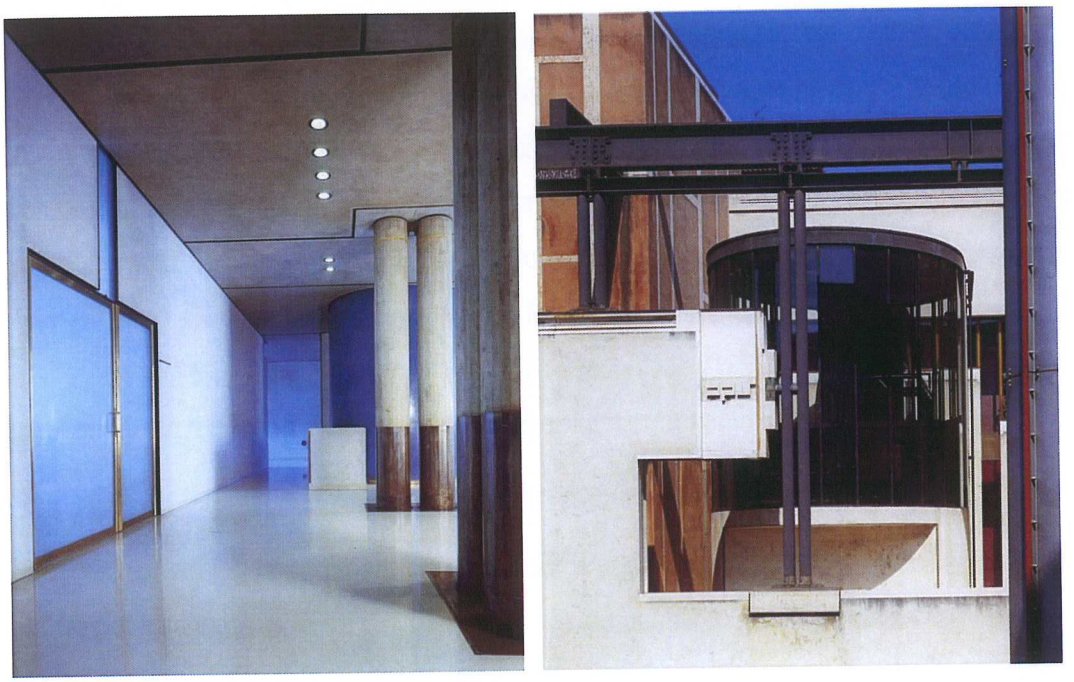


Fig A.10 Carlo Scarpa, twin columns from the *Banca Popolare di Verona*.
(Source: Carlo Scarpa, Benedikt Taschen)

SR: I don't know it. Is it in the Brion cemetery?

MF: Yes. Of course the entire Brion cemetery design is based on eleven (Fig. A.8). But Scarpa's tomb is in one of the corners of the cemetery and it is all a play on eleven. It was designed by his son after he died. And of course he is buried vertically!

SR: Vertically! Why?

MF: Well he wanted that.

SR: He wanted to stand up?

MF: Yes. But again, this use of eleven is part of the discourse of construction. He takes a very simple problem of construction and he makes out of it a system of building.

MF: This is a nice article. It is called "Tolerance or Play: Conventional Criticism, Critical Conventionalism, In Light of the Italian Retreat from the Modern Movement."[13] What happened was there was a famous article by Banham, against the Italian Neo-liberty, claiming that they were withdrawing from the Modern Movement. Basically the discussion I had was that from the construction point of view the difference can be characterised as the difference between

[13] Marco Frascari, "Tolerance or Play: Conventional Criticism or Critical Conventionalism in the Light of the Italian Retreat from the Modern Movement," *Midgård*, 1,1 (1987): 7-10.

tolerance and play. If you talk with an old cabinetmaker, at least in this country, I don't know if it's the same in Australia, he will say that when he makes the door he has to leave some play. In Italian it's the same they talk about *giorco*, otherwise the door doesn't close. That is a completely different mental construction from talking about tolerance. Tolerance is something you don't want. It's something you have to tolerate. Play is something that you want and it's a different thing. Of course the Italian Modern Movement was moving in this direction going back which Banham didn't like. Modern architecture doesn't allow play. It has to tolerate the fact that you cannot cut the wood exactly so you have to figure out something to hide that.

SR: I've never thought about it that way. Tolerances are something that you have to tolerate.

MF: Yes, something you tolerate because your dream is to be perfect or precise, whereas the old way of thinking was to be playful. There was no question of being precise. So this article is talking in general about architecture but in reality the basic concept behind it is the difference between tolerance and play architecturally speaking.

SR: Does this fascination with words come from the fact that you are bilingual, or probably trilingual? Etymology is a very important ingredient in your work.

MF: No this comes from my favourite philosopher, Giambattista Vico. It's not etymology, it's philology, which is a different thing. It's love of how thinking develops through the use of words. Of course you have to use etymology because it's part of the game. You have to go to the origins and see how things move out. That will reveal a lot of things. I try to get to the common language and figure out what people will think.

SR: Your work is very rich in that sense. Getting back to construction teaching for a minute. Historically why do you think there is this division between mind and body?

MF: Descartes. He was the one who really defined the separation. Then what happened was that the School of Engineering came about. The French invented a different school for engineering and a different school for architecture. The realm of construction was more on the engineering side. This happened slowly, it didn't happen overnight, but it happened and slowly construction was taken out of architecture, so when you get to the romantic period architects are artists and not anymore builders. There is a funny opera called La Boehme; architects became bohemians and therefore they lost completely their relationship with construction. And what happened was that, slowly, all the processes of construction in engineering became so rarefied that there was no longer the physicality of construction from the engineering side.

They would figure out things not through the process of design but through analytical procedure. So the analytical mind takes over.

SR: What I don't understand is where the power of that idea comes from, and why it is so pervasive. There is almost no questioning of this current way of thinking about architecture, which nowadays considers construction to be second-class to design.

MF: Yes in architectural schools design is more important and construction is less important. That happened because of the split and the fact that they realised that construction doesn't have any impact on what the modern design was, this idea about purity, which is baloney. The reality was that Corbu was a good builder; he was attempting a lot of things with construction. Frank Lloyd Wright was always attempting things with construction. When he made the mushroom shaped structure for the Johnson Wax Headquarters he had to load one to prove to the city that they would hold. The whole Falling Water house was again a powerful game of construction which, by the way, they had to spend a lot of money to fix up.

SR: There is the story that he had to personally remove some of the formwork from the concrete because the builder thought it would collapse!

MF: Yes, but the mentality in the schools was that construction was ruled out. These people did the spaces that they did and someone else figured out how to build it. The engineer dimensioned the building and the dimensioning of the building was completely unrelated to the process of construction. And of course the technology evolved very fast in the last period. If you think of it most Modern buildings were aiming towards other systems of construction. The Rietveld House, which is technically the idea of slabs and free planes, is in reality the oldest traditional system of construction because he knew how to do that. That's the point. But the propaganda that was made wasn't showing that you can achieve that with brick and wood. No, these are concrete slabs flying! And therefore the whole thing of construction got screwed up.

SR: So in fact the engineer became very powerful, and still is, in terms of their influence, their power and their authority, and the way they are paid, which is much better than architects. Then there is design, and construction seems to have got lost in the middle somewhere. Which seems crazy to me.

MF: Now there are building managers who are taking care of it because they are the ones who have to figure out how to build the building. Because the engineer has told them "this is the section" and "this is the dimension" and these guys have to go around to builders and figure out how to get things on site, how to erect them, which was the old part of architecture. One of

the things I teach my students is that if you look at classical columns at the top they have a tiny rim this is called a mutola, then there is the capital (Fig. A.2). The mutola is attached to the column; it is not attached to the capital. The reason is very simple. It's a construction problem because when the column was on the ground and had to be lifted you put a piece of rope around the column and the mutola stopped the rope slipping off when it was lifted!

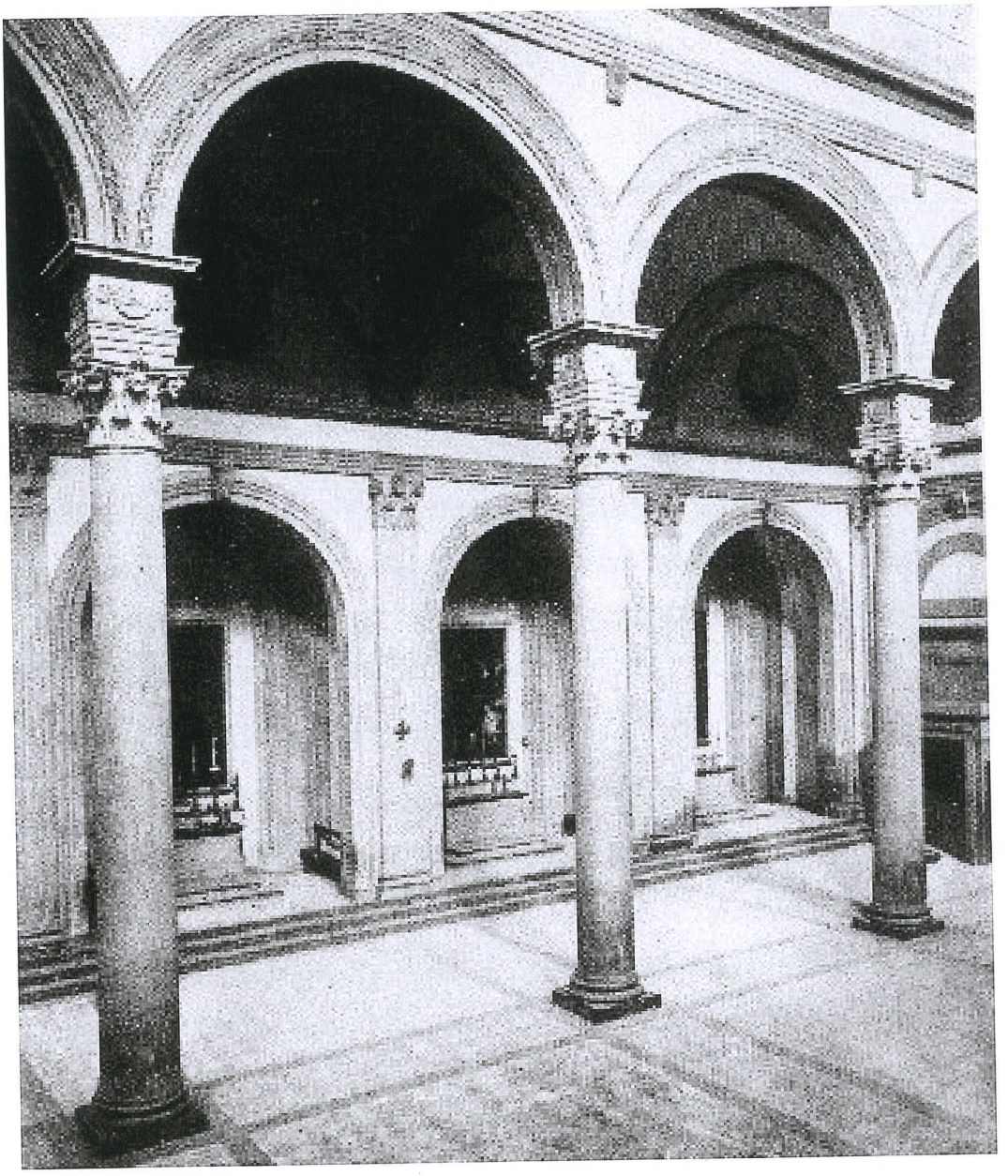


Fig. A.11 Brunelleschi's Church of Saint Lorenzo (Source: unknown)

If you go to Brunelleschi's church of Saint Lorenzo in Florence there are these beautiful arches, then there is a cube and then a plate and there is the capital then the column (A.. 2, A.10). Why do you have that cube there? Construction! What they did was put a temporary beam between the columns and then erect the centring, build the arch remove the beam do

the next. This is the result of construction. No engineer would ever do that. Engineering will tell me what kind of bricks I have to have, what kind of resistance they have to have, but it will never give me this detail as the result of thinking about construction, whereas this is true architectural thinking from my point of view. Then what Brunelleschi does is that he takes this and loads it with so much meaning because then all the plan of the building is based on this game. So you can find it in every corner of the building. It is the perfect grid controlling the whole building.

SR: Did Scarpa do the same the thing?

MF: Oh yes, a lot of things. I'll show you (Fig. A.2). This is the result of construction. Scarpa has always this kind of element. You see a piece of metal and he has this round element and he has a nice piece of brass put there. Why? Very simple. You make this from a square piece of metal. The guy has a saw and he cuts in from both sides. The result of this is two possibilities: either you stop short or you go over. Neither gives a sharp corner. So what Scarpa did was he talked to the guys and he said first you drill a hole and then you cut with the saw. So when you reach the hole you hear immediately because the saw suddenly sounds different and you know where to stop. So these decorative elements are purely the result of construction. It's not the result of a fancy idea about doing something like that. I would say that if ornament is elegant it is the result of construction.

SR: You talk in the Tell-the-Tale Detail about Scarpa's adoration of the joint.

MF: Yes. The reason why he selects a special joint between marble and marble was so the guy could move to put in the piece of marble. Of course the Modern Movement would ask for that to disappear.

SR: Do you think that is one of the reasons he was marginalised from the Modern Movement and never quite fitted because of his ideas about joining? He worked with play, not tolerance.

MF: Exactly.

SR: It's fascinating, because when you look at his work the joints are so beautiful, but it is hard to understand how they were developed or why. But then when you begin to understand how they were generated it becomes clearer.

