CONSTRUCTIONAL 'THEORY' IN BRITAIN
1870s – 1930s

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I, Pinai Sirikiatikul, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Abstract

Unlike spoken and written theories, the constructional 'theories' explored in this thesis are drawn essentially from 'practice'. While occasionally drawing upon what architects said and wrote, the thesis investigates the extent to which architects have worked out their theoretical propositions within the practical aspects of building, without necessarily articulating them verbally. Of the recent discussions on the relation of architectural theory to building practice, Kenneth Frampton's *Studies in Tectonic Culture* (1995) stands out; but Frampton's book is limited by his anti-post-modernist framework, his mode of argument that largely attributes the value of architectural works to a theoretical dimension, his treatment of construction as a constant and passive given, and his disregard for the entirety of British architecture. This thesis criticises *Studies in Tectonic Culture*, arguing that British architecture offers some alternatives for thinking about the dialectics of 'theory' and 'construction'. The way in which some British architects of the late 19th and early 20th centuries worked – experimental, craft-based and treating the process of construction as integral to the process of design – indicated that for them construction was more than simply a medium through which an architect's ideas are expressed; and out of their calculated employment of construction, considered in terms of 'labour', 'building', 'material', and 'representation', could emerge a certain 'implicit intellectuality', which was no less a 'theory' than verbally articulated statements existing prior to construction. It is not theory that dictates construction, but rather that 'construction' itself can be a 'theory' in the process of becoming. In opening up possibilities for thinking about constructional 'theory', the thesis suggests the removal of an assumed theory/practice distinction, proposing instead 'practice' as essentially an indispensable body of 'immanent theory' as an alternative to Frampton's theory of the *Tectonic.*

CONTENTS

‘All social life is essentially practical. All mysteries which lead theory to mysticism find their rational solution in human practice and in the comprehension of this practice.’ [i]

[i] Karl Marx, "Theses on Feuerbach" [1845], in *Marx/Engels Selected Works, Volume One* (Moscow, USSR: Progress Publishers, 1969)

INTRODUCTION

The 'Unwritten Chapter' of Frampton's *Studies in Tectonic Culture*

Construction is without question indispensable to all built architecture. Construction itself may be as old and omnipresent as any other form of human practice, but a theory of construction, as distinct from a practice of construction can be traced back not much more than three centuries. Theories of construction, existing prior to and independently from actual buildings, originated in the eighteenth century, and out of them came the doctrine of Structural Rationalism, whose best known and most comprehensive exponent was Viollet-le-Duc. In France, especially, and to a lesser extent England and United States, it provided the main constructional theory of modernism; in German speaking countries Gottfried Semper's different, but not unrelated, theory was dominant. But what other 'theories' of construction do we know?

Of recent discussions of theories of construction, Kenneth Frampton's St*udies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture* is amongst the most widely read. *Studies in Tectonic Culture* is a remarkable work, setting out a comprehensive revision of modernist architecture in terms of constructional principles. However, Frampton formulated *Studies in Tectonic Culture* as a reaction against post-modernism, and his understanding of construction is constrained by this particular viewpoint. Associations between post-modernism and the British Arts and Crafts movement, through the figure of Edwin Lutyens, led Frampton to disregard the entirety of Arts and Crafts architecture, for it would have been unsuited to his anti-postmodernist framework. My study of a British 'theory' of construction thus hesitates to follow Frampton's operation. In this introduction, I offer a critique of *Studies in Tectonic Culture*, arguing that while British architecture is left out in Frampton's book for historiographic reasons, it nevertheless gives an alternative or possibly equally good opportunity for the understanding of the relationship between architecture and construction as any of his other choices of case studies.[1]

In *Studies in Tectonic Culture*, Frampton set out to study the way in which architects in the past two centuries had attempted to demonstrate construction in building form, and he regarded a successful and artistic result that provides the viewer with understanding of how the pieces of materials are put together in architecture as a 'poetic of construction'. Historiographically speaking, Frampton's aim was to re-interpret modern architecture according to its constructional significance, rather than interpreting it according to the development of spatial concept as had customarily been done beforehand. While he did not object to history that saw architecture as the development of concepts of space, he proposed to study the history of modern architecture by shifting attention to 'tectonic culture', as he put it:

> Without wishing to deny the volumetric character of architectural form, this study seeks to mediate and enrich the priority given to space by a reconsideration of the constructional and structural modes by which, of necessity, it has to be achieved.[2]

Reversing Adolf Loos's insistence on the priority of the space over the structure, Frampton prioritises the construction, stressing that in it lies the essence of architecture.

His turn to construction was polemical. It was polemical because he deliberately formulated it as a reaction against a semiotic theory – the theory that had dominated post-modern discourse and caused a tendency to reduce built works of architecture to mere visual signs. In his earlier essay

[1] My thesis began as the 'unwritten chapter' of Frampton's book, as Professor Mark Crinson put it when I told him before I started the thesis what I was thinking of doing. However, I soon realised that the task was less straightforward than merely adding a further chapter.
[2] Kenneth Frampton, *Studies in Tectonic Culture: The Poetic of Construction in Nineteenth and Twentieth Century Architecture* [1995], Third printing ed. (Cambridge, Massachusetts; London: The MIT Press, 2001), p. 2.

Towards a Critical Regionalism of 1983, Frampton had made clear his preference for construction and his aversion towards *scenographic* architecture:

> the primary principle of architectural autonomy resides in the *tectonic* rather than the *scenographic*: that is to say, this autonomy is embodied in the revealed ligaments of the construction and in the way in which the syntactical form of the structure explicitly resists the action of gravity. It is obvious that this discourse of the load borne (the beam) and the load-bearing (the column) cannot be brought into being where the structure is masked or otherwise concealed. On the other hand, the tectonic is not to be confused with the purely technical, for it is more than the simple revelation of stereotomy or the expression of skeletal framework. […] The tectonic remains to us today as a potential means for distilling play between material, craftwork and gravity, so as to yield a component which is in fact a condensation of the entire structure. We may speak here of the presentation of a structural poetic rather than the re-presentation of a façade.[3]

Frampton used the same argument in his 1990 essay, 'Rappel a l' Ordre: The Case for the Tectonic', following which he developed it at length in his 1995 book on *Studies in Tectonic Culture*. The problem about post-modern architecture was, he thought, its failure to present the constructive expression of architecture – the quality that makes architecture differ from building. The stylistic scenography characteristic of post-modern architecture, whose buildings were usually poorly crafted, not only made for him architecture more like visual signs, but it had also resulted in the absence of bodily experience in buildings, causing the alienation of human orientation in the built environment. Frampton criticised the emergence of the scenographic architecture of post-modernism - that treated built work only as sign - as a retrograde feature; against 'the tectonic trajectory in the face of a postindustrial civilization that seeks nothing less than the reduction of the entire world to one vast commodity', instead, he set out to redeem architecture from what he perceived as its emptiness by suggesting to restore architecture's

[3] Kenneth Frampton, "Towards a Critical Regionalism: Six Points for an Architecture of Resistance" [1983], in *The Anti-Aesthetic: Essays on Postmodern Culture*, ed. Hal Foster (Seattle, Washington: Bay Press, 1993), p. 27-28. (Italics in the original)

capacity for rendering human existence, and this was to be attained through what he called the 'Tectonic'.[4]

Unlike other contemporary theorists who often drew their argument from discourses outside architecture such as science, literature or art, his aim was to draw architecture back to the act of making architecture. For Frampton, the essence of architecture lies in its own finished result, and it is through its capacity to present itself in terms of constructive aesthetic that he hopes to restore to architecture its integrity.[5]

> building remains essentially *tectonic* rather than scenographic in character and it may be argue that it is first and foremost an act of construction rather than a discourse predicated on the surface, volume and plan, to cite Le Corbusier's 'Three Reminders to Architects'. 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.[6]

Frampton's theoretical formation in which the built architecture stands for itself, rather than for something outside it, came heavily from the philosophy of phenomenology. So a second problem with which Frampton was concerned was how phenomenology could inform our understanding of architecture. Since one of the bases of phenomenology is the concern of the relation between objects and the human subject, Frampton followed the phenomenologists' proposition by arguing that the essence of architecture exists through the relationship between architectural objects and human subjects. Central to Frampton's argument, as Jorge Otero Pailos has put it, is 'the primacy of lived experience over

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[4] Frampton, *Studies in Tectonic Culture: The Poetic of Construction in Nineteenth and Twentieth Century Architecture*, p. 376.
[5] Kenneth Frampton, "Rappel a L' Ordre: The Case for the Tectonic" [1990] in *Labour, Work and Architecture: Collected Essays on Architectural and Design* (London; New York: Phaidon Press, 2002), p. 94.
[6] Ibid., p. 93.

detached mental analyses as a means to understand the history of architecture'.[7] Under the actual physical appearance of architecture, Frampton believed, there is a 'thingness' uniquely known to our bodies. Following the philosopher Martin Heidegger, he wrote: "all structural form […] may serve to remind us, after Heidegger, that 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".[8]

With the regard to architectural and cultural significance, Frampton made clear that the history of 'tectonics' with which he was concerned is not just the history of engineering, but involved more the expressive potential of construction. Deriving his argument from Carl Bötticher's idea of the *core-form* and the *art-form*, Frampton quoted Stanford Anderson to explain what he meant by *Tectonic.*

> "*Tektonik*" referred not just to the activity of making the materially requisite construction … but rather to the activity that raises this construction to an art form … The functionally adequate form must be adapted so as to give expression to its function. The sense of bearing provided by the entasis of Greek columns became the touchstone of this concept of *Tektonik*.[9]

Not unlike the nineteenth-century English theorist Robert Willis's idea of *apparent construction*, 'Tectonic', in this regard, is the visual result that affects the viewers through expressive structure. His focus on the expressivity of structure and on the connection between building parts frame his selection of case studies. In subsequence chapters of the book, he explored the ways in which modernist architects like Frank Lloyd Wright, Auguste Perret, Mies van der Rohe, Louis Kahn, Jøhn Utzon and Carlo Scarpa used construction to form their architecture. In particular, he

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[7] Jorge Otero-Pailos, *Architecture's Historical Turn: Phenomenology and the Rise of the Postmodern* (Minneapolis, Minn.: University of Minnesota Press: 2010), p. xii.
[8] Frampton, "Rappel a L' Ordre: The Case for the Tectonic", p. 95.
[9] Frampton, "Towards a Critical Regionalism: Six Points for an Architecture of Resistance", p. 27-28. (Italics in the original)

examined the various ways each architect attempted to render the structure of buildings visible as architectural forms.

Of all the physical components of building, Frampton turned to the 'structural unit as the irreducible essence of architectural form'.[10] Unlike space, which leaves no trace of the action which brought it into being, the joint is, for him, capable of revealing how constructional parts are put together. Inspired by Semper's theory of the knot as a mythical origin of architecture, Frampton saw in the making of junctions the theoretical process that can bring back the lost dimension that once connected humanity to architecture. As he wrote:

> To recover in a literal sense some dimension of an eternal present, lying outside the nightmare of history and beyond the processal compulsions of instrumental progress. This drive insinuates itself again today as a potential ground from which to resist the commodification of culture. Within architecture the tectonic suggests itself as a mythical category with which to acquire entry to an anti-processal world wherein the 'presencing' of things will once again facilitate the appearance and experience of men.[11]

Since Frampton perceived architecture as a theoretical process arrived at through structural logic, linking together labour, craft, and aesthetic process, how did he justify his view?

Frampton's insistence on the tectonic as an intellectual framework, while critical and decisive in a shift from the history of space and of styles to a history of constructional importance, was nevertheless reliant upon quite a narrow view of tectonic culture. As he set up tectonic discourse as a reaction against post-modernist reduction of thing to images, Frampton chose to disregard any building associated with images, symbol, and abstraction, even though they might have no less a constructional significance than the case studies in his book. It is then no surprise that the

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[10] Frampton, "Rappel a L' Ordre: The Case for the Tectonic", p. 92.
[11] Ibid., p. 103.

entire practice of the Arts and Crafts movement is left out from Frampton's tectonics. Always claimed as 'a way of building' rather than a movement pursuing a particular style, the Arts and Crafts movement is still praised nowadays for its concern primarily with building construction, and in that respect it could be treated as an alternative to post-modernism. In his recent article 'Crafts Works', for instance, Robert Adam wrote:

> When Kenneth Frampton invented critical regionalism in the early 1980s as a modernist snub to post-modernists, the arts and crafts movement offered instant modernist credentials for his promotion of local materials and craftsmanship. Not only that, it meant you didn't have to abandon free-style planning, inventive detail and horizontal windows. Even the anti-modernist CFA Voysey was called up by some – a trick turned by suggesting you cover up the pitched roofs and think of Corbusier.[12]

Indeed, as Robert Adam suggested, the Arts and Crafts movement was well-suited to enquiries in tectonic discourse, but the fact that the Arts and Crafts movement had been treated by some post-modernist architects as source of styles, images, and representation made it unsuited to Frampton's propose. Frampton's tectonic culture is then limited by his own 'anti-postmodern' framework; he concentrated only upon twentieth century architecture and excluded various alternative versions of the tectonic.

The second shortcoming of *Studies in Tectonic Culture* lies in the way Frampton made his argument. As Frampton focused mainly on the visual expressivity of structure and the connection between constructional parts, he traced how these features are made and articulated in the building process and describing in various stages of the building process, starting from theoretical formation to the production. Throughout his book, and especially the main chapters where he dealt with the works of selected modernist architects, he gives an impression, though he does not say exactly this, that the building process of architecture consisted of four stages, linked

[12] Robert Adam, "Craft Works", *RIBA Journal* (January 2009): p. 46.

to four occupations. Frampton started first by discussing theory, so the first occupation for Frampton is always a theorist who forms the tectonic idea that the building appearance must be of capable of revealing and augmenting the constructional significance. The second stage is when an architect applies the theory to a work of architecture. The third step occurs when an engineer helps the architect to translate this to the possibilities of the structure. And lastly are the people who build the designated form.

Systematic though these four stages may seem, we should not assume that this is necessarily the only order possible in the building process. In certain cases, the order could be reversed, as, for example, happened in Carlo Scarpa's architecture, where craft in some instances preceded design. Not all aspects of buildings start from drawings. Making and execution, reliant upon knowledge of the use of materials and craftsmanship may be starting points as well as end parts.[13] The English architect John Brandon-Jones recalled, as he struggled to produce working drawings for a pier, his contractor saying to him: 'I think I would be better, Master Jones, if I was to build the pier and then you could draw what I had built'.[14] Such a way of working, in which an architect cooperates with builders right from the start, with shared ideas of materials and the construction, calls into questions Frampton's singular model of building process as sequential, always starting from general design concept and resulting in detailed construction.

Of the four stages, Frampton seems to treat the theoretical stage as the most significant. In most of the chapters, he starts by identifying the theory known to the architects and the ways in which they applied the theories to their works, assuming that understanding the architecture relied on

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[13] It should be noted that while Frampton acknowledged that Perret had total control over the construction, he discussed this advantage of holding practical aspect of building only briefly and put it at the end of the discussion, as though it played very small part in the creation of Perret's work. See Frampton, *Studies in Tectonic Culture: The Poetic of Construction in Nineteenth and Twentieth Century Architecture*, p. 155.

[14] John Brandon-Jones, "The Use of Materials: A Study of Contradictory Attitudes", in *Craft History One* (1988), p. 113-114. I owe this reference to Adrian Forty.

knowledge of the theory known to architects. In each of the main chapters, which discuss architectural works of individual architects, he begins with what architects had, or might have, in mind, to justify the construction significance of their work. An example of this mode of interpretation occurs with the architects Louis Sullivan and Frank Lloyd Wright, whose work is related to Gottfried Semper's theory. Though, as he noted, Sullivan and Wright never made reference to Semper's doctrine, Frampton assumed a connection between their works and the theory of Semper: 'we have every reason to suppose that they were aware of his theory, given out that Chicago was so impregnated with German cultural values and ideas'.[15] Then he went on to connect Wright's theoretical propositions with Semper's principle, suggesting that his work is an attempt to manifest the textile weaving of architectural membrane. That Semper's influence on Wright's thought may be indisputable, yet, it can also be asked, how could a thing that was built by American construction tradesmen be said to be the product of the mind of the German theorist? The same approach, of linking construction with pre-existing ideas, is applied in the other chapters, most of which, except for Carlo Scarpa's, are discussed as if they were a part of either Structural Rationalists' or Gottfried Semper's discourses, for Frampton sees these two traditions as the main theoretical sources of modernist construction, indispensable for the apprehension of architecture.[16]

Although such theories may be a factor in what the architect was thinking at the moment he or she was designing, theories known to architects are never sufficient to recount all there is to be

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[15] Frampton, *Studies in Tectonic Culture: The Poetic of Construction in Nineteenth and Twentieth Century Architecture*, p. 95.

[16] While Frampton acknowledged that Scarpa's architecture can hardly be analysed in 'a systematic manner', for, 'his achievement can only be understood as a continuum', he connected Scarpa's work with Semper's discourse, as if the architectural work is the direct application of the established theory. Considering his mode of argument that largely attributes the value of architectural works to a theoretical dimension, as he did in the other chapters of the book, the linkage between Scarpa's architecture and Semper's theory is however not surprising; see, for example, following sentences: 'The principle façade of the Banca Popolare appears to be articulated according to Semper's four elements, so that we are presented with an earthwork in stone, a screen wall in plaster, and a steel framed loggia at the top of the building. The Ziggurat moulding serves to divide up the body of the building into these specific elements'. Quotations are from Ibid., p. 329.

known about the works of architecture they had managed to build. The fact that theories are prior and therefore exterior to the actual building practice puts theories at a distance from the end result. What Frampton generally failed to provide was evidence of how any theory made its way into the act of building. Because he assumed that the resultant work is the straightforward demonstration of a pre-existing idea, without any need to explore what went on in the process of construction, his analysis of construction ends up more as a reification of pre-existing ideas, than as empirical historical enquiry into construction.

More particularly, there has always been a tendency to think that creativity lies primarily in the architects' mind. The tendency to see architecture in relation to 'theory' subordinates the creative factors deriving from other occupations, and often gives the impression that the architects themselves were solely responsible for the overall effect of architecture. The genius of the architect has sometimes been exaggerated – a figure like Le Corbusier, for example, is a case in point: as the British historian Andrew Saint observed in relation to Unité d' Habitation's project:

> Le Corbusier was far from the first architect to be bold with technologies that he had not mastered, and to exploit others to help him do so. […] Le Corbusier glorified the means as well as the ends, and so led clients and the public into supposing that he was in control of a process relentlessly biased towards effect. While he supplied modern architecture with evergreen images and concepts, he also bequeathed to it the habit of justifying sleight of hand.[17]

The story of Le Corbusier's Philips Pavilion is perhaps an even more perfect illustration of the misapprehension of the architect's superior role. Marc Treib, who investigated the construction process of this building, revealed that although the architect was responsible for initiating the design, he had no idea of how to construct it. The responsibility for the structure and the construction, which are in fact the most daring aspects of the work, rested solely with the

[17] Andrew Saint, *Architect and Engineer: A Study in Sibling Rivalry* (New Haven and London: Yale University Press, 2007), p. 276.

engineer and the contractor, and it is the engineer and the contractor alone who resorted to old building techniques of moulding and tying, in order to get the work built successfully.[18] That Le Corbusier did not know how the Pavilion was going to be built, and that the making of it emerged from the engineer and the contractor, shows that not all woks of architecture conform to Frampton's model in *Studies in Tectonic Culture*, in which theory and the work done by architects always take precedence over execution.

The evidence of the Philips Pavilion, where both the theory and the work done of the architect were subsidiary to the act of construction, should warn us against expecting a theory or an architect's account to reveal all there is to a work of architecture.[19] The structure of the Philips Pavilion, so futuristic in its form, but built with means, that might have been used in the most primitive buildings, illustrates the fact that new, theoretically-derived systems of construction will not always replace established ones, but rather there is a process of assimilation and appropriation, as a new system of construction is adapted to an existing building tradition, or grafted on to it.

It is with such issues of constructional assimilation that Frampton seemed to be less concerned in his book. To emphasise the constructional significance of architecture, but to attribute the value primarily to what architects might have derived from the theory, as Frampton did in *Studies in Tectonic Culture,* while it suited his propose of encouraging architects to be attentive to theoretical

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[18] Marc Treib, *Space Calculated in Seconds* (Princeton, N.J: Princeton University Press, 1996)
[19] Hannah Arendt's distinction between a story told by actors and a story told by historians is worth noting here: 'All accounts told by the actors themselves, though they may in rare cases give an entirely trustworthy statement of intentions, aims, and motives, become mere useful source material in the historian's hands and can never match his story in significance and truthfulness. What the storyteller narrates must necessarily be hidden from the actor himself, at least as long as he is in the act or caught in its consequences, because to him the meaningfulness of his act is not in the story that follows. Even though stories are the inevitable results of action, it is not the actor but the storyteller who perceives and "makes" the story'. See Hannah Arendt, *The Human Condition* [1958] (Chicago; London: University of Chicago Press, 1998), p. 192.

sources outside post-modern theory, gives the theories held by architects a privileged position that is unwarranted, and does not always conform to historical evidence.

Moreover, Frampton has a tendency not to recognise that there is always a gap between what is conceived as a design and what is built in reality. Design practice, in which the act of imagination is part, does not necessarily correspond to what is actually produced in execution. The development of this view is articulated by what some contemporary French historians have called 'technical imagination' - that at any given time, it is possible for our mind to imagine only certain ways of carrying out construction, and that this, rather than the range of actually available technical means, provides the real limits to constructive opportunities. [20] Frampton gives no attention to the dynamics present within construction, but assumes construction to be a constant and a passive 'given'. For him, construction is something that is simply present equally available to all people at any given time and place, and always fulfilling the same role in the architectural process. Frampton's static treatment of construction without considering other possible dynamics is a weakness in his account of the tectonic.

As we have seen, Frampton's attempts to reveal the constructional significance of architecture is limited by his ordering of the building process to four stages, his mode of argument that attributes the value of the work largely to the theoretical dimension, and his lack of recognition of the distance between the worlds of design and of execution. The book's anti-postmodernist framework makes it more of manifesto rather than a satisfactory work of historical scholarship.

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[20] For a discussion of 'technical imagination', see Rémi Rouyer, "Architecture Et Procès Techniques : Les Figures De L'imaginaire" (PhD thesis, Université Panthéon-Sorbonne Paris, 2006) I owe this reference to Adrian Forty.

Of the shortcoming of Frampton's book, I believe that the system of four stages is the most problematic, for it becomes a formula. It is always the same, whether or not the constructional process actually occurs at the last stage within the sequence. It is this that causes me to ask whether it possible for these four stages to occur in a different order? How might one write a history of construction in such a way that acknowledges the exchanges between the process of thinking and the process of making, and not treat them as separate as sequential stages as Frampton did in his book? How to acknowledge that the process of thinking belonging as much to the means of construction and not solely to a stage prior to construction, where Idealist philosophy would tends to locate it? How can we draw theoretical propositions from the act of making, that domain which has customarily been characterised as non-theoretical? It is with such a history that this study is concerned, taking as its evidence some examples of late-nineteenth and early-twentieth centuries British architecture.

In opening up the possibility of thinking about constructional 'theory', the thesis takes the building practice of British architects as a critique of the conventional thinking about architecture as theory-guiding-practice. Rather than treating 'construction' as a less than adequate bearer of 'ideas', my intention was, first, to avoid the tendency to isolate theoretical dimensions of the work from the 'process' and, second, to consider 'construction' as itself an embedded theoretical action (*praxis*) in order to disclose its implicit intellectual dimensions. Only by exploring these processes, dealing with 'thought', 'labour', 'building', 'material', and 'representation' outside a strict pre-ordained sequence, could we hope to get better understanding of the relationship between 'theory' and 'construction'.

However, as the study proposes to consider a 'practice' as a sort of 'theory', the terms, given the history of their conventional separation, are not wholly suitable for my purpose. To avoid confusion, throughout this thesis, whenever I deal with 'theory' and 'practice' in the sense of them as two parts of an inseparable whole, I make this clear by enclosing them with inverted commas, in order to distinguish this sense from their conventional definitions.

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Structural Rationalism and Its Critics

Amongst architectural themes developed in the nineteenth century, the concept of Structural Rationalism – honest expression of structure and material – appears one of the most fundamental influences for the Modern Movement. The French origins of Structural Rationalism and its contribution to twentieth-century modern architecture are well known. While the history of Structural Rationalism can be traced back to the eighteenth-century French architecture, it is not until the second half of the nineteenth century that the theory really caught people's attention. The introduction of the new materials of steel and reinforced concrete made it necessary for architects and engineers not only to find ways to make use of these new materials, but also to justify their use. It was sometimes said that the new materials were the main factor leading to the new architecture of the twentieth century, but they were also responsible for generating architectural theory.

This supposition that the new material is responsible for the new architecture comes out of the Rationalists' discussion, particularly the writing of the nineteenth-century French theorist and architect Eugéne-Emmanuel Viollet-le-Duc [1814-1879], who wrote more about Structural Rationalism than any other in his two main books: *Dictionary of French Architecture* published in the 1860s, and *Lectures on Architecture* published later in the 1870s-80s. After Viollet-le-Duc's doctrine was published, it has long been the convention to see it as a coherent theory of structure. Yet, far from being 'rational' in any true sense, structural rationalism's contradictory features have usually gone unnoticed. While Viollet-le-Duc's legacy has been examined substantially, there has been little critical analysis of it; the opportunity is therefore taken here to look historically at its basis and at the way in which it had been applied into architecture, in order to expose its true nature.

Viollet-le-Duc's Structural Rationalism

'Is the nineteenth century to close without possessing an architecture of its own?', asked Viollet-le-Duc in his *Lectures on Architecture*: 'Is it to transmit to posterity nothing but pastiches and hybrids?'[1] Viollet-le-Duc's questions were in opposition to the current convention when a reproduction of the past styles was widespread. Rejecting an imitation of traditional forms, Viollet thought of architecture primarily as a true expression of 'programme' and 'constructive process', of which he wrote: 'To be true in respect of the programme is to fulfil exactly, scrupulously, the conditions imposed by the requirements of the case. To be true in respect of the constructive process is to employ the material according to their qualities and properties'.[2] New forms of architecture, he argued, should be the expression of the means of construction. For him, forms and ornaments cannot be separated, but must be one. Every element in construction must originate a form: 'embroidering the architecture form in one part and attaching ornaments in another is a sin against unity; it is rendering the two systems mutually injurious'.[3] Moreover, to move away from the past style, Viollet-le-Duc suggested that the introduction of new materials made available by industry could invoke the creation of new forms designed to express the properties of these material. He was critical of the transmutation of the forms made by one material to those made of another material. Criticising Auguste Boileau's church, whose form is that of Gothic, but made out of cast iron, Viollet said 'one should not give to cast iron the

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[1] Eugene-Emmanuel Viollet-le-Duc, *Lectures on Architecture (Translation of Entretiens Sur L'architecture,1863:Vol.1 and 1872:Vol.2)*, trans. 1877 (vol.1) and 1881 (vol.2) Benjamin Bucknall (New York: Dover Publications, Inc., 1987), p. 446.
[2] Ibid., p. 448.
[3] Ibid., p. 468.

1.1 Louis-Auguste Boileau's interpretation of the Gothic at St. Eugène, Paris, built in 1855. An attempt to substitute cast-iron for wood and stone at the church was considered deceitful in Rationalist terms. From Conway Library, Courtauld Institute of Art

appearance of stone, for any change of materials must bring about a change of forms'.[4] [fig 1.1] Accordingly, his aims in creating an architecture of the nineteenth century were twofold: an architecture possessing a unified system in which construction and decoration were mutually dependent, and an architecture whose forms come out of material properties.

Robert Willis' Theory

Prior to Viollet-le-Duc's doctrine, an alternative, but less known, theory of structure is found in Robert Willis's writings. A British contemporary of Viollet-le-Duc, Robert Willis [1800-1875], arguably anticipated Viollet-le-Duc's theory of structure with his ideas of 'Mechanical Construction' and 'Decorative Construction', but unlike Viollet, who considered them as the same, Willis drew a distinction between the real and the apparent construction. In his *Remarks on the Architecture of the Middle Ages especially of Italy* of 1835, he wrote: 'there are two things to be observed in the construction of a building'; Willis explained, 'how the weights are really supported, and how they seem to be supported. The first I shall call the *Mechanical*, or actual construction, and the second the *Decorative*, or apparent construction, and it is necessary to make

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[4] Original text is in Eugene Emmanuel Viollet-le-Duc, *Encyclopedie d' Architecture* 5, no. 6 (1 June 1855); source quoted here is Réjean Legault, "L'appareil De L'architecture Moderne: New Materials and Architectural Modernity in France, 1889-1934" (PhD thesis, MIT, 1997), p. 25. For the controversial debate about the church of St. Eugène between Viollet-le-Duc and Louis-Auguste Boileau, see "Viollet-Le-Duc and Boileau: St. Eugene and the Gothic Debate", *Architectural Design* 3/4 (1980): p. 54-59.

1.2 The *Mechanical* and the *Decorative* Construction, from Robert Willis, *Remarks on the architecture of the Middle Ages especially of Italy*, 1835. Willis's illustrations – in which the diagrammatic forms of the Mechanical construction are depicted in style sharp contrast to the Decorative construction – contributed to his urge to make the distinction between the two.

a strong distinction between them'.[5] And it is, indeed, in this separation of the two kinds of construction that distinguishes Willis' account of structure from Viollet's. Willis made it clear that the role of the apparent construction was not necessarily the same role as the mechanical one; that it is an ambiguous system, since it is not the real support of a building, but ornamental articulation made to render the structure underneath visible [fig 1.2]. He saw this apparent construction demonstrated most outstandingly in the Gothic style: 'This style is remarkable for the skill with which all the ornament parts are made to enter into the apparent construction. Every member, nay, almost every moulding is a sustainer of weight, and it is by this multiplicity of props assisting each other, and the consequent subdivision of weight, that the eye becomes satisfied of the stability of the building, notwithstanding their slender proportions'.[6] Regarding it

[5] Robert Willis, *Remarks on the Architecture of the Middle Ages Especially of Italy* (Cambridge: 1835), p.15.
[6] Ibid., p.20-21.

as an independent organism, Willis identified the apparent construction as a surplus of mass beyond the material necessary for support, rendering a building to appear satisfactorily stable. Clearly articulated though his account of structure seems, Willis' theory is less well known than Viollet-le-Duc's doctrine. Even amongst British architects in the second half of the nineteenth century, when they referred to structural theory, it was to Viollet's version they referred, rather than to Willis', although the latter might have been expected to be more important in Britain. Viollet-le-Duc's doctrine assumed the role of a universal theory. Why did this happen?

While we still do not have a satisfactory answer of why Viollet's theory is so much better known in late nineteenth-century Britain than Willis', we can at least understand why Viollet's doctrine was notably famous amongst modernist architects. First of all, it was partly due to changing circumstances within architectural discourse. By the second half of the nineteenth century, the situation had changed from the first half of the century with the effect of the Industrial Revolution which brought with it new building materials, making it necessary to find a theory for how they should be used in architecture. Viollet's Structural Rationalism filled the current demand for a theory. With their persuasive textual and graphic appeal, his two main voluminous books: *Dictionnaire Raisonné de l' Architecture Française* (10vols, 1854-1868) and *Entretiens sur l' Architecture* (2vols, 1863-72) attracted architects searching for an architecture of the century. In this respect, Viollet's books outclassed Willis' *Remarks* – a book of a mere 200 pages with only 15 leaves of illustrations – written primarily for antiquarian circle – making it unlikely, according to Alex Buchanan, ever to appeal to architects.[7]

[7] Alex Buchanan, "The Science of Rubbish: Robert Willis and the Contribution of Architectural History", in *Gothic to Gothic Revival: Papers from the 26th Annual Symposium of the Society of Architectural Historians of Great Britain 1997*, ed. Frank Salmon (The Faculty of Arts, University of Manchester, 1998), p. 30.

Secondly, it has something to do with a historiography of Structural Rationalism – the ways by which Structural Rationalism had been written and transmitted in the post-Viollet era. One of the earliest books devoted to modern architecture to reinforce Viollet-le-Duc's argument is Sigfried Giedion's *Building in France, Building in Iron, Building in Ferro-Concrete*, published in 1928. In his book, Giedion [1888-1968] sustained the argument that the development of a new architecture lay essentially in the appropriate use of modern materials: iron and ferroconcrete. With his active role in the Modern Movement as a historian and as secretary of the CIAM, his first book, and his later well-known book on *Space, Time, and Architecture*, played a crucial role in making Structural Rationalism the basis of the modern movement. Accordingly, Structural Rationalism not only dominated French architectural theory, but, to a certain extent, it dominated the discourse of architectural modernism. The unity of construction and the importance of materials as generators of form became the dominant themes for the justification of modernism.

Since the second half of the nineteenth century, Viollet's Structural Rationalism thus became the most wide spread theory of structure. But this *orthodox* Rationalist principle is only one possibility; what other theories of structure do we know? Surprisingly, ever since Structural Rationalism was popularised by Viollet-le-Duc and reinforced by historians, there has hardly been any critique of Structural Rationalism, nor, even when it went into decline, was any alternative theory of structure evolved. While Structural Rationalism became known in the second half of the nineteenth century and was widely adopted amongst modernist architects during the first half of the twentieth century, it was accepted for most of that time within architectural discourse as a self-justifying system. Even in post-modernism, when architects reacted against modernism, they did not so much react against Structural Rationalism as ignore it altogether, as it failed to address symbolism and meaningfulness of architecture in any other values apart from structural value; post-modernists instead shifted their attention away from structure without either producing any substantial criticism of structure rationalism, nor did they develop other theories of structure to replace it.

There appear to be only four historians who have developed substantive criticisms of Structural Rationalism: Alberto Pérez-Gómez (1984), Antoine Picon (1988), Andrew Saint (1991 and 2007), and Réjean Legault (1997). In this chapter I look first at general criticisms of Structural Rationalism and at the end I shall look at one particular building – St. Jean de Montmartre – which is especially regarded as one of the earliest and purest applications of Structural Rationalism.

General Criticisms of Rationalist Approach

The first criticism of a Rationalist approach to draw into our discussion is taken from Alberto Pérez-Gómez. In his 1984 book *Architecture and the Crisis of Modern Science*, Pérez-Gómez's aim is to find out what went 'wrong' with the architecture of the past two hundred years, during which period the Rationalist approach was a dominant architectural trend. He investigated how architecture of the seventeenth and eighteenth centuries in France lost its metaphysical and essential symbolic dimensions, and then identified the loss of these features as due to the rise of modern science which reduced the existential meanings and cultural dimension of human activities in general and of architecture in particular. The 'logical' approach in architecture which was based solely on scientific knowledge not only rejected the importance of the transcendental dimension, but in itself obstructed, rather than led to any truly meaningful architecture. Pérez-Gómez identified the first criticism of Rationalist doctrine as that proposed by Charles-Francois

Viel [1745-1819], who was 'the first of his contemporaries to realize that the theoretical framework of architecture lacked *real principle*'.[8] As Pérez-Gómez wrote:

> Viel bitterly criticized rationalist architects who were competent in the mathematical sciences but ignorant of beautiful proportions and who lacked genius and taste. Such individuals were attempting to apply mathematics directly to construction and were coming up with extremely poor results. In order to illustrate this thesis, Viel compared "Perronet's new bridge" with Du Cerceau's Pont Neuf, and Soufflot's Pantheon with Mansart's church of Les Invalides. In both cases, he found the eighteenth-century buildings less beautiful and ridden with structural problems. […] He acknowledged the usefulness and precision of mathematics in solving mental or ideal problems, but did not think that they were infallible when applied to physical quantities whose attributes were indeterminate, that is, infinitely diverse.
>
> […] Thus the perfection of architecture could not only be attained by imitating the great buildings of the past, which were universally accepted precisely because they simultaneously embodied *all* the rules. A partial knowledge of mathematics, mechanics, or statics was insufficient to produce good architecture.[9]

According to Pérez-Gómez, Viel rejected a theory based on only the science of construction because he believed that 'quantitative experiments concerning the strength of materials' – such as the method that Rondelet carried out at Pantheon to help Soufflot proving its rationality – by neglecting materials' other richness and being concerned only with its physical ability of supporting load, were insufficient.[10] Quantitative experiments tended to simplify great matters of material and made architecture merely prosaic construction [fig 1.3]. Instead, Viel emphasised that 'the quality of materials (that is, what they revealed to perception and experience) was more

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[8] Alberto Pérez-Gómez., *Architecture and the Crises of Modern Science* (London, England The MIT Press, Cambridge, Massachusetts, 1983), p. 320. (Italics in the original)
[9] Ibid., p. 317-318. (Italics in the original)
[10] Ibid., p. 318.

importance for architecture'.[11] To Viel, rather than enriching its quality with logicality, a theory of structure dried architecture up, and for this reason applications of such a theory 'were not, in fact, more economical since they failed to generate better buildings'.[12] Viel's criticism may have prompted Pérez-Gómez to write that: 'Theory thus reduced to a self-referential system whose elements must be combined through mathematical logic must pretend that its values, and therefore its meaning, are derived from the system itself'.[13]

1.3 J.-R. Rondelet's Machine for Testing Stones at Soufflot's Sainte Geneviève, 1787. 'Rational' construction through scientific measurement dried architecture up, thought Viel. From Robin Middleton, *Jean Rondelet : the architect as technician*, 2007, p.65

A second critique of Structural Rationalism comes from Antoine Picon in his 1998 book, *French Architects and Engineers: In the Age of Enlightenment*, and a similar argument is followed by Andrew Saint in his 2007 book, *Architect and Engineer: A Study of Sibling Rivalry.* Their criticism is that while a 'rational' approach is claimed to be justified by structural analysis and calculation, in practice the results were never arrived at by that Rationalist ideal alone, but always involved in aesthetic judgement. Such 'an allegedly rational approach' had emerged since the Enlightenment – a period in which architects adopted 'the fashion for Structural Rationalism' – and it was especially in France that it was most evident and consistent.[14] In Saint and Picon's discussions of particular debates around structures designed by the eighteenth-century French bridge-builder and engineer Jean-Rodolphe Perronet [1708-1794], we can draw out their contention about

[11] Ibid.
[12] Ibid., p. 320.
[13] Ibid., p. 4.
[14] Andrew Saint, *Architect and Engineer: A Study in Sibling Rivalry* (New Haven and London: Yale University Press, 2007), p. 487.