MF: Of course Scarpa said, "I cannot do columns, I'm a Modern architect!" I'll give you another example of a detail of the two columns in the bank in Verona that is the result of construction (A.2, A.9). The two columns: you have a column like that, and then you have a second column,

and if you look at a picture it's broken like this and it is filled with gold leaf. Why? Simple! When they cast the column this was the joint between the two castings and the wood container of the column would be one here and one there. When I take down the form, concrete will do this. So the builder had to go there and carefully remove the tiny rough part of the joint because we want a clean column. Every time you cast a column it's the same and he will take a little bit of cement and patch up the column. In about five years if it is very humid it will fall off and it becomes ugly. So what Scarpa did was to hammer the joint and use gold leaf to create a beautiful joint between the two castings.

SR: In a lot of Modern Architecture, especially some Japanese architecture, there is a lot of off form concrete used and they seem to make a kind of feature of the tolerance. Like the lifting/casting holes in the panel for example, which are made to be very regular, I imagine at some cost and inconvenience to the builder because you would generally put them in the most functional location. This is in a sense the reverse of what you are describing.

MF: Yes, it is the reverse of that because that is taking tolerance to the extreme.

SR: Yesterday we went to the Building Museum and when we got out of the metro in China Town there was this white stuff that looked like snow coming down in the air like little floating lumps. I wondered what it was and when we got outside the station I saw that they were cladding a building in polystyrene. I had never seen anything like that before, on the outside of the building! They were sticking on panels of polystyrene onto some sort of concrete structure.

MF: Yes it is insulation and they will put a skin of render over it. The basic game here is that the building should look like the drawings.

SR: Never mind how you build it!

MF: And as you say that kills construction completely.

SR: I was thinking about the role of theory in construction teaching and my experience is that construction teachers find it a bit threatening and generally they reject it. I was wondering if we were to get a debate going about theory in construction how would you try and describe the role of theory in construction teaching? In my view it is currently under-theorised. I have found it very difficult to talk to construction teachers about theory without appearing to be critical.

MF: Well, yes. Basically you are taking away from them what they think is right. So it has to be a slow process. It cannot be done immediately. There are several things I would do. The first would be to rediscover two things that would help the students anyway: stereotomy because it

is a means of graphic representation related to the act of construction; and the other one would be descriptive geometry. The third one is something that is called static graphics. Not when I was in school but when my father was in school you could figure out the structure of a building through graphic means alone. It was something that died completely. At one time construction was taught within the field of theory.

SR: History and theory in schools now have nothing to do with construction.

MF: No, but it was. If you take any renaissance book, it is all about construction.

SR: If you were to design a teaching program from scratch would you stream construction teaching or would you integrate it with design?

MF: I would stream it. You have to investigate a little bit what was the structure of teaching in Italy. It was based on the French tradition. When I was at university the idea of character was very strong. Character is a French idea, coming through Violet Le Duc. In Italian teaching there were three courses in character. One was called 'the character of distribution or arrangement.' So the character of the building is determined by the arrangement and distribution of elements, basically function, but it was not done functionally, it was done because it gave character. The other one was 'stylistic character.' This was character created by the style, for example, a government building has to be Classical or Gothic. The third was 'constructed character.' The first exercise that we had in our course on construction character I will never forget. They gave me the plan, section, elevation of a building that was built in wood and they said, you do exactly the same building; you can't change anything but you have to do it in concrete. There was no design involved but I had to change completely the system of construction of the building. That was quite an exercise and I will never forget how much I learned from it. It was a year-long exercise and the resulting building had completely changed its character. By changing the material it looked completely different. It was the same building but it was completely different. Now years after, reading Lodoli, I realised that this was a basic understanding of architecture. Lodoli called it the process of substitution, which is the basic argument of Greek architecture. Greek architecture is about substitution. Why? Because they were seafarers. When you have a boat in the water some parts rot quicker than other parts so you have to remove the rotten piece and replace it with another piece to fix it or make it better. The same worked for Greek architecture: they replaced pieces. With Greek architecture it was very easy to replace parts. You can take out a column and replace it. You cannot do this with Roman architecture. Roman architecture works in a different way; it's a different system. If you

take out one piece of an arch it collapses. So the Greeks substituted pieces and they went from wood buildings to stone buildings by substituting stone for wood. Now you can understand that all Greek decoration is the result of construction. Take the triglyph for example. There are thousands of interpretations of how the triglyph came about, but my argument is very simple. It is the head of a beam in a society that doesn't have a saw. With an axe you can square the tree, very simple, but when you want to cut the beam you cannot do it you have to make what I call a pencil point, and you lose too much wood. There is no way I can go down straight. So what they did is very simple, they took a piece of iron, heated it until it was red, and pushed it down through the wood three times. Then they put a wedge under the beam and hit the beam and it breaks. What is the result? A triglyph. The Greeks then kept this as a memory when they built in stone (Fig. A.11).

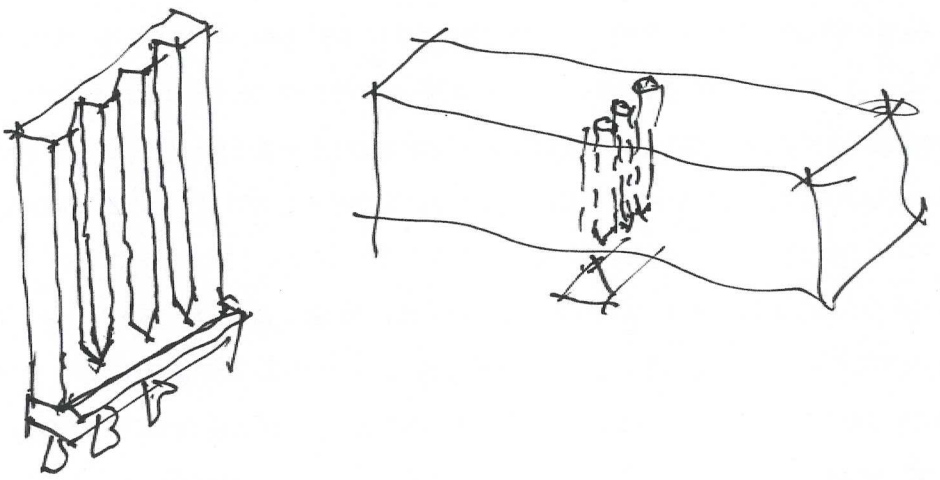


Fig. A.12 Sketch of triglyph and guttae made by Marco Frascari during the interview.

SR: George Heresy has a very different interpretation of the triglyph. He talks about the thighbones of oxen cut up into three pieces with the guttae being the sacred marrow draining out of them.

MF: Yes, and Joseph's interpretation is that they had planks, but I don't buy that because planks are much more difficult to achieve. He says that the triglyphs were the mitred ends of the planks but then these would go down to the bottom but they don't. But maybe it is some combination of these and they are questions of theory, not questions of construction. When I was studying architecture and I learned these things I realised that through my process of

construction I can achieve meaning and that is the game. Eleven is the name of Carlo Scarpa; eleven is the game of construction.

SR: If you had to point to the historical moment when the split between construction and design took place in the academy, what would it be?

MF: The invention of the Polytechnic. The time when the military school becomes the Polytechnic. That is the key moment.

SR: So that's Durand?

MF: Yes, that is the moment. When it gets out of the hands of the architects and becomes the realm of the engineer. It's not immediate in the sense that the architect is not giving up construction but finally when industrialization comes about the profession is ready. In Italy, for example, after the Reconstruction architects knew how to build and there is no industrialization. Every window had to be built one by one but when industrialization came about, windows, doors, floor dimensions, beams and so on, are all produced outside. It is not the result of the architect but is a result of the production industry. What the Polytechnic had done prepared for that to happen. What was happening before in the education of the architect was they went out on site and the builder told them how to build. It happened to me. When I started my first building, this builder had just lost his son in a car accident. He was a small contractor and he had all this knowledge that he had to give to someone, so I showed up with this job, and he said to me: "Every morning at 8 o'clock I'll be in front of your door, you come in my car to site and I'll tell you what I'm doing today." That's how I learned really how to build, not in the office. Of course I had a good training in the office with Scarpa.

SR: Nowadays, of course, you would have to be very careful of a relationship like that with a builder because you would learn how to build polystyrene buildings!

MF: Yes. He was an old man; he had just lost his son who was probably about 25 when he died and he was ready to be told the trade.

SR: Do you think that we are really just fighting a losing battle against the forces of industrial production?

MF: No. I think the battle is that the architect has to deal with industrial production and they don't do it. We have to make students aware of what industrial production is and how we can use this stuff really rather than be constrained by it. I'll tell you about one of my experiences. When I came to America I did a design for a building in Cincinnati Ohio. I was working in an

office there. I had a pretty big area of using glass blocks. My drawing went down to the specification writer, it was a big architectural/engineering office, and he called me and asked me was I crazy using so much glass block? I asked him why and he said to me there was only one factory that produces glass blocks in this country and to produce this quantity would take so long that we would have the building finished before they could deliver them. Ten years after there was going to be no problem at all. Why? Because a Princeton architect made a kitchen with a glass block wall and suddenly it became fashionable.

SR: So suddenly there were glass blocks everywhere.

MF: Yes.

SR: Well, that's another question as well.

MF: How is an architect going to influence industrial production? Not just by being consumers, which is really what the profession does now. You have to fight the battle, then they will do it, because you are the one determining it. Otherwise it's giving up your role as an architect, which is a really bad thing. It seems to me that the Australian profession is a little bit better than here. Here it is getting really bad, bad, bad. Tell me in America who is a really good architect. Don't think about the old.

SR: Is Steven Holl too old?

MF: He's been on the market for a while. He was on the market when I started.

SR: Well, Gehry's definitely too old.

MF: Gehry's too old. There's no new generation coming up.

SR: Which is why I asked the question about fighting a losing battle.

MF: They lost it here. My feeling is that you still have the possibility in Australia. The Japanese still have the possibility of shaping things. Italy has lost the battle. Aldo Rossi died, there are no new Italian architects coming. There is still something going on in England. France has lost the plot. The north European countries are still producing and making clear that industrial production follows them rather than us following industrial production.

SR: Then what do you make of the current interest in the resurgence of the tectonic. For example, Peter Zumthor and Herzog and de Meuron.

MF: Oh yes, the whole bunch, but that is because Kenneth Frampton hammered that. When *Studies in Tectonic Culture* came out he had already been talking about it for ten years. Sure,

he made the use of the tectonic more sophisticated, but basically it was construction. Basically when Heidegger talks about *Building, Dwelling, Thinking,* he's talking about building and he's not talking about tectonics. He's talking about the art of construction. Just about every one read that article but no one really understood what he meant. It is a very sophisticated article. But that's fine. It brought back the idea of building.

SR: An idea that interests me in *Building Dwelling Thinking* is that we don't dwell because we build but we build because we dwell and are dwellers. That seems fundamental to me, but I think in fact most people would see it as the reverse, that in fact, dwelling comes about through building. Not that we build in fact to respond in some way to a place. This leads me to a related question and that is that in the same article Heidegger raises the issue of nurturing and dwelling. I suppose you have to be a bit careful of the nostalgia of that view but actually it's a very powerful idea and the way I think about it now is how it relates to construction because the idea of sustainability and nurturing and so on is very topical at the moment and yet we seem to be going backwards there as well. We seem to be losing that battle because we're creating more and more pollution and there is less and less of the natural environment left and so on and so on. And I see that sustainability in schools of architecture is taught in a very instrumental fashion, focusing on calculating how heat moves through walls and so on

MF: Yes, and again it's a mistake. I'm saying nothing's wrong with those things.

SR: You have to know them.

MF: You have to know it. But at the same time you have to know what is the meaning of doing that, because we fall again into the same mistake. You want a cold wall or a warm wall. What is the meaning of that?

SR: But one of the fundamental problems, it seems to me, that you can't sell the idea of sustainability through being instrumental. People will not understand it, they will not buy it and they will not see it as meaningful.

MF: No. One of the funny things is when you are talking to students they say that different materials have different temperatures. Wood and ceramic floors for example. When you ask them to take the temperature of both materials in the same space they find out that in fact both materials are the same temperature. When they say they feel different temperatures and you explain to them that wood is a good insulator so you don't lose heat and ceramic is a poor insulator so you lose heat. You have to be very careful when you do sustainability because you can do the numbers but what is the architectural effect of doing that? Do you lose meaning

or do you keep the meaning of that architectural event? So by using that analogy they start to figure out that the R value of the room is very good but it doesn't mean that the room is going to be that temperature. They may want to have a room where they lose heat rather than just keeping it. Or I want a room that I want to do this and that, and slowly they get to understanding and meaning. The way it is now they just want the temperature to be the same and they don't touch it because if they do they will discover something about it they don't want, so the meaning is lost.

SR: I think we already talked about rammed earth. People find rammed earth meaningful in terms of sustainability because it's become a symbol of sustainability. But in fact the science of it or the physics of it don't actually work.

MF: Yes it's a symbol. Because they are like the guys with the ceramic floor who say this is a cold floor therefore they don't want it. It's the symbol; it's the perception.

SR: Of course, everything is relative depending on what you're used to and your expectations, and the cost of energy to heat and cool.

MF: Yes, but we are losing the battle and I think the reason why we are losing the battle is because the architect has given up being an intellectual. I'm not talking about the professor, but the architect.

SR: Why do you think that is? Is it because construction knowledge is seen as second-rate? Even to know much about it seems to reduce one's artistic credibility. The design architect does the design and someone else less important works out how to build it.