Structural Rationalism, and because their arguments are quite similar, I will put them together here.

After discussing the well-known structural debate about Saint Geneviève where an analogy between the structure of the church and the skeleton of an animal was made by J.-R. Perronet, Saint went on to observe that Perronet also applied the same argument to his designs of bridges, arguing that they united 'grace with economy of means'.[15] According to Antoine Picon, the question under discussion regarding bridge design in seventeenth-century France was how to make the foundations strong enough to resist the flow of water, which might be increasingly severe during the time of flood, and the effect of scouring, which might wear away the foundation. The solution, at times, was simply to give the bridge massive structure and foundation, as Picon stated: 'The width of the piers and the reduced span of the arches were designed to enable the bridge to resist floods'.[16] However, by the time Perronet was about to design a new bridge, he went to observe a bridge at Mantes and realised that 'the mass of a pier offered no guarantee of stability, and that some of the force in arches could be transferred laterally across piers to the abutments'.[17] So, when he designed a bridge later at Neuilly, Perronet attempted to reduce the redundancy in the structure. Whereas seventeenth-century engineers built bridges that were strong in resistance through their mass, through the width of piers and the narrowness of their arches, Perronet, by contrast, proposed the least possible resistance to the flow of water.[18] At Neuilly, instead of keeping the proportion of the width of pier to arch span as the conventional as 1:6, he increased it to 1:9, therefore diminishing the rise of the arches.[19] The result of this change was a new appearance of arches 'whose variously curved outlines are

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[15] Ibid., p. 297.
[16] Antoine Picon, *French Architects and Engineers in the Age of Enlightenment* [1988], trans. Martin Thom (Cambridge: Cambridge University Press, 1992), p. 159.
[17] Saint, *Architect and Engineer: A Study in Sibling Rivalry*, p. 299.
[18] Picon, *French Architects and Engineers in the Age of Enlightenment*, p. 159.
[19] Saint, *Architect and Engineer: A Study in Sibling Rivalry*, p. 299.

reminiscent of an ellipse'.[20] Saint observed that the bridge's arches at Neuilly 'were still elliptical, but streamlined with '*cornes de vache*': in other words, the facing voussoirs of the arches were chamfered away towards the springing. The pretext for this feature, much copied over the next half-century, was to contrive a wider roadway above while flattening the portion of the arch most exposed to the river in times of flood'.[21] After describing the new form of the bridge, Saint followed with this comment: 'But the intention was also aesthetic: to restore the facing plane of the elliptical arch to the line of a segment – but a shallow, bounding segment now, not the static self-sufficiency of the old semi-circle'.[22] What Saint is suspicious of here is the fact that the change of form was not wholly as was claimed for economy, but also for aesthetic reasons [fig 1.4].

1.4 The Pont de Neuilly designed by the rationalist architect and bridge-builder J.-R. Perronet in 1770. The design of the bridge was justified in terms of Structural Rationalism, but the decision making for its elegant forms involved aesthetic judgement no less than any other bridge. From Robin Middleton, *Jean Rondelet: the architect as technician,* 2007, p. 5

[20] Picon, *French Architects and Engineers in the Age of Enlightenment*, p. 160.
[21] Saint, *Architect and Engineer: A Study in Sibling Rivalry*, p. 299.
[22] Ibid.

Furthermore, Saint continued by examining the three-arched bridges which Perronet designed between 1770 and 1772, of which he wrote:

> Perronet dropped ellipses altogether in favour of these 'stretched' segmental arches butted against the piers. These he then pared down into separate shafts with voids in between beneath the roadway, presented as massive classical columns, single or clustered. Here was his personal response to the neoclassical ideology of post and beam – so-called trabeated construction. […] Because it used less material, trabeation should also have pointed to cheaper bridges, […].[23]

According to Saint, the change of forms of Perronet's bridges derived from structural calculations and experiments as the arches become increasingly flattened, which challenged traditional perception of bridge-buildings, but at the same time referred to the tradition of post and beam construction or trabeated construction – an idea which more generally involved architectural structure. 'The bridge of the Ages of Enlightenment derived from preoccupations fairly close to architecture', as Picon noted.[24]

The culmination of Perronet's invention that caused the transformation of bridge forms into 'stretched arches' was evident at the last two bridges he designed and built during his life time: the Pont-Saint-Maxence [1771-1786] and the Pont Louis XVI [1787-1791]. Picon observed that the new arrangement consisted of 'stretched arches' which 'were achieved by means of a single arc of a circle with a large radius, […] butted against the pier at an acute angle'.[25] This change, Picon analysed as follows.

> By introducing a sudden change of direction in the spring of the arch, where the pressures were strongest, Perronet was in fact defying one of the traditional principles of stonemasonry, a principle of homogeneity […].
>
> The system of 'stretch arches' represented a considerable improvement in bridges, primarily as regards the formal qualities of the construction. The

[23] Ibid.
[24] Picon, *French Architects and Engineers in the Age of Enlightenment*, p. 160.
[25] Ibid.

> presence of sharp angles at the spring of the arch, and the desire to replace the piers with isolated columns represented an approach to problems of structure which permitted the expression of a certain number of contradictions. The first contradiction was between the movement of the river and that of the bridge. Perronet abandoned the old kinds of pier, which resembles ships, and which enables one to reconcile on a symbolic plane the flowing of the water and the transverse passage of men. The construction no longer echoed the pontoon bridge; it was now free of any origin which declared its kinship with the river. In the work of Perronet, the tension of the bridge between its two abutments, the series of flattened arches which conveyed this tension, contrasted with the succession of thin, vertical piers. The articulation of the continuous line of the bridge and of its supports was effected by means of a sharp angle, which served to emphasise the clash of two conflicting logics.[26]

The clash of two conflicting logics that Picon refers to was between the stretched arches, on one hand, and of the columns, on the other hand. While the first can be regarded as truly structural experiment as changing the old system of masonry arches construction into the new system of stretched arched, the second is far away from structural advancement in the same sense, because it relied upon the old architectural tradition of trabeated construction.

The paradox that the bridge forms involved simultaneously two influences which seem to contradict each other – to innovate and experiment but still rely upon tradition – leads Andrew Saint to observe that there was no real fundamental logic for the forms, and thus they were therefore just the result of an arbitrary decision.[27] 'This was more than conservatism', wrote Saint, 'Perronet's effort to transmogrify masonry arches bridges into point-supports and beams had become too much of an end in itself, as he strove to reconcile an *arbitrary* theory of architecture with safe, economical bridge-building'.[28] What does Saint mean by 'arbitrary' here? Previously he

[26] Ibid., p. 160-166.
[27] Saint, *Architect and Engineer: A Study in Sibling Rivalry*, p. 299-300.
[28] Ibid., p. 300.

commented about Perronet's bridges that: 'Here was his personal response to the neoclassical ideology of post and beam'.[29] Is it because he sees no reason why the columns should be in the old trabeated architectural forms whose look contradicted the otherwise innovative engineering of the arches above?

And here one may immediately see the resemblance between the dispute over Perronet's bridge and the debate at Saint Geneviève. At Pont-Saint-Maxence, while it failed to respect the traditional relation between the size of vertical supports and span, it nevertheless deferred to classical theory. Likewise at Saint Geneviève, where the piers that Soufflot had designed to support the dome were criticised as too light and unstable relative to accepted sensation, Perronet's defence was through a biological analogy, that they were like the skeleton of an animal. Thus neither of them is justified by reference to scientific analysis. Picon noted this ambiguity:

> No matter how much Perronet declared his allegiance to it, his was very probably a highly personal definition, […]. More generally, the engineers saw stability as an a priori instrument of verification rather than an unshakeable dogma. To diverge from prescribed rules constituted, as far as they were concerned, a degree of risk but was in no sense heretical.[30]

Seen in these terms, shall we say that 'rational' building is pretence? As what it claimed to arrive at in refinement and perfection of structure came not purely from economic and engineering rationalities alone (if these are what is meant by the term 'rational'), but was also arrived at through certain stylistic preference in architecture. The decision about the appearance of structure is in fact no more rational than other styles which apparently do not make any claim to be rational. So when Saint criticises Structural Rationalism as an 'arbitrary' theory, it is because it essentially fails in its own terms.

[29] Ibid., p. 299.
[30] Picon, *French Architects and Engineers in the Age of Enlightenment*, p. 180.

The third, and by far the most ambitious criticisms of Structural Rationalism, is in Réjean Legault's doctoral thesis of 1977. Unlike the earlier criticisms, Legault's study looked at the way in which the theory of Structural Rationalism had been worked out in practices by architects in the end of the nineteenth century and the early period of the twentieth century, i.e. from 1889-1934. In this period where Structural Rationalism had become widespread through Viollet-le-Duc's publications, Legault explored how architects responded to the theory – and its contradictions – and tried to work within it, while accommodating the contradictions. According to Legault, the problem of Structural Rationalism is most evident in consideration with modern materials: iron and reinforced concrete construction, and he points out the problem to the fact that in their use of these, architects failed to expose fully the structure of a building, as the theory called for. Legault's argument is, perhaps, best illustrated when discussing with the case of St. Jean de Montmartre, and so I will come back to talk about it later in the discussion of this early application of Structural Rationalism.

The fourth criticism of Structural Rationalism is taken, again, from Andrew Saint, and is one that explains his reservations about the theory of Structural Rationalism. If we take a broader historical view, and, in particular, the advent of new materials, such as iron and concrete, it was the most critical time for architects because they were at risk of losing their authority in building construction. Being unfamiliar with structural usage of new materials, architects needed to rely upon the knowledge of engineers, and therefore became subordinated to them. The fact that some of the most 'advanced' examples of structural daring were designed during this time not by architects, but by engineers who used their structural knowledge based on calculus to arrive a new form of architecture, indicates that engineers arrogated the architect's traditional roles to themselves, making architects marginal. Such a situation forced architects to find ways to reassert their control over the use of new materials, if they wanted to survive, as Sokratis Georgiadis has remarked: 'The defense of architect's domain in the face of the ingress of iron – the engineer's material – was in some respects also the defense of the professional interests of the architect against the increasing power of the engineer'.[31]

According to Saint, against the fear that engineers would displace them, some successful architects in the twentieth century, on the one hand, prepared themselves enough and had set up 'the style of partnership' of architect-contractor or architecture-engineer; for example, the Perrets, the Kahns, Wright and Mueller, Owen Williams, Duiker and Wiebenga, and Le Corbusier, so that they could hold onto the practical aspects of building. On the other hand, there were architects who sustained their control over construction through 'a rational approach'. Le Corbusier, again, for example, who admired engineering knowledge greatly, made use of the engineer's argument in his manifesto: 'The architect must be a man with a logical mind, he must mistrust and oppose the passion for plastic, sculpture effects, a man of science yet with a heart, an artist and scholar'.[32] In this respect, the architects assumed the role of engineers, as the engineer Peter Rice later remarked, 'although this is not the work of the engineers it uses adherence to engineering principles to justify its choices'.[33] This was one reason why architects so rarely gave credit to the engineers, as again Rice indicated, when he pointed out that 'there are many engineering contributions which go unrecognized, or which are attributed to the architects or others with whom the engineer is working'.[34] And this was not just the case for Le Corbusier, but for many modernist architects who proclaimed a rational approach. Yet this also led to a dilemma, as Saint pointed out in his discussion of the relationship of Arup and John Utzon,

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[31] Sokratis Georgiadis, "Introduction", in *Building in France, Building in Iron, Building in Ferroconcrete*, ed. Harry F. Mallgrave (Santa Monica, CA: The Getty Center for the History of Art and Humanities, 1995), p. 20.
[32] Source quoted here is Saint, *Architect and Engineer: A Study in Sibling Rivalry*, p. 270; Original text in French is in Marie-Jeanne Dumont (ed.) Le Corbusier: Lettre à Charles L'Eplattenier (Paris, 2006), p.187. (letter of 22 November 1908)
[33] Peter Rice, *An Engineer Imagines* 2nd ed. (London: Ellipsis, 1996), p. 76.
[34] Ibid., p. 75

> One plank of Arup's philosophy was that architects liked to display structure without knowing much about it – sometimes as a substitute for understanding it. That he found vain and rhetorical. His hope always was that a collaborative handling of structure could liberate architecture to do other things. But if architects loosened their grip upon structure, they might decline into decorators of what engineers built for them. That was the instinctive fear of Utzon – 'very, very much an Architect'.[35]

For most modernist architects, such a lack of technical, practical knowledge was what they wanted to avoid, and which they generally tried to obscure. Structural Rationalism was attractive to architects in this respect because it seemed to allow them to take on, or mimic, the engineers' role. By exposing the structure of their buildings, architects made their buildings appear as if they were the products of engineering. In other words, Structural Rationalism as a theory of construction authorised architects to make their buildings a metaphor of engineering.

For this reason, while architects laid claim to rational approaches to construction – the honest expression of structure – from the Enlightenment through to modernist propaganda, Saint does not believe that they did so without an element of dishonesty. Acknowledging that Rationalist theory was something they could use to justify their decision, architects seized upon it in order to maintain their authority within building construction. 'Rationalist rhetoric, bandied between French architects from Rondelet and Le Corbusier', Saint stated, 'reiterated that they would have to get a hold on construction if they were not to be overrun by engineers. Many had tried to do just that'.[36] Accordingly, architects sought self-justification in terms of theory to authorise themselves to recover something that they had lost or were in danger of losing to the engineer. In other words, Structural Rationalist theory was used by architects to assert their equality with engineers.

[35] Saint, *Architect and Engineer: A Study in Sibling Rivalry*, p. 376.
[36] Ibid., p. 241.

The Debate on St. Jean de Montmartre

Now we have so far seen general criticisms of the Rationalist approach, we then move on to look specifically at one particular building. In considering the internal contradiction of Structural Rationalism further, the first reinforced-cement church of St. Jean de Montmartre, designed by Anatole de Baudot [1834-1915], offers an opportunity for investigation. This church both illustrates the application of the theory of Structural Rationalism to the work of architecture, and also in the subsequent interpretation of the church, the uncertainty of the theory – an uncertainty which is central to the Rationalist doctrine.

There are two aspects of Structural Rationalism in the church that have been much debated, and I do not hesitate to make use of Réjean Legault's PhD thesis in re-investigating these two debates. The first debate is about the pursuit of a unified system of construction which the church of St. Jean de Montmartre has been considered as a fulfilment of Viollet-le-Duc's doctrine. The second debate of the church is about the issue of the exposure and concealment of structural material, which Legault took from accounts of the reception of the church in the 1900s. In this latter point, I will also add Peter Collins' criticism of the church into the discussion as well, as it reflects well on the controversy surrounding the theory of Structural Rationalism.

A Unified System of Construction

The pursuit of a unity of construction is a feature of Viollet-le-Duc's doctrine, but there is a significant departure from it in Anatole de Baudot's works. Born in 1834, de Baudot was trained firstly under Henri Labrouste, and it was not until 1856, when Labrouste gave up his teaching studio, that de Baudot came under the influence of Viollet-le-Duc. Preoccupied with the same question as Viollet of what the architecture of the nineteenth century would be, de Baudot believed in his master's doctrine that the development of a new architecture lay in the use of modern materials. De Baudot's first church at Rambouillet is thus widely regarded as the first attempt to put Viollet-le-Duc's ideal into practice.[37] According to Dario Matteoni, the church of Saint-Lubin 'revived both the value attributed to Medieval models and the faith in the potential of new structural method, limited at that time to metal construction'.[38] And as the historian Peter Collins [1920-1981] observed of this church [fig 1.5]:

> In its general appearance this church conformed to pseudo-Gothic precedents, as might be expected of an Inspector of Ancient Monuments, but it also made a gallant attempt to go beyond mere imitation by introducing a new structural principle into the supports, whereby iron columns were so arranged as to avoid the need for flying buttresses. The desired technical result was certainly achieved, but apart from the awkward complexity of forms which resulted, such attempts to obtain perfect equipoise between metal and stone were manifestly unsound, as de Baudot himself tacitly admitted when he later condemned Baltard's contemporary church of St. Augustin in Paris, where a similar system had been used.[39]

1.5 Sketch of Saint-Lubin Church, Rambouillet, 1865-1871. The composite structure of iron and steel works lacks unity that Viollet-le-Duc urged for, thought Anatole de Baudot. From Marie-Jeanne Dumout, 'The Fortune of a Pioneer', *Rassegna* 68 (1996/IV), p.8

[37] Peter Collins, *Concrete: The Vision of a New Architecture*, 1st ed. (London: Faber and Faber Limited, 1959), p.114
[38] Dario Matteoni, "Introduction", *Rassegna* 68, no. 4 (1996): p. 5.
[39] Collins, *Concrete: The Vision of a New Architecture*, p. 114.

1.6 The first reinforced-concrete church of St. Jean de Montnartre, Paris, France, built in 1894 and completed in 1904, photographed in 2008. Anatole de Baudot, architect. Paul Cottancin, engineer. 1894-1904.

Discovering iron to be inflexible, or ‘a deficient material’ as he called it, Anatole de Baudot was preoccupying with the question of ‘how Viollet-le-Duc’s doctrines might be better applied’.[40] The opportunity did not arise until the engineer Paul Cottancin [1865-1928], who was interested in the technical and economic possibilities of reinforced concrete, introduced to him a new building technique of *ciment armé*. With it, de Baudot was able to turn ‘preconceived ideas about architecture’ into realisation, responsive to Viollet-le-Duc’s doctrine.[41] Previously at his first church, in using the modern materials, iron and metal, together with a traditional material, stone masonry, the difficulty arose at the point where the different materials joined; but with the new technique, de Baudot managed to eliminate the problem of ‘connectedness’ between structural parts, creating a homogenous structural system conforming satisfactorily to his master’s ideal. This is what was achieved at St. Jean de Montmartre in Paris [fig 1.6].

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[40] Saint, *Architect and Engineer: A Study in Sibling Rivalry*, p. 225.
[41] Ibid., p. 225-227.

1.7 The Structural Details of the Main Rib of St. Jean de Montmartre in reinforced concrete using the Cottancin system. The additional moulding to the vault is by no means structurally necessary. From Marie-Jeanne Dumout and Martine Ramat, edited, ‘Main Works and Projects’, *Rassegna* 68 (1996/IV), p.48

The church of St. Jean de Montmartre was the fourth commission of de Baudot & Cottancin’s collaboration, and indeed the last one. In their previous project, the high school *Lycée Victor Hugo*, according to Marie-Jean Dumont,

> Baudot succeeded in constructing in reinforced concrete not only the floor and roofs, but a covered area [a kiosk] to be used as a playground. Concrete pillars, hollowed out to accommodate rain-water pipes, are extended as ribs radiating from a surbased vault. Unity of structure, that golden rule of rationalism, was achieved for the first time, […].[42]

[42] Marie-Jeanne Dumont, “The Fortune of a Pioneer”, *Rassegna* 68 (Anatole de Baudot 1834-1915), no. 4 (1996): p. 9

1.8 Networks of Ribbed Vaults, St. Jean de Montmartre, photographed in 2008.

The successful invention of a 'unified system' in reinforced concrete at the Lycée Victor Hugo was to be fully developed at the St. Jean de Montmartre, as designed in 1894 and completed in 1904. The volume of St. Jean de Montmartre is formed by networks of ribbed vaults (used effectively beforehand by Gothic builders) which cross over and strengthen each other. Ribbed vaults which are arranged in octagonal plan rise vertically from the bottom as pillars, but when they reach almost to the ceiling, they bend, as if they were vaults, to cover the nave. What is also happening here is that de Baudot extended each of the sides of the boxed pillars, beyond the box, so that there is a moulding that defines the form of the box, giving an additional definition to the shape of the vault [fig 1.7,1.8]. This adding is by no means logically necessary, adding nothing to the structure. It is just a visual device. In other words, de Baudot attempted to make *apparent* the structure of the vaults which are hidden within the boxed formwork. What is done here is perhaps explained by Legault's words: 'de Baudot attempted to preserve the legibility of the structure members, threatened as there were with disappearance beneath the thickness of concrete'.[43]

[43] Legault, "L'appareil De L'architecture Moderne: New Materials and Architectural Modernity in France, 1889-1934", p. 65-66.

While previously in his first church the masonry roof structure of the building is supported on independent iron columns, at St. Jean de Montmartre the continuous arches make the distinction between roof structures and columns disappear. It was no longer a technique of assembling parts of construction, but here it was a technique of moulding, making all parts of building structure into a single piece of construction. The secret of the singularity and subtlety of the structure lies, of course, in *ciment armé*, using the Cottancin system. Whereas the vault structures were built using shaped hollow bricks as the permanent formwork, then infilling it with cement together with wire reinforcement, the curved surfaces of the ceiling and walls were made of thin slabs reinforced by iron bars. All structures of the building were executed in the single system of construction of *ciment armé*, giving the building structural integrity. 'With this material', Anatole de Baudot himself wrote, 'the architect has at his disposal a process in which structural unity is inherent, and which consequently simplifies the consistent application of principles'.[44] And it is in this that de Baudot was regarded as remarkably successful. Marie-Jeanne Dumont praises the new system, in which de Baudot had created a unity of construction.

> "Ciment armé", with its finesse, its principles of continuity and its triangulated geometry, was reminiscent of the delicate, soaring structures and the dynamic balances of Gothic architecture. "Ciment armé" was the philosopher's stone that Viollet-le-Duc had searched for in vain; that he thought, with little conviction, he had found [it] in iron; it was the material that finally made possible rationalist architectonics. With the church of Saint-Jean, Montmartre, Anatole de Baudot had opened a new path to Structural Rationalism, and had succeeded where his teacher had failed.[45]

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[44] Anatole de Baudot, *L' Architecture Et Le Ciment Armé.*; as quoted in Marie-Jeanne Dumont and Martine Ramat, "Memories, Discourse, Definitions", *Rassegna* 68 (Anatole de Baudot 1834-1915), no. 4 (1996): p. 71
[45] Dumont, "The Fortune of a Pioneer", p. 10.

What we find from Dumont's interpretation here is the belief that Structural Rationalism is about a creation of unified system of construction, in which all parts of building elements both structural and architectural are united within a single system of construction [fig 1.9].

1.9 The reinforced concrete construction of St. Jean de Montmartre adopted "Ciment arme", the system invented by the French engineer Paul Cottancin. From Andrew Saint, *Architect and engineer: A study in sibling rivalry*, 2007, p.227

The Visibility of Structural Material

While the issue of a unity of construction is regarded as a great achievement of the church as to fulfil successfully Viollet's theory, the other aspect of Structural Rationalism debated at the church – the concern of the visibility of material – has caused controversy. The issue of the visibility of material originated in Viollet's doctrine, and was developed by subsequent architects and critics, especially those of the French Rationalist School. In his thesis on *New Materials and Architectural Modernity in France, 1889-1934*, Legault discussed in part the development of Structural Rationalism in post-Viollet era, and I will now take some of his accounts to reflect on the issue of the visibility of the material. But before going into that, there is an error in Legault's thesis which needs to address.

While it is certainly true that the issue of the visibility of material is indebted to Viollet's theory, the quotation from which Legault derived his argument is not entirely appropriate. Legault quoted Viollet as follows: 'the main quality that any architectural members should possess is that of appearing to fulfill the function for which it is intended'.[46] The subject that Viollet was discussing here was that of doorways (porte) and their members, about which Viollet explained that the proportions and scales of doors must change according to their positions in the building. For example, a secondary door must not simply be a scaled-down version of big door, but its proportion and scale was to be designed according to its position. Though Viollet's remark quoted by Legault touches on appearances, it is not entirely about the visibility of material. Furthermore, Legault noted that he took the term 'visible argument' from John Summerson's *Heavenly Mansion*, but, again, in his article, Summerson did not necessarily use the term specially

[46] Source quoted here is Legault, "L'appareil De L'architecture Moderne: New Materials and Architectural Modernity in France, 1889-1934", p. 27-28; original text is in Eugene-Emmanuel Viollet-le-Duc, *Dictionnaire Raisonne De L' Architecture Francaise Du Xie Au Xvie Siècle*, 10 vols., vol. 7 (Paris: A. Morel, 1867-75), p. 439.

for the visibility of material – for what Summerson meant was more of building *function* in general, not specifically of structure or material. Here is what Summerson said:

> For what do we mean by a rational architecture? We may mean two things. We may mean an architecture which aims at fulfilling certain specifiable functions with the nearest approximation to absolute efficiency and economy. Or we may mean an architecture which seeks to express its function dialectically – to offer a visible argument to spectator. The first sort of architecture depends wholly on the extent to which function can be mathematically stated; the second sort depends on the architect's personal interpretation of function. The first sort is ruthless in its application of means to ends; the second sort adapts both means and ends to a game of its own. The first sort of architecture is, as a matter of fact, almost impossible of conception since the total requirements of a building can never be mathematically stated: it is the mystical *functional* architecture of the day before yesterday. The second sort of architecture is a perfectly feasible one, the only proviso being that the function of the building be considered as of sufficient emotional interest to make this dialectical mode of expression significant.[47]

As Legault took the quotation out of the original context, his use of references for the argument of the visibility of material is slightly misleading. To understand what Violllet actually said about the visibility of material, we might look at his discussion of iron construction, a new material of the ninetieth century whose use he recommended should be frank and visible. In his *Lecture VII: The Construction of Buildings – Simultaneous employment of Stone, Brick and Iron*, Viollet said:

> Let it be well understood, once for all, that architecture cannot array itself in new forms unless it seeks them in the rigorous applications of novel methods of construction; that casing cast-iron columns with cylinders of brick or coatings of stucco, or building iron supports into masonry, for example, is not the result either of calculation or of an effort of imagination, but merely a disguising of the

[47] John Summerson, "Heavenly Mansions" [1949], in *Heavenly Mansions and Other Essays on Architecture* (London: Cresset Press, 1998), p. 149. (Italics added)

> actual construction. […] If iron is destined to play an important part in our buildings, let us study its properties, and frankly utilise them, […][48]
>
> The skill of the builder is displayed not merely in assuring himself of the excellence of the materials and the methods he employed, but also in so contriving that the various parts of *the structure* may always be got at, examined, and repaired when required. The iron-work and timber framing should as far as possible remain visible, for these materials are perishable, and liable to changes in their properties. But we see edifices built, whose costly walls of solid hewn stone will defy the effects of time, while these walls enclose vaulting and floors whose duration is very problematical, […]. It would seem as if our architects were ashamed to employ iron; they conceal it as far as possible beneath plastering and pugging, which give it the appearance of a masonry structure. […] the iron is merely a concealed framework, an incased carcass. Iron is made to serve as an appliance for obviating the outward thrust of masonry vaulting, not by means that are frank and apparent, but by contrivances which are carefully concealed, and which, as is the case with all appliances of the kind, are wanting in efficiency.[49]
>
> […]
>
> As we just now observed, the erection of an iron framework in the form of a barrel or groined vaulting, and imbedding this structure in plaster of Paris or hollow brickwork, is a contravention of *true* construction, – placing in close contact two materials of opposite nature; it is shutting up the wolf in the sheepfold.[50]

Accordingly, Viollet suggested that the way forward to a true construction lay in revealing of the armature of a building. While Viollet's argument was partly based on practical justifications that the separation between different materials was necessary to avoid the problem of material expansion and degradation, his urge for the readability of the skeleton was also based on his belief in material as a generator of form, that each material should have its own characteristic

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[48] Eugene-Emmanuel Viollet-le-Duc, *Discourses on Architecture* [1889], trans. Benjamin Bucknall, 2 vols., vol. 2 (London: George Allen & Unwin Ltd., 1959), p. 65.
[49] Ibid., p. 66.
[50] Ibid., p. 67.

expression; in other words, that a new material must not imitate the form previously given of another material, and architects' main task was to find the most appropriate forms according to the nature of materials. Following his previous discussion, Viollet asked:

> Is it possible to give these iron trusses an architecturally decorative appearance? I think so; but this cannot be done by giving them forms appropriate to masonry. […] we have not seriously considered how to make the best use of the material by giving it forms appropriate to its nature. Further on, when we come to treat more especially of the employment of iron, we shall endeavour to show how this material may be rendered ornamental, or rather what are the decorative forms appropriate to it.[51]

It is this issue of 'form-giving' that contributed a theoretical debate of how far the armature of a building should be made visible in building appearance to architects and critics in the late-nineteenth century and the early-twentieth century.[52]

According to Legault, Viollet's call for the use of undisguised metal had well been received amongst Parisian and the Rationalist architects, which reached its climax in the 1889 exhibition where many pavilions were built out of metal structure independent from masonry walls, and the self-supporting iron skeletons of those pavilions were displayed frankly. However, from 1889 onwards, there had been a changing attitude towards the exposure and the concealment of iron. Under the demands to cover iron members to increase fire protection and to build them up with auxiliary materials in order to construct a wall, a new building system of construction, reinforced cement, emerged to improve iron construction, by combining the use of iron with cement. In the new system, the iron framework, previously deemed to be visible, was embraced under the mass of cement and aggregates. Though it had gained favour over the use of exposed iron for technical

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[51] Ibid., p. 70

[52] For discussion about the architectural concept of 'structure', see Adrian Forty, *Words and Buildings: A Vocabulary of Modern Architecture* (London: Thames & Hudson, 2000), esp. p. 280.

reasons, reinforced concrete was criticised in terms of theory by those who were rooted in Viollet's doctrine that it hides the source of its strength, masking the iron framework.

Réjean Legault has looked into the difficulty the new building system of reinforced cement had had in conforming to the exposure of structural material and pointed out that up to 1895, reinforced cement was still regarded as a category of iron construction, and it is the fact the Rationalists still thought of the new building system in association with the old one that put them, as the former advocates of iron construction, in some difficulty to justify their theoretical point of view, for the assumption used for iron were transferred unexpectedly without any change for reinforced cement. To shift from iron construction to reinforced cement and still keep the old expectation offered by iron construction that it could be a visible material of architecture 'gave rise to a paradoxical situation', as Legault put it: 'Wasn't this technical choice in contradiction with the Rationalist principle demanding that the "structural" material be visible?'[53] This contradiction confronted the Rationalist architects in the early-twentieth century whenever they employed the new material of reinforced concrete, and this maybe explains why Viollet's influence declined after 1920 from the architectural scene.

Peter Collins' Structural Rationalism

Of all disciples of the Rationalist school, Auguste Perret is perhaps the most ambitious in an attempt to display exposed reinforce concrete, especially in his late architectural works, and thus it is Perret's effort to expose reinforced concrete that was preoccupying Peter Collins in interpreting Structural Rationalism.[54] Collins was amongst the first to write a history of Structural Rationalism as well as the first to write the history of the church of St. Jean de Montmartre.

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[53] Legault, "L'appareil De L'architecture Moderne: New Materials and Architectural Modernity in France, 1889-1934", p. 66-67.
[54] Ibid., p. 7.

Written in 1959, when French orthodoxy of Structural Rationalism was still heavily dominant, his book on *Concrete: The Vision of a New Architecture* proposed judgement about rational buildings, in general, and about the church of St. Jean de Montmartre, in particular. It established what was to be a widely accepted view of what is regarded as 'rational' architecture – that is the visible exposure of structure. Whatever other successes the church might be said to have had, the fact that the reinforced-cement structure at St. Jean de Montmartre was hidden did not satisfy Collins. (And to think of what would be the closest built example to Collins's ideal, we may think of Auguste Perret's church at Le Raincy in Paris, completed in 1923, where concrete is used at once as structural material and finishing material both inside and outside[fig 1.10].) Given that Collins regarded reinforced concrete as the element of novelty, therefore it must be on view, and so he criticised de Baudot's decision to conceal the concrete structure as follows: 'His [...] objection to ordinary reinforced concrete frame construction seems to have been based on the curious misapprehension that it would only be used as a hidden structural support'.[55] Regarding *ciment armé* using Cottancin's system as the essential cause of innovation, making the structure of the church extremely light as had never been before, Collins greeted the first reinforced cement church with bitter disappointment as such a 'hitherto unattainable slenderness' is completely hidden:

1.10 Auguste Perret's Church at Le Raincy, Paris, completed in 1923, photographed in 2008.

[55] Collins, *Concrete: The Vision of a New Architecture*, p. 116.

> His reinforced walls were of remarkable thinness, but they appeared externally as ordinary brickwork, which indeed to all intents and purposes they were. His vaulting webs were only a few centimetres thick, but this startling achievement was only apparent to those who had seen the working drawings, and since he had been led by his more deeply-rooted prejudices to model them on Gothic prototypes, the novelty of the method passed largely unperceived.[56]

Collins presented the idea that the structural material must be exposed for a building to have 'integrity'; thus, in this respect, he took the orthodox view that the structure of a building and its appearance should be essentially the same, for, following Viollet, they grow from the same principle of a unified system. Collins's reservation about de Baudot's use of hidden structure seems to be part of a tendency to see Structural Rationalism as leading to only a single result, in which all structural elements were exposed. For that reason, his criticism of the church arises out of adherence to Viollet's insistence on the visibility of materials, and it is in the issue that we can see how contradictory Collins' view of the church was.

At St. Jean de Montmartre, what appears on the facade is mainly brickwork, but the brick here is not to support the structure of the church; the supporting element is reinforced cement which is obscured from view. The church was built entirely with the Cottancin's *ciment armé*, and the nature of this system was that reinforced cement used as structure be always covered by permanent formwork. The fact that the formwork stays in place after the cement had cured made it impossible to show reinforced cement. This new mode of construction, which lent itself to the concealment of the structural material, limited any attempt to achieve architectural honesty, through the making visible of the material. The exceptions, where reinforced cement might be

[56] Ibid., p. 117.

shown, were in the roof, ceiling and floor slabs as well as window traceries, formed in temporary formwork, removed after the moulding was finished; but even in these elements, de Baudot was not interested in exposing the material so much as in decorating it. What he successfully sought out was a decorative expression appropriate to the new building system. On the exterior, where the structural material is obscured under brick facades, ceramics and stoneware are applied to arches over porches, intersecting arches, and window traceries. In the interior, de Baudot applied paint covering to all the interior surfaces to 'correct the irregularities of the edges and surfaces made of brick and cement', which he then decorated with graphic pattern of leaves along the lines of structural elements, making them even more distinctive from non-structural elements.[57] At St. Jean de Montmartre, all structural materials are deliberately covered with the decorative materials [fig 1.11, 1.12].

1.11,1.12 The Exterior and the Interior of St. Jean de Montmartre are clad in non-structural materials. Viollet's urge for the visibility of structural material was the principle well adopted by rationalist architects, but it proved particularly difficult with reinforced cement. *Left* from Andrew Saint, *Architect and engineer: a study in sibling rivalry*, 2007, p.228. *Right* from Sous la direction de Jean-Louis Cohen, Joseph Abram et Guy Lambert, *Encyclopédie Perret*, 2002, p.73

[57] Legault, "L'appareil De L'architecture Moderne: New Materials and Architectural Modernity in France, 1889-1934", p. 99.

Réjean Legault, in part, responds to Collins' reading of St. Jean de Montmartre, observing the fact that the structure of the building is not exposed was partly due to de Baudot's concept of reinforced concrete. Previously reinforced cement was conceived as an improvement of iron construction, whose 'honesty' depended on the exposure of structural material, but here the case is different. De Baudot conceived reinforced cement not as an improvement of iron, but as a special medium which could hold all different elements to achieve the unity of construction. So it is not surprising that de Baudot was not interested in the visibility of material in his church, but only in making the unified system of construction evident. Legault who studied the development of materials in early French modernism criticises Collins's view as retrospective, for Collins took the interpretation of Structural Rationalism from Auguste Perret's works to judge the earlier work of St. Jean de Montmartre.

So while reinforced cement here successfully connected all building parts – the structure, the infill and decorative revetment made from different materials – into a coherent construction, yet the other Rationalist concern for architectural expression to focus on the visibility of materials – to treat them isolated and made visible – was not attempted here. At St. Jean de Montmartre, to see cement in the church, we would need to take the brick-formwork away at the first place, and to make visible iron armature, which is embedded in the cement, we would have to remove the cement covering over it, and to do so, in the process, breaking everything into pieces, and losing 'the unity of construction' at the end. If St. Jean de Montmartre successfully turns Viollet's urge for a unified system of construction into realisation, it at the same time ignores Viollet's demand for the visibility of materials. To be coherent, structural elements need to be brought together and this may cause them, in one way or another, obscure from view. To be visible, structural elements have to be isolated, and, in the process, they may lose their unity. In other words, this is a contradictory feature within Structural Rationalism itself where an emphasis upon one principle is likely to contradict to the other, and it is this ambiguity – which the first reinforced cement church illustrates – that causes Andrew Saint to remark: 'That famous Parisian church blends the *integrity* and *awkwardness* that mark much French rationalist architecture'.[58]

It is this ambiguity, which is central to the principle of Structural Rationalism, that leaves us uncertain whether it is concerned with the legibility of structure or the visibility of the materials. The legibility of structure arises from something in a building which renders the structural system comprehensible, but in order to grasp the structure, is it necessarily actually to make all the supporting materials visible? The structure, for Viollet, is abstract, and therefore invisible, yet the expectation of his doctrine, as interpreted by Peter Collins, always treats the structure as if it were visible. While this contradiction of Structural Rationalism would not have occurred in Viollet's time (as reinforced cement was not yet in use as a building material and his theory has nothing necessarily to do with it), the application of reinforced cement always gives rise it.