MF: Yes but it wasn't always like that. That has been the modern tradition, especially in the English speaking countries. In France, Italy and Spain the architect is still an intellectual.

SR: I don't know about in America but in Australia architects often talk about their professional base being eroded by other professionals like project managers and so on and that they are having less and less influence.

MF: Sure, but the key element is that we design the building and they don't.

SR: But it seems to me that construction is central to design yet in education it's become marginal.

MF: Yes, I think this is the core of education. It doesn't mean that we necessarily have to know all the important systems of construction. If I learn one, I can adapt myself to other systems of construction. When I came to this country I went from wet construction to dry construction. I

will never forget my first contract. In Italy when we do a contract with a builder one of the key elements is who's going to pay for the water because the quantity of water is really a lot. When you build in brick, it means everybody on site has to have access to water, like your stonemasons who have to wash, to wash, and to wash. So, for instance, if I had a well, it's cheaper for me to give the water to the contractor because it would cut the cost. If I have to buy the water from the city it's worth it to me for the contractor to buy the water because he gets a better price. So, that was a fundamental thing when I began working as an architect in America. I remember working with a client to sign the contract with a builder and I asked who was going to bring water to the site and who's going to pay for it? He said, "my guys drink Cokes at work!" And I felt so stupid because I was only used to wet construction!

SR: Well that seems like a good place to finish. Thanks so much for sharing your thoughts with me.

MF: You're welcome.

Appendix B

DRAWING CONSTRUCTION
Interview with Alberto Pérez-Gómez: Montreal December 2005

Introduction

Like many others, I first became aware of Alberto Pérez-Gómez through *Architecture and the Crisis of Modern Science*, a work that details, among many other things, the final evisceration of symbolic meaning from architecture during the European Enlightenment, epitomised by such figures as Jean-Nicolas-Louis Durand (1760-1834). This work had been central to my previous research in the area of the factory-made house, an early twentieth-century phenomenon foreshadowed and made possible by the reductive practices instigated during the early modern period, which this book examines. His more recent work, *Architectural Representation and the Perspective Hinge* (1997), co-written with Louise Pelletier, focuses on the "value-laden tools of representation that underlie the conception and realization of architecture." The book reveals in a great deal of historical detail how these representational tools, perspective, descriptive geometry, axonometry and isometry for example, developed to eventually constitute a systematized means of describing a whole building. While these tools grew out of an increasingly technologized, objectified and controlling view of the world the 'values' they embody are not well understood in current practice or pedagogy. In fact the reverse is true; representations of buildings are generally regarded as neutral instruments, as a kind of "one-to-one correspondence between the represented idea and the final building."[1]

Prior to interviewing Pérez-Gómez in Montreal, where he is Saidye Rosner Bronfman Professor of the History of Architecture at McGill University, I met him at an Architectural Humanities Research Association (AHRA) conference at The University of Nottingham titled *Models and Drawings: The Invisible Nature of Architecture* (November 2005). His keynote address titled "Poetic Origin" revealed a willingness to tackle controversial issues and I started the interview that follows by reading the abstract back to him and pointing out how unpopular and seemingly reactionary were his views, namely, that digital media has not improved the built environment and that the "digital 'avant-garde' has degenerated into a banal

[1] Alberto Pérez-Gómez and Louise Pelletier, *Architectural Representation and the Perspective Hinge*, pg. 3.

mannerism."[2] With schools heavily promoting and marketing courses in digital media and computers having become central to all architectural programs it is unusual to hear such an eminent figure in the area of architectural representation within the academy questioning the hegemonic digital environment of both learning and practice.

Alberto Pérez-Gómez was born in Mexico City in 1949 and after completing his undergraduate degree there he went on to write a Masters and a PhD at the University of Essex in England. The themes of *Architecture and the Crisis of Modern Science* were in fact originally presented in his PhD which was supervised by Joseph Rykwert and Dalibor Vesely, two figures who have had an immense impact on the world of architectural theory. Pérez-Gómez was appointed to the professorship at McGill in 1987; before that, from 1983 to 1986, he was Director of the School of Architecture at Carleton University in Ottawa. At McGill he is currently Director of Post-Professional (Masters and Doctoral) Programs and he chairs the History and Theory of Architecture Division. In addition to the two books mentioned, he has also published: *Built upon Love: Architectural Longing after Ethics and Aesthetics* (April 2006); *Polyphilo or the Dark Forest Revisited: An Erotic Epiphany of Architecture* (1992); co-edited with Louise Pelletier, *Architecture: Ethics and Technology* (1994); translated and extensively introduced *Claude Perrault's Ordonnance for the Five Kinds of Columns after the Method of the Ancients* (1993); and co-edits with Stephen Parcell a book series, *Chora: Intervals in the Philosophy of Architecture* (1994, 1996, 1999, 2004). There are in addition two works of poetry and about ninety articles, essays and book chapters, a list of which can be found on his web page at McGill.

In a two hour interview it is of course impossible to discuss meaningfully such a vast intellectual output, and so I chose to steer our conversation towards topics in which our interests overlap, representation and construction in particular. In fact, one reason for seeking the interview was to discuss the possibility of rethinking construction pedagogy through its methods of representation by revisiting the graphic techniques of stereotomy and descriptive geometry, which appeared to require a close connection to, and understanding of actual construction. In my experience, this connection is becoming harder to achieve with less opportunity for site visits and the increasingly ubiquitous, powerful, and, in relation to architecture's materiality, alienating digital learning environment. Of course *Architectural*

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[2] Alberto Pérez-Gómez, "Poetic Origin (abstract)," in Jonathan Hale and Bradley Starkey (eds), *Models and Drawings: The Invisible Nature of Architecture*, AHRA Annual International Conference 2005, Nottingham: The University of Nottingham, 2005, pg. 22.

Representation and the Perspective Hinge is essential reading for a project of this kind because it reveals, as Pérez-Gómez says early in the interview, the "profound historical roots" of the current digital world. In the book, he points out that the computer is the "culmination of the objectifying mentality of modernity and it is, therefore, inherently perspectival."[3] Recently, Dalibor Vesely has also published an impressive book on the topic of representation, *Architecture in the Age of Divided Representation: The Question of Creativity in the Shadow of Production* (2004). In a similar vein, Vesely's book examines the anticipation of modernity through the development of Renaissance perspective against the background of a medieval philosophy of light. Divided representation refers to the inevitable tension that arises between architecture's instrumental and communicative roles.[4] On the rear cover of the book, Pérez-Gómez writes, "Vesely demonstrates the centrality of architecture to culture – not as a dream, nor as an aesthetic or functional artefact, but as a communicative practice."

My initial interest in construction drawing techniques grew out of the simple and somewhat instrumental pedagogical technique of encouraging students to consider the material implications of their design drawings. A curve quickly sketched without an understanding of how it might be built can have huge implications for construction. Of course this is a means of linking together construction and design; once construction techniques for making curves are understood it influences their use in design. Ultimately, the aim is to understand these techniques so well that they become generative rather than applied in an instrumental way after the design is completed. Teaching construction in a manner that reinforces the supposed neutrality of construction materials and techniques, conceiving them as neutral instruments that can be applied in an instrumental fashion to designs already conceived, is something that I have tried to avoid for many years. My personal revelation on reading *Architectural Representation and the Perspective Hinge* was that not only are the materials and techniques of construction usually assumed to be neutral instruments but so are the drawings by which they are depicted. As Pérez-Gómez and Pelletier so thoroughly reveal, nothing could be further from the truth.

Interestingly, after re-reading *Architecture and the Crisis of Modern Science* with this different agenda in mind, I realised how central the development of perspective, stereotomy

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[3] Alberto Pérez-Gómez and Louise Pelletier, *Architectural Representation and the Perspective Hinge*, pg. 378

[4] Dalibor Vesely, *Architecture in the Age of Divided Representation: The Question of Creativity in the Shadow of Production,* Cambridge, Massachusetts: MIT Press, 2004.

and descriptive geometry were to changing perceptions of the world and our place within it. Pérez-Gómez writes that it was during the seventeenth century that "methods of *perspectiva artificialis* became truly popular with artists."

> Perspective became strictly possible only when man began to view himself as a subject and external reality as a collection of objects. The development of perspective theory is intimately connected with the epistemological revolution and, associated with this revolution, the fundamental dissociation between man and world, between mind and body. Cartesian philosophy postulated perspective as a model for human knowledge.[5]

Similarly, stereotomy, "the use of geometric projections in determining the shape and dimensions of stone or wooden elements in arches, vaults, trusses, stairs, and domes,"[6] was an attempt to turn a practice extant in stone cutting yards for many hundreds if not thousands of years, into an objectified, technical theory. It first appeared in print in Philibert de l'Orme's *Architecture* in 1567 and was revisited in architectural treatises for the next several hundred years. Stereotomy was never a successful means of conveying precise dimensions or technical methods to the stonemasons, as it was usually too theoretically and technically complicated to be useful in practice. Masons still relied on their experience and interpretive skills to cut stone for complicated architectural forms and I am reminded of the current interpretive practice of developing shop drawings used by more specialised trades these days as a means of conveying how to actually build something the architect has drawn to the workshop.

It was the development of descriptive geometry by Gaspard Monge, a detailed description of which he published in *Geometrie Descriptive* (1795), that has probably had the most profound effect on the depiction of architectural construction. This, as Pérez-Gómez points out, is the "mathematical discipline in which Euclidean geometry became truly functionalized, that is, reduced to the realm of algebraic analysis."[7] Descriptive geometry was the final setting in place, of a mathematical description of space that allowed the development of isometric and axonometric drawing. It also allowed the development of the modern working drawing, as it provided a means of fully describing three dimensional objects in two dimensional drawings. Monge's descriptive geometry was taught at the *Ecole Polytechnique*,

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[5] Alberto Pérez-Gómez, *Architecture and the Crisis of Modern Science*, Cambridge, Massachusetts: MIT Press, 1983, pg. 174.

[6] Alberto Pérez-Gómez, *Architecture and the Crisis of Modern Science*, pg. 227.

[7] Alberto Pérez-Gómez, *Architecture and the Crisis of Modern Science*, pg. 279.

an institution that has, with very few exceptions, been the basis for the academic model of architectural education ever since. Here, Pérez-Gómez uses the example of Durand's design method, which advocated the arrangement of objectified architectural elements on a universalising grid, which was taught at the École, to illustrate the reductive and eventually meaningless nature of buildings derived in this manner from that time to the present. As he says, "... architectural design as a whole was reduced in Durand's theory to a formal game of combinations, devoid of transcendental intentions."[8] Clearly, my project to contemporise stereotomy and descriptive geometry with the aim of more closely connecting drawing with construction will have to tread carefully, since these graphic techniques are not as benign as I initially thought!

> The descriptive sets of projections that we take for granted operate in a geometrized, homogeneous space that was construed as the "real" space of human action during the nineteenth century. Our implicit trust in the application of a scientific methodology to architecture derives from techniques prescribed by Jacques-Nicholas-Louis Durand in his *Précis des Leçons d'Architecture* (1802 and 1813). Durand's *Mécanisme de la composition* was the first design method to be thoroughly dependent on the predictive capacity of these projections. For him descriptive geometry was the modus operandi of the architect. Although descriptive geometry promoted simplistic objectification, this projective tool is a complex product of a philosophical tradition and technological worldview that defines the European nineteenth century and leads to our own "world order." It is, therefore, not something we can simply reject or pretend to leave behind.[9]

Architectural Representation and the Perspective Hinge examines architectural representation in a great deal of detail during a period that witnessed the transition from an ancient and medieval mode of building that did not involve many drawings, to the modern technological era where buildings are documented in minute detail. The authors point out that although they offer a "collection of historical narratives of different 'scales,' ranging from the general to the specific," the "work should not be interpreted as a general history of perspective." Rather, their "aim is to probe the possibilities of building architecture as a poetic translation, not a prosaic transcription, of its representations." For me, the former is perhaps best exemplified by the Gothic cathedral. There were few drawings used in its design and construction and it was never conceived as a '*whole building*.' "Gothic architecture, the most 'theoretical' of all medieval building practices, was fundamentally a constructive practice, operating through well-established traditions and geometric rules that could be applied directly on site." This was

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[8] Alberto Pérez-Gómez, *Architecture and the Crisis of Modern Science*, pg. 304.

[9] Alberto Pérez-Gómez and Louise Pelletier, *Architectural Representation and the Perspective Hinge*, pg. 5.

perhaps as much a ritual act of construction as it was a poetic translation. "Construction proceeded by rhetoric and geometry," building was an enactment of ideas orchestrated by the master mason that represented the "city of God on earth."[10] In contemporary architectural and building practice, the best we can hope for is that the builder is 'on board' and displays a willingness to understand and interpret the drawings or, if in doubt to ask for clarification. Most architects will tell you that a building project is either a joy or a nightmare based on the attitude of the builder. More often than not the drawings become a battleground, a test of will, and sometimes a legal contest rather than the opportunity for "poetic translation." While of course the builder needs a degree of clarity in the drawings, it is misleading to think that they are neutral and just need to be carried out. As Pérez-Gómez says during our conversation this, "is important because the work of the architect is in the making of this mediation." Probably most architects have had the experience of their drawings being handed over to a client, who then employs a builder or a project manager to build the building. The finished product somehow resembles the drawings but is bereft of the architect's intended poetic content and this is not simply due to omissions from the drawings. Without the architect or their trusted representatives playing an interpretive and mediating role during construction, an architectural presence is unlikely to exert itself in the finished building. "For architecture the difficulty of maintaining a symbolic order is necessarily double, since it concerns both the project and its 'translation' – an unfolding that is seldom present in other arts." [11]

Interviewing Alberto Pérez-Gómez, reading his book on representation and re-reading *Architecture and the Crisis of Modern Science* has been an extremely rewarding experience. Perhaps this is because I have been thinking about and trying to overcome the supposed neutrality of construction in teaching and recently also in practice for so long that when I began to contemplate more fully the role of representation in this absurdity it seemed to reveal the problem much more fully. Of course, as often happens with new insights, I wondered why I had not understood this before and if I seem to be labouring the point it is because I think that a better understanding of the long history of architectural representation may ultimately lead to

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[10] Alberto Pérez-Gómez and Louise Pelletier, *Architectural Representation and the Perspective Hinge*, pg. 7-8.

[11] Alberto Pérez-Gómez and Louise Pelletier, *Architectural Representation and the Perspective Hinge*, pg. 6.

an understanding that construction drawings should be as much about their "potential to construe a symbolic order"[12] as they are the pragmatic conveying of information to the builder.

[12] Alberto Pérez-Gómez and Louise Pelletier, *Architectural Representation and the Perspective Hinge*, pg. 6.

Interview

SR: I thought I would begin by referring to the abstract of your paper delivered at the AHRA Models and Drawings conference last month in Nottingham as a means of steering the interview towards topics in which we have a mutual interest, in particular, the relationship between architecture and representation or, even more specifically in my case, the relationship between construction and drawing. In your abstract and paper you were quite disparaging about digital media. I might read the abstract and ask you to comment. You write that: "Despite all the excitement about digital media, it is still impossible to argue that the integration of these concerns into the production of architecture has had a positive effect on our built environment. The digital 'avant-garde' has degenerated into a banal mannerism, producing homogeneous results with little regard for cultural contexts all over the world. Clearly such means of representation are here to stay, and this poses enormous questions. Addressing primarily our vision (and not other senses of embodiment) experimental video, computer-graphics and virtual images have transformed our conceptual understanding of reality. Monopolising the discourse surrounding visual representation, discussions around the so-called 'digital revolution' often exclude more primary issues of meaning and ethics."

In the second paragraph of the abstract you write: "Architectural conception and realisation usually assume a one-to-one correspondence between the represented idea and the final building. The fact that digital media *also* make this literal transcription more feasible through automation and robotics has resulted in an unwillingness to question this premise. Absolute control is essential in our technological world. Although drawings, prints, models, photographs, and computer graphics play diverse roles in the design process, they are regarded most often as necessary surrogate or as transcriptions leading to the built work. Acknowledging that value-laden tools of representation underlie the conception and realization of architecture, this paper discusses an understanding of architectural representation that may be conducive to poetic building, proposing alternatives to the ideological stagnation plaguing most contemporary architectural creation."

This is quite an unpopular point of view! Schools of Architecture have invested so much in computing and drawing boards are disappearing from both schools and the professional office so it is difficult to counter this without appearing quite reactionary, and as you say, there is a general unwillingness to debate these issues. So, my question after all this is to ask if you to be more specific about what you think the effect of digital media is having on the poetic translation of ideas into built form. I know this is a very big question. Maybe you could give a

pedagogical example, in terms of how the computer has become part of the way students produce design and construction drawings.

A P-G: Yes. It is a very big question. I'll do my best to answer it. During the conference I tried to provoke discussion. I'm aware that digital tools are not going to disappear, and I think that one has to work through them. But I think it is very important to work through these questions critically. To work through these questions critically you have to be inside the issues much more than I am. So, I admire some of my students and colleagues who bite the bullet so to speak, but I am convinced of the fact that the software imposes certain parameters. In my limited judgment the most productive programs seem to be those connected to animation, or similar to Photoshop.

SR: You said in answer to a question after you presented the paper that you prefer a Photoshop building to a Form Z building.

A P-G: Yes! This is as much as I understand because I know this is a complicated problem and these things are changing from day to day and every day I meet people who tell me well, it's not quite like that. You know I have a friend who is working on re-writing software algorithms and it's no longer mathematical! All I can say is that I still don't have much positive evidence, in my own experience with students or in my experience of cities or understanding of architecture. I'm not pessimistic, but knowing that digital media depends on algorithmic languages, I find it very difficult to believe that there is an easy transaction here. You have to be on your toes always, you have to look for failures of the system. It's very hard to say much more than that. What leads me to this conclusion is my conviction that in fact what is happening now is not something that just happened ten years ago, but it has profound historical roots that conceptually have been there from the beginning of the nineteenth century. This isn't what people working with digital media would ever grant, you know, and that is a central problem. Digital media merely provide much more powerful tools to continue with ways of conceiving and making architecture that have already failed.

SR: It really gets back, I guess, to this business of value-laden representation and that's really what you're saying has its origins in the beginning of the nineteenth century. And again, this is a big question, but could you tell me what you think some of those values are? I guess they're about projection and about perspective and about creating distance between the viewer and those things depicted in the drawing, about creating a viewing point for the observer and so on. Of course in *Architectural Representation and the Perspective Hinge* you go into it in a great

deal of detail about these issues but generally in the academy and in practice these things are not really questioned. Elevations, perspectives, axonometric projections are assumed to be neutral, representational tools. I have to say that until recently I have not really questioned these drawing conventions but it is interesting to think about the supposed neutrality of these forms of representation when, in fact, as you say they're not neutral at all.

A P-G: Yes, they're not neutral at all. There is no short answer to your question. One must patiently follow the history of architectural representations to see how they relate to the buildings that become the outcome of these processes. So, for example, knowing that only very late in the Renaissance or early in the Baroque architects could understand representations as coordinated systematically makes a big difference when one understands that some architect made a plan and the nature of this plan didn't have this kind of one to one relationship to a picture of the building. It was a completely different activity. Marco Frascari talks about it very well. I think that we are very much on the same wavelength there. The nature of the plan is not a picture; it's more like a conjuring device. You're trying to forecast what might happen and you know that there is much at stake at the moment of enactment, which is very much like music was before the nineteenth century. The composition was not a 'work' until it was performed and usually the composer made it happen, very much like jazz improvisation today. In contrast, for Modernity there is the assumption that the work resides in the representation and therefore the representation is neutral, it just has to be carried out. The problem is important because the work of the architect is in the making of this mediation. Do you see what I mean? That process has to be understood, it has to be valorised. Peter Greenaway talks about the process of movie making in this way. He says "I'm bored with my movies, I can never watch one from beginning to end," and I believe him. He says he is much more interested in the process of making the movie and the process carries the values in that sense. It's not just a means towards an end. That's basically the argument here, except that the evidence that we try to put forward in the book is historical, so it takes a few pages

SR: This leads to the pre-modern, medieval and classical idea of the ritual act of construction as an enactment of the plan and elevation that did not have a one to one relationship to its representation and involved those who had designed or projected the building as well as those actually making it. This idea fascinates me because it draws out the symbolic relationship between making a representation and making a building. How it's made, what it's made of, who has made it and so on is where a lot of meaning resides. Modern construction has little ritual content but rather is about resources, about planning and construction management,

efficiency and budget control and aggressive meetings where people shout at each other about something that has been left off the drawing and so on.

A P-G: There are many dimensions to this. Ritual is a complicated word, but properly speaking, it's an action the efficacy of which does not depend on you. You surrender its efficacy to other forces. So by definition it's something that is very difficult to accept in the modern world. When we talk about a pre-modern ritual act of construction not only in the western tradition but more generally in other cultures or pre-Classical Greek cultures, this is what's going on. You put something in motion, you're not responsible and that's what ritual is. So when we talk about modern rituals, this is a very complicated problem. What are we talking about? In a certain sense, I think post-modernity, philosophical post-modernity, is starting to understand finally that indeed we are not fully responsible for the future of the world, that there is something out there that has to be accounted for, but of course it is also not possible to say that from here we go to some kind of theology; that couldn't be a solution. We are living in a kind of post- Nietzschean world. But in the traditional sense, somehow one would embrace the fact that things are not controllable and this is what makes life beautiful. This is again very hard to acknowledge for modern humanity. There is this famous Japanese poet that said precisely that. The most beautiful thing about life is its uncertainty. So I think that is probably how I would frame that problem. It becomes a personal thing, very much like the understanding of poetry as myth. It's a similar problem, when someone like Louis Aragon says that his writing about Paris is like a modern mythology. Well, in a sense modern works of literature take the function of the old myth, they disclose things that are larger than humanity and so on. But also in the order of things, they're understood as a secondary form of knowledge. Ever since Liebniz the poetic has been considered as secondary to the mathematical and scientific knowledge.

SR: Getting back to the modern, I suppose that in terms of trying to think about a more poetic way of building, a more meaningful way of building, as far as I can tell in the rough and tumble of the building industry, the idea of ritual is pretty well gone.

A P-G: It's pretty well gone.

SR: Now the only opportunity may be as you say in the drawing and the representation and the development of the idea. Once the idea becomes a contract …

A P-G: That's exactly right, and it really depends on the scale of operations. I know architects that insist that the work has to be only of a certain scale you know, and are very aware of this, and it's very important because of these questions.

SR: This is not to say of course that there aren't beautiful, meaningful, poetic buildings being built but I think probably what both of us are more concerned about is the vast, overwhelming amount of building that is really quite the reverse.

A P-G: Yes, of course. I think in general I do agree with what you said in the beginning of the question that the material imagination, as Bachelard calls it, is primary in all of this. That a building built with love is significant, almost regardless of many other things, and I'm thinking here in black and white.

SR: I wanted to ask you a question about teaching here at McGill. To return to your book on representation for a minute, it's quite complex and would be relatively difficult for undergraduates to read but it is attempting to question and in a sense overturn conventional views about the neutrality of representation. I wondered how you at McGill go about introducing these ideas. I realise you probably don't have much to do with undergraduate teaching, but nevertheless I'm sure you know what goes on.

A P-G: Yes of course. I have many ways of answering this. You probably know that I was Director of the School of Architecture at Carleton and when one is Director it is easier to do things like this. I think the program in that sense still works the same. There were workshop courses attached to the main studios where there were professors who had different outlooks. There were also workshop courses that were intended to raise all sorts of issues of representation from different disciplines from dance to painting. It was a very good thing. Now when I came here of course there was a different agenda for me. I had to create a highly academic graduate programme. However, I do teach two lecture courses open to the professional school where students produce speculative projects. In the graduate program we run an experimental studio that tries for example to look at the city in a different way, to map the city in ways that are not conventional. So students can understand how you can map in relation to a question, rather than assuming that mapping can only take place as a scientific or quantitative operation. One must acknowledge, however, that mainstream education at McGill is rather straightforward. The school chooses to be closely bound by the North American 'checklist' that constitutes the central criterion for accreditation.

SR: I want to return to my interest in construction teaching and relate it to an experience I had recently teaching construction in a design studio. I was asked to tutor students in construction: materials; building techniques and so on and because of the structure of the studio student projects were quite advanced. Ironically enough, it seems that CAD which is primarily a tool or

an instrument for creating construction drawings has become a de facto design tool and it is quite inappropriate for that purpose.

A P-G: Yes. Well that worries me very much and I agree it is inappropriate.

SR: I would sit down with each student and they would flip open a laptop and use the mouse to seemingly skate over the surface of a CAD drawing they were using to develop their design and then zoom in to show me a detail and then zoom out, skate again, zoom in! Within a few minutes I was completely lost and could not make head nor tail of either the design or construction of their project.

A P-G: I have exactly the same problem.

SR: In relation to construction, there was almost no sense of the material essence; the materiality of their buildings.

A P-G: Yes. It's completely irrelevant for them.

SR: It seemed to me that the CAD drawing exacerbates this problem, which I have been thinking about for a long time, and that is the supposed neutrality of construction

A P-G: You're absolutely right.

SR: What struck me when I read your book on architectural representation was that currently not only are the materials of architecture considered neutral but so are the tools used to represent both design and construction which are now often conflated through the use of CAD. This seems detrimental to both design and construction and ironically enough exacerbates the problem of the connection between the two.

A P-G: That's right.

SR: There also seems to be less and less understanding of the generative role of construction, in particular, of detailing. Marco Frascari would say that really construction is where a significant portion of a building's meaning lies rather than form, rather that plan, rather than elevation.

A P-G: So, this demands some radical rethinking about how you teach materials, yes?

SR: Exactly. This leads to my question. In my own work I'm trying to think about how to strengthen the relationship between construction and design and it seems that currently that relationship is becoming weaker, almost to the point of non-existence. Students I'm sure look

at their design and think, well, I'll work out how to build it later. They have a form, they have plans and elevations then they look for something to build it out of.

I suppose I was thinking back to the idea of representation and how drawing and model making may be used to strengthen that relationship rather than make it weaker, and specifically, for example, things you mentioned in your talk, stereotomy and descriptive geometry for example. I don't know a lot about those things; I know a little bit about them, but they fascinate me. They seem to represent a very direct link between drawing and design and its intimate connection with building. You're literally drawing individual pieces of the building that would be fitted together on site.

A P-G: That's right.

SR: So my question is, do you think there's any way of contemporizing, for example, those two techniques of stereotomy and descriptive geometry in an attempt to strengthen the construction design connection?