Andrew Saint's Comments on Structure Rationalism

While Collins read St. Jean de Montmartre in terms of a Structural Rationalism that it is primarily about the visibility of structural material, this is by no means the only way Structural Rationalism could be interpreted. Recently, another interpretation of Structural Rationalism has been proposed by Andrew Saint. Unlike most other architectural historians who have looked into Structural Rationalism, Saint has doubts about Structural Rationalism, as implied in his articles *Some Thoughts about the Architectural Use of Concrete* of 1991 and in his recent book *Architects and Engineers* of 2007. Although a large part of these writings is devoted to the realities of architectural practice, and does not ever directly deal with the theory, he makes many passing criticisms of Structural Rationalism.

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[58] Saint, *Architect and Engineer: A Study in Sibling Rivalry*, p. 266. (Italics in the original)

Saint's first observation about Structural Rationalism is his clear recognition of the theory's French origins and development. In his 1991 article, when he discussed about the works of the French architect Auguste Perret, Saint wrote:

> In weighing how far Perret's position on these issues is 'rational', we must be aware of the ambiguity of that word. 'Rationalism' describes not only the expression of the most appropriate and considered means for solving a problem, but also the Cartesian force in French architectural tradition.[59]

Moreover, when Saint wrote about Auguste Perret's Notre Dame du Raincy, he mentioned that concrete is 'a material which the French have always felt to be their own invention'.[60] What Saint implies here is that what is considered 'rational' about the structure of buildings, as in the case of Auguste Perret's works, was conditioned by its location on French soil; such expectations would not necessarily arise in other parts of the world, and for this reason the commitment to expose structural elements both inside and outside of a building is rather a local French interpretation of Structural Rationalism. A building that does not follow this rule, though likely to fail in French Rationalist terms, is not necessarily contrary to Rationalist principle. Saint, who has devoted his study to the realities of architectural practice, then is able to observe that:

> Often these more mannerly and costly buildings that concealed their construction behind a veneer of brick or stone were of greater interest than the cheap warehouses where concrete elevations were permitted. Yet the structural puritanism of later critics, Collins among them, has meant that such buildings are dismissed as of little or no architectural value.[61]

Because this idea that the structure must be exposed is evident in Peter Collins's book on *Concrete*, Saint regards Collins's view of Structural Rationalism as prejudiced against concealed-structure buildings. Against Collins's view that the 'rational' way of construction is to expose structure, Saint pointed out that this very restrictive interpretation of 'rational' construction excludes from

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[59] Andrew Saint, "Some Thoughts About the Architectural Use of Concrete", *AA Files* 21-22 (1991): no. 22, p.25.
[60] Andrew Saint, "Notre-Dame Du Raincy", *AJ* 13 (Feb 1991): p. 37.
[61] Saint, "Some Thoughts About the Architectural Use of Concrete", no. 21, p. 29.

the category of rational buildings any building whose structure is clad in other materials: 'That some degree of subordination to existing style and co-ordination with other material may be right and proper Collins does not for a moment consider'[62]. Similarly, we see this statement again when Saint mentioned Easton and Robertson's Royal Horticultural Hall, a building which hides its structure with brickwork, as he put it: 'Collins, with his commitment to originality, rationality of structure and absolute correspondence between the outside and the inside of a building, evidently felt that the Horticultural Hall and other derivatives from the Breslau Market Hall failed the test of architectural admirability'.[63] As we have seen, what Saint suggested here is that the idea of rationality in architecture we have today has been cultivated by the tradition of French rationalism, and re-strengthened by Collins, and it has come, irrationally, to seem to be the *only* 'rational' way of construction.

In this respect, if we return to the structural and non-structural layers of the church of St. Jean de Montmartre, we would expect Saint to read the church differently from Collins. While Saint never gives an exact answer to the question, throughout his writings (especially in his article *Some Thoughts about the Architectural Use of Concrete*) he is generally open to the fact that the structure of a building can be exposed, and thus we may infer from other remarks what he thinks about the church's double fabrics:

> if non-structural features diverge in character or position from the elements and means of construction, or if they envelop them, they can be proscribed as merely ornamental; if they drew attention to those elements, the same features can be legitimized by the same theory. Yet the doctrine of structural primacy will always allure, because structure alone holds out the promise of unity. It is the one thing a building cannot do without. That is why the idea that everything else in

[62] Ibid.: no. 21, p. 26.
[63] Ibid.: no. 22, p. 28.

architectural expression should derive from structure is both logical and attractive.[64]

Accordingly, while the choice of reinforced concrete as the hidden structure of St. Jean de Montmartre was due to its ability to create a homogeneous structure, therefore following the *unified* principle of Structural Rationalism, the choice of brickwork, plaster and ceramic tiles as the church's surfaces can be put into question, for do they follow 'from the nature of construction', or are they just 'imposition and disguise'?[65] It is exactly these questions which cause Saint to have doubts about the supposed logic of Structural Rationalism, and it is because the answer is ultimately an aesthetic choice that Saint doubts Structural Rationalism – i.e. it claims to be 'rational', yet ultimately it relies on aesthetic judgement, as he shows with his discussion of Perronet. Why is there more 'integrity' in exposing rather than concealing structural element? Was the intention of choosing non-load bearing material aesthetic or in the nature of construction? Are the cladding materials 'ornamental' in the pejorative sense implied above, or were they 'legitimate'? Maybe what Saint refers to as the 'awkwardness' of this church derives from the uncertainty of the answer to this question [fig. 1.13].

1.13 Ceramics Tiles above the Doorway of St. Jean de Montmartre, photographed in 2008. De Baudot's use of non-structural materials to conceal the concrete construction did not follow the law of structural rationalism. Yet does this invalidate the church as a 'building'?

[64] Saint, *Architect and Engineer: A Study in Sibling Rivalry*, p. 157-159.
[65] Ibid., p. 157.

If this dispute about the visibility and concealment of materials did not necessarily determine the perfect way of realising Structural Rationalism, it has certainly determined the ways in which Structural Rationalism has been interpreted. Now let us be clear, Structural Rationalism, as with other architectural theories, is not a static concept. It was created by theorists and has evolved both in terms of theory and of architecture. So, first of all, we should bear in mind that there can be different opinions about it. As we have seen so far in Collins' and Saint's positions on structure rationalism, two different kinds of theories are presented: on the one hand, a theory which almost always tends towards a single result, and on the other hand, a theory which presents a possibility of alternative solutions.

The criticisms of Structural Rationalism discussed above are intriguing because they succeed in demonstrating the illogicality of Structural Rationalism. But what was wrong with Structural Rationalism as a whole? Using a dogmatic rational approach to make architecture has something to do with Idealist philosophy. If, to quote Viollet-le-Duc, for example, one believes that 'technical knowledge and science of construction can only be based upon elements already present in the brains of those who are going to fashion for practical use and give durable form to brute matter', one will in a way be inclined to think that all parts of a building from the large part to the smallest detail, both outside and inside, must be congenitally connected, since they derive from the same pre-existing idea.[66] Dumont's interpretation of St. Jean de Montmartre as a unified system best illustrates this Idealist tendency in Viollet's thinking. If there is one thing problematic with Structural Rationalism as a theory, it has to be its faith in an Idealist idea of unified system that subordinates ornament to construction. For if, according to the law of unitary structure, these two different elements are considered as the same thing, they then must present their different functions with the same expression. In other words, it is indeed the lack of distinction between

[66] Eugene-Emmanuel Viollet-le-Duc, *The Foundation of Architecture: Selections from the Dictionnaire Raisonne*, trans. Kenneth D. Whitehead, 1st ed. (New York: George Braziller, Inc., 1990), p. 105.

the real and the visible in Viollet's principle, and yet the expectation that always treats them separately, that causes contradiction within the theory itself. Viollet's doctrine is elegant, persuasive, yet is complicated by the problem with modern materials and construction. For example, whenever the skin of a building becomes independent of its structure – a condition that has always been possible in modern construction where the real construction is built first and then follows with prefabricated cladding for finishing – it gives rise to the question of Structural Rationalism, for what appears on the modern façade might be expected to be based on apparent rationalism. In this condition, whereby the appearance of structure becomes more important than the true expression of the real structure, Willis's alternative conception of structure, which makes a distinction between the real and the apparent construction, gains a value that Viollet's theory lacks.

Structural Rationalism is thus convincing at first sight, but also problematic. In this doctrine, one of the most important requirements was *consistency*: i.e. all decision-making in construction must be based upon scientific reasons or derived from a unified theory of construction. A design whose executions were somehow arbitrary as a result of something other than strict reason would be judged as irrational. All the parts of a rational building, therefore, have to conform to the rules in such a way that subjectivity would be eliminated. The challenge for Rationalist architects was the need to find a way of creating their constructions without having to accept inconsistency and arbitrariness in execution, and without using historicism and architectural sensibility as their justifications. The irony of Structural Rationalism was that no building could ever perfectly fulfil its principles. The pursuit of perfect application seems always to have been frustrated. No building has ever arrived at a truly satisfactory demonstration of the theory, and even the purest application of Structural Rationalism at St. Jean de Montmartre still causes controversy. Whereas most orthodox Rationalists strictly believed that everything in architecture could be justified by scientific reasons, without having to accept variation in building construction, the reality is quite another story, for what we see here from the ways Structural Rationalism had developed into works of architecture are as much to do with arbitrary decisions and aesthetic judgements. The result, in terms of architecture, cannot be seen as wrong – it is simply that the principle of Structural Rationalism, to which dogmatic Rationalists laid claim, is no more rational than any other aesthetic theory.

This brief history of Structural Rationalism draws our attention to the existence of differing views amongst theorists and historians as to the nature of the theory. De Baudot's remark in his *Encyclopédie d' Architecture* gives a view of just how inconclusive the theory of 'rationalism' might have been:

> This word "rationalism", much used these days to indicate the viewpoint that would submit works of architecture to the dictates of Reason, tends, because of its absoluteness of meaning, to create difficulties in thinking, to judge by the varied and unclear interpretations given it.[67]

The uncertainty of the interpretation given to Structural Rationalism presents a question of what kind of a theory it actually is. Although the orthodox interpretation of Structural Rationalism developed by most modernist architects and critics might appear to make it a coherent theory of structure, the discussion here requires us to see it as another kind of 'theory'. In other words, we are led to reject any absolute sense of Structural Rationalism, as Anatole de Baudot had himself once urged:

> Certainly, the rational element was not enough to provide an answer to the artistic problem; but it was the point of departure, the constant guide of his creative genius and powerful originality; the whole question is to discover how

[67] Original text is in "Le Rationalisme En Architecture. Sa Part Dans Le Passé, Comparaison Des Édifices Anciens Et Modernes", in *Encyclopédie D' Architecture* (1888-89), p. 145 ; source quoted here is Marie-Jeanne Dumont and Martine Ramat, "Memories, Discourse, Definitions", p. 71.

> far he used this element to avoid being merely rationalist, in the absolute sense of the word.[68]

For de Baudot, the aim of the Rationalist is, paradoxically, to avoid being Rationalist: to be truly Rationalist, one should not be merely Rationalist. If Structural Rationalism is criticised for its absolute sense, the real sense of the theory lies in the avoidance of a dogmatic rationalism whose aim was only to achieve a single solution, and in the acceptance that uncertainty and arbitrariness are integral part of the theory whose application can be variable. It is this feature in particular that suggests that Structural Rationalism is better understood as a plural concept.

Indeed, must a theory always lead to a single solution? If it can lead to a plurality of solutions, does that invalidate it as a theory? This is the problem that arises in dealing with Structural Rationalism as an architectural theory.

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[68] Original text is in "Le Rationalisme En Architecture. Sa Part Dans Le Passé, Comparaison Des Édifices Anciens Et Modernes", p. 145 ; source quoted here is Marie-Jeanne Dumont and Martine Ramat, "Memories, Discourse, Definitions", p. 71.

2

Labour

As in other industries, the introduction of capitalism caused significance changes in building. The subordination of work, according to capitalist logic, called for an adjustment in labour relations in the building trades. Of all architects in any countries, none devoted as much attention to the relationship of labours to architecture as did British architects in the nineteenth and early-twentieth centuries. Their arguments and debates about labour relations, which spanned of almost a century, can certainly be considered to have contributed to the formation of theoretical propositions within British architecture. Though they denied characterising it as a body of theory, due partly to their ideological reluctance to separate mental processes from manual activities, it is still fair to say that the alienation of labour was one of the features specifically of concern to British architects. This chapter therefore traces back this capitalist formation and explores how far the division of labour can be considered as contributing to any sort of theoretical proposition within architecture.

In eighteenth-century Britain, the architect's main line of business was their responsibility for building work. The responsibilities for this work might range widely from preparing a design, estimating the cost, selecting tradesmen, directing and regulating the construction on the site; moreover, once the building was completed, architects measured the amount of the work carried out and made payments using the money they got from the owner to pay tradesmen consistent with the work done. In this way of working known as 'measure and value', architects played a primary role as the director of the building work.

The situation in the British building industry started to change towards the end of the eighteenth century. As the scale of building became more and more complex, calling for a larger workforce, plus the demand for more rapid completion, people started to look for alternatives to the old method of 'measure and value'. The arrival of what were called 'contracts in the gross' began with military contracts during the Napoleonic Wars. The initial reason was that the British government wanted a guaranteed price for buildings; as such, the first general contractor whose method later became the almost universal model of contracting was Thomas Cubitt.[1]

Contracting in Gross

The characteristic of 'contracting in gross' was that building contracts were signed with one person known as the general contractor, who undertook to direct the whole work for a fixed sum. Unlike 'measure and value', where the cost of building was calculated after completion, under the 'contracting in gross' method the general contractor was able to estimate the total expense of the work, and made an agreement with the owner, in advance. Once contracted, the general contractor provided all building materials and employed the necessary classes of tradesmen – such as craftsmen, masons, plumbers, smiths and bricklayers – over whom the general contractor would have direct control, and they were to be paid according to rates set by the general contractor. Having the advantage of owning the capital to employ large number of tradesmen, the general contractor, who was sometimes called 'a builder under capitalism' or 'a merchant builder', became the one who took control over the building work and the responsibility for the outcome of the work.[2]

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[1] The rise of the general contractor and the new system of 'contracting in gross' is well told by E. W. Cooney, "The Origins of the Victorian Master Builders", *the Economic History Review* 8, no. 2 (1955).
[2] Ibid.

While the general contractor gained many advantages from the new organising system that was set up, architects were put at a disadvantage. The problem was that since the general contractor came to take responsibility for construction, architects now had less control over building work. They no longer selected the builders nor craftsmen, and their power over supervision of the work was restricted. Under the new system of 'contracting in gross', architects were thus limited, though not entirely, to work as providers of detail drawings and specifications as the basis for a legal agreement as to how the work was to be built.[3] As the separation between the stage of design and that of execution became more clear-cut, architects found themselves spending greater time in their offices, working on drawings rather than giving direct instructions to builders on the site. A particularly telling illustration of architects' anxiety about losing control over building work was given by an anonymous author in *The Builder* in 1874, as follows,

> we are inclined to attribute the timidity of much modern detail to the too exclusive practice of designing on paper, and on the drawing-board, without immediate reference to the building, and the effect of the work *in situ*. Those who have examined in detail such work as that of the front of Wells, for instance, must feel how little those capitals, with their dark hollows and mass of overhanging bosses at the angles, have to do with mere paper designing; how completely they bear evidence of having been cut for the situation and with an immediate eye thereto. This contradiction is the one argument which can really be brought forward for that theory of the mason-architect, - of the spontaneous design of a building, - which has been carried (in theory) to such absurd lengths by certain persons. But without in anyway impairing the position of the architect, as the real designer of the building, it is possible that detail should be designed more by personal direction and by sketches on the spot, than by finished drawings of details made in an office quite apart from the position they are to occupy. A move in this direction would, we think, have some influence in leading to more life, boldness, and vigour in the detailing of modern structures, and giving them thereby some of that interest and power of expression which

[3] Ibid.: p. 176.

> strikes us in so many old works, even in so corrupt a style as that of the striking and picturesque fragment of building […].[4]

For architects such as this anonymous writer in *The Builder*, the emergence of the new system of 'contracting in gross' diminished their control over the building work, and so – many looked for ways of getting around the problem. While there were good reasons for architects in the nineteenth-century Britain to attribute the cause of degradation of architecture to the introduction of the new system of contracting – for it placed an intermediary between architects and craftsmen, and deprived them of active collaboration with each other – there was also an underlying unease that the general contractor posed a threat to their career. In this situation, there were to emerge two strategies that architects in the nineteenth-century Britain tried to use to re-assert their leadership within building industry.

The Arts and Crafts Approach

The first was the Arts and Crafts approach. The particular emphasis of the Arts and Crafts architects on construction was traditionally considered as a fulfilment of John Ruskin's teaching. However, Brian Hanson in his book, *Architects and the "Building World" from Chambers to Ruskin: Constructing Authorit*y, argued that Ruskin's contribution to architecture, and to the Arts and Crafts movement in particular, has always been misunderstood and misinterpreted. He pointed out that Ruskin's thought lay in his conception of nature, in the sense that nature could not be grasped by the intellect alone, but had to be understood through work. By this implication, architects, for Ruskin, must be absorbed into the 'artist-workman' – a worker who is also able to design and being an artist himself. In his book, Hanson distinguished between Ruskin's position and that of the Arts and Crafts architects, arguing that Ruskin's teaching had never been satisfactorily achieved by the Arts and Crafts architecture in the sense that Ruskin had urged. By looking at these difficulties that architects in the eighteenth and nineteenth centuries had in

[4] Anon., "On Massiveness in Architectural Design", *The Builder* (1874, April 11): p. 301.

dealing with the problem of losing control over the building work, Hanson showed that, in fact, the Arts and Crafts showed a significant departure from Ruskin's ideal. To Hanson, the main difference between Ruskin and the Arts and Crafts architect was to do with their attitudes towards the architect's status in building industry. While the Arts and Crafts architects were inspired by Ruskin's principles, the situation they were encountering forced them to compromise his ideas with their desire to renegotiate their relationship with artisans. While close association with building tradesmen was always their ideal, in practice, the Arts and Crafts exponents like G.E. Street, Philip Webb and William Lethaby found it necessary to claim legitimacy for their role in leading the building construction in which all forms of work were put firmly under their control. In this respect, the Arts and Crafts architects modified Ruskin's radical view of 'artist-workman' – a view that saw the architect as just another builder working alongside other workmen on the building site. Instead they were closer to the idea of a 'master builder' (a phrase with which Lethaby described his master Philip Webb) who directed a team of builders to carry out the work according to his own design.[5]

With this desire of maintaining their hierarchical relationship over builders, it comes as no surprise that the Arts and Crafts architects always objected to the use of a general contractor, and took a conservative stand against employing the 'contracting in gross' method; they preferred to deal with known tradesmen chosen by themselves, over whom they could exert a certain level of control. While architects in nineteenth-century Britain attributed the degradation of architecture to the division of labour being introduced elsewhere in the building industry, ironically, it was the very presence of the architects themselves that was part of the cause of the problem.

[5] Brian Hanson, *Architects and the "Building World" From Chambers to Ruskin: Constructing Authority* (Cambridge: Cambridge University Press, 2003), esp. chapter 5, 6 and 7.

While the Arts and Crafts approach went to extremes in rejecting the general contractor, the other, less well known approach in dealing with the modern mode of production lay in the practices of those architects who wanted to take advantage of the contemporary conditions of production, while at the same time maintaining control over the crafts. How could a craft-based system be reconciled with the logic of the capitalist mode of production? The amalgamation between these two seemingly conflicting systems is the strategy that we now turn, as it constitutes the other main 'theoretical' stance in late nineteenth-century British architecture.

'Theory'

Given that we are proposing to discuss about a 'theory' of construction in late nineteenth-century Britain, it might be useful to ask: what is it a 'theory' of architecture? Normally what is called a *theory* depends on with a discourse, with what has been spoken, or written, whereas what is called *practice* is almost always regarded as being non-theoretical. But is this necessarily the case? Can something that was taking place solely through 'practice' also be called a 'theory'? Just by asking these questions, we now face a paradox, for if anything in 'practice' can be described as 'theory', it would seem to contradict the accepted nature of theory.

To consider this seemingly impossible paradox, architecture, as an activity that deals with mental processes as well as practical processes, offers some possibilities for discussion. Generally speaking, theoretical discussion amongst architects is concerned with design; theories, considered as something that derive from architects' intentions, usually touch more upon the design process and less on the construction. Whatever thoughts architects put into the construction process have usually been characterised under practical terms, not as theory. But, it is fair to say, not all creative acts lie only in the design process; they may belong also in the process of execution, in which immediate solutions to emerging problems were worked out as the work went along.

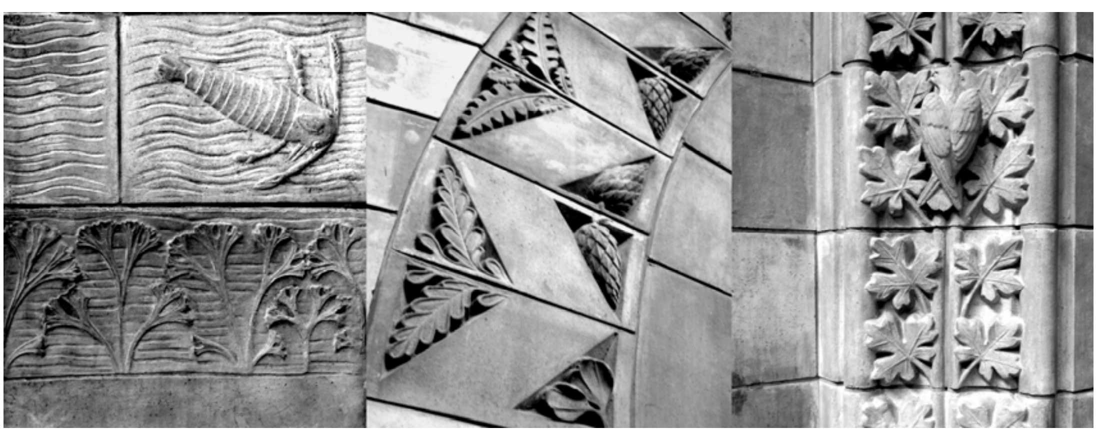
Moreover, it is important to note that whatever an architect had said and designed in drawings does not necessary corresponds to what was built. Both the verbal explanation and the work prepared in the design stage may be less relevant to the result than the work of those who managed to get it built; namely, engineers, contractors and builders. While, on one hand, the architect's explanations and drawings express intentionality, the built work, on the other hand, speaks on its own terms and surely contains both things that were intended, and things that were not – the fact that should warn one not to expect the account of the design stage to explain everything about that piece of architecture. Through the reality of construction, a built work gains something over the architect's verbal description and representation, since it is a consequence of all actions that have gone through all the processes involved from the design stage to the process of execution. A careful examination of the work itself, and of the condition under which the work was created, thus makes it possible for us to see the act of 'building' as something that can carry 'thought', and therefore capable of bearing theoretical propositions. While what we are going to look at does not look like a theory in a sense in which people usually talk about architectural theory, it may nevertheless change our understanding of 'theories'. Rather than intellectualised theory, it is in fact *non-articulated* 'theories' – perceived through the 'building' – with which we are now concerned.

Returning to this other 'theoretical' stance in late nineteenth-century British architecture – the combination of the advantages of the general contract with a degree of control over craft process – the architecture of Alfred Waterhouse at Natural History Museum offers a good case to look at. Of all architects in late nineteenth-century Britain who found themselves losing control over building work, none adjusted themselves better to the changes in labour relations than Waterhouse with his use of terracotta. Although Waterhouse [1830-1905] was not the first architect to introduce terracotta into architecture, his inventive and critical use of the material enabled him to involve the architect more closely in the control over the finish of the building than was otherwise possible. How far, then, might his work be considered as a 'theoretical' preposition?

2.1 The Natural History Museum, London, built in 1873 and completed in 1880, is the first building in Britain whose façades, both exterior and interior, are clad entirely in terracotta. From Colin Cunningham, *Alfred Waterhouse, 1830-1905: biography of a practice*, 1992.

Alfred Waterhouse's Natural History Museum

The Natural History Museum, London [1873-1880] is well known for its terracotta cladding, but little is known however about how and under which conditions it was made [fig 2.1]. What was the secret of what was achieved? The programme for a new museum of natural history was initiated by the natural theologian Richard Owen in the 1850s to relocate the collection of natural specimens previously stored at British Museum in Bloomsbury to a new site. In January 1864, an open architectural competition for a new museum was announced. A total of thirty-three design proposals were submitted, and the winning prize was won by the engineer, Francis Fowke. However, Fowke soon died, and rather than the commission going to the second-place candidate, Robert Kerr, for reasons that remain unclear, it was handed over to the architect Alfred Waterhouse to execute Fowke's design.[6] Unsurprisingly, Waterhouse did not follow Fowke's winning design, but proposed his own instead. Since Owen's programme for the Natural History Museum was to bring science to the public view, Waterhouse interpreted this didactic purpose by making the architecture of the Natural History Museum itself an illustration of natural history. The fabric of the Natural History Museum was thus clad with ornamental motifs depicting several hundred of extinct and living species, all of which were to be executed in terracotta. These figures of animals and plants are well-crafted, indicating some sorts of craftsmanship involving in the production process [fig 2.2]. The question is how these seemingly exquisite pieces of terracotta were produced, given the fact that the architect of this building was constrained to work under a new system of contracting – the so called 'contracting in gross' – through which all building works were, in theory, not controlled by architects, but by general contractors who took control over the building work and the outcome of the work. To find explanations to the question, we should start by asking what the material of terracotta meant to the architect in question.



2.2 'An Illustration of Natural History'; Figures of animals and plants executed in terracotta on the interior fabric of the Natural History Museum, London, photographed in 2011.

[6] Waterhouse signed a contract on the appointment of architect for building of the Natural History Museum on 29 September 1870. See The National Archives, Kew, 'Memorandum of the Terms of Appointment of Architects of Public Buildings', P.R.O., WORKS 17-16/2 (144-146).

In his lecture to Birmingham art students in 1882, Waterhouse justified his use of terracotta only in terms of function and aesthetics, as

> […] made from a clay found in the same pit as the coal which did the mischief. […] It seems the only building material which can successfully withstand its corroding influence. In terra cotta the fire will at once give us those beautiful accidental tints of which we might avail ourselves if we chose boldly to use them.[7]

But a further reason for the choice of terracotta, not mentioned publicly by him, lay in the fact that this material avoided some of the problem caused by contracts in the gross, and, to a certain extent, offered possibilities to the architect to re-establish his position. Waterhouse's intervention in the building work can be clarified by examining the process of contracting. The extent to which Waterhouse intervened into the building work of the general contractor is revealed through his correspondence with the First Commissioner of H. M. Office of Works, particularly through ways in which he set out to deal with the production of terracotta.

The Contracting Process of Natural History Museum

Waterhouse's first responsibility as the architect of the new Natural History Museum was to prepare the design and the necessary documents, namely the Contract Drawings and Specification, for the purpose of the Contract. These contracting documents specified the work to be done in detail in drawings and written forms to enable contractors, who were invited to tender in competition, to estimate accurately their tender price for the building. Once the price was agreed, the Contract would be signed between two parties: H.M. Office of Works and the general contractor [fig 2.3]. At the outset, Waterhouse indicated his intention to have a separate contract for the making of terracotta, not to be part of the general contractor's work. Furthermore, he did not want a single supplier to be contracted for all the work. As, on 27 November 1871, he wrote a

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[7] Waterhouse's lecture to Birmingham art students was reported in Alfred Waterhouse, *Building News* (1882): p. 245; source quoted here is Colin Cunningham and Prudence Waterhouse, *Alfred Waterhouse, 1830-1905: Biography of a Practice*, ed. Dennis Farr, *Clarendon Studies in the History of Art* (Oxford: Clarendon Press, 1992), p. 162.

2.3 The Contract Drawing, signed both by the architect, Alfred Waterhouse and the contractors, Baker and Son, was referred to the Contract dated on 7 February 1873. From National Archive, Kew, P.R.O., WORK33.

letter to the First Commissioner to have separate tenders for the terracotta work:

> I beg to submit to you that the right way of dealing with this question will be to procure, in the first place, estimates from several of the best manufacturers not with a view to the whole of Terra Cotta being placed with any one firm but divided between two or three whose estimates are most favourable.[8]

He also suggested to have competitive terracotta makers to submit their sample of models of terracotta, made according to his design, for competition, in order that Office of Works and Waterhouse could choose the most suitable manufacturers. As Waterhouse wrote to the First Commissioner:

> As a preliminary step I beg to apply for permission to get models to be cast in plaster and duplicates sent to each Terra Cotta maker invited to tender. From such models the various manufacturers would be able, without much trouble or

[8] The National Archives, Kew, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (1), 27 November 1871. See letter in full in Appendix A1.

expense, to prepare samples of the actual work required and they should be required to do so, and to submit them with their tenders. These samples would thus enter into the Competition and enable us the better to decide upon the manufacturers to be employed. When these latter are decided upon it will be understood that the samples they have submitted will be made use of as standards by which to test the colour, quality of material and truth of line of the work they shall afterwards deliver.[9]

The First Commissioner, however, ignored Waterhouse's advice for a separate tender for terracotta, leading Waterhouse to explain again what would be the best mode of working to deal with the material. Waterhouse said:

> Perhaps you will allow me to recapitulate to you what I endeavoured to explain […] with regard to the Terra Cotta, and to ask you to favour me with your commands with regard to the method to be adopted to secure what we shall require in this material. There are, in this country, not more than four or five firms who manufactures what may be called really satisfactory Terra-Cotta; and of these, <u>one</u> of them produces a material, which is acknowledged to be the best adopted for <u>external</u> purposes, both in color and quality, of any in the Market; and, as it is the best, so it has been hitherto, the cheapest. Of the other firms, two or three of them make a Terra Cotta which is especially suitable for <u>internal</u> use.
>
> The course which, in the interest of economy, I consider it would be best to pursue, is to advertise for separate tenders for the Terra Cotta-work required. The firms I have allowed to will be sure to apply for the quantities, to enable them to tender. The quantities, I consider, should be divided into five or six sections, and each competing firm should tender for each section separately on the understanding that the orders for the various sections might be given to various makers. By this means, if proper reticence were observed as to our intentions, I believe we might secure the best makers, for each description of Terra Cotta required, and secure from them their lower prices.

[9] Ibid.

> The other alternative is this, to secure certain specimens of Terra Cotta from the best makers such as we should wish to use in the building, and lay these before the competing builders, as samples of the quality of material and workmanship we should insist upon. Were there a large number of firms to select from I should see no objection to his course, but the evil I fear is this. The samples we should put before the competing contractors would really speak for themselves as to their makers and all the contractors would go to the same men for the price of the difference classes of material; and the latter would thus quote prices, virtually <u>without competition</u>, for they would know that each particular specimen could only be reproduced by the one firm which had made it. Such prices therefore, I fear, would be higher than if no definite specimens were submitted and the Terra Cotta makers quoted their prices under the influence of a real competition.[10]

While Waterhouse explained what he saw as the best method to ensure satisfactory workmanship for the terracotta, the First Commissioner, again, did not follow Waterhouse's insistence for a separated tendering, asserting 'that the terracotta work should not form the subject of a separate competition, but should be included in the Tender for the erection and entire completion of the building'.[11]

Waterhouse's endeavour for a separate tendering for terracotta, though not successful, is indicative of his early attempt to intervene to building work. The implication is that, in proposing a separate contract for terracotta work independently from the rest of the work and in setting a competitive tendering in which each firm had to submit models made according to Waterhouse's design, he could be more certain about the selection of terracotta makers as they would be more appropriate for his design than letting the work in the hands of the general contractor. If he did not get involved and just let the terracotta work to be included in the entire

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[10] The National Archives, Kew, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (4-5), 19 December 1871. (underlined in the original) See letter in full in Appendix A2.
[11] The National Archives, Kew, 'H.M. Works' letter to Alfred Waterhouse', P.R.O., WORKS 17-16/3 (13-17), 5 January 1872. See letter in full in Appendix A3.

contract of the general contractor, he would have lost almost completely the control over the making of the terracotta.

The problem of losing control of the terracotta making to the general contractors had always been in the back of Waterhouse's mind. Between 1871 and 1872 Waterhouse prepared the detailed drawings and specifications for the purpose of the contract. By this time, he was informed that the overall budget for the construction of the building was going to be cut down from £500,000 to £330,000, and so was forced to produce a design to match this stipulated amount. Of a total of twenty-three firms approached by Office of Works, the lowest tender was proposed by the firm Baker and Son for £395,000. Together with the amount which would be spent for other separate works (such as pantry for £8,000, warming £5,200 and modelling £5,000) the proposed cost of £395,000 still exceeded the budget of £330,000. From August 1872 to October 1872, Waterhouse was requested 'to reduce the cost of the building to the original estimate',[12] yet 'without an affect on the accommodation of the building, or its architectural characters',[13] and he underwent his endeavour in modifying his design, including revising details, materials and specifications as well as reworking on 'some of the details of the elevation' which Waterhouse called 're-clothing of my design',[14] in order to arrive at the exact saving[15] – a reconsideration that at the end caused some necessary delay. On 12 August 1872, for example, he wrote to the First Commissioner that the cost would be on budget: 'Having thus modified the specification I beg to say that I have no reason to think that the result of the tenders will differ to any material extent from the amount

[12] The National Archives, Kew, 'H.M. Works' letter to Alfred Waterhouse: Excess of lowest tender over estimate', P.R.O., WORKS 17-16/3 (91-92), 18 September 1872.
[13] On 12 August 1872, Waterhouse described the modification in the specification he made for the reduction of price to the F.C. See The National Archives, Kew, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (70-71).
[14] The National Archives, Kew, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (102), 15 October 1872.
[15] The National Archives, Kew, 'Waterhouse's letters to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (94, 98), 4 October 1872 and 7 October 1872.

authorized to be expended'.[16] His answer, however, was seen by the First Commissioner as no guarantee that the cost of the building would not exceed the stipulated amount, and he requested Waterhouse for a more definite assertion, to which, Waterhouse replied:

> I have never given any more definite assurance than this to a client, because I could never hold myself responsible for the acts of Competing Builders who are entirely independent of me; and I should especially regret to have it thought that I had given Her Majesty Government such an assurance with regard to a work of this magniture & exceptional character.[17]

'Entirely independent of me' – the phrase, though Waterhouse used it in relation to the expense of the work, sums up perfectly his anxiety over the loss of control over the building work. The rejection of a separate contract for the terracotta and a decision from the First Commissioner to put the terracotta work under the general contract immediately suggested that some further intervention would be vital if the architect was to ensure his presence in the building work.

A Nominated Sub-Contractor of Terracotta Production

Though the Natural History Museum was built using the general contractors, Baker and Son, Waterhouse relied on what seemed to be 'a nominated sub-contractor' to tender for the terracotta making. While rejecting a separated tendering for the terracotta, the First Commissioner allowed Waterhouse to adopt a nominated sub-contract for it. The nominated sub-contracting for a particular part of building like terracotta making was not new; the subcontract such as this had commonly been used, both under 'measure and value' and 'contracting in gross' systems, for works required specialists' undertaking such as gas-lighting, heating or ornamental carving. But what is interesting about this mode of working is that it was nominated who was going to be in charge of that particular work – the fact that enabled Waterhouse to select the terracotta maker,

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[16] The National Archives, Kew, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (70), 12 August 1872.
[17] The National Archives, Kew, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (79), 30 August 1872. (underlined in the original) See letter in full in Appendix A4.

independently of the general contractor's control. Without the nominated subcontract, the selection of the craftsmen would have been solely the general contractor's responsibility.

This adoption of a nominated sub-contractor for the terracotta work was almost certainly insisted upon by Waterhouse, though no direct evidence of this has been found. Had there not been delay in the construction and an ensuing investigation, the following account of controversy relating to the terracotta might not have become known. It exposes Waterhouse's further intervention in the contracting process.

Waterhouse's Intervention in the Contracting Process

The special mode of working with the terracotta adopted at the building of the Natural History Museum occupied an ambiguous position in the contracting process. While the tender for terracotta was set by Office of Works to be included in the entire contract of the general contractor, on 5 December 1872, about two months before Baker and Son signed the Contract for the erection of the Natural History Museum for the sum of £352,000, it appeared that the Contract was added the following condition: 'The Terra Cotta maker to be paid monthly on delivery certified by Mr. Waterhouse as to quantity, quality and value on orders signed by us [Office of Works]'.[18] 'The meaning of which was that', as Henry A. Hunt later described, 'Messrs. Gibbs & Canning were to be the Terra Cotta Makers; but that they should have a better security for the payment of their money than was afforded by depending entirely upon Messrs Baker and Son for it'.[19] To the contractors, under the condition that terracotta work was included in their contract, this meant that they had to pay for the terracotta work according to the authorisation of the

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[18] The National Archives, Kew, 'George Baker and Son's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (109) 5 December 1872. (in brackets added) See full letter in Appendix A5; also, the letters indicating Waterhouse authorising the payment to the Framer & Brindley on account of modelling can be found in The National Archives, Kew, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (177), 2 July 1873; and WORKS 17-17/1 (17), 'Certificate No. 13', 13 January 1876.
[19] The National Archives, Kew, 'Baker & Sons Contract', P.R.O., WORKS 17-17/1 (13), 16 March 1876. See full letter in Appendix A6.

architect [fig 2.4]. In 1876 when it appeared that there was slow progress on the construction, Hunt was requested by Office of Works to investigate the cause of the delay, and found that that main reason was due to the insufficient supplies of terracotta from Gibbs and Canning of Tamworth. About to blame Baker and Son for the delay, Hunt found that there was no contract made between the general contractors and the terracotta makers. Hunt, however, believed (without showing any evidence) that 'the employment of Messrs Gibbs & Canning as Manufacturers of Terra Cotta was practically forced upon Messrs Baker & Son by Mr. Waterhouse'.[20]

2.4 **The Additional Conditions**, engineered by Alfred Waterhouse, to the terms of the Contract. From National Archive, Kew, P.R.O., WORK 17-16/3 (109)

[20] Ibid.

Under 'this peculiar condition' – a phrase used by Baker and Son themselves in describing to the First Commissioner their obligation to accept the tender of the terracotta manufacturer to be incorporated in their contract – the general contractors had relatively no power over the production process of the terracotta.[21] And later, when it appeared to be they who had to be solely responsible for the delay, Baker and Son wrote a letter to Waterhouse, reproaching him for interfering in building process, for taking over the control of the making of terracotta to his own. In their letter to Waterhouse on 4 January 1877, Baker and Son wrote,

> In regard to the Terra Cotta it is needless probably to remark that all arrangements with Messrs Gibbs & Canning <u>were made</u> by you, <u>by whom they were appointed</u> and that prior to and since the signing of the contract we have had <u>no practical control</u> of either the modeller or Messrs Gibbs and Canning. We have afforded every assistance in our power to expedite the work but all instructions upon the subject have been given direct by you to the modeller or Messrs Gibbs & Canning.[22]

Waterhouse, however, did not hesitate to deny this charge, claiming that no arrangements whatsoever were made by him with the terracotta makers, Messrs Gibbs and Canning, nor were they 'appointed' by him. However, he acknowledged the general contractors' lack of 'practical control' over the modelling since, as he wrote to Baker and Son, 'that portion of the work was purposely excluded from your Contract'.[23]

Waterhouse was correct in saying that the contractors' control over the models 'has commenced from the various times at which they have been ready for placing in the hands of the terracotta makers', yet their 'practical control' lay neither in the making nor controlling the quality, but

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[21] The National Archives, Kew, 'Baker & Son's letter to F.C. of H.M. Works', P.R.O., WORKS 17-17/1 (23), 27 March 1876.
[22] The National Archives, Kew, 'Baker and Son's letter to Waterhouse', P.R.O., WORKS, 17-17/1 (265), 4 January 1877. (underlined in the original) See letter in full in Appendix A7.
[23] The National Archives, Kew, 'Waterhouse's letter to Baker and Son', P.R.O., WORKS, 17-17/1 (292), 22 January 1877. See letter in full in Appendix A8.

solely in obtaining adequate supplies of terracotta, in which they had difficulties.[24] As on one occasion, for example, when Gibbs & Canning was late in supplying the terracotta, all Baker and Son could do was to send 'a competent man to reside at Tamworth, whose sole duty it will be to see that the various parts of that work are made and sent off in the order in which they are required'.[25] While the terracotta was as much a part of the general contract as any other works included in it, Baker and Son's direction over the terracotta was very restricted [fig 2.5].

2.5 **'Terra Cotta Claims'** The controversy between the architect and the contractors regarding the terracotta work led to an investigation into the cause of the affair. From National Archive, Kew, P.R.O., WORK33.

[24] Ibid.

[25] The National Archives, Kew, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (196), 15 January 1874.

While the tender for terracotta was not separated as Waterhouse originally intended, at least, the additional condition under the Contract that gave Waterhouse an authority to certify payments to terracotta makers offered considerable advantages to the architect, allowing him to entertain more control over the terracotta makers than the general contractors.[26] On several occasions, Waterhouse, not the contractors, wrote to letters to inform the First Commissioner about the progress of the terracotta manufacturing. His letter to the First Commissioner on 14 January 1876, for example, gives an idea just how satisfied he had been by having the terracotta under his control:

> I thought it desirable, as the works were partially suspended in consequence of the frost, to send the Clerk of the Works to Tamworth to see how the manufacture of the Terra Cotta was proceeding. He reports to me that there is a large stock in hand and that the quality of that now being made is very satisfactory. [27]

Throughout Waterhouse's intervention into the contracting process, of which the terracotta making was part, his effort had always been an emphatic desire to give substance to the role of an architect. The different between the general contractors and the architect was that while Baker and Son controlled most things of the construction, under the specific condition the architect managed to set up, they had little authority over this particular, and very significant, part of the construction process. His proposal to have separated tender for the terracotta work, his suggestions to Office of Works to employ the most desirable terracotta makers, and to hold authority to certify payment to them all indicate Waterhouse's determination to intervene in the contracting process. The result of this intervention showed that he successfully took the control of the terracotta work.

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[26] See, for example, The National Archives, Kew, P.R.O., WORKS 17-17/1 (17), 'Certificate No. 13', 13 January 1876, when Waterhouse and Baker and Son authorised the sum of £1700 to Messrs Gibbs & Canning.
[27] On Waterhouse's control over the manufacturing of terracotta, see, for example, The National Archives, Kew, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-17/1 (2), 14 January 1876.

But intervention in the contracting process is not enough to understand Waterhouse's critical 'practice' in the use of terracotta. To appreciate his concern for its design and construction, we need to know the procedure through which the material had been produced. And to understand Waterhouse's avoidance of negligence and poor craftsmanship as might have occurred were it outside his own control, we need to understand the role of terracotta in the architecture of the Natural History Museum.

Division of Labour in Terracotta Making

With his authority over the process and its workmen, Waterhouse applied the principle of division of labour to the process of manufacturing terracotta. Waterhouse set out to break the process of terracotta making into a number of stages; each stage was carried out by an individual specialist, over whom Waterhouse could still exercise a considerable degree of control. The thinking behind the design and construction, and the collaboration between him and his workforce in the manufacturing process, are significant to understand Waterhouse's creative use of terracotta.

The production process of terracotta making was divided into four stages of working, involving four different occupations. The first stage was for the architect, Waterhouse, to design on paper the decoration of the building to be made of terracotta. The second stage was the responsibility of a modeller, M. Dujardin of Farmer and Brindley, who would transfer Waterhouse's drawings into plaster moulds in preparation for casting. At the outset, the cost for modelling was set at £5,000, and it was separated from the general contract. In his letter on 27 May 1873, Waterhouse explained to the First Commissioner how satisfactory this separate tendering had been to him.

> The sum of £5000 has been allowed in our calculation for the preparation of the models for the Terra Cotta. As it is so uncertain at present how much work of this kind will be required, I have been unable to procure a definite tender for it. I have however ventured to employ Messrs. Farmer & Brindley to proceed with those models which are first required, on the understanding that an account is rendered to me at the end of each month. For the two months ending 30 April the expenditure on this head was £49.15.0 and the work executed was satisfactory and cheaply done. The arrangement appears to work well so far but at any time it can be put an end to, if more definite arrangement can be made. I presume I am at liberty certify this account periodically? [28]

If the separate tendering provided Waterhouse freedom to direct the process of model preparation independent of the general contractors, the skill of the sculptor Dujardin was advantageous to him. At this stage, as Colin Cunningham observed, Waterhouse drew only one-side elevation of each model, he then relied upon Dujardin's expertise 'to judge the appropriate depth of relief and the delicacy or vigour of the modelling'.[29] And, since the clay, according to its nature, would normally shrink in size by about one-twelfth after being fired in a kiln, Dujardin was to make the model bigger than the actual size of the finished block accordingly.[30] Accordingly, the sculptor was a crucial figure in the success of Waterhouse's application of division of labour, since the form of the terracotta depended upon the perfection of its mould, and this control of the exact replicas of the blocks to be manufactured depended on the meticulous skill of the sculptor. If the sculptor had been less good at translating Waterhouse's two-dimensional drawing into three-dimensional models, or unable to produce a perfect form for the moulds, the whole process after that – moulding and manufacturing terracotta – would have been unsatisfactory.

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[28] The National Archives, Kew, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (167), 27 May 1873. See letter in full in Appendix A9.
[29] Colin Cunningham, *The Terracotta of Designs of Alfred Waterhouse*, 1st ed. (London: WILEY-ACADEMY, 2001), p. 67, 70.
[30] Ibid., p. 71.

2.6 The production of terracotta was separated into distinct stages, carried out by different occupations, each of whom pursued a single task: ‘Drawing’ by the architect Alfred Waterhouse, ‘Modelling’ by the modeler M. Dujardin, ‘Moulding’ by the Terra Cotta makers Gibbs & Canning of Tamworth, and, finally, ‘Assembling’ by the general contractors Baker and Son. From Colin Cunningham, *The Terracotta Designs of Alfred Waterhouse*, 2001, p.70,72,73, and 106

The next stage of terracotta-making process is the process of casting – a process that was to produce a number of exact blocks. Of all terracotta manufacturers available at the time, Messrs Gibbs and Canning of Tamworth, who had supplied the terracotta items for the building next door, the Albert Hall, was chosen due to its exceptional capability to create ‘variegated buff’ of terracotta – an artistic quality Waterhouse found attractive.[31] But with the complexity of the construction of the Natural History Museum, a condition that called for efficiency and consistency in the production line of terracotta, Waterhouse demanded Messrs Gibbs and Canning of Tamworth to expand its production capacity: ‘to increase their staff, expand their drying sheds, and even build more kilns’.[32] The tasks of the manufacturer here were that they made the moulds of each clay models. Then the precise clay blocks would be cast from the moulds. After the clay blocks had been allowed to dry, they were later baked in a kiln in order to make them hard [fig 2.6]. The finished prefabricated blocks would then be transported to the site.

[31] Colin Cunningham, *Alfred Waterhouse, 1830-1905: Biography of a Practice*, ed. Dennis Farr, *Clarendon Studies in the History of Art* (Oxford: Clarendon Press, 1992), p. 162.
[32] Ibid., p. 161.

In the final stage, the contractors Baker and Son fixed them onto the building of the Natural History Museum.

As we have seen, the labour in making terracotta blocks was broken down into many stages; each stage was depended on the specialist who pursued the single task, and each specialist was under the direct supervision of the architect. By splitting the work into different components – the drawing, the model making, and then the casting – over each of which Waterhouse had a relatively large amount of control, it enabled the architect to have overall supervision of the making of terracotta – without which the result might be less than satisfactory. Thus Waterhouse's intervention here can be seen as a device developed in order to strengthen the architect's control over the work to be carried out. It was a 'by-product', or a way around, of the division of labour in order to guarantee quality of the work produced.

What is significant at the Natural History Museum was the ways in which Waterhouse managed to turn a mode of working of a nominated subcontracting into a powerful and flexible instrument for the realisation of architecture. If subletting under the general contract had been regarded as tending to lead to negligence and poor craftsmanship, Waterhouse found his own solution to the problem. In terms of organising the work, Waterhouse took advantage of the general contract by letting the general contractors direct almost all the building work, except for the ornamental part, which Waterhouse managed to reserve to himself. With the combination between the nominated subcontractor for the craft production and the general contract for the remainder of the work, Waterhouse was capable of combining craft expertise within an otherwise industrialised process.

For better or for worse, the success of the Natural History Museum lay precisely in Waterhouse's intervention in contracting process. While Waterhouse never said as much, what he was doing was to restore the relationship between architect and craftsmen. Waterhouse's successful intervention may be seen as more of an immediate response to specific problems of the circumstances than the announcement of a new brand of theory. Yet how might we understand this action? Was it just the architect's tactic? Or could we consider it as 'theory'? If so, what kind of a 'theory' does this episode point to?

Waterhouse never published his thoughts about the process of architecture – but this is not to say that his work lacks a 'theory'. His letter to the Office of Works makes clear that he had a calculated strategy for executing the work, and that was it was neither in his nor the Office of Works' interest to disclose this. In this regard, his theory is deemed to be 'unspoken'; his intervention was, in other words, action *un*accompanied by speech.

It may be for this reason that Waterhouse has been relegated to the status of an essentially conventionally practical architect. Colin Cunningham, for example, while emphasising his practicality as central to Waterhouse's architecture in his book *Alfred Waterhouse 1830-1905: Biography of A Practice*, has little to say on Waterhouse's theoretical propositions.[33] While it may be true that Waterhouse did not have a reputation for being a theoretical architect, this is not because his concern in architecture was limited merely to practicality, nor because of any inability on his part to conceive the work in theoretical terms. In fact his 'practice' and 'theory' seem to be entirely interconnected. He theorised his work through 'practice', or, to put it another way, he practiced through 'theories', regardless of that fact he did not articulate these in public. In Waterhouse's strategy for controlling production of the building and terracotta manufacturing, the distinction between 'theory' and 'practice' remained ambiguous.

[33] Ibid.

Returning to our central issue of the dialectics between 'theory' and 'practice', the building of the Natural History Museum presents the question of whether this is a 'theory'. Does 'theory' have to be articulated? Does it have to be spoken for it to become a 'theory'? It is difficult to find an exact answer to the questions, but at least we can talk about them and see the limitation, or the possibility, of what we now call 'theory'. Is a 'theory' separate from 'practice' or embedded in it? How far might one consider 'practices' as carrying theoretical content?

If part of the difficulty in answering these questions lies in the ambiguity of what we understand as 'theory', this ambiguity has always been a difficulty within architecture. According to the architectural historian, Jorge Otero-Pailos, an obligation to think of theory and practice as separate is the intellectual problem left by modernist ideology. Even if this was so in the twentieth-century architecture, there is no particular reason why such an issue should only be applied to modernism and post-modernism and the debates about them. Indeed, such a problem can be found in previous periods of architectural history. As we shall see, Waterhouse's situation antedates a problem that has come to light in relation to the modern and post-modern eras. In his book, *Architecture's Historical Turn*, published in 2010, Otero-Pailos said:

> It is difficult for us today to look at a camouflage pattern, a supergraphic paint scheme, or a carefully framed picture of a construction joint as anything more than various aesthetizations of theory, that is, as ex post facto representations of intellectual work. Yet before the rise of what we now call architectural theory, these practices were included in what was considered legitimate intellectual work in architecture, not something secondary to mental acts but as their primary source and governing standard. Architectural phenomenology refers to this ambiguous intellectual realm and to the process whereby architects became aware of its ambiguity, testing, contesting, celebrating, and exploiting it for the

> purpose of defending the belief that architectural practice embodied a unique mode of intellectuality that could not be separated from aesthetic experience.[34]

Otero-Pailos has looked at the ways in which architects and historians in the post-modern era have dealt with the questionable division between theory and practice and investigated how certain thinkers have promoted the understanding of phenomenology – an idea that human bodily experience plays important role in our understanding of the world – for recounting the understanding of architecture. The consequence of their attempts, Otero-Pailos suggested, has called into question the accepted notions of theory and practice. As he wrote,

> Architectural phenomenology played a central role in setting into motion what we now call theory – not only intellectually, through the expansion and rearticulation of architecture's modes of scholarship, but also socially, by staking out a new position for architect-historians within the academy as the custodians of architecture's peculiarly ambiguous mode of intellectuality.[35]

Otero-Pailos went on to observe that despite the attempt of architect-historians to resolve the question of an assumed separation between theory and practice, by avoiding considering 'the emergence of theory as something separate from practice',[36] their emerging occupation as a scholar, whose trade detached them from the production of building, put them too 'in the paradoxical position of having to theorize their own demotion of theory'.[37] Having looked into the difficulties that post-modern architect-historians in the USA had had up to the mid-1980, in testing the limit of what was deemed to be a 'theory', while also accommodating some of its contradictions, Otero-Pailos suggested that it is not that phenomenology antedated post-modernism, as is usually understood – in fact both cannot be considered separately, for it was from architectural phenomenology that post-modernism emerged.

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[34] Jorge Otero-Pailos, *Architecture's Historical Turn: Phenomenology and the Rise of the Postmodern* (Minneapolis, Minn.: University of Minnesota Press: 2010), p. xii.
[35] Ibid., p. xiii.
[36] Ibid., p. xii.
[37] Ibid., p. xiv.

If Otero-Pailos' account provides an insight into the rise of architectural phenomenology in America, his close investigation into Kenneth Frampton's intellectual development shows us a new side of Frampton's *Tectonic* theory, bringing out how the philosophy of phenomenology impacted on Frampton's theory; hence, I will briefly summarise Otero-Pailos's account here.

Jorge Otero-Pailos' reading of Kenneth Frampton's *Tectonic* theory

The architectural thinker who has done most to promote 'practice' as a way to think about 'theory' is Kenneth Frampton; his ideas about the tectonic, developed in the 1990s, are by far the most ambitious recent theory of architecture to refer to construction. According to Otero-Pailos, the problem with which Frampton was concerned is how phenomenology could inform our understanding of architecture. Since one of the bases of phenomenology is a concern about the relation between objects and the human subject, Frampton followed the phenomenologists' proposition by arguing that the essence of architecture exists through the relationship between architectural objects and human subjects. Central to Frampton's argument is 'the primacy of lived experience over detached mental analyses as a means to understand the history of architecture', wrote Otero-Pailos.[38]

Otero-Pailos situated Frampton's intellectual formation within the Arts and Crafts tradition, seeing him as somebody who is interested in the notion of 'labour' – a subject which is not necessarily that obvious about Frampton's writings. In particular, Otero-Pailos identified that Frampton drew heavily from Hannah Arendt's book, *The Human Condition*, especially her ideas on 'labour' and 'work', and went on to infer that Arendt's philosophy helped Frampton to develop his theory of *Tectonic*. According to Otero-Pailos, Arendt categorised human condition

[38] Ibid., p. xii.

through three fundamental activities of human being: 'labour', 'work', and 'action', as Otero-Pailos wrote:

> According to Arendt, labor referred to the bodily activity required to stay alive, and effect bound up in the natural metabolism of the living body and its cycles of consumption and reproduction. Labor's product was biological life, and left no durable traces behind except life itself. [39]

For Arendt, labour does not perpetuate itself; it is used up once the process is done, whereas what makes 'work' is what Arendt called the product of 'surplus' labour. Arendt argued that the human "is capable of producing a 'surplus' " – a surplus that could be alienated from individual in the logic of capitalist economics. According to Otero-Pailos, Arendt, following Karl Marx, was preoccupied with the question of 'how could humans redeem themselves from labor in a way that was not oppressive (i.e., without enslaving other)?' But unlike Marx, who thought that labour must come to an end before freedom could take it place, Arendt, with her etymological analysis of the terms: 'labour' and 'work', proposed that 'the former were consumed in the process of making them, […] whereas the latter endured beyond their creation', hence 'humans could achieve freedom from labor, while continuing to exercise the labor required to stay alive'.[40]

According to Otero-Pailos, Frampton's reading of architecture is reliant upon Arendt's distinction between 'labour' and 'work', and the idea that the product of 'surplus' labour can be transferred to something permanent, which Arendt called 'work'. For Otero-Pailos, Frampton equated Arendt's *labour* with 'building' and *work* with 'architecture'. Just as 'labour' and 'work' could stay together in human condition, so too, he proposed, 'building' and 'architecture' could be experienced together without necessarily prioritising one over the other. Problematic though Frampton's analogy is – because it is not that one is used up; the other permanent; both 'building' and 'architecture' are certainly a product; the difference is that the latter yields an aesthetic

[39] Ibid., p. 222.
[40] The quotations in this paragraph are from Ibid.

surplus more effectively than the former – it is, however, this basis that provides insight into Frampton's proposition towards 'building' and 'architecture'.

For Frampton, the problem with 'building' and 'architecture' in architectural historiography is that the history of architecture is all about architecture and less about building, and therefore the human labour element is excluded from it. Frampton's aim was to write a history of architecture that includes both. As he proposed:

> Architecture history, as it is traditionally taught in architectural schools, is essentially still a primer course in the masterworks of western architecture. As such it concerns itself with the 'works' of architecture as opposed to those anonymous structures that have always arisen out of their never ending process of biological 'labor'.[41]

After all, it was Arendt who provided a philosophical basis for Frampton into thinking that architecture can be understood without a theory, but through the way in which an architectural 'work' is produced. Arendt's philosophy, from which Frampton's *Tectonic* theory was developed, is also useful to our question – especially to our particular problem of the dialectics between 'theory' and 'practice'– and so I would like to prolong this discussion a little further. For this purpose, I will use Arendt's theory of 'action' to investigate how far the building of the Natural History Museum can be read as a theoretical proposition.

Hannah Arendt's Theory of 'Action'

In *The Human Condition*, Arendt identified action as the fundamental basis of political freedom. The problem about human freedom was people's lack of opportunity to make themselves appear

[41] Kenneth Frampton, "Labour, Work & Architecture", in *Meaning in Architecture*, ed. Charles Jencks & George Baird (London: Barrie and Jenkins, 1969), p. 154.

in the public realm. She argued that human existence occurred essentially through deeds and words, as she said:

> In acting and speaking, men show who they are, reveal actively their unique personal identities and thus make their appearance in the human world, […]. This disclosure of "who" in contradistinction of "what" somebody is […] is implicit in everything somebody says and does.[42]

For Arendt, only through action and speech do human subjects prove their existence in the space of public appearance. According to her, humans do not just simply act, but also perform deeds. In other words, the act of doing has a theoretical context to it.

While what Arendt meant in terms of 'action' was very much about democratic politics, her theory surely has implications for architecture. However, since the characteristic of 'action' is that it is intangible, ontologically, where does that theory manifest itself? According to Arendt, 'action', like labouring, is a biological process, that is to say, 'not tangible, since there are no tangible objects into which it could solidify; the process of acting […] can leave behind no such results and end products'.[43] 'Action', in other words, is used up once the work is finished, leaving no trace whatsoever in the finished product. For 'action', Arendt continued 'the end (*telos*) is not pursued but lies in the activity itself which therefore becomes an *entelecheia*, and the work is not what follows and extinguishes the process but is imbedded in it.; the performance is the work'.[44] If then the act of doing has a theoretical basis to it, it is in its activity itself where such a 'theory' lies.

Arendt's attempt to identity the particular characteristic of 'action' – as something intangible but that can have a consequence – gives us insight into the dialectic between 'theory' and 'practice'. It

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42 Hannah Arendt, *The Human Condition* [1958] (Chicago; London: University of Chicago Press, 1998), p. 179.
43 Ibid., p. 183.
44 Ibid., p. 206.

2.7 The Interior Fabric of the Natural History Museum, photographed in 2011. Although forced to work under the contracting in gross, Alfred Waterhouse managed to avoid the undesirable loss of control over the making of terracotta.

is perhaps fair to say that there can be theoretical bases that are not yet put into words, or cannot put into the form of language. Nor are they demonstrated in the finished product. Like 'action' in Arendt's terms, the act of Waterhouse's intervention in the contracting process, while regulating the building mode of production, had disappeared after the work was finished. The limit of the 'work' is that it reveals the element of human labour in the appearance of the finished object, but not the action. While it had operated through the process of making, the 'action' became an end in itself as soon as the work was completed – there is nowhere we can point to the existence of action in the finished result.

Terracotta 'Actions': An *Implicit* 'Theory'

To understand the building of the Natural History Museum as having theoretical context, it

2.8 Perspective Drawing of the Natural History Museum Main Hall. The ‘Letters’ specified refers to several terracotta facing at different positions in the building. The realisation of Waterhouse’s design was only possible through his control over the making of the terracotta work. From Colin Cunningham, *The terracotta designs of Alfred Waterhouse*, 2001, p. 77.

might be useful to come to terms with Arendt’s idea of ‘action’. Waterhouse’s ‘action’ of intervention in the contracting process is intangible, not visible in the finished result, but it is in the ‘action’ that his ‘theory’ is generated, since it created the framework within which the ‘work’ and the ‘labour’ took place. Waterhouse set out the arrangement by which the terracotta cladding covered the part that was under control of the general contractors, enabling him to conceal work of which he was not in control, while exposing the decorative covering, over which he retained control. In a manner similar to Semper’s idea of cladding, where he set out the distinction between covering – the dressing – and the framework supporting the dressing, what is remarkable about the terracotta at the Natural History Museum is that it provides an architectural camouflage, allowing an architect to achieve the coherence he wanted for the whole design [fig2.7,2.8].

The different between Arendt's 'action' and Waterhouse's 'action' is that for Arendt action reveals 'who' is the actor amongst the public, while for Waterhouse the opposite was the case. The fact that Waterhouse's intervention was *non-explicit*, which can be regarded as 'speechless' – or 'action without a name', in Arendt's terms – had a particular consequence within architecture. Not only did it make a close collaboration possible between the architect and the terracotta makers, it also saved the architect from losing control over the building work. Through 'intervention' in the contracting process, Waterhouse was capable of taking the initiative in combing two different modes of working between the adopting of the general contract and the craft process. Waterhouse, in this sense, pioneered the avoidance of the undesirable loss of control over the building work with the general contract, and successfully inserted an architect's identity into what otherwise would have been the province of the general contractors.

Waterhouse's 'action' can be seen essentially as a 'theory', which whether it be put into words or simply shown in the finished result, does not really matter. All that matters is that 'building' as an *activity* can be seen as a medium for revealing the potentiality of 'theory'. And it is in this regard that we might say that in architecture the relationship between 'theory' and 'practice' coexistent. It might sound strange to say this, for it goes against our expectation of thinking of theory and practice as separate entities. And while in other disciplines – engineering, for example – a theory is thinkable purely by means of abstraction through mathematics and physics of how the structure works, and then practice is applied from that theory, such a division between theory and practice is hardly applicable to architecture. The particularity of architecture as different from other fields is that 'theory' and 'practice' are not two separate processes. We cannot produce pure 'theory' in architecture without calling for the *act* of its realisation: 'building'. This is not to say that we cannot have a theory before the execution, but if a 'theory' in architecture is to acquire its validity, it has to be realised to become apparent. Only when we appreciate the theoretical implication in 'practice' does the legitimacy of the 'theory' become apparent. 'Theory' of this sort – and one that this thesis is proposing – is neither just the result of pure thinking, nor is it the 'mental image' in Platonic view that 'preceded its coming into the world and survives its potential destruction'.[45] Rather, it is the thought process through which architects must 'transform for the materializing reification', to use Arendt's terms.[46]

Due to this particular characteristic of architecture, an architectural 'theory' is essentially dependent upon 'practice', without which it cannot come into existence. The analysis of the 'theory' demands the consideration of the 'practice', and vice-versa. Without the one, the other would be unthinkable. So when Otero-Pailos refers to architecture as having a 'peculiarly ambiguous mode of intellectuality', it is because architecture is an ambiguous field in which 'theories' and 'practice' are always synchronised in operation, and the usual expectation of a distinction between them is doomed to failure.[47] What is so remarkable about Waterhouse's Natural History Museum is that it is a prime example of a work of architecture where a theoretical basis was pursued through 'action' in Arendt's terms, allowing us to get closer to the true nature of 'theory' and 'practice'.

If this peculiar relationship between 'theory' and 'practice' comes close to what is discussed nowadays in architecture and in other fields, it has been exercised earlier, in late-nineteenth century Britain. What comes out of this discussion of one architect working on one particular building is an answer to the general issue of whether 'theory' is separate from 'practice' or part of it. It is something of a surprise to find this issue embedded in the terracotta of the Natural History Museum. Moreover, Waterhouse's unorthodox approach of practicing architecture makes us

[45] Ibid., p. 173.
[46] Ibid., p. 170.
[47] Otero-Pailos, *Architecture's Historical Turn: Phenomenology and the Rise of the Postmodern*, p. xiii.

realise how misjudged our suppositions about the late-nineteenth century British architecture have been. Contrary to the general tendency to regard British architects of the late-nineteenth century as theoretically 'backward', their ability to perceive that 'theory' is something that is part of 'practice' may prove them in some respects more advanced than those operating in a more traditional notion of theory where theory and practice are treated separately. British architects understood something about the nature of 'theory' that was not necessarily so obvious to people working in other fields. What makes the Natural History Museum such an interesting work of architecture is that it offers some possibilities for re-adjusting our understanding about the relationship between 'theory' and 'practice'. While the building is known to be designed by an architect whose approach might be regarded as excessively practical and theoretically 'backward', the irony is that his building turns all who practice architecture, in one way or another, into theorists [fig 2.9].

2.9 The Natural History Museum Main Façade clad entirely in terracotta – a material in which the architect of the building has a strong presence, from Colin Cunningham, *The Terracotta Designs of Alfred Waterhouse*, 2001, p.62.

3

Building

Ever since Structural Rationalism was applied to architecture, it has been closely identified with technological invention. Rationalists tended to believe that by adopting a new technology in construction, a new form of architecture would emerge. Being enthusiastic about new materials and technologies such as iron, steel and reinforced concrete, they used them to create new possibilities in the design of structure; architects like Henri Labrouste, Anatole de Baudot and August Perret shared the belief that architecture was essentially developed out of the progressive development of structure. Technological novelty became central in justifying the 'rationality' of architecture, and it led to an assumption that architecture was entering a new phase as a result of technology. The development of Structural Rationalism was thus based only upon assumptions about the development of technology.

An assumed tie between technology and rationality in architecture is evident in Giedion's early writings of modern architecture. Since Giedion belonged to Hegelian tradition – a tradition that reduces the complexity of the past event to a unifying essence and treats it as a spirit of the time, a *zeitgeist* – he saw the Industrial Revolution as representing the *zeitgeist* of his own time. In 1928, he wrote in *Building in France, building in iron, building in ferroconcrete* that: 'The "new" architecture had its origins at the moment of industrial formation around 1830, at the moment of the transformation from hand work to industrial production'.[1] Regarding the Industrial Revolution as an imperative agent for progressive social change, he added: 'The task of this

[1] Sigfried Giedion, *Building in France, Building in Iron, Building in Ferroconcrete* [1928], ed. Harry F. Mallgrave, *Texts and Documents* (Santa Monica, CA: The Getty Center for the History of Art and Humanities, 1995), p.86.

generation is: to translate into a HOUSING FORM [Wohnform] what the nineteenth century could say only in abstract and, for us, internally homogenous constructions'.[2] And elsewhere, he put it: 'Only now is the housing form being seized by those hidden forces that a century ago drove man to the constructional and industrial attitude'.[3] For Giedion, the science and technology of the industrial era were now the determinants of architecture (and of all other cultural artefacts such as paintings, sculpture and literature as well). In his book, selective iron and reinforced-concrete buildings in France since 1786 up to 1920s (designed by progressive architects, many of whom were Rationalists) are presented in more or less chronological sequence, suggesting that, firstly, each building exemplifies what he considered as an architecture that speaks the language of its own time; and secondly, that the successive transformation of buildings from one period to another, as they are arranged, indicates that the future of architecture lay in progressive development of building technology. For these reasons, Giedion reinforced the Rationalist's assumption that the form offered by new building technologies such as iron and reinforced concrete construction was a 'rational' expression of modern architecture. In other words, he suggested a link between Structural Rationalism, technological dynamism and progressive social change.[4] Though only in his early writings, Giedion saw the destiny of architecture as lying in a world based on scientific technical enlightenment.

The historiography of modern architecture in which it is bound to technological progression, such as Giedion's, tends to give little importance to earlier ways of building. With this emphasis on technological advance, 'modern architecture' and 'rationalism' are prone to being discussed only in terms of newness and innovation, whereas old building technologies were suppressed and rarely given a place in the history of modern architecture. They were seen as degraded

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[2] Ibid.
[3] Ibid., p.93
[4] For a book review of Giedion's *Space, Time and Architecture* and *Mechanization Takes Command*, see, for example, Arthur P. Molella, "Sigfried Giedion's *Space, Time, and Architecture* and *Mechanization Takes Command*", *Technology and Culture* 43, no. 2 (April, 2002)

technologies destined to be substituted by new ones for the sake of an assumed logical expression of the spirit of the age. Traditional and less technical though old building technologies may be, they are not necessarily irrational. It is only the fact that modernist rationality tended to base its justification upon technological innovation that made 'technical rationality' superior to other kinds of rationalism.

Alternative Rationalism

In recent years, such an assumption has appeared more and more doubtful. In terms of technology, a new interpretation of technology attempts to release it from universality and emphasises instead its cultural variation. The American historian of technology, Thomas J. Misa, for example, asserts that technology has always been viewed by modernist theorists, including architectural ones, not only as an agent for societal change, but also as opposition to traditional practices: 'These theorists of modernity', he wrote, 'invariably posit "technology," where they deal with it at all as an abstract, unitary, and totality entity, and typically counterpose it against traditional formulations'.[5] Aware of the limit of these restricted views, Misa continued,

> these overaggregated approaches cannot help us discern the *varieties* of technologies we face and the *ambiguities* in the technologies that we might exploit. Abstract, reified, and universalistic conceptions of technology […] blind us to the ways different groups and cultures have appropriated the same technology and used it to different ends.[6]

Misa's concern is to find ways of understanding the reality of technology more fully as he sees it being interpreted mainly in terms of abstraction.

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[5] Thomas J. Misa, "The Compelling Tangle of Modernity and Technology", in *Modernity and Technology*, ed. Philip Brey Thomas J. Misa, and Andrew Feenberg (Cambridge, Massachusetts; London, England: The MIT Press, 2003), p. 8-9.
[6] Ibid., p. 9. (Italics in the original)

Furthermore, in his book *The Shock of the Old*, the British historian of science and technology, David Edgerton, pointed out that it is an unfortunate myth of modern culture that we are made to believe (by the promoters of new technologies) that these new technologies are always better than older ones. Observing the ways in which old technologies have continued to be used since 1900, particularly in cases where new technologies failed to produce a better result (which is frequently the case), Edgerton proposed that the new technologies do not always replace the older ones. More particularly, older technologies still occupy a larger share of world's technological resources than so called 'new' technologies. '[M]any things we think of as old', Edgerton wrote, 'remained in practical use for longer than our future-oriented accounts of technological history allow. Our industrial, scientific and technological museums testify to the long life of many machines, and yet, at the same time, many deny the significance of this point for our thinking about technology'.[7] For Edgerton, many technologies we think of as new have in fact been around with us for longer than we usually acknowledge, and the new inventions of technology have often been less important than the survival of seeming old technologies which have always played a significant role in society.

While Edgerton drew his evidence from a variety of social practices, ranging from transport to contraceptive pills, and from refrigerators to machine guns, he has less to say on 'construction'. But his general argument, as we shall see, has implication for construction no less than the other practices. While the technology of building construction is always developing, primitive ways of building; such as mud and rammed earth construction, are far from disappearing, but are still in active use nowadays in many parts of the world. It is also important to note that a social practice like construction which involves many occupations: architects, engineers, contractors and builders, is diffused much more slowly and more different than architectural style. Styles of

[7] David Edgerton, *The Shock of the Old: Technology and Global History since 1900* [2006] (London: Profile, 2008), p. 29.

architecture may change from time to time, yet construction is not always altering in accordance with them. The most avant-garde design is often not built out of the latest method of construction, and indeed it is common for architects to adapt older ways of building in their most futuristic designs. Although there is always a tendency to cast 'old technologies' as being appropriate to the third-world countries, where first-world technologies are lacking and only local technologies and traditional modes of working are available, old technologies have been relevant and persisted in developed countries as well. Consider, for example, Le Corbusier's early villas, such as the Villa Savoye and Maison La Roche, whose white-walls stimulate poured concrete, but were in fact made out of brick and cement-block work. The construction is in fact composite, partly brick and partly concrete, but the walls are rendered so that they seem as if they were modern construction of poured concrete [fig 3.1, 3.2].

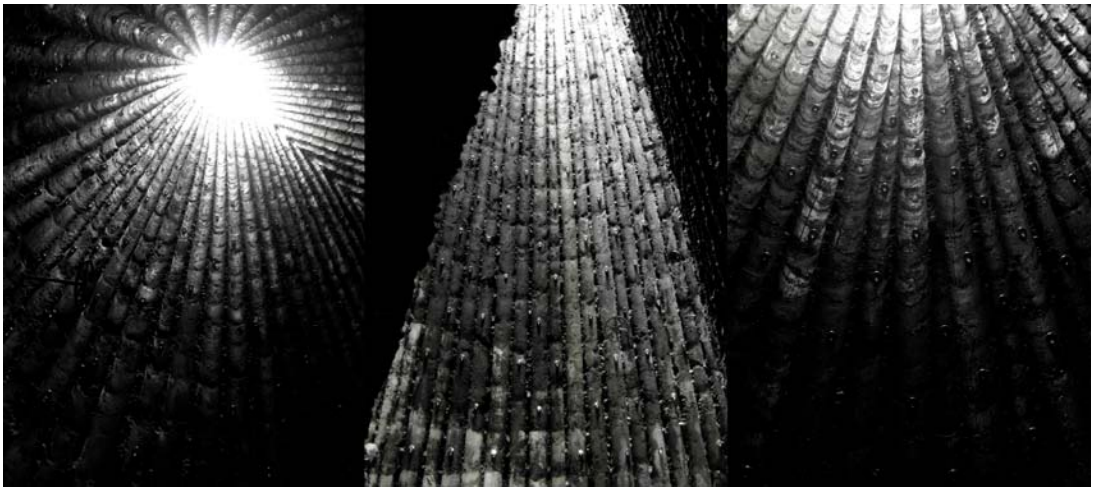
3.1 Villa Savoye, underconstruction, Poissy, Paris. From Phaidon, *Le Corbusier le grand*, 2008, p.206.