A P-G: I have some ideas about that. The interesting thing about stereotomy and projective geometry is that historically they have origins in practice. The first time the issue appears in a treatise on architecture is with Philibert Delorme in the Sixteenth Century; he was the son of a medieval master stone mason so he knew the craft of cutting stone. But he was fascinated with the question of how the craft operation was connected to drawing. And this is what he adds to his reading of Vitruvius, two big chapters on projections. But if you do it in reverse, if you try to build what he built from the projection without knowing how to cut stone, it's absolutely impossible. You see the paradox here? So it's really interesting to follow this, because of course in the long term, if you follow the history of this problem all the way to the Nineteenth Century it becomes the reverse. Already in the early Seventeenth Century there is Girard Desargues, probably the first to device a projective geometry enabling one that does not know how to cut stone to dictate a kind of logical sequence, to 'teach' the mason how to do it in order to construct a vault.

In any case I think that because of this connectivity and because architecture is about projections, the question that you were asking about how to make this into a project that can be contemporised could be very interesting. But you would have to probably get the students in the workshop to build and then draw, and test these connections. Do you see what I mean? Rather than simply teaching descriptive geometry. I've tried with students in the past to take some of the projective drawings of Guarini and 'build stereotomic details. This process

demonstrates how the drawing provides only incomplete information. Going back and forth becomes an invaluable learning experience.

The key is for students to build. This is actually a very hard thing to do. Now we have laser cutters and machines that make models out of powder, you press a button and you make these amazing models generated from the computer screen. This is a fun thing to do but it really works completely against this difficulty which is central to architecture. So yes, if I was teaching construction, I think something like that would be very interesting to do.

SR: I don't know if this would be trying to swim against the current?

A P-G: Yeah, I don't know. There are programmes in North America, like those at Cooper Union and RISD in which the computer is kept in its place, so to speak, and the studios still smell like materials. There is always a way. I still like John Hejduk's idea of going to the workshop to build, say, a well-crafted screw from scratch. What does it have to do with building construction? Everything, in fact. That's really the way to talk about materiality, to be thrown into the ocean and be asked to swim. It is impossible to rule out computers but I think gentle resistance is good. Making the workshop important and sometimes forcing this issue works. Here in our little workshops we force the issue. The students always appreciate it.

SR: Returning to one of my interests which is tectonics and really trying to revive some sort of meaningful approach to making buildings other than plan, form and so on. I suppose I'm trying to provide students in particular with another way of thinking about making a building that means something apart from just a crazy form or a skewed plan. There are professional architects, who I think have approached architecture from that point of view, Stephen Holl for example, or Peter Zumthor and Herzog & de Meuron. I suspect that they use computers but I'm wondering if the tectonic qualities their buildings reveal are only possible because they design them using hand drawing.

My question is, given the current teaching environment where there is more and more computing and less and less hand drawing, is trying to promote hand drawing and an interest in tectonics futile? Should we just say, well this tool has arrived and overwhelmed us, it's everywhere, let's just go with the flow! I'm thinking of your comment about the pervasive notion that robotics will eventually provide a literal, one-to-one transcription between digital media and building and that maybe it is kind of pointless to try and hang on to a poetic way of dealing with materials.

A P-G: It's an interesting observation. I know a bit about Stephen Holl's practice. He insists on using the computer only after sketching in watercolour. His drawings are beautiful, and the challenge is one of translation into building. The ideas are gestated in the initial medium, and then he uses the computer for production. I know my colleague and very dear friend Juhani Pallasmaa follows a similar process. For both those practices hand drawing is very important. Yes, they use a computer as well; it's inevitable. Juhani is building an enormous building in downtown Helsinki. You would love his most recent book it is a collection of essays called *Encounters.* Of course his better known book, *The Eyes of the Skin: Architecture and the Senses* is really a phenomenological discussion of architecture. He was the local architect for Steven Holl's Kiasma Museum in Helsinki.

The other way to think about it is that the materiality of the world is a fact! Why wouldn't we think about materials poetically? Even if computers are dominant, it is certainly possible to argue as you do that one must teach materials though materials. Do you know the works of Gaston Bachelard, the books on poetic imagination, on material imagination, where he talks about water and dreams, the earth and the poetics of reverie? The book that many architecture students know is *The Poetics of Space*. In fact there are five books (two on earth), where he looks at the four Aristotelian elements arguing that no matter how many new 'materials' we find or invent, they still in some way relate to earth and fire, earth and water, and he looks at the articulation of the elements poetically. It's really about poetry, written literature, but how the reality of these elements is made evident through poetry. So clearly, the question of materiality to me can be made evident through representation and can be made evident in many other ways.

One argument that I always hear from colleagues is that there is a new material being invented every three minutes, but really the reference is always back to the four elements: that's the way our humanity understands itself in this given world. To teach the primacy of materiality as given in embodiment is therefore not at all reactionary. It is a way to understand how things make sense, they cannot only be what they are, they also stand for something else; this is the way that human perception operates. I could make a number of arguments to say that there is some validity to try to understand materials as poetic agents. OK, you want to invent a glass that you can use structurally, it can be very poetic. This may be very exciting, yet if it is meaningful it refers to something known, it can't be just arbitrary.

SR: In a pre-Modern sense I guess materials were thought about quite differently. An architect had an idea about a building and there was a limited palette of materials and then you brought

the idea and the materials together. Nobody was sitting around developing materials and then working out how to use them in buildings.

We have talked about the symbolic relationship between drawing and building which appears to have just evaporated although I suppose the relationship is still symbolic it's just that I don't like what it means! The relationship between CAD drawing and materials symbolises the further reduction of materials to neutral instrumentals, which is really what I'm trying to argue against. Contemporary architecture seems to be about creating meaningful buildings out of neutral materials, which is a very strange way to think.

A P-G: It's because the meanings are imposed from outside and they're usually ideological or they're fabricated, like a logo. Meaning is expected to be on a one to one relationship to what it signifies. In symbolic signification you have an openness to plural meanings. Assuming a neutrality of processes and modes of production, contemporary buildings tend to reveal a very flat world of significations. The building can stand for a corporation, or for a national state; a weird material may stand for its process of construction, but hardly for anything else. Real symbolic representation is not something that you fabricate, it's something given in great measure. The material, however innovative, has a referent. It's not just something arbitrary for example: it is not enough to say "I like titanium." Humanity will not give up. In a certain way there will always be a sense that it's possible to do things in other ways because ultimately we don't control them all; there is more than the human world. Contemporary humanity is arriving at this realization from many angles, like deep ecology for example. You know there are a number of concerns that are not all connected or that don't seem cohesive but seem to acknowledge this reality, and in a certain sense may work in our favour in the sense that architecture is about the built world, a finite world, a mortal world. These things are not going to change, no matter how many materials one invents, and so the questions can always be retrieved. It's true they may not always be popular, but when you retrieve them they appear as the perennial foundational questions for most people.

SR: Yes, well it is good to hear you say that because sometimes there is a sense of hopelessness about the tide of technology. Heidegger can be so bleak!

A P-G: But he also says that in the problem also lies a glimmer of hope simply from recognizing it as a problem. Maybe that's what we're here to do. Personally, that has been my life's work. Then you wait, and you are always at the margins in a certain sense. But it's an important question.

SR: OK. Well one final question. In preparation for this interview I looked at your website and it says that you are "engaged in a project to redefine the nature of architectural education by revisiting its historical sources during the Enlightenment and the early nineteenth century, an urgent task after the failure of globalization which has become patent after September 2001." Of course, in relation to the teaching of construction this is an important moment because it is when architecture became irrevocably split from engineering. Construction and structures became part of engineering and architecture became more aligned with art. Engineers were the agents of progress. How is the project progressing?

A P-G: Yes, well, we've gone some ways with that project. Part of it became important in a PhD thesis with a student of mine (Marc Neveu), who studied the Italian side of the problem, in particular focusing on Carlo Lodoli and the notion of the *indole* of materials, the idea that the materials have a character. The Italian word is different from both the French and English concepts of character.

I did most of my work on the French Enlightenment in relation to drawing and its transformation between the eighteenth and nineteenth century with the birth of axonometry and isometry. As a means of representation axonometry turns around in the artistic avant-garde to actually question the banality of depth as 'third dimension.' Here I recalled Merleau Ponty speaking about Cézanne, for example, when he says that for Cézanne the issue was to paint a reality that was not rendered perspectively, and so he paints the *Mont Sainte-Victoire* countless times because *depth* is of a different origin. I think this is a challenge for architectural representation because the possible re-enchantment of the world has to do with the perception of depth as a first dimension, rather than perception of the world as three-dimensional. Depth is quantitatively different from everything else and I think that is clear in artefacts from all cultures. The first thing that grabs me is always the amazing representation of depth say in an ancient Greek urn, or in a medieval painting, in a Persian miniature or a Chinese garden painting. I think that this stands for a whole complex set of issues. If students can deal with this issue of depth in their presentations then they are in a better position to think that their architecture may be poetic. It doesn't deal with materials in a direct way.

The last part of this general concern about architectural education involved looking very carefully at a late Eighteenth Century writer called Charles-François Viel, who was very interested in education. He makes an appearance in my first book, but there is a lot more to him than what I could say there and he's part of a new book (now recently published). He is interesting because he's critical of both architecture as an art, and architecture as engineering

or science. Viel is critical of a reduction of architecture to beautiful renderings (in the tradition of the Ecole des Beaux-Arts). He also rejects the reduction of architecture to structural determinism and engineering. He cannot imagine that buildings can be conceived in a few hours or days, because you need time to know about construction, going with your teacher to the construction site and keeping a log of what happens on site. That's the only way to learn, he says, not through books, not through lectures. So he's critical of the artistic mode of education. He's also critical of the engineers that pretend to be able to design a structure and forecast how it will behave. He says that that's the end of architecture. Surprisingly for his time, he places architectural education among the humanities. It's very interesting because it's very early and very unique. In the Nineteenth Century as far as I know, there are very few people who think that way. Architecture remains polarised between the fine arts and the sciences, and to a great extent it remains so. If it belongs to knowledge, in the University, it belongs with the humanities. I think that's brilliant.

SR: Well thanks for agreeing to the interview it's been really great to meet you.

A P-G: You are very welcome.

Appendix C

ON COMMON GROUND
Interview with David Leatherbarrow

SR: When I first read *On Weathering* I became very interested in your non-instrumental but very powerful and meaningful way of thinking about the materials of architecture. My students have found it very helpful and enlightening. It is something of a revelation for many students to realize that the weather eventually destroys all buildings. Could I start by asking how you became interested in developing this non-instrumental approach to materiality?

DL: A full answer to your question would be partly biographical, partly disciplinary, partly historical, and partly educational. In the narrowest sense, my interest in weathering emerged as a reaction to what was, and still is typical in many design programs in the United States; namely, that design means composition, where composition means more or less what can be pictured or is picture-like. While there's nothing necessarily wrong with composition in this sense, Mohsen Mostafavi and I felt that this view needed to be augmented by another kind of understanding, one that is in the most obvious sense concrete because it considers things that are palpable or material and, more radically, temporal. We felt that both design projects and projection itself could be understood to extend beyond the moment of the building's realization. There is a second phase in a building's history that follows construction, a phase that isn't subordinate to the first. In fact, it is largely this afterlife that makes buildings sensible, legible, and meaningful. It first of all enriches, and then undercuts design's authority. So for us the fact of weathering called for a reconsideration of the relative autonomy and presumed authority of the design act. When the reality of the building is seen to depend on material realization and developments or contingencies outside the architect's control I think the understanding of the project is much more profound, much richer. The simple technical problem of weathering seemed to be a good point of departure because while it is obvious, local and familiar, it carries with it a whole set of implications that we tend to neglect because weathering is generally thought of as an aspect of problem solving – keeping the rain, wind and cold out. However, when anybody outside our discipline is asked about architecture, he or she will more or less immediately attest to the value of weathering. It does not subtract from but adds to the building, an addition that doesn't result from design, doesn't result from construction. The gift of quality

comes from a source that no one can control. For us this realization opened up a completely obvious and yet unexplored dimension of architectural sense, one that we thought could not only be used to complement or compensate for inadequate composition, but also provoke one's imagination about otherwise unseen possibilities.

SR: In relation to your work, I often try to explain to students that thinking about the materials of architecture provides them with an alternative way of understanding how to make a meaningful building, one that stands apart from planning and formal considerations, which is where students often seem to want to start. They start with plans and then draw elevations, and so on. So in relation to construction teaching, it is quite a powerful idea to think of materials, detailing and so as a way of opening up the design process.

DL: Well, let me say two things, the first about teaching construction and the second about how a building makes more sense when approached from the point of view of materials. At Penn, we made a decision some time ago, fifteen years ago perhaps, that we would refuse the famous distinction between theory and practice. It was decided that those of us who taught in the studio would also teach in the seminar room or lecture courses, and in reverse those who taught subjects like structures, construction, building systems, or theory and history, would also teach in the studio. Why? Because we wanted our students to see that theory and practice are complementary. We thought that if we could show them how they reciprocate one another through our own teaching, maybe they would learn this in their own work and become better architects. So, the first thing we did was to let theory and practice play complementary roles. That meant that the core coordinator, which is the job I've had for almost two decades, has the responsibility to grant a certain degree of autonomy to the taught courses such as theory and construction. In addition to that relative autonomy we also structured the studio projects with their own educational objectives, in the light of what was going on in the taught courses. Insofar as the construction teacher was also in the studio, he or she could guarantee that students had continued and regular contact with the subject matter of construction. The same was true for those who taught drawing and those who taught theory. Try to imagine a core studio comprised of faculty who are also active in the lecture and seminar room, teaching theory, drawing, structure, construction or building systems. Now, this means that we were continually wondering about ways in which studies in construction and materials, for example, could be brought to bear on the studio. That caused us to wonder if we might reverse the famous sequence from big to small, from form to material, or from composition to detail, and whether studies in what we these days call material qualities, and more narrowly finishes,

could cause our students to think about the temperature of a space; that treating metal in a certain way, for example, warms it up, that treating wood in another way cools it down; and further, that the temperature of materials might be envisaged as a simple metaphor for spatial qualities, that the configuration of spaces might be initially thought of as a configuration of materials or of the qualities associated with them. By reversing the process and asking new questions about how to structure a set of rooms, we not only sought to guarantee a relevance to materiality but also to cause students to disabuse themselves of assumptions about plan configuration, about typical formats, of composition, etc. So it had two consequences: one, it guaranteed the relevance of certain aspects of architectural design and experience, and two, it caused our students to come up with plans and sections that they would not have come up with before.