3.2 Le Corbusier's Villa Savoye, photographed in 2008. The real construction of Le Corbusier's Villa is of reinforced-concrete frames, infilled by brick work, though the appearance after its completion is rendered as if it were all made of poured concrete.

3.3 Philip Pavilion under construction, the Brussels World's Fair of 1958. Its futuristic design was executed with the mixture of old and new methods of construction. From *Philips Technical Review*, Vol. 20, No. 1 (1958/59), page 32.

A more intriguing example of a modernist building constructed out of older technologies is Le Corbusier's Philips Pavilion for the 1958 World's Fair in Brussels. Although the structure of this building was carefully calculated and underwent many different structural tests, it was executed with the mixture of old and new methods of construction. The curved shell of the Philips Pavilion was made of precast concrete panels. In a hangar, concrete was poured in mounds of sand whose surface was formed by hand according to that of the desired shape. After the precast panels were set and ready to use, they were lifted into place, at first supported by wooden scaffolding, and then fixed together into a coherent structure using prestressed wires, after which the wooden scaffolding was removed. While the method of prestressing the concrete was innovative, the concrete-casting method was remarkably primitive. These old and new methods of casting and assembling the concrete panels proved themselves to be an ingenious solution in realising such a complicated structure of Philips Pavilion, where casting the entire building *in situ* would have required much more skill, time and cost [fig 3.3].[8]

[8] For detailed accounts of construction processes of Philips Pavilion, see Marc Treib, *Space Calculated in Seconds* (Princeton, N.J: Princeton University Press, 1996), chapter 3; p. 52-97.



3.4 Interior Surface of Brother Claus Field Chapel, Germany, designed by Peter Zumthur in 2006. Photograph by Sanistas Pradittasnee.

A reliance upon old technologies was evident not only in modernist architecture, but persists in today's architecture. A particularly interesting case is Peter Zumthor's Brother Claus Field Chapel, built in 2006 in Mechernich near Cologne, Germany, where primitive ways of building were employed throughout the construction process. First of all, Zumthor designed a formwork in a tepee-shape timber. After that, everyday over a period of 24 days, local farmers poured a layer of 50 centimetres thick of rammed concrete around the tent-like formwork, piling the building up till it reached 12 metres high. Then, using the same process as for making charcoal, the timber formwork was burnt totally from the inside for three weeks, leaving burnt surfaces across the inner surface of the concrete. The floor of the chapel was then laid with lead which was melted on site. Setting up the tepee-shape timber formwork, ramming concrete, burning timber, and lead flooring, all are fundamentally primitive technologies. Nowhere in Brother Claus Field Chapel was advanced technology employed [fig 3.4].

What is clear from these examples is that innovative architecture is not always reliant upon constructional innovation. A new construction technique does not always replace older ones, but can sometimes be used in combination with old building techniques. Primitive building technologies have persisted in architecture longer than we usually acknowledge, and not only in the underdeveloped world, but also in the developed one. Edgerton's remark about technologies, that 'the seemingly old was much more important than we sometimes care to recognise' can just as well be applied to construction.[9]

Edgerton's argument is potentially more useful in thinking about construction than a theory which relies heavily on technological innovation like Structural Rationalism. In a sense, his argument is helpful to expand our understanding of architectural 'rationalism' – for if Structural Rationalism is a future-oriented concept, tending to dismiss older ways of building as non-rational, we might posit an alternative rationalism that is not predicated upon technological progress, but is rather a distinctive concept, justifiable in its own terms. Could there be a different version of Structural Rationalism which is not necessary derived only from technological advance? If Structural Rationalism always promotes technological progressivism, is there a theory that goes with technological regression or technological stasis? Can we step away from the fixation on the new, and still be 'Rationalist'? And if Structural Rationalism is a less than coherent concept, that does not always leads to a single solution, it is through examining the above questions that we might further expose some of the ambiguities of the concept and the variety of solutions.

Well-suited to the exploration of such the question is British architecture of the late-nineteenth and the early-twentieth centuries. Not only was the theory of Structural Rationalism never really developed in Britain, but it was also viewed with some suspicion there. In such circumstances there might emerge an alternative theory to Structural Rationalism. But before we go further, it

[9] Edgerton, *The Shock of the Old: Technology and Global History since 1900*, p. 51.

might be useful to ask why Structural Rationalism was not taken up in Britain, given that Viollet-le-Duc's writing had been translated into English since the 1860s.

The Reception of Structural Rationalism in Britain, 1874-1879

Robin Middleton raised this question in his article 'Viollet-le-Duc's influences in Nineteenth Century England', observing that: 'His Dictionnaires were widely used, a great many architects seem to have possessed sets; but they were looked upon as works of reference, repositories of information, providing brief and reliable histories of a whole range of buildings and features'.[10] From a reading of how British architects had referred to Viollet-le-Duc and by looking at the direct contact between them, Robin Middleton deduced that Viollet-le-Duc had little influence in England: 'No one knew quite how his theories were to be interpreted. […], English architects were unable to give convincing form to his ideas'.[11] Since an alternative Rationalist principle was available beforehand in the writing of the architect, A.W.N. Pugin, Middleton remarked that in Britain 'Viollet-le-Duc's theories seemed merely to reinforce Pugin's'.[12]

An analysis of articles in *The Builder* between 1874 and 1879 on theories of construction gives an idea of how limited was the take-up of Viollet-le-Duc's ideas in Britain. The first article in *The Builder* where Viollet-le-Duc's name came up was in relation to 'the division of labour'. The division of labour and its aesthetic consequences in relation to architecture, a major subject of John Ruskin's writings, was one of the central themes in architectural discussion in Britain. The tendency to establish an architect as a distinctive profession, separated from others occupations in building trades such as engineers, contractors and builders, prompted the issue of division of labour to be discussed more widely, especially on the separation between the architect and the

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[10] Robin Middleton, "Viollet-Le-Duc's Influence in Nineteenth Century England", *Art History* 4, no. 2 (June, 1981): p. 203.
[11] Ibid.: p. 214.
[12] Ibid.: p. 204.

engineer. The author of the article 'Viollet-le-Duc on "Architect and Engineer" ' was concerned with this problem, and referred to Viollet-le-Duc as follows:

> On the whole we may concur with the French architect in thinking that the nominal and ostentatious line of demarcation drawn between the two professions is a mistake to some extent, or, at least, is too hard-and-fast a division. It leads to a kind of encouragement to the architect to neglect construction, and an encouragement to the engineer to neglect beauty and expression in his building. And what M. Viollet-le-Duc hints is very true, that the existence of the two professions in their present very distinct form tends to lead each to a feeling of antagonism towards the others, and an indisposition to any system of mutual improvement or advice.[13]

The author, however, quoted Viollet-le-Duc only to agree with him on 'his amalgamation theory', since 'a breaking down, by degree, of the nominal wall of partition between the two professions, would have a beneficial tendency in softening the spirit of antagonism which at the present exists'.[14] But he saw the division of labour as a necessity for complicated construction of his time, and he disagreed with Viollet-le-Duc in his attempt to merge the two professions, architect and engineer, to become one. As he concluded:

> So far we may go with the French architect in his amalgamation theory, but not further. It is more a question as to nomenclature than as to the actual facts in the relation of the two professions.[15]

The second issue discussed in relation to in Viollet-le-Duc's principles is that of consistency and style in construction. In the *Builder* 1876, J. P. Seldon's remark in his article on 'Consistency and refinement' is not unlike Viollet-le-Duc's pursuit of a unity of construction, and indeed he referred to Viollet-le-Duc's *Dictionnaire* as the best illustration of this approach. Seldon wrote:

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[13] Anon., 'Viollet-Le-Duc On "Architect and Engineer" ', *The Builder* (Dec 12, 1874): p. 1026.
[14] Ibid.
[15] Ibid.

> Consistency could not be when the structure and the facade had no necessary connexion, and though refinement could be pedantically imitated, it was only as the lesson conned by copyists, who had nothing of their own to refine. Such as I have described it to you was the architecture of the past, a universal and intelligible language for all the nations of the earth: progressive, simple at first, and complex at last; consistent always; and refined when it reached sufficiently settled conditions. I knew nothing of "styles," but of style, in the sense M. Viollet-le-Duc has so ably treated of in his "Dictionnaire," it took the utmost account.[16]

Later on, in 1878, the idea of structure as a system of building support, independent from the material substance of a building, was followed by the anonymous author of the article 'Architectural Criticism', and this article shows the closest understanding of Viollet-le-Duc's doctrine. The author criticised architectural critics who attributed the ground for a new architecture to the change of society, instead of the change of construction system, as follows:

> They deplore the inability of modern architects to invent a new "style," and yet, themselves, admit the impossibility of such a consummation without the aid of inspiration derived from the advent of a new religion or a grand social revolution. In other words, these critics would have us to believe that, when the wished for crisis does arrive, new geometrical forms and combinations will be invented, which will become the symbolical representations of the ideas generated by the new era. […] this seemingly absurdity arrives from the fact that they confine their observations to the mere arbitrary forms of architecture, and not to the principles which govern those forms. [17]

He went further, almost paraphrasing Viollet-le-Duc:

> They imagine that a new style is to be obtained by the inventions of new forms, whereas the very reverse would be the case. A new style must be the outcome of a new system of construction. The forms which characterize the different phases of architectural art are governed by the system of construction; the system of construction is not made conformable to the arbitrary form of the art.

[16] Mr. J. P. Seldon, "Consistency and Refinement", *The Builder* (Jan 15, 1876): p. 59-61.
[17] Anon., "Architectural Criticism", *The Builder* (April 20, 1878): p. 402.

Invent a new system of construction, and, as a natural result, you will have a new style of architecture. [...] Style in architecture is not the result of peculiarity of ornamentation, but arises from constructive unity, and this is only to be found in Grecian and Gothic structures.[18]

Though the author did not refer to Viollet-le-Duc in particular, his idea of a system of construction is identical to Viollet-le-Duc's that all the best buildings were designed and built upon certain principle of structure, and if that structure was changed, so did its form.

While that article of 1878 apparently followed Viollet-le-Duc's precept, a year later H. Heathcote Statham in his article 'The Logic of Architectural Design' suggested something quite differently about architecture. For example, while Viollet-le-Duc saw architecture as the art of construction, this author comprehended architecture as 'the art of building with expression'.[19] Of Medieval architecture, the author went on to say:

> A point to be noticed was that while in the earlier form of Gothic vault the ribs were really constructional, in the fan vault they had ceased to be so, and were merely an expression, […] the whole design of the Mediæval building became a precise expression of its construction.[20]

Interestingly, Statham's emphasis on constructional expression over the real construction here is reminiscent of Robert Willis' distinction between the real and the apparent structure.

On this evidence from *The Builder*, Structural Rationalism never formed part of architectural discourse in Britain. British architects referred to Viollet-le-Duc's text in order to support their own architectural customs. While Viollet-le-Duc pursued constructive unity, urging for coherence and consistency in construction, what we have seen in British discussions about construction was

[18] Ibid.
[19] H. Heathcote Statham, "The Logic of Architectural Design", *The Builder* (Feb 8, 1879): p. 148.
[20] Ibid.: p. 147.

that they referred to more local questions, sometimes introducing references of Viollet-le-Duc into these. As William H. White observed in 1874 that:

> It is well known to professional men, that isolated sentences from the writings of M. Viollet-le-Duc and others, can be quoted to support the Reviewer in parts of his argument and some of his assertions.[21]

This observation draws attention to how very partial the reception of Structural Rationalism in Britain had been. Rather than accept Viollet-le-Duc's principles, British architects and theorists, while reading it and making use of it to some extent, never understood it in the sense that Viollet-le-Duc had urged. The reason that the impact of Viollet-le-Duc's doctrine was weak may have been due to the fact that the British architectural circle had been dominated by the local architectural writings; for example, of John Ruskin, A.W.N. Pugin, James Fergusson and Robert Willis. It is not surprising to see that when British architects referred to Viollet-le-Duc's writings, they mixed what they read in Viollet-le-Duc with the local issues developed by the local theorists. Arguments about 'the division of labour', 'common sense', 'the picturesque' and 'apparent construction', for example, were all strengthened by references to Viollet-le-Duc.

Whatever the circumstances of the parallel development between 'technology' and 'rational' architecture in other countries, it is apparent that in Britain this was not the only way architecture developed, and so, there is no reason to assume that the development of architecture is, in any way, destined to follow that of technology. Just as technology could be interpreted more openly according to cultural variation, so too 'rationalism' could perhaps take other forms other than Structural Rationalism. The view that rationalism is not absolute, but can be taken place in different forms, has been proposed before in Alan Colquhoun's article: 'Rationalism: A Philosophical Concept in Architecture'. As he said,

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[21] William H. White, 'On "The Hope of English Architecture" ', *The Builder* (1874, Dec 19): p. 1044.

> The definition of the "rational" in architecture has not remained constant throughout history. We are dealing not with a simple, static concept, but with one that had varied according to the constellation of ideas dominating particular historical phases. These changes of meaning are dependent on changes in ideology and cannot be considered independently of either economic and social factors or philosophical ideas.[22]

Colquhoun's argument is particularly fitting to the British situation in the late-nineteenth and early-twentieth centuries. The particular circumstances in Britain which gave rise to a different sort of 'rationalism' came about through change in both ideology and philosophy. Ideas of 'development' in religious circle after the 1860s, and the development of 'common sense' philosophy, initiated by the thinkers of eighteenth-century Scottish School, both had some impact on 'rational' development in the nineteenth and twentieth centuries in British architecture. While the first is associated with technological stasis, the second represents ambivalence attitude towards progress and development. Since they did not prioritise 'progression' as important feature of their concepts, it is through these two local ideas, the reaction against the idea of 'development', and attachment to 'common sense' that a different version of 'rationalism', as distinct from Structural Rationalism, might emerge.

'Sacramentality': The Reaction Against the Idea of Development.

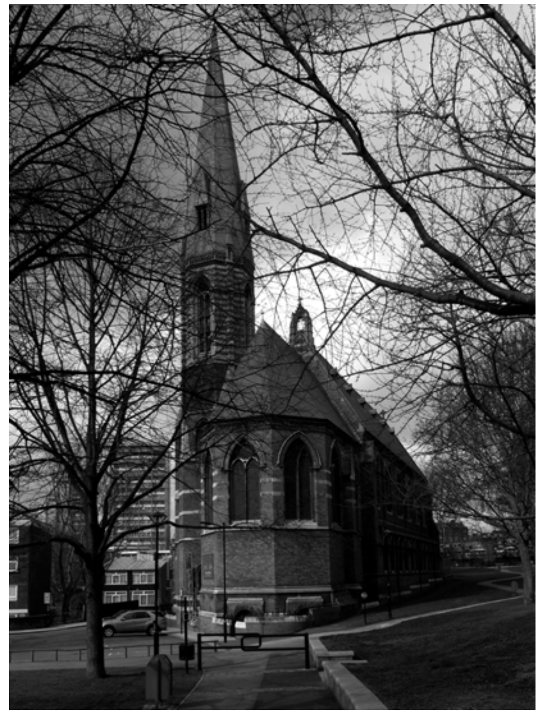
The first circumstance that gave rise to an alternative notion of rationalism in Britain, as distinctive to Viollet-le-Duc's views, is the changing attitude towards the idea of 'development' that occurred in religious circles after the 1860s. The reaction against the idea of development as occurred in church buildings is studied by Michael Hall in his article 'What Do Victorian Churches Mean?' It is worth discussing it briefly here.

[22] Alan Colquhoun, "Rationalism: A Philosophical Concept in Architecture", in *Modernity and the Classical Tradition: Architectural Essays 1980-1987* (Cambridge, Massachusetts; London, England: The MIT Press, 1989), p. 58.

Hall's argument takes as its starting point the belief common in mid-nineteenth century Britain that church building embodies religious meaning. He argued that there was a connection between the way in which the Christian doctrine was understood and the way in which church buildings had developed. In particular, he pointed out that it had been through 'the idea of development' that gave rise to a dramatic change in the architecture of church buildings of the mid-nineteenth century. Hall showed that just before 1860s, the main idea in religious doctrine was the idea of development, and this idea had been applied to the work of architecture, so that as he said: 'If doctrine could develop, so surely could architecture'.[23] Yet around the 1860s, a rejection of the idea of development started to occur, first in religious thought and science, and later in architecture. According to Hall, a sacramental doctrine emerged with a new teaching that in fact religious doctrine was not about development, as had previously been understood, because it lay beyond time. This new understanding came partly from an anxiety that the new discovery in science (such as Darwin's *On the Origin of Species*) meant that science no longer proved or supported religious teaching, thus causing 'the loss of confidence in the union of art and science'.[24] As Hall put it: 'The possibility that science might confirm religious teaching had receded, and with it the force of metaphors drawn from the natural world in ecclesiastical architecture and art'.[25] Hall observed the consequence of these changes in architecture, and suggested that architects had disregarded the sort of element associated with the idea of development in church buildings. Just as the doctrine was not about development, so a church – a physical expression of that religious meaning – should not be about development either. With the new understanding in the sacramental doctrine reacting against the ideas of progress, church architecture was then reinterpreted as 'a building that stands outside time […] the church elides

[23] Michael Hall, "What Do Victorian Churches Mean? Symbolism and Sacramentalism in Anglican Church Architecture, 1850-1870", *Journal of the Society of Architectural Historians* 59, no. 1 (Mar 2000): p. 80.
[24] Ibid.: p. 84.
[25] Ibid.

3.5 St. James the less, 1860-61, designed by G.E. Street, photographed in 2010.



3.6 St. Mary Magdalene, 1868-78, designed by G.E. Street, photographed in 2010.

past and present'.[26] Hall concluded that 'an architecture that is designed to reinforce that belief about humanity's relationship with eternity is entitled therefore to reject the idea of historical development or progress in design. In heaven, there are no revivals'.[27] Accordingly, it was this new emphasis on timelessness in the 1860s-1870s, as an alternative to the idea of development of 1840s-1850, that caused architects to turn back to original state of Christian architecture. There ceased to be an expectation that churches should reveal evidence of development; ultimately, the architecture of this period was referred back to the stage of origin.

Convincing though Hall's argument is about the close connection between religious teaching and architecture, what actually occurred in church buildings just after 1860s did not always quite correspond to his argument. A number of churches built in 1860s were still developmental; St. James the Less and St. Mary Magdalene in London, for example, both designed by G. E. Street,

[26] Ibid.: p.87-89.
[27] Ibid.: p. 94.

used an evolved Gothic Revival architecture [fig 3.5, 3.6].[28] The reinvented Gothic elements that appear in Street's churches go against Hall's argument. Both still belonged to developmental theory of Gothic Revival, and are not 'sacramental' in Hall's terms. Perhaps a better example of Hall's argument of 'a building outside time' occurred later, in the 1890s, at Westminster Cathedral.

While Michael Hall makes clear the close connection between the change in religious doctrine and that of architectural 'styles', what is less clear, and is where I would like to extend Hall's argument little further, is the connection between doctrinal thinking and structural development in architecture. Did the changing attitude towards time and history have anything to do with construction? If a church was reinterpreted as a building standing outside time, what was the consequence for its construction? Westminster Cathedral, from the design of which ideas of 'development' were specifically excluded, serves as a promising site for our investigation of these questions.

J.F. Bentley's Westminster Cathedral

Although most architects in the 1890s were enthusiastic about the Gothic Revival, regarding the Gothic Style as a proper form for a church, Cardinal Vaughan of Westminster Cathedral disagreed with such an assumption and went on to adopt another kind of architecture. His idea not to build the new cathedral in the accepted style of the time, i.e. Gothic, was deliberate in order to distance it from Westminster Abbey, so well-known for its magnificent Gothic style, but it could be seen as an attempt to step outside time, too. The cardinal's approach was shared by the architect, John Francis Bentley [1839-1902]; although Bentley's initial thought for Westminster

[28] I owe this observation to Adrian Forty.

Cathedral had been to build it in Gothic (partly because this was the style in which he had been trained in his formative years), he later came to agree with the cardinal's view.

> It was thought by the Cardinal that to build the principal Catholic church in England in a style which was absolutely primitive Christian, which was not confined to Italy, England, or to any other nation, but was, up to the ninth century, spread over many countries, would be the wisest thing to do. Personally I should have preferred a Gothic church; yet, on consideration, I am inclined to think the Cardinal was right.[29]

Pursuing a sense of primitivism, Bentley selected Byzantine architecture as the prototype for Westminster Cathedral, as it could communicate the religious purpose of returning to the stage of origin. He wrote:

> What gives the building of this period a pre-eminence, and a greater interest over any other, is that it was the first phase of Christian Art; that it expressed in full the hallowed genius of Christianity, and was the outcome of a sensitive æsthetic people inspired by the Seers of Patmos.[30]

In a private latter to Charles Hadfield, Bentley expressed his thoughts on how the cathedral should be built:

> I feel that the old principle of construction is carried on, and that curse of modern construction and source of decay – the use of iron (or steel) – has been avoided, against the consensus of opinion expressed by the engineers; this much I am proud of, for I feel that a service to building has been effected, and that I have disproved, and broken the backbone of that terrible superstition, that the use of iron is necessary to long spans.[31]

Bentley's reinstatement of the 'primitive Christian architecture' for the building of Westminster Cathedral is nothing less than an apotheosis of the old. His idea of building the structure of Westminster Cathedral without the use of any advanced technological innovation, but calling instead upon the old methods of working, was polemical, since Bentley proposed to

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[29] Charles Hadfield, "Westminster Cathedral", *RIBA Journal* X (1902-3): p. 251-252.
[30] As quoted in Ibid.: p. 252.
[31] As quoted in Ibid.: p. 258.

3.7 *Top*, General view of Westmister Cathedral, seen from South-East,
from Winefride de L`Hôpital, *Westminster Cathedral and its architect*, 1919, p.62

3.8 *Below*, Plan of Westminster Cathedral,
from W.R. Lethaby, 'Westminster Cathedral', *Architectural Review,* Vol.11, 1902, p.4

build Westminster Cathedral in antithesis to the supposition that a long-span building was possible only with iron construction. Contrary to the general, more progressive view that was so keen on the development of building technology, his proposition was that significance in architecture was not necessarily based upon advanced technology of building methods and materials, and hence it was possible to ignore them. If his desire for primitive, low-tech construction at the end of the nineteenth century was not because of a lack of access to technological novelty, what reasons were there? [fig 3.7, 3.8]

Bentley's solution of not using iron, but to use another 'modern' material of concrete, and to use it in a way which was consistent with older ways of building, suggests that he deliberately chose not to project his building into the future, but to let it remain, in technical terms, in stasis, or undeveloped. His attempt raises some questions not only about a possible solution of a building outside time, but also a possible alternative to a technological orientated theory like Structural Rationalism.

What does it mean to resist using a new technology deliberately? Is there a theory that goes with this technological regression, or is it just backward-looking and reactionary? Can a resistance towards technological progressivism be compatible with a theory of construction? If Structural Rationalism tells us that time is always moving forward, are there other ideas about time that can communicate through a theory of construction? Is there a theory of construction which can communicate alternative versions of time, other than that of progress?

When it comes to construction – a practice that is always attached to material reality – to consider construction as something outside time is more complicated. At any given time of structural development, it is difficult, if not impossible, for an architect to find an approach to construction that is 'outside time'. The choice of construction methods and materials is inescapable. Since there are always preferred or available technologies at any one time, whatever the architect does, whether he adopts new constructions, or, equally, he refuses to adopt them, he is taking a position towards time and temporality. It is virtually impossible to escape from the dimension of time within the language of construction. Lying within the linear route of time and always put against the past, construction, seen in these terms, does not lend itself to 'sacramentality'. The difficulty is that by abandoning the 'safety' mode of contemporary construction of iron construction, it seems likely that the architect put himself at risk of having no basis for decision at all. Can construction be made to behave as if stepping outside the flux of time? What might be the equivalent of 'sacramentality' in construction? These are the problems with which the making of Westminster Cathedral was concerned.

In June 1895, the construction of Westminster Cathedral began. The new building rested on the existing foundations of the old prison, which partly underlay the site. This existing 9-feet thick concrete platform saved considerable money on the foundations, although in some parts of the platform, new concrete needed to be poured to level the foundation and improve its firmness.[32] Furthermore, an additional foundation of brickwork was added to the lower concrete foundation, taking 10 months between January and October of 1896 to be finished. For the erection of building up to the level of the domes and vaulting, brick was the main material both for interior and exterior walls, but stone was used as well for external dressing, while free-standing columns were all made of marble.

The Building of Mass-Concrete Domes

Above the wall level, concrete domes were erected, and this is perhaps the most interesting part of the construction where Bentley's 'theory' is implicit. Buildings with long spans have always challenged architects and engineers, and Westminster Cathedral, whose nave is sixty feet wide – by far the widest nave of any cathedral in Great Britain – is a case in point. While architects and engineers often employ technological novelty to create a long-span building, what was unique at Westminster Cathedral was that Bentley envisioned covering the long span with homogenous concrete domes, without recourse to the use of steel or any technological advance. Indeed, the technique of erecting the domes at Westminster Cathedral remained virtually as primitive as that of the Ancient Romans.

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[32] Winefride De L'Hopital, *Westminster Cathedral and Its Architect*, 2 vols. (London: Hutchinson and Co., 1919), vol.1, p. 63.

The work of erecting the dome and vaulting started in November 1899 and was completed in July the following year. To maintain such traditional method in making the domes, the first task, and one that was highly important, was to build the wooden centering. But, it should be noted that at first Bentley considered to erect the domes by saving much centering – a technical solution that could achieve great economies – by 'using cast segments of a sphere and building them up into domes'.[33] There is no record as to why this audacious method was abandoned, though Hadfield wrote: 'This, no doubt, was a practical constructive scheme, but probably it would have had a tendency to thrust outwards, and it was by degrees that he [Bentley] came to abandon this method for that of a homogenous mass of concrete thrown on to a *centering* (really the expensive part of the method)'.[34]At the end, the domes were poured with unreinforced concrete on a full-centering.

Vaulting for such massive domes with traditional wooden centering called for an enormous amounts of timber, so much that Bentley's daughter, Winefride De L' Hopital, said that the interior of the cathedral 'almost resembled a great forest'.[35] Bentley's method for erecting the domes therefore did not save on centering, and was as primitive as the technique of earlier builders, yet Hadfield praised Bentley's solution as economical.

> I submit that this outlay had been proved to be true economy, both in the light of results obtained and, possibly, of the outlay incurred. Had his first idea been carried out, the construction might have been a less perfect one […]; and,

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[33] Hadfield, "Westminster Cathedral", p. 260. It is worth nothing that Lethaby regarded the technique of saving centering as Byzantine method of construction. Referring to Choisy, Lethaby wrote: 'Byzantine builders endeavoured to suppress preparatory and auxiliary work, and to execute their vaults and domes without centering. "The greatest number of their vault […] rose in space without any kind support…" '. see W.R.Lethaby, *The Church of Sancta Sophia Constantinople: A Study of Byzantine Building* (London and New York: Macmillan & Co., 1894), p. 199.

[34] Hadfield, "Westminster Cathedral", p. 260. (in square brackets added)

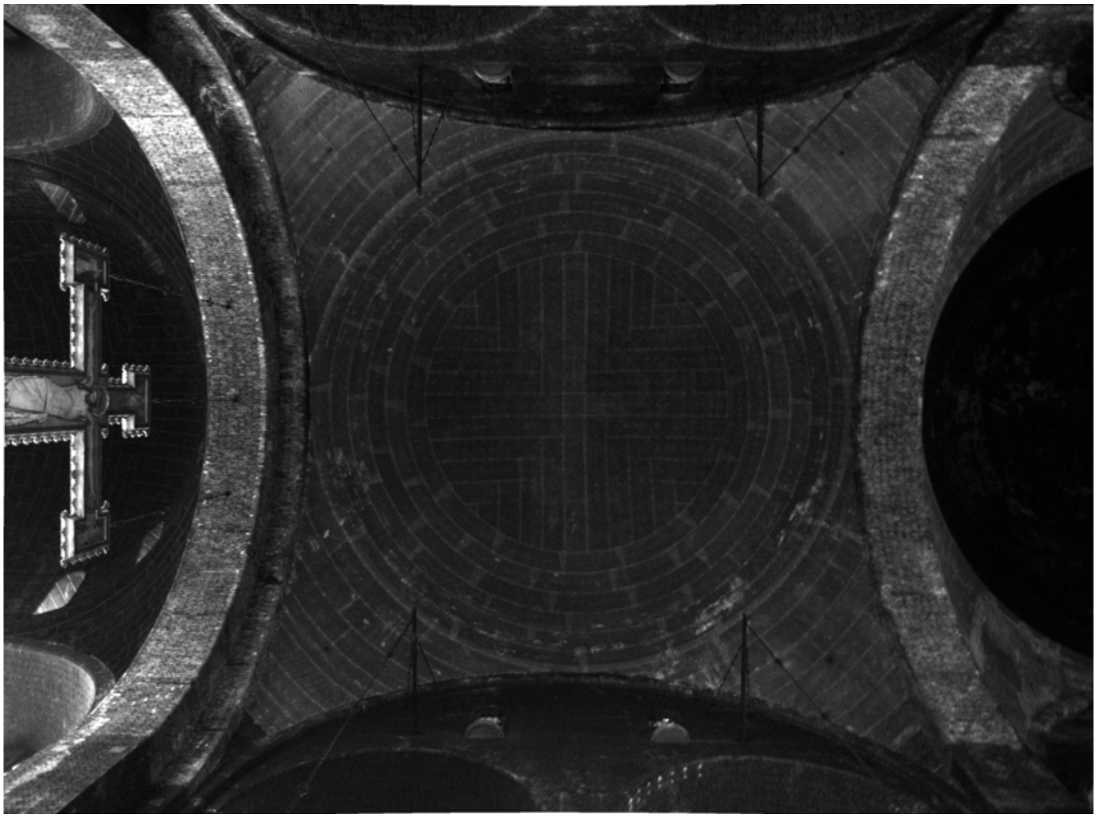
[35] L'Hopital, *Westminster Cathedral and Its Architect*, p. 87.

3.9 The J. Muirhead Bone's Sketch of Westminster Cathedral's Interior, underconstruction, from Halsey Ricardo, 'John Francis Bentley', *Architectural Review* 11 (1902), p.154.

> moreover, liable to the constructive failure which the history of our craft tells us have occurred time after time since the age of Justinian.[36]

Perhaps it was not so much a matter of being economical that Bentley was concerned about as to how the building might be built without being 'developmental'. For, apparently, there was nothing novel or challenging about the structural solution in the executed scheme, but on the contrary it was unexciting and prosaic. But his concern with 'primitive Christian architecture', and with 'timelessness', might mean that he preferred a construction that was neither too subtle nor too technically advanced – one that might show 'developmental' overtones. To be out of time, the construction had to be in a non-time-bound building technique [fig 3.9].

[36] Hadfield, "Westminster Cathedral", p. 260.



3.10 The Inner Surface of Westminster Cathedral Dome unveils the trace of boarding after the wooden formwork was removed, photographed in 2010. The traditional method of casting mass concrete upon wooden centring without reinforcement was carried out for the building of what was then the largest dome in England.

Vaulting the domes using centering called for traditional procedures in much the same way as earlier methods of working. The centering, which spanned 60 feet internally and rose to a height of 90 feet, had to be strong enough to bear the massive weight of concrete, and also rigid enough to 'preserve the true curvature of the concrete, until it had finally set' – the features that demanded high level of workmanship [fig 3.10].[37] As the architect John A. Marshall wrote in 1907: 'Full responsibility for the centering rested with the builder who had contracted to carry out the work; and if his method lacked the daring and skill of a Brunelleschi, or a Fontana, he certainly incurred no risk, and did not stint the timbering'.[38] The concrete used for all parts of the domes composed of 'four parts of broken brick to one part of Portland cement, mixed carefully together

[37] Mr. John A. Marshall, "Westminster Cathedral: Paper Read before the Architectural Association, on the 12th April, 1907", *AA Journal* (May 1907): p. 123.
[38] Ibid.

3.11 **‘Sacramentality of Construction’.**
The Structural Detail of mass concrete dome over the nave, Westminster Cathedral. From Winefride de L`Hôpital, *Westminster Cathedral and its architect*, 1919, p.89

with the least possible quantity of water, the broken brick having been well saturated before the cement was added’.[39] Next, sand was then thrown over the surface of the centering. This would prevent the adhesion of concrete to the wooden formwork and make easy the removal of the formwork beneath the finished domes. Then, tons of concrete, previously mixed, was poured onto the wooden centering ‘in a series of superimposed rings of concrete averaging 4ft. in width’.[40] At the base of each dome, where the horizontal stress is greatest, the concrete shell was built to a thickness of 3 feet, and it then tapered to only 13 inches at the top, at which point the oculus is left open. As we have seen, nowhere in the construction of Westminster Cathedral does it suggest anything developmental, nor was it required a complicated solution of building technique [fig 3.11].

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[39] L'Hopital, *Westminster Cathedral and Its Architect*, p. 90.
[40] Marshall, “Westminster Cathedral: Paper Read before the Architectural Association, on the 12th April, 1907”, p. 123.

Just as the construction was conceived of as primitive, so too was its building process, which was carried out under the old system of contract pricing known as 'measure and value'. According to this system, Bentley was responsible for measuring the amount of the work done at each stage of construction, and for authorising payments to the tradesman according to the amount of the work finished, thus avoiding the possibility of piling up of debt. As De L' Hopital observed,

> Every fortnight the work was measured up by Mr. A. J. Gate, the surveyors to whom for many years had been entrusted the quantities of Bentley's works, and the contractors received payment for it immediately on presentation of the architect's certificate.[41]

By this date, the system of 'measure and value' was rarely used except for restoration work, as it was most usual to build with a general contractor using a contract 'in the gross', whereby the overall price of the building was known in advance. 'Measure and value' was an older system, though it persisted in certain kind of building contract, was not normal for such a large building as Westminster Cathedral. The choice of the 'measure and value' system may have had something to do with that fact that the owner, the Catholic Church, wanted to have more control over the costs of the building, since, as it was not allowed to borrow money, all the money for construction had to come from fund raising. It may be that the Catholic Church saw the old system of 'measure and value' as better suited to regulating the speed of construction to their fund-raising; if so, the strategy was successful, for it was reported that no debt was ever incurred.

If the idea of sacramentality embeds in the construction and in the building process, the third element, where the idea is played out, is the material of concrete. As a modern material, concrete, has generally been emphasised for its innovative aspect; that it is capable of offering new possibilities in the design of structure, yet Bentley's used of concrete at Westminster Cathedral does none of those audacious characteristics. Carried out by seemingly primitive ways of

[41] L'Hopital, *Westminster Cathedral and Its Architect*, vol.1, p. 69.

3.12 The Outer Surface of the Nave Dome, Westminster Cathedral, was clad with artificial stone slabs before totally waterproofed. From Charles Hadfield, ‘Westminster Cathedral’, *RIBA Journal X* (1902-03), p.264.

building, the un-reinforced concrete dome became a means to expose the mistaken supposition that long-span buildings must be built of advanced technology.

Practically, the nave domes were built in double layers, between which the air-gap of three or four inches is provided for keeping consistent the interior temperature. The outer domes are made of artificial stone slabs [fig 3.12]. Once installed, the outer shells were covered with leadwork, protecting the concrete from the rain. Lethaby wrote,

> The outer casing is of concrete slabs bedded on ribs which rest on the inner dome proper. This shielding of the dome, while allowing a free passage for air and for any water which may get through, seems to be an admirable expedient, and in the truest sense original – an originality which is no caprice, but reaches out from the firm ground of necessity’.[42]

[42] W.R.Lethaby, “Westminster Cathedral”, *Architectural Review* 11 (1902): p. 3.

Lethaby's remark here is interesting, for he suggested that the method Bentley employed here, though simple, is not without originality. For a principle of the vaulted system, we would again refer to Lethaby, whose remark on the vaults of S. Sophia makes explicit his theory of construction. In his book *Sancta Sophia* (the book that Bentley claimed as one of the most important references to the design of Westminster Cathedral: 'San Vitale at Ravenna and Lethaby's book really told me all I wanted'.[43]), Lethaby wrote 'the gradations being gentle and the means less obvious, the forms are more like those found in nature, and the result is extremely beautiful'.[44] A similar idea of structural theory reappears again when Lethaby made a remark on the interior of Westminster Cathedral.

> Inside all is different. You step over the threshold of the cardinal's door, and the instant impression is that of reality, reason, power, serenity and peace. Almost a sense of nature – the natural law of structure.
>
> The great size of this reservoir of air at once frees our imaginations. The height and distances allow of that blueing of the atmosphere which turns it from mere nothingness into a visible entity – a portion of Space, a slice of Infinity, fit symbol of the Infinite. […] The obvious sense and soundness of the structure here beats down all the mutually destructive opinions of experts in taste.[45]

Within the undecorative, unfinished structure, the overwhelming volume of the space, Lethaby saw as capable of communicating the spiritual, and out of such abstraction of 'reality, reason, power, serenity and peace' came Lethaby's *natural laws of structure.* Being set against the idea of 'taste', while at the same time having a close affinity with 'reason', Lethaby's rationalism, as implicit here, urges neither visual sign of support, nor has it anything to do with technology progression, but rather it is more to do with spiritual satisfaction [fig 3.13].

[43] L'Hopital, *Westminster Cathedral and Its Architect*, vol.1; p. 35.
[44] W.R.Lethaby, *The Church of Sancta Sophia Constantinople: A Study of Byzantine Building*, p. 222.
[45] W.R.Lethaby, "Westminster Cathedral", p. 6.

3.13 Westminster Cathedral’s Interior, photographed in 1902: ‘**Almost a sense of nature – the natural law of structure**’, wrote Lethaby. For Lethaby, the undecorative, unfinished structure of Westminster Cathedral gave rise to spiritual satisfaction. From Conway Library Collection, Courtauld Institute of Art.

What we see at Westminster Cathedral’s domes is an essentially traditional method of vault construction applied to the ‘new’ material of concrete. Concrete, though virtually a modern material at the time, was used in a manner consistent with the means of Roman builders, without employing any advanced technology. While Structural Rationalists argued that a new material like concrete must bring about a new form of architecture, leading architecture towards progressive development, to use concrete just as it had been in older building methods would have been unsatisfactory to the Rationalists, for it would betray the 'technological rationality' of the new medium. But Bentley's way of using concrete can be understood in terms of the reaction against the idea of development and a building outside time – the particular ideas circulated in religious circles and church buildings since the 1860s. At Westminster Cathedral, if being beyond time meant returning to the style of primitive Christian architecture, the same idea seems to have been applied in the construction, the building process and the material used. While the language of construction always attaches itself to time and temporarity, and any attempt to escape from these is always doomed to failure, at least Bentley appeared to succeed in offering an alternative way of thinking about construction and material, treated not as something that project into the future, but as something in stasis, remaining the same as the past. Primitivism, as an architectural ideal pursued in the making of the cathedral, gives the construction of Westminster Cathedral exemption from the progressive linearity of time. As a result, the construction of Westminster Cathedral gains value in 'sacramental' meaning, but not in terms of dynamism of temporality.

The ways in which Francis Bentley approached construction through the ideas of 'sacramentality' offer a distinctive theoretical proposition. While a modernisation theory always told us that architecture must always be ever-developing, yet the construction processes of Westminster Cathedral shows that the significance of old building technologies could be continued with new materials to produce results that were distinctive, without being attached to 'progress'. British 'rationalism', as demonstrated in this great early-modernist building, while being accompanying towards the past and tradition, deserves to be recognised as a distinct 'theory' of construction, different from that of Viollet-le-Duc.

Common Sense

If the reaction against the idea of development gave rise to one alternative notion of rationalism in Britain, another is connected with 'common sense'. As well as being a way of thinking about the world, 'common sense' was also a way of thinking about architecture in relation to 'rationalism'. The nineteenth-century Scottish architectural historian, James Fergusson, for example, showed a particular attachment to 'common sense'. He wrote: 'The only hope is that the absurdity of the present practice may lead to a reaction, and that Architecture may again become a real art, practised on some rational basis on common sense'.[46] Similarly, William Lethaby, who connected what he thought of as 'rational' with 'common sense' on many occasions, wrote in his 1895 article 'Modern Building Design: Positive Conditions', as follows:

> It was not by some impossible return to some art Eden, a general agreement on a "point of departure" and a "point of view," but a common sense adaptation of means to ends […], there were surely infinite possibilities open to a rational growth of architecture, which should examine once again the first ground-work.[47]

From their remarks, it is evident that both Ferguson and Lethaby referred to the 'rationality' of architecture, which was *not* identified with the 'universal rationality', but could be linked with the local idea of 'common sense'. To understand what is meant by 'Rationalism' in British architecture, we need also to look more closely at the concept of 'common sense'.

As a concept, 'common sense' is a way of thinking, of make judgments about the world. The concept was first developed in Philosophy, especially by those thinkers of the eighteenth-century Scottish school. The general aim of common-sense philosophers, like

[46] James Fergusson, *History of the Modern Styles of Architecture: Being a Sequel to the Handbook of Architecture* (London: John Murray, 1862), p. 299.
[47] W.R.Lethaby, "Modernism Building Design: Positive Conditions", *The Builder* (Nov 9, 1895): p. 334.

Thomas Reid in the eighteenth century, G.E. Moore in the twentieth century and others, was to find grounds for the possibility that common sense could establish the truth of judgements, and that such judgements might be of equal value as those that derived from logic and reason. While common sense, as Thomas Reid said, 'is another name for one branch or one degree of reason', common sense is not based on rules, and any attempt to lay down definite rules would destroy the core of the concept.[48] Common sense, in a way, is a body of knowledge based on human experiences supposed to be shared amongst people in common; 'there are principles implanted in our nature', the eighteenth-century philosopher Lord Kames said, 'that permit us to draw certain conclusions that reason alone does not establish, and it is such tendencies of our nature that we need to rely upon as a basic source of truth'.[49] Common-sense judgement, while supposed to be comprehensible to all, was not rooted in definite rules, it was as the philosopher Kant pointed out 'judgement universally communicable without concepts'.[50]

Antidote to Specialised Knowledge and Expertise

Recent studies in the philosophy of common sense have suggested that the anxiety over the division of labour and the popularity of common sense were related events. It is observed that: 'The increase in specialized knowledge causes a decrease in proportion of common knowledge held by members of that society',[51] and therefore common sense becomes most valued when people feel anxious about the claims of experts. Seen in these terms, it comes as no surprise that in nineteenth and early-twentieth century Britain when the division of labour and specialisation was having such marked effects on society in general, and on building production in particular,

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[48] Thomas Reid, *Essays on the Intellectual Powers of Man* (Edinburgh: J. Bell, 1785), p. 530.
[49] Lord Kames Henry Home, *Essays on the Principles of Morality and Natural Religion* (Edinburgh: R. Fleming, for A. Kincaid and A. Donaldson, 1751)
[50] As quoted in Frit van Holthoon and David R. Olson, "Common Sense: An Introduction", in *Common Sense: The Foundations for Social Science*, ed. Frit van Holthoon and David R. Olson, *Sources in Semiotics, Volume Vi* (Lanham: University Press of America, 1987), p. 6.
[51] Ibid., p. 9.

common sense became central to British architectural discussions. The frequency with which it was used by British architects and the value they gave to the concept prompts us to ask what 'common sense' meant to them. To what extent was 'common sense' used and developed in nineteenth and twentieth centuries British architecture? Did the concept 'common sense' represent a distinct current of architectural theory, a 'theory' with which to resist the 'expert'?

The presence and persistence of common sense as an alternative approach in architecture is evident in the writings of many British architectural writers. In his *History of the Modern Style of Architecture* of 1862, the nineteenth-century Scottish architectural historian James Fergusson identified the cause of the decline of architecture in his own time as due to its inaccessibility to common peoples. In his criticism of St. George's Hall, Liverpool, for example, he pointed out that its Classical rules, though praised by experts in the arts, were nevertheless incomprehensible to much of general public. Ferguson wrote:

> The learned in Art, for instance, go into ecstasies on observing the purity of style and correctness of composition which pervade every part of St. George's Hall, Liverpool. It recalls every association we ever felt in contemplating Classical Art, and reproduces all we ever dreamt of as great or good in the best age of that school. But common people do not feel this. […] What an uneducated man would appreciate and admire would be elegance combined with common sense, while the only things that offend an educated man would be faults which are equivalent to false quantities and errors of grammar.[52]

For Fergusson, 'common sense' gained a universal accessibility greater than the abstract rules of proportions and geometry exercised by the experts, and his aim was to restore 'common sense' once again into architecture.

[52] Fergusson, *History of the Modern Styles of Architecture: Being a Sequel to the Handbook of Architecture*, p. 329.

A similar attitude towards common sense as an alterative approach to that of those experts was also present in J.P. Seldon's article on 'Consistent and Refinement' of 1876. Seldon said 'we do not want genius so much as common sense […] it really matters comparatively little whether Nature has endowed you with genius or not, for if you will keep in the right road, and obey the dictates of common sense, your work will be right, if not brilliant, and in time is sure to bring its reward'.[53] In an 1879 article titled 'Common sense in Architecture', moreover, Cole Adam attributed the loss of common sense in architecture to the practice of professionalism: 'I believe that the main cause lies at the root of professional training'.[54] He then went on to say that architects could regain common sense by knowing the 'practical aspects' of building processes – an experience that architects working only in the office would normally lack.

> It should be an understood thing in the articles of agreement that a pupil should spend a large part of his time upon works in progress, that he might see for himself what drawing mean when carried out, learn the different modes of construction, – from foundations to paintings, – be compelled to make measured drawings from the work, accurately showing how the parts are put together, and to make himself familiar with the terms and method used in buildings. Better still, that after his pupilage was up he should, if it can be managed, be sent for a couple of years or so to a large builder, and there taught the practical side entirely of the question, even to manual labour, and that perplexing study, a builder's account. Engineers do this, and their works are pre-eminent for common-sense. Why should not architects made themselves also familiar with the capacities of the materials in which they will have to work?[55]

While referring the idea of 'common sense' in various different ways, what these architectural writers shared was the belief that common sense provided a basis on which to criticise a more restrictive view of architecture. To some extent, common sense came to be seen by British architects as a 'theoretical' construct, an alternative to that exercised by rules, whether those rules

[53] Seldon, "Consistency and Refinement", p. 59.
[54] Mr. Cole A. Adam, "Common Sense in Architecture", *The Builder* (Dec 27, 1879): p. 1427.
[55] Ibid.

were proportions, geometries or styles. To see how far this was really the case, let us then look further at the way in which this concept had been used theoretically in British architecture.

While the concept of common sense served as an alternative ground for architectural judgement, it came to be treated in architecture both in positive and negative senses. Because common sense involved not only basic beliefs, held by common people, but also appealed to an improvement founded on that belief, common sense could be both conservative and progressive, and this ambiguity characterised its uses in nineteenth and early-twentieth century Britain.

To begin with the positive usage, common sense allied with the idea of progressiveness. This progressive aspect of the terms is present in James Fergusson's *An Enquiry into the True Principle of Beauty in Arts*, when he praised the success of engineering works in Britain:

> Of those arts which in this country have been cultivated on the most common-sense principles, and consequently which have been most essentially progressive, there is none more remarkable than that of Civil Engineering […] and if take any series of engineering works […] we shall easily see how progress is effected.[56]

Moreover, in his *History of the Modern Style in Architecture*, Fergusson reinforced the progressive sense of common sense as follows:

> This [common-sense style], never having attained the completeness which debars all further progress, as was the case in the purely Classical or in the perfected Gothic styles, not only admits of, but insists on, progress […] Its greatest merits is that it admits of that progress.[57]

It is clear from Fergusson's accounts here that an ability to improve upon precedents is most important for the common-sense principle.

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[56] James Fergusson, *An Historical Enquiry into the True Principles of Beauty in Art* (London: Longman, 1849), p.158.
[57] Fergusson, *History of the Modern Styles of Architecture: Being a Sequel to the Handbook of Architecture*, p. 329.

Since historical precedents provided the source of the lost common sense architects wanted to recover into their architecture, it became a normal justification for architects to study past architecture. Alfred Bartholomew, for example, wrote in his *Specifications for Practical Architecture*: 'The use at present in architecture of a little of that which most persons consider to be common sense, which is always to be found in the works of the ancients, joined to their exhibition of first-rate intellect, seems to set a modern self-made architectural critic, into a fit'.[58] Moreover, in his research on the church of Sancta Sophia, Lethaby wrote in the preface that:

> A conviction of the necessity for finding the root of architecture once again in sound common-sense building and pleasurable craftsmanship remains as the final result of our study of S. Sophia, that marvellous work, where, as has so well been said, there is no part where the principles of rational construction are not applied with "hardiesse" and "franchise."[59]

Furthermore, in his article 'An Architectural Symposium', Lethaby wrote:

> But above all this, there was something too in a finished old work – a certain feeling of pleasant humanness in the work – which we should observe. In this way we should try to substitute an ordinary, rational way of common-sense building for the prevailing chaos of architectural design.[60]

The value of common sense sought by these architects lay in work produced by predecessors earlier in the evolutionary progress, and it was the task of present architects to improve on it according to present circumstances. It is in this 'revivalism' aspect of common sense that it always lent itself to ever-developing process that prompted James Fergusson to referred to the Renaissance Revival as that: 'it [the Renaissance Revival] introduced common sense into

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[58] Alfred Bartholomew, *Specifications for Practical Architecture: Preceded by an Essay on the Decline of Excellence in the Structure and in the Science of Modern English Buildings; with the Proposal of Remedies for Those Defects.* (London: John Williams, Library of Fine Arts, 1840), p. 18.
[59] W.R.Lethaby, *The Church of Sancta Sophia Constantinople: A Study of Byzantine Building*, p. vi.
[60] W.R.Lethaby, "An Architectural Symposium", *The Builder* (Oct 17, 1896): p. 307.

architectural design',[61] as well as causing George Gilbert Scott to criticise any attempt at exact copyism without improvement as lack of 'common-sense development'.[62]

But while common sense is regarded as an idea that lent itself to a path of progress, it is sometimes regarded as folk wisdom, uncultivated and vulgar, though this is not the sense that common-sense philosophers have intended for the term.[63] David Olson wrote: 'Interpreting in a negative sense, it sometimes came to be seen as a manifestation of the "primitive mind" characteristic of the children, ignorant, and fanatics and madman'.[64] In this regard, the concept of common sense became problematic. Since its value always lies in a deep-rooted understanding of tradition, it is then always going to be connected with unease about innovation.

In terms of architecture, with its alliance with the practicality and soundness of past architecture, 'common sense', as it were, has a tendency to resist innovation. Viollet-le-Duc criticised British architecture, suggesting that its retrogression was due to British's obsession with practicality – an idea central to the concept of common sense. Unlike Fergusson, who insisted on the progressive sense of the term, Viollet-le-Duc expressed his view that too much concern with the practical aspect of the building brought about the lack of inventiveness that he perceived in British architecture:

> Among them if a method passes for a good and practical one, they perfect it, extend its consequences, follow its progress and cling to it. We, French, on the contrary, are always seeking, but we perfect nothing. The Anglo-Norman

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[61] As quoted in Peter Collins, *Changing Ideals in Modern Architecture 1750-1950* [1965] (Montreal&Kingston, London, Ithaca: McGill-Queen's University Press, 1998), p. 99.
[62] George Gilbert Scott, *Remarks on Secular & Domestic Architecture, Present & Future* (London: John Murray, 1857), p. 220.
[63] Niclolas Rescher, *Common-Sense: A New Look at an Old Philosophical Tradition*, *The Aquinas Lecture* (United States of America: Marquette Press, 2005), p. 25-26.
[64] Olson, "Common Sense: An Introduction", p. 8.

> constructions are usually executed with more care than ours, but to know one is to know them all.[65]

Furthermore, Nikolaus Pevsner also made a passing comment on the resistance to modern architecture in Britain as partly due to the persistence of the idea of common sense. He wrote in 1942: 'If we remember the reluctant scepticism which delayed modern architecture and design on its way into and through England, […]. Here, obviously, enterprise and perseverance have been at work, logic and discipline, civilized urbanity and humane common sense'.[66] For Viollet-le-Duc as for Pevsner, common sense, whose value is attached to practicality, had obstructed, in one way or another, development in British architecture.

As we have seen from the different attitudes towards the concept of 'common sense', the peculiarity of common sense is that it bears the mark of ambiguity. On the one hand, it provides an alternative to expertise; its universal accessibility means that it is not going to be overly complex, technical and specialised in nature. On the other hand, common sense always has a tendency to keep a distance from vulgarity and primitivity for the sake of development; its value lies not in reproducing of old precedents, but in the gradual improvement upon them. In other words, while it reverts to the earlier sources, common sense gains its value from its immense adaptability and opening to possibilities.

For better or for worse, it is in the tension between attachment to tradition and innovation that made common sense so significant in the development of nineteenth- and early-twentieth century British architecture. Common sense was the concept that made British architects feel most

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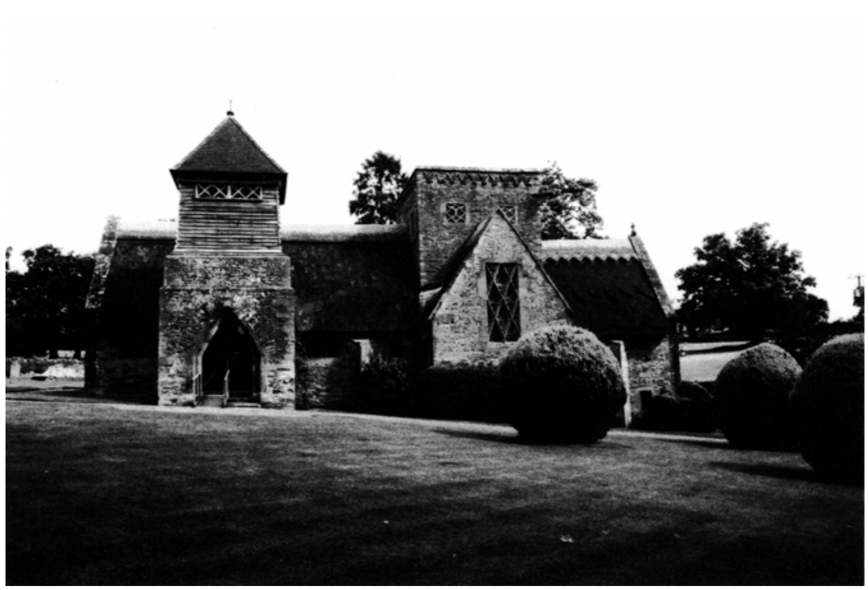
[65] Eugene-Emmanuel Viollet-le-Duc, Rational Building: Being a Translation of the Article "Construction" In the Dictionnaire Raisonne De L'architecture Francaise of M. Eugene-Emmanuel Viollet-Le-Duc, trans. George Martin Huss (New York and London: Macmillan and Co., 1895), p. 166. I owe this reference to Adrian Forty.

[66] Nikolaus Pevsner, "Patient Progress One: Frank Pick" [1942], in *Studies in Art, Architecture and Design* (London: Thames and Hudson, 1968), p. 191.

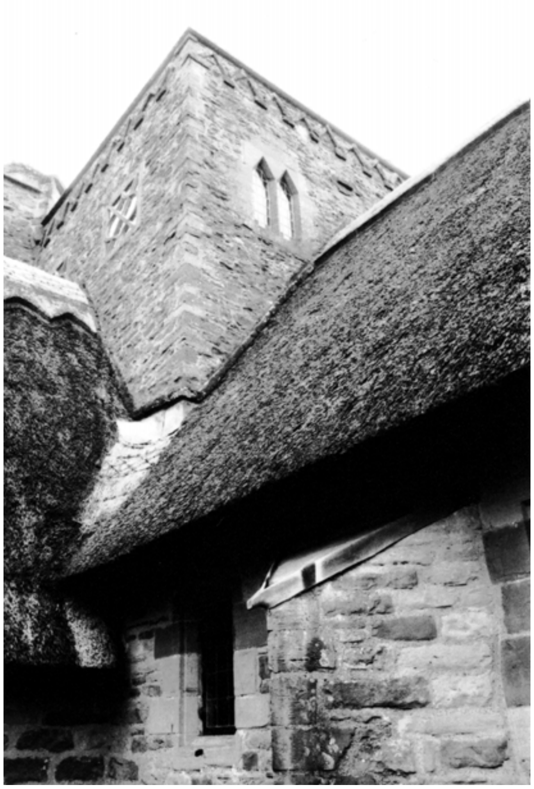
comfortable with their past and tradition, while acknowledging that their improvement upon them would lead towards a degree of perfection that had not hitherto been reached. John W. Papworth, in his paper 'On Beauty in Architecture and Its Alliance with the Past' made an intriguing remark that plays around the ideas of old and new: 'this is the only way to develop a new style, or to develop an old one, which is the same thing'.[67] It is as if the success of the architects who operated through common sense rested upon their abilities to bridge the distance between those two opposite ends: the primitive and the progressive, the ordinary and the expertise, and the old and the new.

Of all British architects obsessed with common-sense thinking in architecture, William Lethaby was perhaps the ablest exponent, and his last church – All Saints, Brockhampton, designed in 1901 and completed in 1902 – is particularly suited to exploring the idea of common sense in architecture [fig 3.14].



3.14 All Saints' Church, Brockhampton, designed by W.R. Lethaby in 1901-02. The composite nature of roof construction mixes thatch with concrete, most unusual for a new church built in the early 1900.

[67] John W. Papworth, "On Beauty in Architecture and Its Alliance with the Past", in *Paper Read at the Royal Institute of British Architect, Session 1856-57* (London: Published at the Rooms of the Institute, 16, Grosvenor Street, 1857), p. 99.



3.15 All Saints' Church, Brockhampton, 1901-02. While less durable than hard materials, like tiles and shingles, the thatch is supported by the concrete vault, and protects the concrete from the weather, preventing the roof from leaking.

William Lethaby's All Saints, Brockhampton

Probably the most original architectural work of William Lethaby, All Saints is a small, humble church in Brockhampton, Herefordshire. The first impression of the church is of architectural oddities. It looks traditional, but at the same time not quite like anything done beforehand. The external appearance of the church is an acknowledgement of Herefordshire traditional buildings. The rubble stone masonry on all facades and the crossing tower, the thatched roof, and the timber tower on the south porch, are all linked to the known and the familiar of local building materials and forms.

But a thatched roof on a church is rare, especially so on a new church built in 1902. Lethaby's interest in ordinary humble buildings and materials such as a thatch is understandable for he appreciated craftsmanship, but to use it for his new church was something that went against the general perception of the material at that time.[68] Generally speaking, thatch was considered an inferior material, used for roofing relatively 'poor' buildings, such as barns, cottages, huts or shacks, and would not normally have been considered appropriate for a building such as a church, least of all a new church built in the 1900s. All Saints looks at first sight as if it were treated with less 'value' than it deserves. The church stands in incongruity with its materials [fig3.15].

Intriguing though this may seem, what made Lethaby saw this as a reasonable thing to do, perhaps, lies in the composite nature of construction, mixing thatch and concrete. The thatched roof is used in combination with a concrete vault, thus the thatch, while less durable than hard materials, like tiles and shingles, is supported by the concrete vault, and protects the concrete from the weather, preventing the roof from leaking. But there is more to it than this. This use of concrete at the church caught Nikolaus Pevsner's attention, and he remarked of the church in *Building of England: Herefordshire* as 'one of the most convincing and most impressive churches of its date in any country'.[69] What Pevsner acknowledged as the originality of the church is not only the fact that it predated what had been done on the Continent about twenty years later, such as Dominikus Böhm's church using a similar kind of low-sprung arches as All Saints, but also a pioneer use of concrete in making the roof of the church.[70] In this latter aspect, he compared Lethaby's All Saints with St. Jean de Montmartre in Paris designed by Viollet-le-Duc's heir, Anatole de Baudot. Pevsner made a comparison between the two churches as follows:

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[68] Lethaby appreciated the workmanship of ordinary humble buildings, acknowledging that this must be the basis for the development of architecture: '[…] passing by some farmhouse built within the century or even some present-day cart-sheds and field-gates, thatched ricks and hay-wains, we realised that this poor but essentially interesting artisan work was really the latter-day remnant of the crafts that built our ancient towns, churches, and manor-houses', as quoted in "Modern Building Design", *The Builder* (Nov 2, 1895): p.312.

[69] Nikolaus Pevsner., *Herefordshire*, *Buildings of England* (Harmondsworth: Penguin, 1963)

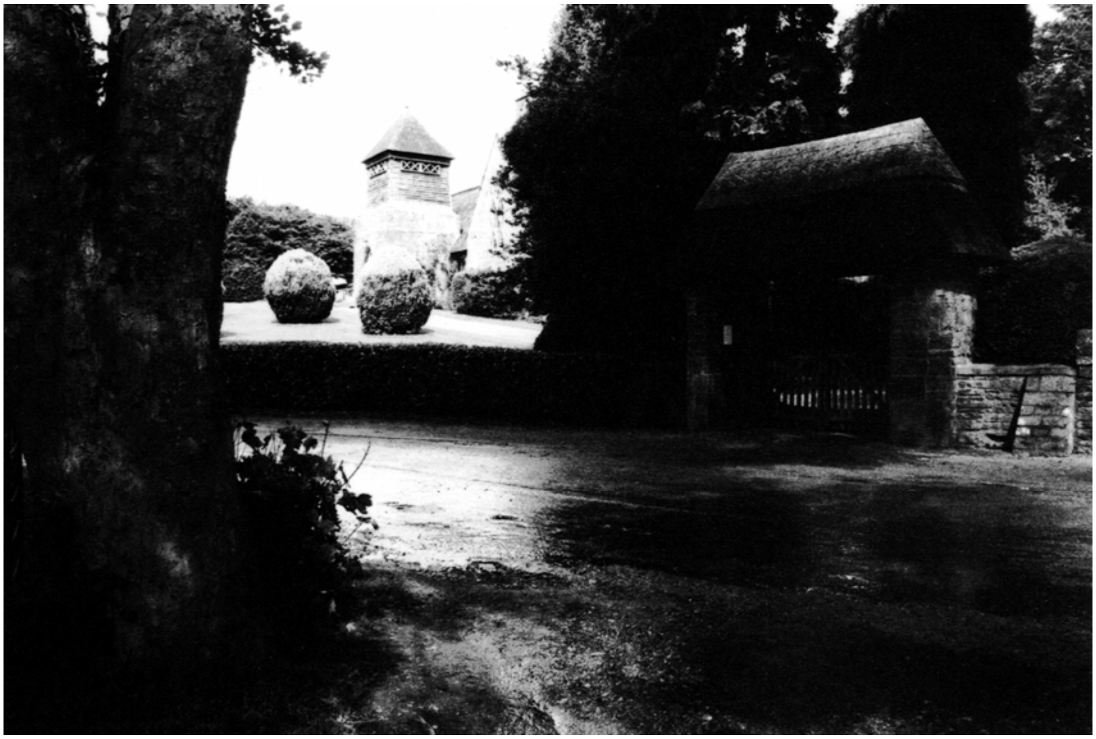
[70] Pevsner remarked of the interior of All Saints' Church as 'Expressionist in the sense in which central Europe designed churches about 1920', as quoted in Nikolaus Pevsner, *Buildings of England: Herefordshire* (Puguin, 1963), p. 90-91.

> with low walls, and steep, strong, closely-set, single chamfered arches rising straight out of the walls. The tunnel vault they support Lethaby made of slabs of concrete. […] But the slabs in Brockhampton Church are not reinforced. Their use was probably suggested by the wish to have a safe and lasting ground-work for the thatched roof. So in this technological respect Baudot's all-concrete church scores over Lethaby's.[71]

Extraordinary but unlikely though this comparison may seem, this line of argument, which started from Pevsner, of an expectation that the use of concrete at All Saints church should have had similar intentions to that at St. Jean de Montmartre has been followed by other historians, and, accordingly, it has become almost a convention to talk about the church as if it were something to do with Structural Rationalism. Peter Blundell Jones in his article on 'All Saints Brockhampton', for example, while giving an insightful account of the making of the church, following Pevsner's argument, suggests that one of Lethaby's pursuits at the church was Structural Rationalism.[72]

Curiously enough, this church in rural England, designed and built with limited local means, with craft skills and without any advanced engineering, is compared to a building that pursued the very latest structural innovation. The structure of All Saints by no means corresponds to Viollet's theory of Structural Rationalism. First of all, it is not a unified system of construction, but a composite structure; stone masonry for walls, timber construction for the roof of the crossing tower and the belfry, and concrete for the nave, chancel and transept vaults; the stability of the church was arrived at by the mixing of structural systems and materials. Nor are the structural materials of the church fully exposed. Concrete vaults, for example, are covered with thatch externally, while their internal surfaces are plastered with white lime; therefore in this building

[71] Nikolaus Pevsner, "Lethaby's Last", *Architectural Review* (1961, Nov.): p. 354.
[72] Peter Blundell Jones, "All Saints Brockhampton", *AJ* 192, no. 7 (15 August 1990): p. 26.



3.16 All Saints' Church, in small village called Brockhampton, Herefordshire, was built with local means of construction by local craftsmen without any latest engineering. Photographed in 2009.

the concrete remains concealed. As the structure of the church is composite and not fully exposed, how could the church be satisfactorily judged by the principle of Structural Rationalism? [fig 3.16]

If the church does not conform to Structural Rationalism, what *kind* of 'theory' does the church belong to? Or could we forget about theory, and accept simply that Lethaby building the church without a theory at all? But what does it mean to have a building without a theory?

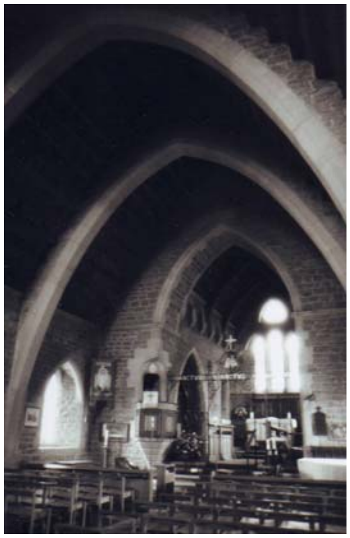
A 'Theory' Without a Theory

Of course, we can have construction without a theory; most of vernacular architecture carried out by indigenous peoples, for example, was built without a theory of construction. But this is hardly the case with somebody like Lethaby who was so immersed in theories: indeed, no-one in Britain was more aware than he of contemporary theories of structure and architecture. In Lethaby's writings, it is evident that he wanted architecture to have nothing to do with fixed rules. Lethaby's rejection of fixed rules, such as those necessary to arrive at certain proportion, was common at the time. His aim was to find a suitable architectural solution without relying on anything fixed: 'All these notions and nostrums of "correct style" and "fine composition" which are not only vain, but by offering fixed formulas block our finding a way by rational development'.[73] Apparently, his 'rationalism' was nothing to do with proportions, styles and rules. Paradoxically though this may seem, if there is anything we can draw as Lethaby's 'theoretical' proposition, it is from the sense of rejection against such the theories. It is a 'theory' without a theory with which we are now concerned.

If Lethaby's 'theory' has nothing to do with established rules, it nevertheless maintained that architecture develops step by step upon existing models. Lethaby, in his 1913 article 'Art and Workmanship', believed that " 'design' is not an agony of contortion but an effort to arrive at what will be obviously fit and true. […] Usually the best method of designing has been to improve on an existing model by bettering it a point at a time.[74]" This mention of 'gradual development' corresponds to what he had done in the making of the church, for his building methods are apparently based on existing models, as is evident from the two main parts of structure.

The first is the arches. The main structure of All Saints is an arch-based system. Basically, the structure of the church remains that of the thick stone wall acting as an abutment to a series of sand stone arches. The arches which spring from almost half-way down the walls are strengthened by triangle-shape buttresses, extending from the walls. This design of the low-

[73] W.R.Lethaby, "The Building Art: Theories and Discussions. – III," *The Builder* (March 9, 1923): p. 405.
[74] W.R.Lethaby, "Art and Workmanship" [1913], in *Form in Civilization: Collected Papers on Art and Labour* (London: Oxford University Press, 1957), p. 169.



3.17 Edward Prior’s Bothenhampton Church, Dorset, 1887-1889, photographed in 2009.

sprung arches was perhaps a way of improving on the way in which Edward Prior had raised the arches at Holy Trinity Church, Bothemhampton, designed in 1884 and finished in 1889 – it was a church Lethaby certainly knew, since, as Trevor Garnham pointed out, he ‘designed gesso-work decoration for the altar table of Prior’s church’.[75] [fig 3.17]

The second part of the church that Lethaby developed from existing models was the roof structure. The initial design of the roof structure of All Saints was similar to that of Prior’s church in that it was at first designed as timber construction ‘a plain-tiled roof on exposed oak purlins running from arch to arch’, as Peter Blundell Jones has described.[76] By the middle of 1901, however, it was clear that Lethaby had changed the design of the roof structure into a combination of timber and concrete. From the drawings issued on May 28, 1901, Purlin members, in the size of 5″× 5″ made of oak, were to be put over the stone arches and they were to be locked with the arches by hook irons. Then, upon these purlin members, two layers of ‘2″ deal boarding’ and ‘3″ coke breeze concrete’ were to lay over one after another. These thin boards and layers of concrete were to prepare a surface upon which thatch roof would rest and they would be locked

[75] Trevor Garnham, “William Lethaby and the Two Ways of Building”, *AA Files* 10 (1993): p. 35.
[76] Jones, “All Saints Brockhampton”, p. 34.

3.18 Lethaby first designed the roof structure of All Saints in timber but later changed into Mass-Concrete. Drawing dated May 28,1901. From RIBA Drawing Collection.

together with thatching irons [fig 3.18]. Between this stage of design and the final construction, Lethaby once again changed the design: the vault was to be completely built out of concrete, without a timber structure. This use of concrete in making the vault was in fact a building technique that Lethaby developed from the previous version he himself had experimented with earlier at a little church at Melsetter in Orkney, his first experiment with concrete construction [fig3.19]. [77] But at All Saints, concrete was used more extensively. Lethaby gave the construction details for the concrete vaulting as follows:

> The concrete vaulting to the chancel and the transepts to be formed on rough boarding laid on centering. The boarding to be first thoroughly wetted. The concrete to be kept in place where necessary until set by boarding placed under occasional rafter, the concrete to be lightly beaten with wooden beaters.[78]

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[77] Interviewed with Trevor Garnham.

[78] W.R.Lethaby, "Specification of Works by W. R. Lethaby for Building a Memorial Church at Brockhampton, Hereford & Worcester", in *WILLIAM LETHABY PAPERS/ Ref no. LeW/2/12* (RIBA Drawing Collection, V&A London: April 1901)

3.19 The Chapel of Melsetter, Orkney, 1898. William Lethaby, architect. From Trevor Garnham, *Melsetter House: William Richard Lethaby*, 1993.

As Lethaby's use of concrete here was so different from the contemporary way of working with concrete, to understand Lethaby's approach to construction more clearly, we must take into account some of the issues concerning concrete architecture in its early years.

Reinforced-Concrete System

As a building material, mass concrete had been used in Britain for churches since the mid-nineteenth century, seemingly for economy. The real change started at the end of the nineteenth century when reinforced concrete was introduced by concrete firms, normally of foreign origin, not as a material, but a *technology* under licence. Under this new system, architects who wanted to build in reinforced concrete had to obtain one of the available licenses from the owner; the only patented system available up to the point when All Saints was built between 1900 and 1901 was the French Hennebique system, which later had L. G. Mouchel as the local agent.[79] In these circumstances, while reinforced concrete made it possible to produce relatively cheaper construction and effectively fire-proof, the condition under which it was established by concrete companies as a licensed system gave rise to difficulties for architects wanting to use it.

Changes in the practice under a patented system have been discussed by Patricia Cusack, and the characteristic was that architects would design a building and then pass the design to a concrete specialist to work out how to construct it in a reinforced concrete system. The specialist, applying the patented system, would adapt the architects' design to reinforced concrete and in turn provide all structural details according to the procedure for that particular system of concrete construction. Although the architects were still in charge of supervising the construction, they were wholly reliant upon the knowledge of a concrete specialist. Architects' anxieties about their inability to supervise concrete construction made them hesitant to take any risk, hence they tended to design buildings that were to be built in concrete as if they were using traditional materials, usually simulating what would be done in concrete as stonework – an act that was unacceptable for those Rationalists who followed Viollet-le-Duc's doctrine that an arrival of new materials must bring about a new form of architecture. 'The results', as Patricia Cusack has stated, '[…] evidence the dominance of style over material'.[80]

The establishment of proprietary systems put architects at a disadvantage, leaving them responsible only for initial designs - a task that was relatively small part of the whole building process, whereas the greater part of technical design and construction of reinforced concrete works were carried out exclusively by a specialist. The removal of architects from the

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[79] Patricia Cusack, "Architects and the Reinforced Concrete Specialist in Britain 1905-08", *Architectural History* 29 (1986)

[80] Patricia Cusack, "Agents of Change: Hennebique, Mouchel and Ferro-Concrete in Britain, 1897-1908", in *Early Reinforced Concrete*, ed. Frank Newby, *Studies in the History of Civil Engineering; 11* (Aldershot: Ashgate, 2001), p. 164.

construction aspect of the work was a threat to them; the other threat was that it withdrew the architect's opportunities in selecting a contractor. The concrete specialists took over the choice of contractor and licensed him to execute their designs, under the condition that a contractor must use only their system.[81] While a proprietary system gave benefits to the concrete entrepreneurs, who had invented it, at the same time it marginalised architects from the business of execution.

The separation of the design from the execution, unavoidable when adopting reinforced concrete, would have been unwelcome to those architects who saw the union between those two processes in building construction as a necessary basis for a satisfactory work. The value of this way of working to them was that it gave them overall control over the craft of a building, allowing them freedom in every stage of building processes. The Arts and Crafts architects, for example, practiced in this way, as they were actively concerned in both designing and supervising building. In this sense, an architect was primarily 'a master builder', and indeed he was sometimes described by Arts and Crafts' thinkers just in these terms. Lethaby quoted Philip Webb to this effect 'the architect should be an upper foreman',[82] and '"design" must be thought about as the natural outcome of the work and not as something superadded to it'.[83] Lethaby's concern was that 'construction' was essentially part of the means for generating architects' thought through the work – for which it was necessary that building construction was kept under the architects' authority.