That leads to the second issue, a broad one so I'll be brief about it. Since I was an undergraduate and studied architecture with Daniel Libeskind I've been reading in a certain tradition of philosophical thought. Studies I begin with Daniel I continued with his professor, Dalibor Vesely, who has for several decades now been instructing in what is called phenomenology and its relationship to architecture. As you probably know, reading Heidegger as you do, one of the primary aspects of phenomenological thinking is that the famous distinction between the body and the mind is just a latter day dogmatic prejudice of ill-conceived metaphysical thought. In our field, it seems so obvious that materials relate directly to form, so much so it might seem that phenomenology has nothing really new to say to us, but merely confirms what architects have known for a very long time. It would only be with the advent and pervasive influence of aesthetic thinking in our field that this obvious fact was ignored or suppressed. This allowed architects to become purveyors of form, and critics to see no other difference between the work of Graves and Piano than the shapes they make. But this is a very, very late development in our tradition, and to my way of thinking a derivative approach to architecture. So, behind part of my answer and much of my work are some fairly simple and yet profound interpretations of the perception of things in the natural world and the way they give themselves to our experience. This approach has also caused me to doubt many of the procedures and protocols of contemporary designs. It's never been a question for me of whether one could develop a design without a sort of gestalt corporeality or physicality, which is partly a matter of construction and materials but also of location, the physicality and the cultural memories of a place.

SR: The courses you describe sound fantastic. I wish I could have taken them! The second part of your answer brings to mind an experience I had a couple of days ago in Washington. I came out of the underground train station and there was this white material floating in the air and I wondered what it was. It looked like polystyrene. When I looked up at the building being constructed over the entry to the station and they were sticking polystyrene all over the outside of the building and then rendering it to create a kind of rustication. I asked myself, what kind of self-respecting architect would use that kind of technology? It seems to be associated with the culture of throwing things away and of instant gratification. Our two cultures are similar in this regard. We want something more, or something different, or something better all the time. This seems to work against the idea of creating architecture in which there isn't the split between mind and body, between the aesthetic and the practical.

DL: At a conference almost three decades ago, when Léon Krier and Michael Graves were standing up on stage I remember Graves saying somewhat pathetically that he is doing buildings using his decrepit technology because he wants to practice design in order to prepare himself for the time when he can build in granite, which is what Krier was recommending. Krier, for his part, said: "I am an architect and therefore I do not build," (in times such as ours). I don't want to adopt either of those points of view. I don't want to see design in our cultures as preparatory to something more serious, the way Graves did in the 70s and 80s. Nor do I want to retreat from the modern and contemporary context, assuming nothing can be done in the absence of load-bearing masonry.

The second part of my answer to your question is that it seems to me that architectural schools have a specific responsibility to the profession; namely, to serve as a point of resistance and even criticism, and secondly to outline otherwise unseen possibilities for future practitioners. Our task is to prepare our students to join the battle and fight for the qualities they seek in buildings with the elements, skills, and concepts they have at their disposal. Part of my writing, and certainly a lot of my teaching, has been an attempt to say what's possible, given the present circumstances. This is why in *Surface Architecture* Mohsen Mostafavi and I advocated the technique of taking what is pre-made and remaking it through design and construction. This means accepting the standard as the first premise but then modifying it, perhaps through misuse or unforeseen application, in order to build qualities that were unexpected but still an outgrowth of the very properties of the things themselves. So you could ask: "Well doesn't the polystyrene defeat all of that?" I'd like to believe it needn't. I don't think these times are entirely propitious for architecture. It isn't easy to design in an economy such

as ours, but I don't think that means we should give up. I think we should use thin materials, and then by way of techniques that weren't intended and applications that were not foreseen, use them in ways that allow us to achieve the qualities we seek. So, I'd like to say that teaching in construction and teaching in the use of materials is at once introducing students to what is proper and sensible and at the same time freeing them for a kind of experimentation (these days it's called research) that allows them to discern new possibilities that bring these materials and technical possibilities into line with the non-technical expectations – those of a particular site, of a particular program, and of cultural association. All of that is roughly what I meant earlier when I spoke of misuse of materials. One of the basic premises of my teaching and writing since I wrote *Roots of Architectural Invention* is that the commonly held assumption that there is a nature of materials is a gigantic fiction.

SR: I would agree with you.

DL: This view is typified perhaps by that great statement from Kahn about allowing a brick to be what a brick wants to be. I think materials "are what they are" because of the ways we handle them. Through the ways they are handled their properties come into visibility. This means the whole matter rests on finishing, application, and modified use. That's where the nature of a thing is made visible.

SR: Yesterday I went to the National Building Museum in Washington and there is a gigantic atrium in the centre of the building the roof of which is held up by brick columns eight feet in diameter that have been plastered and painted to look like marble. Clearly they are not marble but they are never the less quite fantastic. In contrast, the statement from Kahn about bricks knowing what they want to be gets back to this business of honesty, which to use an Australian expression I have always thought was a furphy.

DL: A Ruskinian position.

SR: Yes.

DL: But to me that position often offers little more than a moralizing gloss on the notion of what can be discerned through the techniques of scientific description, let's say crushing strengths. It's basically a moral rendering of the knowledge of materials that can be gained through the procedures of the natural sciences. The problem is not that it's untrue, but just that it's very partial, even though it may be adequate in the lab and give verifiable conclusions that can be repeated. There's no doubt that tests can determine the way stone behaves under loads, but

I'm not sure that this information is sufficient for architectural design, let alone architectural experience.

Now with respect to deception, I think from the start, or at least from the time of ancient Roman buildings with their layered construction, there have always been, and there still are today, many techniques of dissimilation. You lay out the surface as if it were marble, but because it never touches the ground its surficial character is apparent to everyone. I don't know how familiar you are with all the details of Kahn's Richards Medical Research Building, but I was told anecdotally, and it might be true, that some of the people in the office came in one morning and saw that he had drawn in elevation and in section terra cotta slabs underneath the projecting bay windows. Apparently they said something like: "Kahn, you must have been delirious last night. That can't be. It's not in the nature of terra cotta to hang; it's supportive, not supported. How would you ever detail that?" To their surprise he replied: "Surely you can come up with some glue to hold it up there?" They pushed back again: "You've got to be kidding". Although they took the terra cotta off the drawing he came back later that day and put it back again. When you visit the building and you look underneath the bays you see a deep red, as if the colour of the walls had been darkened to make the shadows even more vivid and therefore the depth or relief of the façade more animated. It was clearly important to him.

The same can be seen in the work of many great architects; not only Kahn, but Mies for example. Corbusier is the worst from the moralizing point of view, even though he was an avid reader of Ruskin. The work of almost anyone you can think of who purports to be interested in this premise of honesty to materials or rationality of construction almost always relies on the look of honesty, or the look of the frame. The way it acts or the way it behaves is another matter entirely. It came as a great revelation when Ed Ford brought out his two books on the details of modern architecture. With those books we all saw how the great modern buildings were actually achieved. I tried to show in *Uncommon Ground* that the design of Neutra's Kaufmann House is a miraculous hybrid of three or four different methods of construction. On the surface it looks pretty consistent, but the reality is another thing.

SR: There was a photographer who took lots of shots of Le Corbusier's buildings being built. You rarely see these photos but I saw a fantastic one of Ronchamp under construction. The walls are made of huge rough stones with big thick mortar joints and then of course it's all rendered over to make it look like a fantastic material. When I saw that I thought about your

article on weathering, the idea of the white eye of truth, and I thought, I wonder how many people have seen that photograph of Ronchamp being built.

DL: Yes. Well the Maison Domino is not a slab, it is closer to a waffle, and it's covered with render. It's not a consistent slab at all. Looking at modern architecture, you can unmask its surfaces icon by icon.

SR: It's odd to talk about honesty of materials when so much of a building's construction, most of it really, is hidden beneath its surfaces.

DL: Yes. The four-part equation I was trying to make is: honesty = truth = certainty = verifiability in the lab. This equation was developed in the late Enlightenment period, from about 1750 to 1850 and it entered into the dogma of the Modern Movement. These days I don't think anybody in their right mind believes it – truth, whatever it means in architecture, doesn't come that easily. But, still many claim it for the sake of ... well, for a number of reasons, not only professional superiority. But for others, like Sverre Fehn, Tod Williams and Billie Tsien, Renzo Piano, Peter Zumthor, and Herzog and de Meuron I think it's a dream dreamt out. Today materials do not have "a" nature. Materials are the site of research, places of discovery for our students and good architects. Materials are places to reveal possibilities of space and of construction that were unforeseen. It's really wonderful.

SR: I agree, it is wonderful but I am reminded that Carlo Scarpa said something like "there is no such thing as a good idea, there is only expression." A novel idea in relation to detailing for example, may not in the end have the right expression. Marco Frascari uses a linguistic analogy where details are like words in a sentence. If the detail is unintelligible or doesn't make sense then the building itself may not make sense.

DL: As you know, I've learned a great deal from Marco, but where he and I differ, I think, is that he would like the details to be always insistently congruent with the overall building and composition, but as I study Scarpa and others it seems there is a certain autonomy to some details that prevents them from being construed as an outgrowth of the composition as a whole. This is especially the case in Aalto where things don't add up, but they refer to contents elsewhere in the architect's work. There is a kind of incommensurate quality to the whole building – everything does not fit. Here I have in mind a point of criticism of Frank Lloyd Wright and the later day version of the *gesamtkunstwerk*, where furniture, wall decoration, the spaces, the ensemble of the whole building, the garden, the landscape, and the whole settlement, is expressive of a particular individual's manner of making form. Not only is it over-determining, it

is autocratic – despite all the statements about democratic architecture. I think it is also anti-urban, and I think it is false. I believe better buildings have their relative stabilities as compositions but within that order there are also moments where things don't fit, don't add up because they fit with something else. This means that the building exceeds itself by bringing into its horizon of reference conditions or images that weren't offered by the architect. Such a building is both in and outside itself, defined as much by what it is not as by what it is.

SR: It occurred to me when you were talking about weathering and the way that an understanding of weathering opens you up to the fact that the building is never really finished. It is refinished by the weather but it is ultimately destroyed by the weather unless it is maintained or repaired. This is one of those questions where I'm trying to grope towards an idea. I was wondering about the teaching of sustainability in schools. It is often taught in a very instrumental fashion, by calculating heat movement through walls and the overall energy use of the building and in my view, we're going backwards in terms of sustainability, in terms of not damaging the planet or people so much through building buildings. I'm wondering if there is a less instrumental way of thinking about sustainability that in fact might allow students of architecture to take with them out of their courses something they can relate to, something more than calculations about heat loss and embodied energy, and so on. Something that allows them to think about a building as something that is never finished, for example, something that can be added to, adapted, perhaps a less precious way of thinking about buildings. As I said, this is a question that is forming in my mind, but I can't help thinking that this non-instrumental view of materials and the materiality of the building is a portal to thinking about sustainability in a different way. I hesitate to say that 'will have better effects,' because that's instrumental in itself, but one that will lead to architects creating environments and buildings that are more ethical in that they don't damage the environment from which the materials come or the people that make the materials or who build the building, or in fact, people that inhabit the buildings. So I'm groping towards the idea that through a less instrumental approach there is a way of thinking about sustainability that is much more effective, and I use that word advisedly because I can't think of another one off-hand.

DL: Let me tell you a story that may help with your question. I was at a conference in Oaxaca Mexico last year on sustainability. The conference was being held in a monastery, a very beautiful monastery. I decided to take a break before my talk, and went from the cloister to the cathedral. While I was there, a fairly old man in the centre aisle got down on his knees and started walking (on his knees) to the front of the church. He couldn't make it all in one go, he

had to pause every ten pews, but after a while, just before he got to the altar a woman appeared from the right and wiped the sweat off his forehead with her shawl. He then put his head down on the first step of the altar for a while. After this they left together, bickering about who was to carry the basket of flowers. Still, both were smiling. Anyway, as they passed I noticed his trousers were scuffed, maybe even torn from this weird way of walking. Odd as it was, it gave me a beginning to my lecture at the sustainability conference. I said to the people assembled there, half of whom were engineers, that I thought this little performance was a gigantic waste – a waste of time, a waste of energy and a waste of good trousers. Everybody laughed. I then went on to say that I think art can be seen as a similar sort of waste. That quieted the laughter. Why is it justified to spend so much on the building's front wall, so much on its surface, so much on materials? We could do it cheaper. In the overall economy you're willing to give up something for a higher purpose. So all that needs to be said, I think, is an obvious truth: spending, or the gift of resources depends on your horizon of reference. Sustainability can be locked into an instrumental view of things if that's what you take to be architecture's measure of relevance. My hunch is that no one believes that. From an instrumental view, buildings will always be seen as wasteful, for they use up an unbelievable amount of effort and energy. Why, then, do we spend so much on them? Why do we invest so much with such little direct yield? Why would a person waste energy walking on his knees in a cathedral?

SR: Because it is meaningful to do so.

DL: Sure, it is justifiable in a larger frame of reference. So for me the big promise for architecture, as yet unfulfilled, is getting us to move with greater ease between the topics we are charged to be responsible for as professionals and the topics we must be aware of as people on this planet. We figure that because we're not directly responsible for the planet, we don't need to incorporate our awareness of it in our projects. I'm not saying that architects should start legislating national policy on the use of materials. All I'm saying is that we need to mediate between the local concerns of the building and the broader horizon of reference. That's a way of redefining design, sustaining the tension between awareness and responsibility. I think materials and construction will be part of that redefined design.

SR: You mentioned in *Uncommon Ground*, in relation to the use of pre-made materials that they allow us to forget issues of dwelling because we assume that the person who has produced this material has done so ethically. In fact that may not be the case and I have had this experience myself in design. I haven't got what it takes to actually follow the material back

to its source, and so I suppose my question is about dwelling and Heidegger's idea of nurturing. Whether or not we can think about the materials of a building in relation to place. To me dwelling is about finding a place, it's about building buildings that in some way respond to our place on the planet, in the cosmos, in the locality in the suburb or the city. This gets back to your idea of phenomenology as well, phenomenology of site and of place. I suspect that you also feel that questioning the idea of the pre-made gives us an opportunity to think about dwelling and to think about a building in terms of dwelling, in terms of our place and the way we use resources, materials, energy, and so on.

DL: I feel the need, initially at least, to allow the very instrumentality of modern or contemporary materials and techniques to disturb inherited notions of place and program specificity. It's not that I think that such disturbance is useful in its own right. I see it as a preliminary to redefining the place or the program. I think traditions are built out of differentiation and I think the particularity of our moment will, if recognized, cause us to initially deform, but then reform, places as we've known them. Let me stress, I do not think instrumentality and the narrowing of one's concept of what things can be that results are sufficient for architectural design, but I do think engagement with instrumental thought and its products is necessary as a preliminary to design. Therefore I have a problem with the supposedly Heideggerian view that sees design as a reaffirmation of what is familiar. I think productive design initially de-familiarizes the known in order to allow it to be creatively transformed, so that it can attain through this transformation even greater social or cultural relevance. So in a sense, what I was saying earlier about Léon Krier and the fundamentalism his position implies, relates to some versions of the Heideggerian tradition, insofar as they are similarly conservative in their felt need to affirm the familiar. For me Heideggerian thinking is only relevant if it can be urbanized, if it can be put in the public realm, into the contemporary moment. I understand there are risks of identity, of specificity, of place locale, etc., but I think they're worth taking because I genuinely believe that relevance and contemporaneity depends to a large measure on de-familiarization and disturbance. So I am interested in the thinner materials and the unprecedented lightness of things, but not as an aesthetic quality in its own right, nor as a truth to our time. I think those assumptions are fictitious. The new materials are givens, just as the historical tradition is given. I have seen in the work of my students that creative solutions arise from the juxtaposition and mutual disaffection of new and old materials. In our city, I continually turn my students to the PSFS building by Howe and Lescaze. That building has remade our city and is part of our identity, but when it was first put there, the

materials, the forms, and the escalator made little sense. It was outrageous. How is it possible that it was simultaneously out of context and indicative of what the city could be? I think that's the question or task that every building takes on.

SR: I think that's what I was really trying to get at. Not just to continue with the familiar, but build in a way that allows us to re-understand the city and eventually to see things differently. That's what I mean, not the nostalgic recreation of the familiar.

DL: Yes, blind faith in the past shows bad faith in the present; places must be remade if they're to remain relevant. I guess this is a gentle resistance to the strong momentum of the preservation ethic that has coloured a lot of design thinking, and is legitimizing the wave of contexualism – the notion that the task of design is to fit in. I think this position is really nothing more than a retreat from the challenge and the possibilities of contemporary economy and society.

SR: In Adelaide, most of the infill housing around where I recently built a house is terrifyingly familiar. I think someone described it as inane sprawl and that's the kind of familiarity that I meant, one that doesn't question what we're doing here or how a building might mediate the idea of dwelling in a place, on a planet where you have to create damage to make a building. Those buildings near where I live don't challenge any of that. I'm hoping my building does. It certainly is very different to the surrounding buildings.

DL: I think it may also be a matter of scale. There's a famous story about the Eiffel Tower that can be used as an illustration. When the building was installed in Paris, the greatest poets and cultural figures of the time protested against it. Yet, not more than two decades later it was identified as the greatest and most eloquent symbol of the city. How did that happen? Somehow Paris reabsorbed a gigantic technological object into its fabric. The question here is how many of these objects can a city take? When a piece of the city has been replaced by ten objects that are autonomous to that degree, the social and cultural and spatial fabric may not have enough substance to modify itself and reclaim the new configuration as part of its legible order. In my country we have many cities that have suffered the imposition of too many objects that were overly determined by instrumental concerns. So what I mean by scale is something of a balancing act. On the one hand I feel the need to speak on behalf of contemporary technologies but on the other hand I don't want to get on that train and never look back. When adopted uncritically, instrumental thought puts the whole framework at risk.

SR: That leads me back to a practical question about teaching. In a construction course in a school of architecture, how do you deal with the idea of the pre-made, things that can be ordered from a catalogue? They can be arranged to create a façade but it is very difficult to change them.

DL: We try something different every year along this front. One answer to your question is that I ran a studio a couple of years ago where we had students develop the project in the first couple of weeks in a fairly conventional way and then we had each of them choose a standard window or window system, and install it into their design. Then we brought the actual windows into the studio and had the students do technical drawings of how they were made and how they worked. They also did diagrams of their operation. We approached the problem from the point of view of how the window is made, but also how it operates and tried to remake its construction while preserving its operation as part of the workings of the wall. Then the students could see what minor changes could be made to the standard products. As you said, there's also the issue of composition. How the elements are related to one another is also something that needn't be taken for granted.

Another approach we've taken is to work with dimensionality, first working with standard dimensions and then in a second phase of the project giving a student a certain set of intervals that are incommensurate with the measures of their plan. In other words, if you have to work with 4 x 8 sheets of some material, what then? So, there are these moments in the project where norms outside the rules of the design call for modification to the norms by the architect. We try to seize just those particular moments. That's what we define as design – neither the composition, nor the instrumentality – but the negotiation between the two. That's actually where ingenuity, creativity and originality exist. Not in form-making and not in the effective and planned realization of a construction system, but in the few moments where the two modify one another. That's what I would call design as it is defined in my studio. It's wrong to call graphic composition design. I think that's a mistake. That's a Beaux Arts misunderstanding of an Albertian premise and I think we need to get rid of it. That's non-creativity. Creativity is closer to what I call ingenuity, where you say that with these materials modified in that way I can achieve some of my goals.

The other major step we've taken is what I mentioned a minute ago, where you shift from the way the element looks to the way it acts, which these days is generally called performance or operation. I wrote a paper last year called "Architecture's Unscripted Performance" and wanted somehow to get it both ways: to know how the lighting system, the

roofing system, or the structural system operates according to expectations, but also how it takes account of unexpected phenomena such as those of the environment or abuse, which can be anticipated but not predicted. This is also a question that arises in phenomenology, the question of probability or what is likely. The intuition of what is likely is also characteristic of architectural thought. It's not exactly certainty nor is it the thought that anything can happen, but a degree of typicality that gives a kind of limited and reasonable certainty. Within this style of thought, ones intuition into an element's likely operation in the environment sets the limit of architectural specification.

SR: Do you teach streamed courses in construction? A series of courses in theory, construction or whatever that build on one another as student's progress through their degree.

DL: Our system is two-part. I mentioned a minute ago how we effected integration within the year. In our first year program this semester, for example, we have five studio sections, with 11 students in each, a total of 55 students. And those 55 are also in the construction class, the structures class, the building systems class, the theory class and the drawing class. We try to integrate those subjects but also give them their own relative autonomy. There is also, however a vertical structuring in our curriculum, so that my theory class and the one that follows it and the one that follows that are all related to one another thematically. Yet, we set different expectations for each, different ways of working, different kinds of essays, different kinds of bibliographies, different formats of student presentation. There are levels within the same subject and each of those levels has a kind of horizontal integration. So there's both a vertical and a horizontal structuring of our curriculum. Does that answer your question?

SR: It does, yes. When you write about the material nature of architecture my impression is that you are questioning the current instrumental mode of teaching and practice. I am wondering whether, as an educator and as a theorist, you were not only commenting on these issues but also hoping they would become the focus for debate?

DL: Yes, but to be honest with you, for me writing is a way to think my own problems through. The books I've written arose out of my teaching. Maybe this style of working weakens my standing as an academic, scholar, or historian. I'm a teacher and I write. I don't write with any ease, but I do it because it does give me some distance from my teaching and allows me to give orientation to my teaching. Apart from its contribution to education, my scholarly concentration on materiality, like my interest in the concreteness of a location, was motivated by political or if you will, philosophical concerns. I've already admitted that I am not happy with

the way we normally think about design. I do believe it's necessary to have the disciplinary understanding of architecture. I'm against the idea that architecture is the place to apply knowledge and concepts developed in other fields. I think we have our own discipline. It is a matter of techniques but also of understanding. Yet, the ways we typically talk about architecture today, and the ways we promote design seem to me to marginalize architecture. The matter of sustainability you raised earlier is one that's on my mind a lot. It's a matter of architecture in the public realm and therefore among people in a social situation. I felt the need to recover the building and design's engagement with what is outside the architect's control. Why I say this is quasi-political is that in my country we place great emphasis on individuality. If I've learned anything in reading philosophy and political theory, it's that we define ourselves in the midst of others. You've mentioned Heidegger. A basic premise of his thought is that *sein ist mitsein*, being is being among others. This was also a basic principle of Merleau-Ponty's phenomenology. You define yourself with respect to the other and that other is historical, gendered, physical and cultural. I've always thought it necessary to think of the building as engaged, and the way to discern its levels of engagement is to take up topics such as materiality, site specificity or the political implications of programs, which means establishing some tense relationship between the given milieu in its materiality, historicity, spatiality, etc. and the work itself. So, I think that in a certain sense it is a form of resistance to an overriding tendency in the USA (maybe just in the north-east or the Ivy League schools) that places so much emphasis on the individual, on the autobiographical and the autonomous piece. Whether it's a question of materials, modern technology, or the site, I want to rediscover architecture's engagements. It's not so much that I feel I have any answer to it, but I just have dissatisfaction with the consequences of the kind of design autonomy that is dominant.

SR: How much design comes from construction do you think?

DL: Well, earlier I tried to give you a definition of design that situated ingenuity between the potentialities of pre-made systems and the results of compositional techniques. I think that it is the moment of envisaging realization. So in answer to your question I guess I'd like to say *a lot*. That's why, for example, I'm working against the notion that architectural design is essentially a graphic procedure. I'm working against the notion, held by many of our prominent architects, that the protocols of several software packages are sufficient for the generation of formal solutions and that with Cad/Cam technology we can actually move from the protocols of the program to the construction site with few intermediaries. That seems to me impressively powerful and liberating within a certain horizon, but with respect to other matters such as

duration, contemporaneity, relevance, and historicity it has nothing what so ever to say. It's a monologue. So, it's not only graphic in the sense of lines on paper that I oppose, it's rather a certain disciplinary instrumentality that I think is simply more extreme now than it was when I first started working 20 years ago, which was the heyday of post-modern pictorialism. Now we have a different pictorialism, a more extreme version of the earlier one, but in essence it's no different. I know this is outrageous to say, but the current formal proclivities are really replaying the same old thing with just a more sophisticated technical apparatus. I know my colleagues will say I'm wrong, that there's something qualitatively different about morphogenesis arising out of digital techniques, but I think it's a fairly lean diet. Shifting the metaphor, I don't think you can play the guitar with one string. You can make it a percussion instrument and make noise, but not music; there's no melody, there's no harmony, there's only rhythm, and I think it's okay but very, very partial. So mine is a systematic, a reasonably systematic resistance to that abbreviation of architects' set of references.

SR: Should we be depressed about the current state of architecture?

DL: I studied architecture for the first time between 71 and 76, and I was really depressed; in the years just after 1968 it was very hard to think about building – everyone was doing sociology or game theory. I think it is just the reverse now. I think architecture is in an extremely interesting phase right now. You and I could probably agree on ten architects we're interested in and you and I barely know one another. Nowadays there are interesting things to see and study and that wasn't the case 30 years ago.

SR: It's certainly true in relation to the current interest in tectonics exemplified by Herzog and de Meuron, Peter Zumthor and so on and I admire those architects.

DL: Absolutely! If you go across the spectrum, country by country, Sverre Fehn, Alvaro Siza, Raphael Moneo. Go to Greece, go to Japan, France or England, almost country by country there are interesting projects right now. Does that say anything about the bulk of the work? No. But, it will have an effect. You can go through the journals and even the most trite and trivial stuff shows attention to things that were outside the radar just a short time ago. Still the instrumental tendency and the aestheticising tendency are more extreme, so the narrowing has continued and it's becoming even more strange. But that's not all there is. You can look at that and you can feel depressed. But that's not all you have to worry about. There are other things that are very, very optimistic, very forward looking. Your country has marvellous architects. To be honest with you I have much more optimism now than I've ever had. It's a

time for architecture. It's not just because of the World Trade Centre that everybody is wondering about architecture. It's wider than that and it's only symptomatic of a renewed interest, resulting partly from the over-saturation of media culture. People want to just close their eyes and not see more. They want to be somewhere with quality and a social structure. People are moving back to cities, people are enjoying cultural situations. I have guarded optimism. Just look to the students and see what's on their minds. This is an Ivy League school and the students here are really smart. You ask them why they're coming to architecture school and half of them will say it's a matter of self-expression, and I see the desire. The other half will say it's because of an interest in the ecology, an interest in social ecology and how people can live together in cities.