The date of All Saints makes it too early to consider Lethaby's use of concrete as a direct response to the proliferation of propriety systems (the reaction to specialist systems in Britain was not formulated until later in the 1900s by the RIBA Committee on Reinforced Concrete, the new journal *Concrete and Constructional Engineering*, and the Concrete Institution), and in any case the

[81] Ibid., p. 157.
[82] W.R.Lethaby, *Philip Webb and His Work* [1935] (London: Raven Oak Press, 1979), p. 122.
[83] W.R.Lethaby, "Modernism Building Design: Positive Conditions", p. 334.

3.20 All Saints’ Church, Brockhampton. Even in Britain, where a new construction of reinforced concrete had been used since the end of the nineteenth century, was mass-concrete in use. From Sylvia Backemeyer and Theresa Gronberg, *W.R.Lethaby 1857-1931: Architecture, Design and Education*, 1984, p.77

use of a patented system at All Saints would have been inappropriate, both on account of its remote site, and because it is such a small building.[84] Nevertheless, it is likely that Lethaby would have been perspicacious enough to see the disadvantage of using proprietary systems, even if he had no first hand experience of them – Hennebique’s system was so heavily promoted in Britain that he could hardly have avoided knowing about it. He would have seen the removal of architects from construction, as occurred with the propriety systems, not only as a hindrance to achieve the Arts and Crafts ideal of reuniting architects and workman, but also as a threat to the architects’ role. It is in these terms of maintaining the connection between the design process and the building process – a connection inevitably broken by adopting propriety systems of reinforced concrete – that we must look for any explanation of Lethaby’s use of concrete at All Saints, for it represents an alternative to the procedure that would have followed from the employment of a patented system [fig 3.20].

[84] Some reactions to specialist systems in Britain are discussed by Patricia Cusack, see Cusack, “Architects and the Reinforced Concrete Specialist in Britain 1905-08”; Cusack, “Agents of Change: Hennebique, Mouchel and Ferro-Concrete in Britain, 1897-1908”.

Andrew Saint's Alternative History of Concrete

Seen in these terms, it presents an opening to an alternative history of concrete, such as was proposed by Andrew Saint's two-part article in 1991 on 'Some Thoughts about the Architectural Use of Concrete'. Saint suggested that there were different trajectories of concrete architecture's development, some of which have been less well acknowledged, on account of the dominance of Structural Rationalism within the discourse of modernism. Saint's aim was 'to point out some strands in it which seem to have got lost, or at least not to have received full consideration in orthodox accounts of modern architecture's development'.[85] He offered a rebuttal of the dominant tradition of concrete construction, and in particular of Collins's account in his book *Concrete*, that had denigrated all concrete buildings that did not conform to Structural Rationalism. Saint's message is that not all works have to be judged by those criteria. Saint argued this by tracing other traditions of concrete architecture which had developed independently of the Rationalist's line of argument, especially in Britain, where Structural Rationalism had little been taken up; the case studies that he chose fitted his argument well. Of the early development of concrete in Britain, Saint wrote: 'Far from conceiving that concrete should determine style, builders and architects had a strong sense of the need for its architectural subordination'.[86] Then he concluded,

> this postulate of French rationalist teaching […] is easily satisfied for simple engineering structures. It is less responsible for buildings with any complexity of use or volume, in which a disjunction in materials and form between exterior and interior can often be sensible and meaningful.[87]

In the second part of his article, Saint showed that there were other ways of making concrete, more evident in British architecture than French, one of which was a revival of Roman practice: 'Use of the concrete arch, vault or dome goes back to the earliest days of mass concrete'.[88]

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[85] Andrew Saint, "Some Thoughts About the Architectural Use of Concrete", *AA Files* 21-22 (1991): Vol. 22, p.11.
[86] Ibid.: Vol. 21,p. 25.
[87] Ibid.: p. 15.
[88] Ibid.: p. 3.

Lethaby's use of concrete at All Saints, as unpatented mass-concrete without reinforcement, not only fits this category, but also exemplifies Saint's argument of 'a departure from the narrowest type of Structural Rationalism'.[89]

Unlike French Structural Rationalists, Lethaby was neither interested in showing the visibility of structural material, nor in a supposedly new form of architecture emerging out of concrete. The fact that concrete at the church is not monolithic, but is in composite use with other non-structural, traditional materials such as thatch and plaster work contradicts two of the main principles of Structural Rationalism – i.e. that the structure of a building must be unified, and the structural material must be exposed. While at St. Jean de Montmartre, with which Pevsner compared All Saints, Cottancin's system of concrete construction was used, at All Saints

3.21 All Saints' Church, Brockhampton, under construction.
W.R. Lethaby, architect. Randell Wells, site architect.
From Godfred Rubens, *William Richard Lethaby: his life and work 1857-1931*, 1986, p.157.

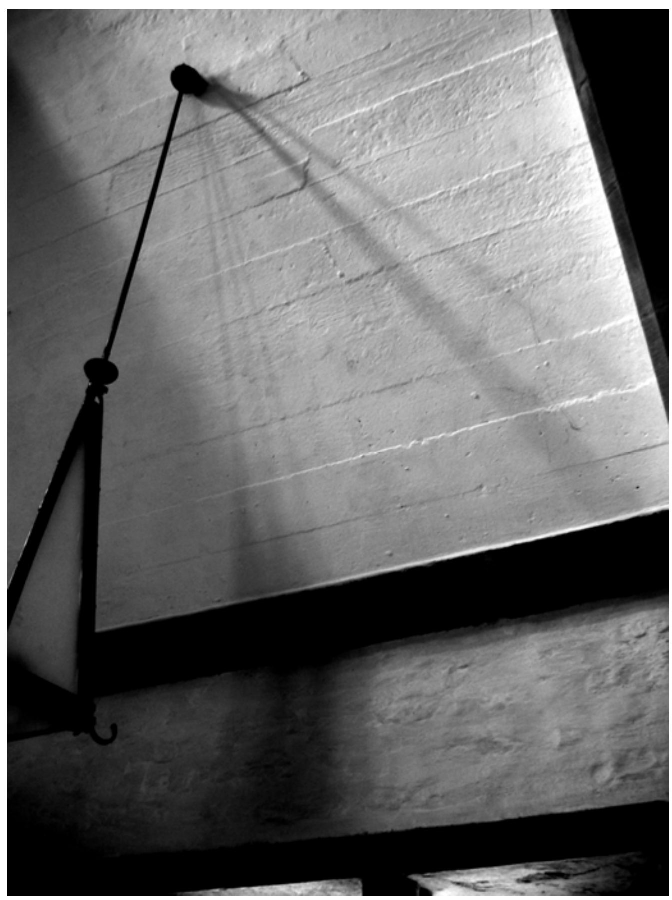
[89] Ibid.: p. 15.

there was no system. It adopted neither Hennebique's nor any other available licensed system of the time, rather concrete is just one material used in combination with other traditional materials, carried out not by the specially trained workers of a patented system, but by local workers directly hired [fig 3.21, 3.22].

If the use of concrete at All Saints is indifferent to Structural Rationalism and patented systems altogether, it is, on the other hand, in accordance with Lethaby's interest in making visible the element of human labour in the work and his obsession with primitive ways of building. We can look for more explanation at the ways in which the concrete vaults are treated aesthetically and practically.

3.22 All Saints' Vault Structure, built out of mass-concrete without reinforcement, forms the tunnel-like interior. From Nikolaus Pevsner, 'Lethaby's Last', *Architectural Review* (Nov, 1961), p.355.

Technically speaking, the interior of a building's vault could have been completed in various ways. The most of obvious choice was to cover the underside surfaces of the vault with plaster in order to achieve smooth surface, upon which another layer of decoration, such as mosaic covering or painting might be applied. Instead Lethaby chose to apply only a thin layer of white lime to the surface. Though this technique may seem equally obvious, it had some important consequences in the finished work. By not giving it into the usual smooth surface, Lethaby calculated that the vault surface still allows the evidence of the construction to be visible. By plastering the surface with a thin wash of lime, the shuttering mark becomes less obvious, but not completely obscured. Traces of the rough boarding used as formwork for the concrete vault, removed after the concrete was settled, are left visible through with lime wash [fig 3.23]. This half-concealing, half-revealing finish, providing a smooth, but not completely smooth surface,



3.23 The underside surface of the concrete vault, while plastered with a thin wash, still allows the shuttering mark of rough boarding to be partially visible, photographed in 2009. All Saints' Church, Brockhampton, 1901-1902.

generates a semi-transparent veil, through which the construction behind the surface is partially apparent. This careful partial concealment of construction evidently evokes Ruskin's and later Morris' argument of making human labour element visible in the work, and fulfils Lethaby's principle that 'Every work of art shows that it was made by a human being for a human being'.[90]

While this partial concealment, partial exposure of construction is a distinctive characteristic of the church, the other unusual element in the work that went against Structural Rationalist expectations is to do with Lethaby's primitive mode of using concrete. His particular interest in primitive means of building emerged from his talk on 'The Architectural Treatment of Reinforced Concrete' at RIBA in 1913. Although the church had been finished a decade before he delivered his lecture, what he had done at the church anticipated what he was to say about the primitive in architecture. Of concrete, Lethaby was interested in its plastic quality – that it is like clay or paste carried out by handwork in primitive culture. In his lecture, Lethaby explained a way of using concrete without reinforcement in making primitive barrel vaults as like the art of pottery:

> concrete was a continuous aggregation like clay or paste. It was a plastic material and was unfitted for sharp edges and delicate forms; it should be continuous like a big piece of pottery. Of course, all architecture in the past had not been the architecture of cut masonry. In many parts of the world the requirements of buildings had been satisfied by erection of clay. Handfuls of wet clay were put on until the building grew, like a swallow built its nest, and this extremely primitive method of building was really in the background behind all their vaults and

[90] W.R.Lethaby, "Art and Workmanship", p. 168. On humanness in the work, see also following quotations: 'But above all this, there was something to in a finished old work – a certain feeling of pleasant humanness in the work – which we should observe. In this way we should try to substitute an ordinary, rational way of common-sense building for the prevailing chaos of architectural design. […] Nobody knew what art was; we spoke of aesthetics, art, beauty, harmony, and proportion, but nobody knew what those things were; but directly one got down to commonplace humanness, or the human way of doing things, the root of beauty in all past work was reached', as quoted in W.R.Lethaby, "An Architectural Symposium", p. 307-308.; and 'Architecture was not really a question of shape, but a question of the quality of effort and the humanity put into things over a great length of time. External forms were nothing in themselves as questions of taste unless they grew up out of a sort of fine reasonableness in doing things', as quoted in W.R.Lethaby, "The Architectural Treatment of Reinforced Concrete", *The Builder* (Feb 7, 1913): p. 175.

domes. The dome and the vault was a matter of architectural development which grew out of the ability of the primitive races to arch over their structures in continuous clay, and it was only that the method of splitting up the clay into blocks and drying them in the sun came into use. […] but it was these crude primitive things in clay which laid down the basis and idea of drawing a roof over from the walls, and which was the foundation of the idea of vaulting, doming, and arching. […] the Roman went on using the primitive vault in a very high form of architecture. Roman architecture for the most part was founded on concrete construction, and the Pantheon, which was the biggest dome in the world, and the enormous barrel vaults of their other structures were built in concrete.[91]

3.24 **'like a big piece of pottery'** - Mass-concrete was being laid on the roof. All Saints' Church, Brockhampton, under construction, 1901-1902. From Godfred Rubens, *William Richard Lethaby: his life and work 1857-1931*, 1986, p.157.

[91] W.R.Lethaby, "The Architectural Treatment of Reinforced Concrete", p. 175.

Seen in these terms, Lethaby's understanding of concrete as having an earthy quality just like clay, built out of the most ordinary means does not conform to the law of Structural Rationalism. Not only does it contradict the Rationalists' assumption that the discovery of a new material would result in a new architectural form, it also denies the general proposition that a new material like concrete should be part of a progressive line of technological development [fig 3.24].

While Pevsner linked All Saints with Structural Rationalism – a principle that viewed architecture as a constantly developing structural art, whose essence lay in the perfection of the structure – All Saints is better understood in terms of an evocation of older ways of building that allowed architecture to be both progressive while also connecting with its earlier tradition. At All Saints, concrete was not necessarily tied to technological progress, but was a 'primitive' material, allowing architecture to once again connect with its older tradition. While the use of concrete here was new, especially for a new church built in the early-1900s, the technique employed was seemingly old. It is in this particular way of working with concrete at All Saints that offers an alternative way of thinking about construction – that it can be both primitive while at the same time modern – and gives Lethaby's theory a value that Viollet-le-Duc's Structural Rationalism lacks.

If one part of Lethaby's methods of working lay in its primitivism, another lies in flexibility and experimentation. Of all the events in the construction of All Saints, the most momentous was the collapse of an arch when under construction as a result of movement in the building's foundations, causing Lethaby to refuse his fees, and at the end of the day to retire from being an architect, leaving the church as his last work of architecture. The collapse of the arch was due to 'some experiment in mortar' that the site architect, Randell Wells, tried during the erection of the arch.[92] This experiment was not successful and so increased the overall cost of the work more than estimated, as the failure demanded the raising of the walls of the crossing tower by a further ten feet. Subsequently, the walls needed to be underpinned to solve the problem of movement in the foundation.

Although these experiments in construction caused the work to be more expensive and led to no improvement in the buildings, what we see here is Lethaby's consent to experiment in work – that the work is always subjected to being changed, developed and evolved, responsive to ever-emerging problems during the course of the work. It is in this freedom that allows the building to have qualities not evident in the initial drawings.

All Saints is a building that seems pragmatic, inevitable and sound, although it does not lend itself to any given architectural precept. It is neither Structural Rationalist, nor is it ordinary traditional Gothic. At no point does this church by Lethaby force us to accept a particular doctrine of architecture. The paradox is that, while it takes references from existing sources, the church is unique and original, creating difficulties with any attempt to put it into any recognisable style. As Peter Blundell Jones remarked, it is 'a new architectural language, full of tacit references, but without quoting anything directly'.[93] Determined neither by any preconceived theory, nor fixed rules, All Saints was the result of adjustment, experimentation and expedient to meet particular conditions and circumstances. While Rationalists maintained a dogmatic adherence to fixed solutions, aiming at exposed structure and unified construction, what we see here at Lethaby's church has less to do with 'theoretical' propositions, and has more affinities with a changeability and flexibility based on the practicality and soundness of a work. Alter all, Pevsner confused the issue by linking the church with Structural Rationalism: whatever degrees of artistic treatment

[92] Godfrey Rubens, *Willliam Richard Lethaby: His Life and Work, 1857-1931* (London: Architectural Press, 1986), p. 23.
[93] Jones, "All Saints Brockhampton", p. 41.

were lavished upon the making of the church, it was done not to test any theory, but merely to make it sound and practical.

But is not this a 'theory'? Since Lethaby was sophisticated and well-informed about theories, to propose to build as un-theoretically as it is at All Saints is anything but intriguing. Does 'practicality', 'soundness' or 'common sense' not presume a theoretical preposition? Or is it rather another sort of 'theory' – a kind of open-ended and non-dogmatic 'theory'? Lethaby himself was sceptical about this question as he put it in 'The Architecture of Adventure' of 1910: 'it may be somewhat curious to note here how often admirable practical skill in the arts may be linked to great poverty of thought in theoretic exposition, so that the splendid achievement of a Palladio or a Chambers in active work may be accompanied by mere twaddle of explanation and rhetoric'.[94] Lethaby's doubt here points at once to a distinction between two discourses: one is building, another verbal. If Lethaby's 'theory' cannot be categorised into any verbally developed theory, the paradox may be accommodated within the flexible nature of common-sense. Lethaby's conviction has strong relevance to the idea of common sense – the concept which had appeared repeatedly throughout Lethaby's writings, both before and after he built All Saints; for example, we find him using the term as early as 1896, when the word 'common-sense' appears three times in relation to William Morris.[95] But the most explicit one is as follows.

> Above all, do not try to be eccentric, striking, or original. Exquisite common sense was what was wanted, and the aim should be masterly construction delightfully finished. Beauty was not a question of mere shapes, but it was the evidence of mind acting properly on material.[96]

Lethaby's accounts here emphasise the notion of 'common sense' as an alternative to fashionable architectural styles. Whatever he meant by 'common-sense', what is clear from this is that his

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[94] W.R.Lethaby, "The Architecture of Adventure" [1910], in *Form in Civilization: Collected Papers on Art and Labour* (London: Oxford University Press, 1957), p. 63.
[95] W.R.Lethaby, "An Architectural Symposium", p. 307.
[96] W.R.Lethaby, "The Architectural Treatment of Reinforced Concrete", p. 176.

emphasis on 'common-sense' was deliberately set up as an alternative approach to building construction to one based on theoretical propositions. The importance of Lethaby's 'theory' at All Saints lies in his particular opposition to established rules, and a belief that the alternative was not inferior to logical process of rationalism. It is in this sense that puts All Saints closer to the idea of common-sense than it is to the theoretical position of Structural Rationalism.

Can we now come to the answer to the question whether we can have 'construction' without a 'theory'? Lethaby's turnaround at All Saints, where he avoided established theories and emphasised instead the craft and practical aspects of the work, raises questions about our understanding of 'theory' in architecture. Normally architectural theory is always regarded as an abstract, predating the practice of construction and always independently of it, whereas construction is regarded as something that is guided by theory. This sequential arrangement and the gap between 'theory' and 'practice' are collapsed into each other at All Saints. For Lethaby, the practice which occurs in construction, while related to the thought that precedes it, is regulated according to practical exigencies and changing circumstances and not to satisfy the demands of pre-existing principles. All Saints, whose theoretical bases are produced though construction, is in itself a constructive thought: the construction is a thought object, evidence of 'mind acting properly on material'.[97] While architecture is most often referred to as a discipline involving a long-drawn-out translation from idea to thing and in which theory and construction are kept distant, what is remarkable about Lethaby's All Saints is that it allows us to see these usually separate states as singular.

Here, it might be useful to return to Kenneth Frampton's *Studies in Tectonic Culture*, introduced earlier in the introduction of this thesis, because what occurred at All Saints provides an

[97] Ibid.

alternative model of the building process to Frampton's formula. The model that Frampton used to describe construction process in his book was a four-step process, starting from theoretical formation, design stage, engineering calculation and then construction, but it does not apply to All Saints. What was carrying out at All Saints was almost the opposite to that system of four stages, because what Lethaby was pursuing here was the way of building. It was not theory that interested Lethaby as a starting point, but rather the question of how building was going to be built – the craft process, the last stage in Frampton's formula. Although Lethaby prepared drawings prior to construction, they were by no means rigid, as though they were merely waiting to be realised by construction. Whatever had been prescribed in drawings was fully adjustable, opening to accept a possible exchange between the process of design and the process of construction as an evolutional factor, driving the work's progress. The building development at All Saints was hardly distinguishable as a sequence of activities; rather it was compressed in time, through which a number of actual inventions were allowed to pass through in order to respond to specific circumstances.

If All Saints does not allow us to see the building development as a linear progression, starting from theory through to construction, Lethaby's general avoidance to have a 'theory' diverts our attention from seeing theoretical formation as the most important, most intellectual stage of a work's creation – a stage to which Frampton in his book paid most attention, as he saw it occupying a prominent position responsible for the work's success. If Frampton's method of drawing the explanation of a work of architecture from theoretical sources known to architects might have been valid elsewhere, it is no longer the case here, and it would be mistaken to suppose that a 'theory' necessarily lies at the beginning of building processes, or to treat it as the result of a stand-alone activity, because it would misrepresent *the kind* of 'theory' that co-exists with the act of construction, which was where a theoretical groundwork of Lethaby's All Saints occurred. Dealing with possibility and difficulty in an empirical situation, Lethaby's theoretical proposition was more of an improvisation, responding to emerging problems, following no consistent with formal design. The construction of All Saints, whose form was adapted to on-site situations, furnishes an example of how a theoretical proposition of an architectural work can become an inherent part of the work, because it is only occurring within and during the work's progress. Just as brick reveal its properties fully when one is put beside or over another, so too architects will find unforeseen potential, or limitation, of construction in the process of building [fig 3.25]. To understand an architectural work like Lethaby's All Saints, it makes more sense to see how building is actually made, how building materials are put together, than to consider how a work might possibly be explained by a pre-existing theory – a method that Frampton customarily uses in his book. While that book claims to be drawn from phenomenological concern, it is the method of referring to pre-existing ideas to explain the object of study – a feature of Idealistic philosophy – within Kenneth Frampton's historiography that calls into question his claims for a phenomenological basis to his *Tectonic* Theory.

3.25 At Lethaby’s All Saints, it was not the theory of Structural Rationalism, but ‘the way of building’ that was a prime interest of the architect. Yet, isn’t this a ‘theory’?

4

Material

'in the case of Michelangelo and Wren, the one started with Classic results and the other with Italian: what should we start with?'

'With materials'.[1]

So answered William Lethaby to Beresford Pite at Architectural Association in 1896, in a talk to the members of the Class of Design on the subject of 'The Problem of Modern Architecture'. Lethaby's reply, which rejected at once the pursuit of the styles, gives an idea just how important materials were for some architects in late-nineteenth-century Britain.

Lethaby's ideas about materials were in part derived from William Morris's lecture, 'The influence of building materials upon architecture', given in 1891, in which Morris had formed the idea of turning to materials in order to resist the imitation of style. The problem of architecture in Morris' time was its preoccupation with past styles, and he argued that the essence of architecture lay instead in the use of the materials and the ways in which they are handled in execution. He said, 'the subject of Material is clearly the foundation of architecture and perhaps one would not go very far wrong if one defined architecture as the art of building suitably with suitable

[1] Anon., "An Architectural Symposium", *The Builder* (Oct 17, 1896): p. 307.

material'.[2] The source to which Morris turned was the certain qualities of 'ordinary country buildings' such as simplicity, unpretentiousness and practicality: 'the skill with which the mason has picked out his longs and his shorts, and put the thing together with really something, you must say, like rhythm and measurement (his traditional skill that was), and with the best possible results'.[3] Such a concern that paid attention to the materials rather than styles was then regarded by the German architect, Hermann Muthesius, as having been first advanced by English architecture: 'It was English's achievement – and it cannot be rated highly enough – to have been the first to find an escape from this dilemma and to have done so at a time when nothing of the kind was yet stirring on the continent'.[4] In his book *The English House*, Muthesius went on to describe the pragmatism of the old craftsmanship that he witnessed many Arts and Crafts architects turning to, and then characterised the British Arts and Crafts Movement as 'Materialism'.[5] Three decades later, when the Arts and Crafts movement was in decline and modernism from Europe was accepted in Britain with enthusiasm, FRS Yorke, in his book on *The Modern House*, echoed the Arts and Crafts' emphasis on materials as being one of the basic starting points giving rise to architectural form: 'This form is the result of the plan, the construction, and the materials, not of a preconceived ides of what a building should look like, or an essay in a popular style'.[6] In Britain over the period from the pioneer of the Arts and Crafts Movement to the early-modernist architect, materials occupied an important part in the debate about what a modern architecture should be – and, possibly, were valued in ways not necessarily quite the same as elsewhere.

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[2] William Morris, "The Influence of Building Materials Upon Architecture", in *Art, Industry and Wealth* (London: Longmans, Green and Co., 1902, originally delivered on 20th November 1891 at a meeting sponsored by the Art Workers' Guild at Barnard's Inn, London), p. 391.
[3] Ibid., p. 394.
[4] Hermann Muthesius, *The English House: In Three Volumes* [1904], ed. Dennis Sharp, trans. Janet Seligman and Stewart Spencer (London: Frances Lincoln, 2007), Vol. I, p. 101.
[5] Ibid., Vol. I: p. 148-149.
[6] F.R.S. Yorke, *The Modern House* [1934] (London: The Architectural Press, 1957), p. 10.

The debate as to whether the British Arts and Crafts was the origin of the modern movement is far from new. Following Muthesius's book *Style-Architecture and Building-Art* of 1902, Nikolaus Pevsner suggested in his book *Pioneers of Modern Design: From William Morris to Walter Gropius* the connection between the Arts and Crafts Movement and the development of modernism, and even though recent studies have given a much wider view of the origins and development of modernism, Pevsner's association between the Arts and Crafts Movement and the development of modernism is in certain respects still valid. The purpose of this chapter, however, is not to reiterate Muthesius and Pevsner's suggestion, but really to ask whether materials did occupy a distinctive, and different, place in debates about modern architecture in Britain.

It is perhaps worth acknowledging that the term 'Materialism', or in the original German terms '*Materialismus'*, which Muthesius used to describe a certain quality he perceived in English architecture, had been present in the German architectural context before – most evidently in the writings of Gottfried Semper and of Karl Schäfer, both theorists of whom Muthesius was a close follower.[7] Muthesius used the term 'Materialism' to characterise a non-idealistic way of thinking about architecture, in opposition to the Idealist philosophy that was present in Semper. But did he use the existing German concept of 'Materialism' to understand English architecture, or did he discover in English architecture a particular quality of 'Materialism' specific to England – and one that he had not necessarily brought with him from Germany?[8] In *The English House,* Muthesius wrote:

> All the prerequisites for every man-made object should lie in its material, purpose and construction, its form should be consequent upon these prerequisites and not upon an independent preconceived idea. But above all, workmanship should be as sound as possible; this became the indispensable

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[7] I owe this information to Dr. Laurent Stalder.

[8] It is also worth noting that '*Materialismus*' was a nineteenth century capitalist's concept that Karl Marx termed to argue against Hegal's Idealist philosophy.

> condition and it was here that the influence of Morris was so important. There were the principles of Ruskin's theories, which have since become so familiar and at the heart of which one can see the awakening of a northern, Germanic view of art contrasting with the Italian, Classical view. Only one aspect was ignored in the formulation of these principles; […] The movement that returned so wholeheartedly to ideals of pure craftsmanship may be described as a kind of Materialism; a similar movement sometimes occurs in painting after periods of lofty idealism during which reality may easily have been lost to sight, in order to re-establish contact with basic principles.[9]

Muthesius's appropriation of a concept from one context to another leaves us uncertain whether he described something he knew from his German upbringing, or something he had just discovered about English architecture. But the source of this difficulty lies not just in terminology, but also leads on to another question, which is whether we can see the concern with materials as having a theoretical context specific to a certain place, in a certain time, or was it just the same as the rhetoric of modernist architecture elsewhere?

Material is without question essential to architecture. Every building culture of course engages with materials, but their attitudes towards them can be different, depending on how materials are given their place in relation to other elements required for the creation of architecture. A quick sketch of attitudes towards materials in the following discussion will give an idea just how the British attitude towards materials differs from other building cultures, namely in France and German speaking countries.

Three Nineteenth-Century Notions of 'Material'

In France, Rationalists held that architecture derives from a determined system of structure. Viollet-le-Duc proposed that 'all architecture proceeds from structure, and the first condition at

[9] Muthesius, *The English House: In Three Volumes*, Vol. I, p. 148.

which it should aim is to make the outward form accord with that structure'.[10] In other words, what is built takes second place to the system in which adopted to build it. Structure, for Viollet, is irreducible, permanent, surpassing beyond the life of the building itself; though buildings decay, their structures endure, and it is possible to adopt a structural system of old buildings; the system of vaulting of the thirteenth-century Gothic cathedrals, for example, for a creation of new architecture. Such a manner of reworking something old and translating into a new form does not, according to Rationalist principle, apply to materials. Viollet-le-Duc proposed that the form of architecture, apart from being the outcome of the structure, needs to communicate the characteristic of the material of which it is made of. Viollet-le-Duc made this point clear when he put it as follows:

> Does it then follow that if we would make use of the novel materials […], we should content ourselves with substituting arches of cast or plate iron for arches of stone? No, we may adopt the principle, but while adopting it, since the material is changed, we should change the form.[11]

What Viollet was against here is the mimicry of form used in one material for another material. Not only are architectural forms generated by the structural principle, they need to be in accordance with the nature of the materials used to make them. It is this proposition of French Rationalists that each material brings out its own 'truthful' form that helped to formulate one of the most well-known axioms of modernist architects that a new material would lead to a new form of architecture, and encouraged Rationalist architects in the early-twentieth century to make visible the structural materials.

The second distinctive idea of materials that contributed to modernist discourse belongs to the building culture of the nineteenth-century German speaking countries. In his theory of style,

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[10] Eugene-Emmanuel Viollet-le-Duc, *Discourses on Architecture* [1889], trans. Benjamin Bucknall, 2 vols., vol. 2 (London: George Allen & Unwin Ltd., 1959), p. 3.
[11] Ibid., p. 54.

Gottfried Semper proposed that the ultimate goal of architecture is to bring out symbolism. While this impulse for the symbolic is to be realised in the actual physicality of the work, Semper however argued that it is crucial to forget about the properties natural to the materials in order to reach a level of symbolic creation. 'The destruction of reality, of the material', Semper said, 'is necessary if form is to emerge as a meaningful symbol, as an autonomous human creation'.[12] A little further he continued:

> Only complete technical perfection, only the judicious and proper treatment of the material according to its properties, and above all only the consideration of these properties in the act of shaping form can cause the material to be forgotten, can liberate the artistic creation from it, can elevate even a simple landscape painting to become a high work of art. […] the appear of a work of art should make us forget the means and the materials by which and through which it appears and works and be sufficient to itself as form – to demonstrate this is the most difficult task of a theory of style.[13]

Semper's rejection of the physical properties of materials is perhaps best illustrated by another German theorist, Carl Bötticher, when he gave an example of stone:

> the intention here is not to characterize the stone as dead stone but, on the contrary, to let the dead substance of the stone fade away […] As soon as the stone is covered by a form analogous to its idea (i.e., an art-form), the concept of the stone has disappeared and that of the analogue takes its place.[14]

Both Semper and Bötticher placed a higher value on artistic symbolism. Unlike Viollet-le-Duc who regarded the imitation of form used in one material to another as 'untruthful' to the nature of the materials, Semper argued that the development of architecture derived from this very process of metaphorical transformation; only as the nature of the materials is 'translated' can symbolic meaning emerge. Just as the meaning of the word spoken in one language can be

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[12] Gottfried Semper, *Style in the Technical and Tectonic Arts, or, Practical Aesthetics* trans. Harry Francis Mallgrave and Michael Robinson (Los Angeles: Getty Research Institute, 2004), p. 439.
[13] Ibid.
[14] Source quoted here is Wolfgang Herrmann, *Gottfried Semper: In Search of Architecture* (Cambridge, Mass.: Mit Press, 1984), p. 143.

translated into another language, so too a particular symbolic meaning in architecture is transferable between different media.

The next architectural idea of materials, we now consider, was proposed by the nineteenth-century British architectural thinker John Ruskin. In *The Seven Lamps of Architecture*, Ruskin's view of materials was that the material on its own was not active in the creation of architecture. While Ruskin would have agreed that different materials possess different physical properties and that no material is quite the same as another, for him, what was lacking in raw materials were intellectual thought and human labour. For Ruskin, only by these extrinsic elements employed in the fabrication process can unanimated materials be rendered into a sophisticated, lively object of architecture, and it is in this capacity of turning 'inert substance' into a 'life' that set architecture apart from other forms of production. In *The Lamp of Life*, Ruskin put his idea as follows:

> this is especially true of all objects which bear upon them the impress of the highest order of creative life, that is to say, of the mind man: they become noble or ignoble in proportion to the amount of the energy of that mind which has visibly been employed upon them. But most peculiarly and imperatively does the rule hold with respect to the creations of Architecture, which being properly capable of no other life than this, and being not especially composed of things pleasant in themselves, – as music of sweet sounds, or painting of fair colors, but of inert substance, – depend, for their dignity and pleasurableness in the utmost degree, upon the vivid expression of the intellectual life which has been concerned in their production.[15]

For Ruskin, the interest of architecture came from the action working upon materials. The emphasis on 'practice' rather than on theories, as Ruskin suggested here, seems to be one aspect of a difference between the British concern with materials and that of France and German-speaking countries, and it is here – in 'practice' – that discussion about British idea of materials should begin.

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[15] John Ruskin, *The Seven Lamps of Architecture* [1849] (New York: John Wiley & Son, 1865), p. 123.

If the tendency not to separate doing from thinking was specific to British concerns with materials in the nineteenth century, it has some affinities with the philosophy of phenomenology concerning the close relationship between idea and things. In his essay 'The Origin of the Work of Art', the philosopher Martin Heidegger made a criticism against Platonism, which with tendency to make a distinction between idea and things underlay Western Philosophy up to twentieth century. Heidegger argued that these two domains must not be treated separately:

> To keep at a distance all the preconceptions and assaults of the above modes of thought, to leave the thing to rest in its own self, for instance, in its thing-being. What seem easier than to let a being be just the being that it is? Or does this turn out to be the most difficult of tasks, particularly if such an intention – to let a being be as it is – represents the opposite of the indifference that simply turns its back upon the being itself in favor of an unexamined concept of being? We ought to turn toward the being, think about it in regard to its being, but by means of this thinking at the same time let it rest upon itself in its very own being.[16]

For Heidegger, the ideas of the thing lie not in something that preconceive it, but in our perception of the thing and in the thing itself. Furthermore, in relation to the creation of a work, Heidegger stated: 'to create is to cause something to emerge as a thing that has been brought forth'.[17] Earlier in the text, he talked about the creation of the work in relation to the materials.

> When a work is created, brought forth out of this or that work-material – stone, wood, metal, color, language, tone – we say also that it is made, set forth out of it. But just as the work requires a setting up in the sense of a consecrating-prasing erection, because the work's work-being consists in the setting up a world, so a setting forth is needed because the work-being of the work itself has the character of setting forth. The work as work, in its presencing, is a setting forth, a making. But what does the work set forth? We come to know about this only

[16] Martin Heidegger, "The Origin of the Work of Art" [1950], in *Poetry, Language, Thought* (New York; Toronto: Harper & Row; Fitzhenry & Whiteside Limited, 1975), p. 31.
[17] Ibid., p. 60

> when we explore what comes to the fore and is customarily spoken of as the making or production of works.[18]

Any raw material – 'something lying at the ground of thing, something always already there' – for Heidegger, as for Ruskin, is inert; but once it is brought forth and made to stand for the properties it self-evidently acquires, it will be turned to become the work that has a capacity to represent the thingness of the thing, of which the work is made. As Heidegger put it, 'to let a being be as it is' or '*The work lets the earth to be an earth'*, and it is this revelation process of the matter that Heidegger regarded as the art of architecture.[19]

A building that well illustrates Heidegger's idea is Kelling Place, Norfolk, the country house designed and built by the Arts and Crafts architect Edward Prior between 1904 and 1906. At Kelling Place, Prior took to the extreme Ruskin's idea of turning something worthless into something of value. To the south of the site, an area of land was excavated to the depth of six feet where materials such as gravel, flint pebbles and sand were found. Prior managed to use them as building materials for the construction of the house; gravel was used as aggregate for mass-concrete wall construction; flint pebbles as facing materials; and sand as mortar. Only relatively small quantities of brown stone, flat tiles and pantiles were imported for walling details, chimneys and decorations. On its own, each individual piece of material in the walls of the house does not mean much, and to remove it from its place in the wall, it would be to reveal it as raw and natural as when it came out of the earth, but the overall effect of the materials is a lively, relentless patterning of diverse textures and colours, transcending the natural state of the materials. Prior's handling of local materials may be regarded as an affinity with locality and the

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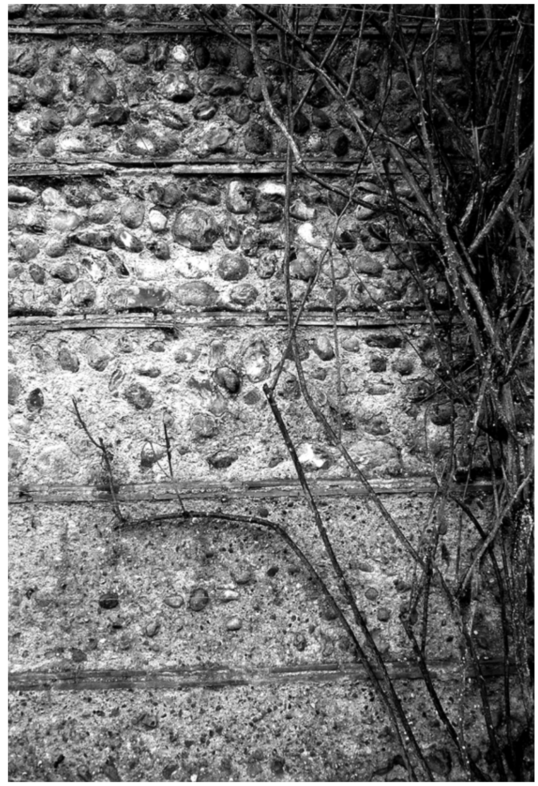
[18] Ibid., p. 45.
[19] As quoted in Ibid., p. 31, 46.

4.1 *Far left* Edward Prior's Kelling Place, 1904-1908, Norfolk, photographed in 2010. Most of the building materials for the construction were found there at the site, but it needed an architect's ingenuity to turn those seemingly inert substances into a work of architecture.