SR: Well that's fantastic because, let's face it, you would not become an architect for the money.

DL: No. We go to school as long as a lawyer and get paid less than a plumber!

SR: Well we've run out of time. You've given me lots to think about and I really appreciate it thank you.

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Chapter Three

Fig. 3.1 House in Adelaide, Stone Wall Detail (2002)
Photo: Sam Ridgway

Fig. 3.2 Ca'Dario
Photo: Mathieu Blais

Fig. 3.3 First-Year Construction Models
Photos: Oliver Schulz

Fig. 3.4 House in Adelaide, Design Sketches, Working Model and Sample Stone Blocks
Drawings and Photos: Sam Ridgway

Fig. 3.5 House in Adelaide, Final Working Drawing of Stone Façade.
Drawing: Sam Ridgway

Fig. 3.6 House in Adelaide, Stone Façade at Solar Noon and Late Afternoon.
Photos: Sam Ridgway

Chapter Four

Fig. 4.1 The Labyrinth, Here Lives the Minotaur
Drawing: Marco Frascari

Fig. 4.2 Angels and Angles and Hopping Angel
In Architectural Demonstrations Each Angle is Dressed like an Angel
Drawings: Marco Frascari

Chapter Five

Fig. 5.1 Marco Frascari: Arthur Ross Gallery, Remodelled Entrance, Detail of New Opening through Wall (1982-1983)
Photo: Sam Ridgway

Fig. 5.2 Arthur Ross Gallery, Remodelled Entrance, Plan, (1982)
Drawing: Marco Frascari, Architectural Archive, The University of Pennsylvania

Fig. 5.3 Arthur Ross Gallery, (1982-1983)
Photos: Sam Ridgway

Fig. 5.4 Master's Apartment in the House Of 1925, Skylight detail, Stair and skylight
Photo: Sam Ridgway; Drawing: Cai Jun

Fig. 5.5 Master's Apartment in the House of 1925, Sketch Design, Plan
Drawing: Marco Frascari, Architectural Archive, The University of Pennsylvania

Fig. 5.6 Master's Apartment in the House of 1925, Sketch Design, Section
Drawing: Marco Frascari, Architectural Archive, The University of Pennsylvania

Fig. 5.7 Master's Apartment in the House of 1925, Initial Sketches of Skylight, Stair and Handrail Details
Drawing: Marco Frascari

Fig. 5.8 Master's Apartment in the House of 1925, Initial Sketches of Bookcases
Drawing: Marco Frascari

Fig. 5.9 Master's Apartment in the House of 1925, Initial Sketches of Skylight, Stair and Handrail Details
Drawing: Marco Frascari

Fig. 5.10 Master's Apartment in the House of 1925, Working Drawing of Stair, Handrail and Balustrade
Drawing: Marco Frascari and Jahan Sheikholeslami

Fig. 5.11 Master's Apartment in the House of 1925, Balustrade and Bookcase Details
Photos: Sam Ridgway

Fig. 5.12 Master's Apartment in the House of 1925, Stair, Handrail and Kitchen Partition Details
Photos: Sam Ridgway

Fig. 5.13 Casa Rossa, Dining Space
Photo: Marco Frascari

Fig. 5.14 Casa Rossa, Construction and Finished Facade
Photos: Marco Frascari and Sam Ridgway

Fig. 5.15 Casa Rossa, Post-Construction Technography, Piano Nobile
Drawing: Marco Frascari, Architectural Archive, The University of Pennsylvania

Fig. 5.16 Casa Rossa, Post-Construction Technography, Mezzanine Plan
Drawing: Marco Frascari, Architectural Archive, The University of Pennsylvania

Fig. 5.17 Casa Rossa, Post-Construction Technography, Anatomical Study
Drawing: Marco Frascari, Architectural Archive, The University of Pennsylvania

Fig. 5.18 Loggia Bernarda Andrea Palladio
http://en.wikipedia.org/wiki/Palazzo_del_Capitaniato

Fig. 5.19 Casa Rossa, Bathroom Wall and Stair Detail
Photos: Marco Frascari and Sam Ridgway

Fig. 5.20 House at Roncoleva, Fireplace, Entry Stairs and Deck
Photos: Sam Ridgway

Fig. 5.21 Villa Rosa, Kitchen
Photo: Marco Frascari

Fig. 5.22 Villa Rosa, Working Drawing
Drawing: Marco Frascari

Fig. 5.23 Villa Rosa, Working Drawing, Plan
Drawing: Marco Frascari

Fig. 5.24 Villa Rosa, Working Drawing, Section with Albrecht Durer Figure
Drawing: Marco Frascari

Fig. 5.25 Villa Rosa, Kitchen Addition Hinged Around Air Conditioning Duct
Drawing: Cai Jun

Fig. 5.26 Villa Rosa, Bedroom
Photo: Marco Frascari

Chapter Six

Fig. 6.1 Peter Zumthor, Saint Benedict Chapel (1989), Sumvitg Switzerland, Ceiling Detail
Photo: Sam Ridgway

Fig. 6.2 "THREE OVERLAPPING DRAWINGS can be made out from the incised lines on a temple wall (*colored lines*). These drawings specify the shape of the column shaft and base: two vertical cross sections of the column (one of which is drawn on its side) and a horizontal section through the shaft. The upright vertical section is scaled in the vertical dimension to one-sixteenth the actual size; all the other drawings are full-scale. The joints between the marble blocks of the wall (*black lines*) are also shown. Each drawing was meant to depict half of the structure it represents; the other half is simply its mirror image. Only the top fourth of the recumbent full-scale section of the column shaft is shown. The arc below the chord outlines the nearly imperceptible curvature of the shaft's contour. The diagrammatic horizontal cross section of the shaft includes three divisions that fix the spacing for the 24 flutes around the shaft's circumference. Each closely spaced parallel line in the third drawing represents one Greek foot in length along the column shaft. In this compressed version the convex contour of the column can be clearly seen. The varying radial dimensions of the shaft could be measured off this drawing directly. "

Source: Lothar Haselberger, "The Construction Plans for the Temple of Apollo at Didyma," *Scientific American*, (December 1985), pg. 120.

Fig. 6.3 "PLANNED AND ACTUAL COLUMN BASE can be compared in profile. The shaded outline (*left*) is a scaled cross-sectional diagram of the base of a temple column (*photograph at right*). The inscribed lines on the adytum wall are drawn here (*color*) to the same scale as the section insofar as they are visible or can be reliably reconstructed by extending visible lines. Disregarding what appear to be "first tries" at a base design, the match is close. The re-drawing of the semicircular moulding (*A*) and of the protruding curve below it (*B*) indicates that the sketches on the wall were drafts, the final versions of which were then executed."

Source: Lothar Haselberger, "The Construction Plans for the Temple of Apollo at Didyma," *Scientific American*, (December 1985), pg. 118.

Fig. 6.4 (A) An axonometric projection of the voussoir of a hemispherical dome. All the edges of the voussoirs converge towards a single centre, O. (B) An axonometric projection of a voussoir in a perfect arch, starting with a rectangular shape.

Source: Jean-Pierre Adam, *Roman Building: Materials & Techniques*, London: B.T. Batsford, 1994, pg. 169.

Fig. 6.5 "triple arch with a rough extrados of opus quadratum. The irregular extrados is visually corrected by a sharp projecting archivolt springing from the band of the impost. Monumental gateway of Patara , second century, Lycia."

Source: Jean-Pierre Adam, *Roman Building: Materials & Techniques*, London: B.T. Batsford, 1994, pg. 169.

Fig. 6.6 "Funerary relief of a stone-mason, with the representation of a square, a stone-mason's hammer (or kivel) and a scabbling hammer. (Musée de Berry, Bourges; JPA.)

The base of a funerary monument on which are shown, from left to right: a mallet; a levelling square; a plumb line; a square; and a double bladed stone-hammer. (Museo della Civiltà Romana, room LII; JPA.)

Stone-mason's cippus showing: a foot without gradations (29.6cm long); a levelling square; a square; a compass; a maul or a bladed stone-hammer and callipers. (Capitoline Museum; JPA)"

Source: Jean-Pierre Adam, *Roman Building: Materials & Techniques*, London: B.T. Batsford, 1994, pg. 33.

Fig. 6.7 "Drawings on the plaster tracing-floor, dating from c. 1360-c. 1500 (drawing: A.R. Whittaker)"
Source: J. H. Harvey, "The Tracing Floor of York Minster," in Lyn T. Courtenay (ed.), *The Engineering of Medieval Cathedrals: Volume 1*, Ashgate Publishing, 1997, pg. 85.

Fig. 6.9 Drawings showing the complex construction of the four incised choir piers of Durham cathedral (1093-1104). Each pier consists of a cylindrical part and a respond. The number and the precision of the blocks required for each pier including the incised spiral which was carved before the blocks were laid, meant a high degree of planning by the master mason which was translated into a series of templates used by the masons to cut he blocks.

Source: Jean Bony, "The Stonework of the first Durham Master," in Lyn T. Courtenay (ed.), *The Engineering of the Medieval Cathedrals*, Ashgate Publishing Limited, 1997, pg.125,126.

Fig.6.10 (A) "Mason's templates cut from zinc sheets at the Bath and Portland Stone Company, Bath, England."

Source: Lon R. Shelby, "Medieval Mason's Templates," *Journal of the Society of Architectural Historians*, 30, 2 (May, 1971): pg. 141.

(B) Illustration from Book III of the renaissance architect and scholar Philibert de L'Orme's L'Architecture (1564) showing some of the "instruments that pertain to the art" of making geometric cuts "which should be known by architects and master masons to direct the cutting of stones for any purpose required." They are very similar to those used by ancient masons (Fig. 3) but with the addition of the (simple) templates (F and G).

Source: Sergio Luis Sanabria, *The evolution of the Late Transformations of the Gothic Mensuration System: Volume II, Appendices*, Michigan: UMI Dissertation Information Service, 1984, pg. 142.

Fig. 6.11 Viollet-le-Duc's drawing shows the stereotomy of one element of a medieval church, the *Tas-de-Charge*, the base or springing point for a fan vault. Templates were used to guide the accurate cutting of each stone before it was lifted into place.

Source: John Fitchen, *The Construction of Gothic Cathedrals: A Study of Medieval Vault Erection*, Oxford: The Clarendon Press, 1961, pg. 76.

Fig. 6.12 A plate from J.-N.-L. Durand's *Précis des Leçons d'Architecture* (1819).
"Durand's demonstration of the 'correct and effective way to design,' illustrated in the centre of the plate, shows the precise coordination of the plan, section, and elevation, the 'set' that constitutes the 'objective idea' of a whole building. The comparison between the plans of the pre-Renaissance Basilica of St. Peter in Rome and the modern building from the sixteenth century purports to show the 'calamitous effects' evident in the modern example, resulting from the lack of observation of the 'true principles of architecture,' ultimately epitomized by descriptive geometry."

Source: Alberto Pérez-Gómez and Louise Pelletier, *Architectural Representation and the Perspective Hinge*, pg. 5.

Appendix A

Fig. A.1 Sketches made by Marco Frascari during the interview. Clockwise from top left: Serlio's drawing showing how to proportion a temple door; Carlo Scarpa's gravestone; Italian hollow tile construction; relationship between base and height dimensions of Gothic, Ogival arches; Palladiana/Serliana; sketch of bedroom section by Sam Ridgway.

Fig. A.2 Sketches made by Marco Frascari during the interview. Clockwise from top left: diagrams of Scarpa's detailing of the joints between the formwork of concrete columns; column capital detail from Brunelleschi's church of Saint Lorenzo; genesis of Scarpa's detailing based on construction techniques; column capital showing mutola attached to column.

Fig. A. 3 Serlio's drawing of temple door proportions.
(Source: Sebastiano Serlio on Architecture, Volume One, Book 1, On Geometry)

Fig. A.4 Carlo Scarpa, preliminary sketch for the twin pillars, *Banca Popolare di Verona.*
(Source: Carlo Scarpa, Benedikt Taschen)

Fig. A.5 Palladio's deign for the addition of a classical arcade to a medieval basilica.
(Source: Andrea Palladio, The Four Books of Architecture, Third Book)

Fig. A.6 Palladio's design for the addition of a classical arcade to a medieval basilica.
(Source: Andrea Palladio, The Four Books of Architecture, Third Book)

Fig. A.7 Palladio's Basilica in Vicenza.
(Photo: Sam Ridgway)

Fig. A.8 Detail of Carlo Scarpa's tomb in the Brion Cemetery
(Photo: Sam Ridgway)

Fig. A.9 Carlo Scarpa Detail of Brion Family Chapel
(Photo: Sam Ridgway)

Fig A.10 Carlo Scarpa, twin columns from the *Banca Popolare di Verona*.
(Source: Carlo Scarpa, Benedikt Taschen)

Fig. A.11 Brunelleschi's Church of Saint Lorenzo
(Source: unknown)

Fig. A.12 Sketch of triglyph and guttae made by Marco Frascari during the interview.