4.2 Details of Garden Wall made out of 'found' materials, Kelling Place, Norfolk, photographed in 2010. To remove the material from its place in the wall, it would have returned to its natural state.

economy of materials, but what turned the 'raw matter' lying there into an extraordinary piece of architecture is a combination of architects' determination and human labour.[20] For the construction, Prior was against the adoption of a general contractor, who would provide both materials and labour for the building work; instead, he appointed a clerk of works, Randell Wells (who was also the site-architect for the construction of William Lethaby's All Saints, Brockhampton) to supervise tradesmen and craftsmen directly hired, and the extraordinary result clearly derives from the ingenuity of the process by which the building was constructed. In other words, what turned inert matter into life was 'practice'. It is precisely in this sense that Prior

[20] For such interpretation of Prior's use of the materials at Kelling Place as an affinity with locality and the economy of materials, see, for example, Dan Cruickshank, "Material Values", *The Architect's Journal* 210, no. 19 (18 November 1999): p. 42.

brought forth the matters lying there in the ground and made them to stand forth, so that one can see Kelling Place as a demonstration of Heidegger's essay. And again it is here in the practice – something that can neither be isolated before nor added after, but something that plays its part through the process – that essentially turns inert matter into the work of architecture [fig 4.1, 4.2].

'Practice'

It may be useful at this stage to comment on what we call 'practice'. Let us be clear, 'practice' cannot be added on later nor described beforehand. Whatever has been said to initiate a work, once the work process begins, the action of practice take over. Not like a pure intellectual thought, usually considered as a framework at the beginning of the work process, practice is neither derived nor justified from the proposition outside its own creation; it is an inextricable part of the work process itself. While theories enjoy a position as an independent thought, 'practice', with its bond to the work process, by contrast, prevents itself from being independent, and therefore is rarely recognisable as carrying any theoretical proposition. What is puzzling about 'practice', and causes it to be neglected as a form of theory, is that it is almost always unarticulated and non-explicit but belongs to the art of making – the craft.

But, on the other hand, the 'practice' of architecture is not just about manual labour. Though architecture displays affinities with craft insofar as it is worked out by manual labour, architectural practice is not itself a form of craft. It is worth noting that Heidegger drew a distinction between a craft and a work:

> Handicraft – a remarkable play of language – does not, to be sure, create works, […]. Calling art *techne* does not at all imply that the artist's action is seen in the light of craft. What looks like craft in the creation of a work is of a different sort.

> This doing is determined and pervaded by the nature of creation, and indeed remains contained within that creating.[21]

According to Heidegger, the practice of an art, including architecture, and that of craft are not quite the same. The difference is that skill (*Techne*) which produces craft is in conformity with traditional modes of working, whereas what is needed in producing art or architecture also demands 'practical judgement' (*phronesis*) – a disposition which, according to Shirley Grundy, "would encourage a person acting in a certain situation to break a rule or convention if he/she judged that to act in accordance with it would not promote 'the good' ".[22] In this regard, what makes architecture requires certain values of 'informed action' which the disposition of craft alone lacks.

The particular feature of so-called Arts and Crafts architecture is that it is an architecture that is given some of the feature of craft, while still retaining its nature as the work of architecture. The attempt of those architects who turned their interest into a craft process was not so much that they wanted to create a work of architecture as craft, but was to try to allow architecture to have some qualities of craft. It is then in such an attempt of trying to make architecture more like craft that we must look for theoretical propositions about the work; if the creative process has gone into the production process, and 'remains contained within that creating', as Heidegger put it, we may see 'theory' as something that is embedded in 'practice'.[23] In other words, it is by practice's very nature as an intermediary between the act of making and the substance of materials that permits us to deal with what abstract theories do not fully allow us to address, namely, the process.

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[21] Heidegger, "The Origin of the Work of Art", p. 58-60.
[22] Shirley Grundy., *Curriculum: Product or Praxis* (London: Falmer, 1987), p. 61.
[23] Heidegger, "The Origin of the Work of Art", p. 58-60.

If the British tendency not to separate 'practice' from 'theory' was as characteristic of late-nineteenth-century British architecture as it was of the philosophy of phenomenology in certain respects, did this continue to be true for the early-twentieth-century British architecture? Robert Atkinson and Hope Bagenal's book *Theory and Elements of Architecture*, published in 1926, might help to clarify this question.

Robert Atkinson and Hope Bagenal's *Theory and Elements of Architecture*

Robert Atkinson is best known as both an influential teacher at the Architectural Association School, and an established architect. Hope Bagenal, who also taught and worked as a librarian at the Architectural Association, is best known for his initiative in studying architectural acoustics in Britain; the buildings he designed acoustical systems for included important projects like the Liverpool Philharmonic, Royal Festival Hall and Manchester's Free Trade Hall. Even though Atkinson and Bagenal's roles in the development of Britain architecture are well accredited, the book they wrote together, though it was referred to in all articles written about them, is less known than it deserves to be.[24] Written in 1926, at around the same time as Heidegger wrote *Being and Time*, Atkinson and Bagenal's *Theory and Elements of Architecture*, largely passed architects by, since it appears at first sight to be a replication of Ruskin's ideas and was published at just the wrong moment. However, it is more than this. There are at least three features that make their book deserved to be read as an original statement of British 'theory' of the early-twentieth century.

[24] For references to Robert Atkinson, see, for example, Alan Powers, in *Robert Atkinson, 1883-1952*, ed. Paul Spencer-Longhurst (Architectural Association, in collaboration with the Barber Institute, University of Birmingham, 1989), Gavin Stamp, in *Robert Atkinson, 1883-1952*, ed. Paul Spencer-Longhurst (Architectural Association, in collaboration with the Barber Institute, University of Birmingham, 1989), F.R. Yerbury, "Robert Atkinson", *AA Journal* (Feb 1953): p. 119-121; for references to Hope Bagenal, see, for example, William Allen, "Obituary: Hope Bagenal", *AJ* (30 May 1979): p.1102, "Hope Bagenal", *RIBA Journal* (December 1979): p. 515.

First of all, their notion of 'theory' demonstrates some of the phenomenological concerns not to separate ideas from actual physical objects of study. Atkinson and Bagenal were very determined about this; at the outset of the book, they stated:

> Architecture carries with it the labours and fatigues of an active historical process, in which the needs and ideas of men living and dead, the materials available, and the temper of workers, are stubborn factors. For this reason it is both the most limited of the arts and, at the highest, the most inclusive. Knowledge and the preservation of knowledge enters into it, as into civilisation itself.[25]

The work of architecture, for them, was the object of study within which the processes of thinking, the materials and the labour required for the creation were put together into conjunction before they can be turned to become something of useful and worthwhile. For 'theory', Atkinson and Bagenal turned to look at basic elements of architecture, such as walls, roofs and openings, since these elements contain within themselves successful experiments that have been tested through time. As they said: 'Much of our knowledge must come from the past because architecture, like law and other fundamental activities, works cumulatively by a series of slow tests. […] The past is full of buildings that have been and are still being tested, and the testing process is architectural history'.[26] Another feature in *Theory and Elements of Architecture* that puts the book close to the phenomenologists' concerns is Atkinson and Bagenal's attitude towards architecture as something that offers the means for human subjects to locate themselves in relation to the universe, later more fully developed in the philosophy of phenomenology. In their discussion about openings, Atkinson and Bagenal wrote,

> Since his [human's] own life is related to the universe outside he must frequently pass in and out by means of a door. Also since light and air are necessary to life inside as well as out there was another use for the opening distinct from man's

[25] Robert Atkinson and Hope Bagenal, *Theory and Elements of Architecture* 1st ed., vol. 1, Part 1 (London: Ernest Benn Limited, 1926), p. 1.
[26] Ibid., p. 3.

exists and entrances; it was also necessary to his health as a window to admit the sun. This passage to and fro between an inner and an outer world this intercourse between man and his environment necessary to his health is at the root of all ancient symbolism attached to door and window.[27]

Atkinson and Bagenal went on to describe through historical examples how doors and windows in architecture served as an instrument by which human subject concerned themselves with the universe. Atkinson and Bagenal viewed the role of architect, as they put it at the very end of the book, as 'a builder who desires the universal in his work'.[28]

The second idea that makes Atkinson and Bagenal's account distinctively British is that it can be seen as a counter-argument to Structural Rationalism. Unlike Viollet-le-Duc, architecture for them is not necessarily just a demonstration of structure. Atkinson and Bagenal made this point clear when they talked about walls.

> But architecture has never been purely structural. It has been structural plus a whole range of other factors. It must be recognized that wood and wattle forms were for long imitated in masonry because they were familiar and beloved, as decoration to concrete walls. To-day steel structures are made to conform to a masonry tradition because among other and less admirable reasons, its shapes are decent and familiar. Is it right or wrong that there should be this overlapping and survival of forms after their true reason for existing has disappeared? The student must think out this problem for himself; the phenomenon is not confined to architecture. Clear thinking upon facts will lead him to new and truer forms which, in their turn – if they are beautiful – will become familiar. But let him begin by being certain of one thing, namely, that whatever forms he uses he shall know their meaning and implication.[29]

Following this discussion, Atkinson and Bagenal went on to give an example of walls in Egyptian architecture. They observed that Egyptian walls, which were actually made of many stones, are

[27] Ibid., p. 269. (In square brackets added)
[28] Ibid., p. 367.
[29] Ibid., p. 99.

rendered monolithic, as if being made of just one large stone [fig 4.3]. Such a transmutation of material however was regarded by Rationalists as 'deceitful' to structural principles, and to the nature of materials, since they would have seen it as the imitation of the form used in one material into another material, without taking into consideration the possibilities of, say, the imitation of the form of clay in a stone building. But while in France the issue the transmutation of materials did not conform to the orthodoxy of Structural Rationalism, the objection does not seem to have applied in Britain; Atkinson and Bagenal in their book saw the transmutation of the materials, justified by other cultural factors, such as the desire of the Egyptian builders to achieve the image of eternity in their architecture. It is in a counter-argument such as this that we might find that the transmutation of materials gaining some other significance in British situation. Rather than being an absolute, the transmutation of materials not only conflicts with orthodox Rationalist theory, but allows an opening to other concerns – concerns that may be guided by 'practice' – rather than dictated by theory. With their attitude towards the transmutation of materials as something that may add value to architecture, Atkinson and Bagenal's position is closer to Semper than to Viollet-le-Duc, but following Ruskin, they insisted on the presence of material.

4.3 Pylons of Temple at Edfu, from Robert Atkinson and Hope Bagenal, *Theory and Elements of Architecture*, 1926, p. 100. The imitation of the form of clay in a stone building, though considered 'deceitful' in Rationalist terms, did not fail Atkinson and Bagenal to appreciate other of its significance.

If a non-ideological approach and a counter-argument to Structural Rationalism contribute to the British features of Atkinson and Bagenal's 'theory', the third idea, deriving directly from Ruskin and the Arts and Crafts' legacy, is their inclusion of intellectual and manual labour as co-ordinated parts required for the creation of satisfactory architecture.

For Atkinson and Bagenal, a theory alone is not sufficient to produce a work. Intellectual though the idea may be, it is not equal to the intellectual qualities of the work. Neither can the work's qualities be found outside the work, nor are they substituted by any other form. What Atkinson and Bagenal saw in the work is its capacity to carry intellectuality, and it is in this way of thinking that they thought belonged to a British way of thinking. Atkinson and Bagenal put it as follows:

> The apparent accidental beauty in the texture of a rubble wall cannot be achieved by the modern architect without considerable craftsmanship. It can only be arrived at by the co-operation of the hand of the builder with his brain, not by his brain alone. Yet when it is present in a work it makes an immense positive contribution of a kind that nothing else can make. This sense of texture as a human element in the best building came to be recognised in England at the end of the nineteenth century […]. A standard was set in this respect in England which has had far-reaching results and at this day distinguishes the best English architecture from the best French. But beauty of surface is a contribution only and can never of itself compensate for the lack of intellectual qualities. It is a kind of grace that come from the true synthesis of brain and hand in building, and should be used to enhance the intellectual qualities.[30]

As a statement that undermines the distinction between 'theory' and 'practice', it may point towards British attitudes towards materials of the early-twentieth century, when the Arts and Crafts way of thinking without separation between 'theory' and 'practice' was still current – and one that might lead us to arrive at a better understanding of the difference between the British theory of materials and the European ones. If neither Viollet's Structural Rationalism, nor

[30] Ibid., p. 354, 356.

Semper's principle of the 'disappearance' of material, were ever adopted in Britain, what 'theory' was there to take their place?

If these features – of being non-ideological, insubordinate to Structural Rationalism and inclusive of mind and hand – characterise Atkinson and Bagenal's account and may be taken as a British theoretical proposition, let us see if any 'theory' of materials emerges from 'practice'? Can we consider something that is known through 'practice', practical reasons and judgements as having a theoretical context? How far one could regard the interest in the *use* of materials in this country as an alternative 'theory' of construction? Since in Britain, as we have seen, material seems to have been viewed, to use Heidegger's terms, as 'formed matter' that it is above all 'constructed' by human practice, we then can only hope that it is in 'practice' itself that a theoretical concern with the materials essentially lies. It is in this regard that put us in the position to confront the actual physical fabric of a built work itself, since it is in it that will be giving materials capacity to reveal their significance, and from which a theoretical proposition concerning the materials can be deduced.

The Royal Horticultural Hall, *1923-1928*

To consider such above questions, the Royal Horticultural Hall designed by Murray Easton and Howard Robertson is a good case to look at. As one of the most interesting works of architecture built in Britain in the 1920s, the building of Royal Horticultural Hall might thrown some light on whether British concern with materials was in any way distinct from ways in which materials were explored elsewhere.

At the corner between Greycoat Lane and Elverton Street in Westminster, London, there stands the building for the Royal Horticultural Hall. From the street level, the walls play a major part of the outer appearance, while the roof is almost invisible from the street. The exterior does not suggest anything striking. Only when we come closer to the front façade does the building reveals itself as more elaborate, being made with several crafts and materials: dressed Portland stones cover the lower part of the main elevation and the plinth and surrounds on the side elevation on Elverton Street. Marble fascia panels are used for the frieze over the main entrances, while the doors' lintels are made of wrought iron, with gilded edges. Above the doors, the canopies are modelled in cast lead and gilded, while their soffits are bush-hammered and left exposed. The recessed horizontal strip above the cornice is of Crowborough stock bricks laid vertically, separating the lower part of the building from the upper part, where horizontal brickwork is the main material. The variety of materials employed in this single façade, however, does not do more than add an element of decoration. The overall character of the building is predominately brick and stone. Together with Georgian windows on the front façade, the outward appearance of the Royal Horticultural Hall is a tactful attempt to give harmony and therefore respect to domestic surroundings, yet without suggesting anything whatsoever about the interior [fig 4.4].

4.4 The Royal Horticultural Hall Front Façade, Westminster, London, 1923-28, photographed in 2010.

4.5 The Royal Horticultural Hall Rear Façade, photographed in 1928. From Verner O. Rees, 'The Royal Horticultural Hall', *The Architects' Journal* (October 24,1928), p.567.

Only on the rear façade, since it has no an annexe building attached as in the front, do we get a hint of what might lie inside the building. On the east façade, a series of window openings is aligned with three columns, over which an elliptical arch springs, covering the central part of the rear wall – a suggestion that a curved roof might rest on top of the building, whose main structure is probably of columns and arches springing from them. Only when we are in the interior do we actually realise that that peculiar arrangement on the rear façade is deceptive. Neither columns nor arches are behind the walls. What is concealed behind the walls is a series of parabolic structures spanning the entire width of the exhibition hall [fig 4.5].

Since it is entered from a small, low ceilinged, lobby, the space of the exhibition hall appears at first impression to be spectacularly higher than it is. While the hall has a conventional 'nave and aisles' plan, in which the nave is covered by a series of stepped roofs and the aisles by flat slab roofs, the feature of parabolic sections gives the interior space a new and striking expression. The reinforced concrete parabolic arches of the Royal Horticultural Hall have been linked to precedents in Europe, especially in France at least in this particular case, but there are important differences between the Continental way of using materials and the British one.[31] For example, the behaviour of parabolic arches at the Royal Horticultural Hall differs significantly from the semi-circular arches of Auguste Perret's Esders Clothing Factory of 1919 in Paris, where the inner side and outer side of the arch section curve in parallel to one another [fig 4.6]. Nor is it like the parabolic arches of airship hangars at Orly, designed by the French engineer Eugène Freyssinet between 1921 and 1923, where the lower parts of the parabolic arches are bigger than the upper [fig 4.7]. None of these features apply to the Royal Horticultural Hall. Rather than attributing the significance of this work to its precedents by pointing out their superficial similarities, we might

[31] Morton Shand was the first critic of the Royal Horticultural Hall to refer to precedents of parabolic structure in Europe. See P. Morton Shand, "Salute to Adventurers. The New Royal Horticultural Hall.", *Architectural Review* LXV (January, 1929): p. 18.

4.6 August Perret’s Esders Clothing Factory, Paris, France, 1919, from Sous la direction de Jean-Louis Cohen, Joseph Abram et Guy Lambert, *Encyclopédie Perret*, 2002, p.95

4.7 Eugene Freyssinet’s Airship Hangars, Orly, France, 1921-1923, from, *Encyclopédie Perret*, 2002.

do better to look at its own building process, for it is only in this domain where the distinctive features of the Royal Horticultural Hall reveal themselves more clearly.

In early-1924, due to the inadequate space of the existing hall, the Council of the Royal Horticultural Society saw a need for a new hall which would provide more than twice the capacity of the present hall. Later in May 1925, after the proposal for building the Royal Horticultural Hall was opened for competition, a total of four designs were submitted, one of which proposed to cover the hall with a series of stepped roofs, together with vertical windows to transmit daylight to the hall. From the outset, this ‘stepped roof’ scheme gained favour amongst some members of the Council, but as this particular type of roof form was unlike anything previously done in Britain, the Council felt the need to study recent examples of the roof form more closely in Europe and elsewhere. As one member of the Council stated,

> With regard to these, it would surely be unwise to accept that which has a roof consisting of steps and which only admits light through the vertical windows without carefully considering a building lighted on this principle. The nearest example is understood to be at Lyons and it seems desirable to inspect this with as little delay as possible. Even if this system of lighting were satisfactory, it would probably be undesirable to construct an exhibition hall with side aisles,

4.8 Tony Garnier’s Cattle Market, Lyons, France, photographed by F.R.Yerbury, 1928, from Howard Robertson and F.R.Yerbury, *Examples of Modern French Architecture, etc*. 1928, p.vii, photographed by F.R.Yerbury.

4.9 Arvid Bjerke’s Congress Hall, Gothenburg Exhibition, Sweden, from Brent Elliott, ‘The Royal Horticultural Society’s New Hall’, *Thirties Society Journal* 7 (1991), p.16

> for my experience with the exhibitions leads me to suppose that none of them would be satisfied if they were placed in the aisles. I am ascertaining from the architect whether this building could be constructed without these side aisles.[32]

Following this suggestion, the architects of the scheme, Easton and Robertson, visited Tony Garnier's cattle market in Lyons [fig 4.8] and other buildings with a similar type of stepped roof such as Arvid Bjerke’s Congress Hall at the Gothenburg Exhibition [fig 4.9], whose main structural feature was of laminated timber arches carrying tiers of clearstory windows, as well as some important halls in America and in Britain.[33]

In July 1925, two alternative schemes remained under consideration: Easton and Robertson’s ‘Swedish Design’, so called since it had been developed after the roof feature of Arvid Bjerke’s Gothenburg Hall, and the other alternative, ‘The Railway Station Design’ (no architect’s name was given in the committee minutes), similar to St. Pancras Station, whose long span interior is

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[32] RHS’s Council Minutes, May 5, 1925

[33] RHS’s Council Minutes, July 28, 1925; Andrew Higgott wrote that ‘Robertson and [F.R.]Yerbury visited the Jubilee exhibition at Gothenburg in Sweden. The centerpiece was Arvid Bjerke’s Congress Hall, a bold design of timber arches supporting a row of clerestories. Robertson’s own design for the Royal Horticultural Hall, the subject of a successful competition entry soon afterwards, reproduced similar forms in concrete’. As quoted in Andrew Higgott, “Introduction”, in *Travels in Modern Architecture 1925-1930* (London Architectural Association, 1989), p. 10-11.

uninterrupted by supporting columns, 'The Railway Station scheme' proposed to cover the entire area of 20,400 square feet with glass roof on a single span of steel trusses. As it was explained,

> By bringing the ends of the weight carrying steel of the roof of St. Pancras Railway Station, the provision of heavy brick supporting piers of large area has been avoided, and the brick walls between the steel trusses are really screen walls of moderate thickness. This method is eminently constructional, and is economical both of floor space and masonry. It is believed also that the internal appearance of the Hall with these great arched steel trusses would be decidedly effective.[34]

While this scheme gained the favour of some members of the Council, it was far from most desirable.[35] To fulfil the demand for a distribution of daylight with minimum obstruction by covering the whole area of the hall with glass roof presented some undesirable features too familiar in local experience. As H.B. May commented:

> To myself the paramount question is the construction of the roof; and the success or failure of the Building to fulfil the objects for which it is required entirely depends on that factor. The Crystal and Alexandra Palaces are notoriously unsuitable for horticultural purposes, and the Society's disastrous experience at Olympia is too recent to have been forgotten.[36]

It was unsuitable for the purposes of horticultural society presumably because the use of glass for the roof at Crystal Palace involved difficulties to control direct sunlight, and high costs to keep such a vast area of glass roof clean.[37] Moreover, the experience of the glass roof in the old hall of the Royal Horticultural Society, which at that time needed serious maintenance, also proved sufficiently undesirable for some member of the Council to reject 'The Railway Station Design'.[38]

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[34] RHS's Council Minutes, July 28, 1925

[35] See the approval of 'The Railway Station Scheme' in 'Memorandum from the Secretary', RHS's Council Minutes, 22 July 1925.

[36] RHS's Council Minutes, 'Memorandum by Mr. H. B. May', July 27, 1925.

[37] Anon., "The Royal Horticultural Society's New Hall", *Engineering* (Dec 21, 1928): p. 763.

[38] The objection to 'The Railway Station Scheme' was proposed by M. B. May; see RHS's Council Minutes, July 27, 1925. The estimate cost for repairing the glass roof of the RHS's old hall 'amounted to £ 1,793 with additional £ 150 for special glazing bars and new glass', as quoted in RHS's Council Minutes, November 3, 1925.

‘The Swedish Design’, on the other hand, whose distinctive features consist of stepped roofs and clerestory windows, offered more advantages. Amongst its several benefits, the control of lighting and protection against excessive sunshine by a combined solution of stepped roof slabs and vertical glazing, and the prospect of reduced maintenance made the Council preferred Easton and Robertson’s Swedish Scheme over the other alternative.[39] As the architects later described their design: ‘This form and construction arose from the desire to obtain lighting that would closely approximate to outdoor conditions, and which would yet lend itself to a satisfactory architectural expression and be of such a permanent nature as to require very little upkeep’.[40] At the end of the day, it was ‘The Swedish Design’ that won by nine votes to five amongst the Council.[41]

The requirements for uniform illumination throughout the exhibition hall without the technical drawbacks of roofing the whole area with glass, and for the provision of the maximum space with ‘the minimum projection of the trusses’ were indeed complicated, and required both architectural and engineering solutions to be worked out fully in advance.[42] As we have seen, this was not the case of the Arts and Crafts architecture, where to some extent the ‘work’ was carried out while the construction was progressing. The work of preparation required here necessitated the architects’ direct collaboration with a structural engineer.[43]

[39] RHS’s Council Minutes, July 28, 1925

[40] Murray Easton and Howard Robertson, “Short Description of the New Hall”, *Journal of the Royal Horticultural Society* LIV (Jan 1929): p. 113.

[41] RHS’s Council Minutes, July 27, 1925

[42] RHS’s Council Minutes, November 28, 1925

[43] After the appointment of Easton and Robertson as the architects of the project, it was not yet decided whether the structure of the building was to be built in steel or in reinforced concrete. It was then understood by some member of the Council that the structure of the new hall was to be built in steel as F.R.S Balfour suggested that ‘an expert in the use of steel-work should co-operate with the architects in the construction of the new Hall’, as quoted in RHS’s Council Minutes, Sep 8, 1925.

The emergence of a particular form of practice at the Royal Horticultural Hall not only presents us with an opportunity to investigate an early case of collaboration between architects and an independent consulting engineer, it also offers a chance for further investigation of the question posed by the English modernist critic, Morton Shand, as to whether this was an 'English' or 'Foreign' work.

Morton Shand's Notion of 'Englishness'

Immediately after the completion of the Royal Horticultural Hall, in his 1929 article 'Salute to Adventurers', Shand drew attention to Easton and Robertson's failure to show the structural feature of the building on its exterior, saying while this might cause some trouble to 'Pedants', by which he meant Structural Rationalists, it did not prevent it from being worth appreciating, and then he continued as follows.

> By seeking their inspiration, not in fulsome orthodox glosses of the dead letter, but in the still living spirit of our superb heritage of sober and sparing grace, Messrs. Easton and Robertson have inaugurated a new epoch in British architecture. […] Some critics consider this building international in character; by which, presumably, they mean that it is not typically English in any of the senses in which we have grown accustomed to envisage Englishry in brick and stone. Naturally enough it shows certain discernible foreign influences. How should this be otherwise when no English precedents existed – barely even any serviceable English experiments – for the solution of many of the delicate and intricate structural problems which the architects have had to work out for themselves? [44]

While we do not know exactly what Shand meant by 'Englishness' here, Shand's subsequent account suggests a particular view of 'Englishness' as something embedded in a distinctive way in which the materials and the structure were worked out through the architect's own

[44] Shand, "Salute to Adventurers. The New Royal Horticultural Hall.", p. 17.

experiments. In other words, Shand questioned whether something unprecedented could possibly be considered as 'English' feature.

Before we go any further in considering what might be the 'the Englishry' of the Royal Horticultural Hall in more detail, we should ask why materials might make us to think about 'English' or 'Foreign' at all. Although the argument that a particular choice of local materials is indicative of national identity is common, this is not often applied to a seemingly universal material like concrete. While indigenous materials such as local brick, stone and wood are much used to identify buildings as belonging to one place rather than another, concrete, especially in the 1920s, was an exception in that it was used to indicate universality. As Adrian Forty has pointed out, the general view amongst modernists was that concrete was a modern medium that allowed architecture to suppress its differences and to promote its universal value.[45] Against such a general attitude towards the modern material, was there still an opportunity for an architect to express something that is distinctively national with concrete? How far is this theoretical proposition specific to Britain?

In considering this paradox, that concrete is at once a material of worldwide discourse, but at the same time indicative of national identity, no building of the 1920s offers a better opportunity for investigation than the Royal Horticultural Hall – a type drawn from foreign example, but realised in the British context by ones of the first twentieth-century British architects to have collaborated with an independent British consultant engineer. It is here that we should turn back to the change taking place in building industry at the end of the nineteenth and early-twentieth centuries in

[45] See Adrian Forty's writings on concrete, for example, Adrian Forty, "Cement and Multiculturalism", in *Transculturation : Cities, Spaces and Architectures in Latin America*, ed. Mark Millington and Iain Borden Felipe Hernández (Amsterdam Rodopi, 2005)

order to understand a condition giving rise to their 'collaborative' approach more clearly and to understand what the new material, concrete, meant to them.

Since 1890s, the new material of reinforced concrete had become available through patented systems controlled by a small number of specialist firms. Each firm had its own patents, and their commercial success depended largely upon the protection of their proprietary system. To use reinforced concrete for building, architects, who had had little part in the development of the material, were obliged to adopt one of those patented systems from the specialist firms. Under this system, to design the structural work architects were obliged to call upon a concrete specialist, working out of the proprietary systems. While the concrete specialist would offer structural solutions and procedures for the work to be constructed according to the architects' design, the disadvantage of using the firm's specialist was that the choice of materials, structural details and constructional method must follow the procedure of that proprietary system. The choice open to the architect was between one or another proprietary system, but the choice of a particular system was not a sure route to the best design.

An alternative procedure became possible when the licensing systems for the materials began to break down around 1920s, as the original patents expired, opening the opportunity for an independent engineer to design a structure without commitment to any particular system.[46] The advantage of this was to allow architects and engineers to adopt structural solutions free from the concrete companies – a condition that the engineer Oscar Faber considered as better suited to the interests of both architects and engineers. As he wrote in 1924,

> Let it be granted, then, that well-advised engineers and architects will call in a specialist to design for them their concrete work. They are confronted with

[46] Andrew Saint, *Architect and Engineer: A Study in Sibling Rivalry* (New Haven and London: Yale University Press, 2007), p. 267.

> several problems, through they probably thought their difficulties over long ere now. Firstly, what is to guide them in the choice of their specialist? They scan the list of experienced firms, and may find themselves committed to the use of a "system" or a patent bar, and the engineer of the firms in question will point out the merits of the "system" and the bars. […] Surely the true specialist who the architect and engineer will seek should not be fettered by allegiance to any "system" or bar, and should use in every contingency an arrangement of bars dictated solely by the science underlying his art.[47]

Faber believed that the adoption of a concrete specialist tied to a particular firm limited the structural possibilities of architecture. For him, the only satisfactory structural result was to be derived from those who had no commercial connection with the concrete firms.

Whether or not encouraged by Faber's book, it was apparent that Easton and Robertson decided to approach an independent structural engineer, as Faber had proposed, and it was indeed he whom they invited to be the consulting engineer for the Royal Horticultural Hall. As soon as reinforced concrete was chosen as the main structural material, as the architects considered it as 'the most satisfactory and economical material for the hall roof trusses', Easton and Robertson proposed to the Council the employment of Oscar Faber as a structural engineer.[48] Their explanation to employ a structural engineer is worth considering here, for it demonstrates well the advantage of a structural engineer over a concrete specialist. In their letter to the Council on 11 November 1925, Easton and Robertson explained,

> The construction of this building presents structural problems of unusual difficulty owing to the very large span of the hall roof trusses and to the lack of abutment. The general design of this and every other part of the building and the co-ordination of all structural details are part of the architects' duty, but the

[47] Oscar Faber and P.G. Bowie, *Reinforced Concrete Design Vol. I. - Theory* (London: Edward Arnold & Co., 1924), p. 257.
[48] RHS's Council Minutes, 28 November 1925

detailed working out of the structure whether in steel or reinforced concrete is not, and is generally arranged for in either of the following ways.

(a) By the employment of specialist firms who work from the general designs and give a tender which includes the preparation of fully designed detailed.

(b) By the employment of an engineer who may be appointed either by the architects or by the Client.

We consider that it is very greatly to the Society's interest to adopt the last mentioned course for the following reasons. The engineer acts in the employer's interest and not that of any contracting company. It is therefore possible to have open tendering on a uniform design and an economy of design which naturally is not the first aim of a company which is interested in the selling of steel etc. [49]

Easton and Robertson foresaw that using the specialist of a concrete firm would limit them to the choice of the firm's proprietary constructional method, compared to the open systems offered by an independent engineer; and they justified the advantage of employing a structural engineer over a concrete specialist in that it offered a saving in fees, as well as allowing them to achieve a more slender structure. As they added:

[…] the L.C.C. will accept from an engineer of repute reduced structural members which it will not accept from a specialist contracting firm. […] This superiority applies to economy as well as to result for it is obvious that specialist firms do not do work for nothing and as a matter of fact this charge is generally not less than 10% on actual costs, although the fact that it is included into the contract may lead building owners to believe that they are not paying for it. […] The standard fees of engineers for such work are 5% on the actual cost of the steel work and 7½ % on the cost of reinforced concrete work. The higher charge for the latter is due to the fact of its being in the first place cheaper than steel

[49] RHS's Council Minutes, 11 November 1925 (see letter in full in Appendix B1)

> work and in the second place involving a very great deal of additional work and supervision.[50]

The Council accepted the architects' recommendation to employ an independent engineer for the structural work, but as reinforced concrete was new both to the client and to the architects, there was a disagreement between them as to whom the responsibility for the work on this material belonged. The Council understood that the reinforced concrete required the expertise of the engineer and was therefore solely the engineer's responsibility. This is evident when the Council then negotiated with the architects that the architects' fees should not be as much as they proposed (6% of the value of the work in total), but should be reduced, by excluding the percentage on the cost of reinforced concrete work, to 2½ % of the total value of the work, while the engineer alone would receive the full rate of fee for the reinforced concrete work.[51]

The architects, however, objected, as they saw the task of designing the reinforced concrete structure as a collaborative work, as much the architects' responsibility as the engineer's. On 28 November 1925, they explained to the Council,

> We are fully aware that this proposal is made with a view to safe guarding the interests of the Society and to prevent work being paid for twice over and we feel that some explanation of an architect's position in a case like this is necessary. The standard rate of 6% is based on the average costs of designing the various parts of a building, the architect, so to say, taking the "fat with the lean." The use of modern construction is steel or reinforced concrete eliminates a great part of the cost of brick work and massive construction which used to constitute the remunerative part of architectural design. In the present instance, for example, walls of 2'3" in thickness would be required under the Building Act whereas by structural design 14" work is all that will be necessary. The elimination of this solid work effects savings for the client in

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[50] Ibid

[51] For issues of the architects and engineer's fees, see RHS's Council Minutes, 11 November 1925 (see letter in full in Appendix B1), 28 November 1925, 1 December 1925, 9 May 1926.

space, time, and cost. It therefore reduced the architects fees while it adds to his work. He must design the general lines of the structure and constantly consult with the engineer in order to ensure the correct working of every detail and service. It is by no means a case of handing over rough drawings to be worked up by the engineer. [52]

By 'handing over rough drawings to be worked up by the engineer', it is most likely that Easton and Robertson were referring to the customary practice when a specialist firm was appointed, in which case the architects would take no part in the design of the structure. Easton and Robertson, however, made sure that to the Council they did more than that, that their responsibility for the design of structure was extensive, involving them in preliminary study of the roof type, in construction of a model for the study of the illumination of the hall's interior, carried out at the National Physical Laboratory, and in preparation of drawing work. Easton and Robertson insisted upon the special circumstances of the design of the Royal Horticultural Hall, as follows.

> Had we been asked to design the office block and to collaborate with an engineer […] the case would have been different. As it is, a large part of our time has been given to the study of the roof forms and we have had two models made at our own expense, besides having undertaken a great deal of investigation into the best forms, – this investigation having included examination similar work in various continental countries. This and the study of the special technical problems connected with lighting etc. we assumed to be parts of our duties and we may say that on a very moderate basis our costs, including our own time and that of draughtsmen, have up to now been not less than £1,000 and this without having reached a point where contract drawings can be prepared. […] we should like to feel that our efforts in this direction are not hampered by the knowledge that [what] we believe to be more than the usual amount of study is to be paid for by less than the usual fees. [53]

At the end of the letter, Easton and Robertson expressed their preference for employing the engineer under their authority.

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[52] RHS's Council Minutes, November 28, 1925

[53] RHS's Council Minutes, November 28, 1925, see full letter in Appendix B2. (in brackets added)

> Finally may we suggest that in making any appointment the Society should be avoid the difficulty of divided control by making the engineer responsible for his part of the work through ourselves. The contrary arrangement has been known to lead to unfortunate results such as independent certification of sums claimed by contractors and the responsibilities of the architect to the client is correspondingly weakened.[54]

If Easton and Robertson's preference for the employment of an independent engineer over a concrete specialist showed their concern to maximise the benefit to be gained from the engineer's participation in the process, their desire to put the engineer under their control showed how anxious they were about the role of the engineer – a revealing incident in the long running story of the relationship between architects and engineers. While the potential consequence of collaborating with the engineer presented considerable advantages, it also presented the architects with a major risk of losing responsibility over the structural work. Rather than letting the engineer in and accepting the loss of more than half of their fees, it was absolutely crucial that Easton and Robertson reacted to the introduction of the engineer by presenting the concrete structure as a piece of collaborative work. This particular case of the collaboration between the architects, Easton and Robertson, and the engineer Oscar Faber, illustrates Andrew Saint's argument about the way architects negotiated their relationship with engineers.

A Collaborative Approach between Architects and an Independent Engineer

In France, as Andrew Saint showed, Rationalist architects, anxious that engineers would take over completely the structural work, adopted a theory of Structural Rationalism enthusiastically, for it allowed them to act more like engineers. While trying to obscure their lack of technical knowledge of engineering, French Rationalists aspired to the engineers' role by exposing the structure of their buildings, making them as if they were engineer's products. Saint implied, even

[54] Ibid.

though he does not quite say as much, that this doctrine was developed by Rationalist architects in order to protect themselves against their rivals, the engineers.[55]

But while French Rationalists succeeded by means of this theory in maintaining their status, the lack of interest in Structural Rationalism in Britain provided no such equivalent protection. Easton and Robertson could not resort to the argument of Structural Rationalism to justify their authority over the engineer (a principle that would not have been likely to convince the Royal Horticultural Society's Council). Unlike French Rationalists, they had to deal with the situation rather differently, since they found themselves facing an ambiguous situation with the engineer. On the one hand, they wanted to work in collaboration with the engineer because the engineer was source of structural, technical knowledge, deemed essential for the use of modern materials of steel and reinforced concrete. On the other hand, the engineer could endanger their career, on account of their own inexpertise, and risk of losing responsibility over the concrete work. It was almost inevitable for them to move into collaboration with the engineer, but at the same time to try to emphasise the specialised dimension of their work as something different from engineering, in order to reinforce their role. It was these circumstances that led to the emergence of collaborative approach between the architects and the engineer at the Royal Horticultural Hall, but in a sense that the architects still retained their authority over the engineer. To understand significance of this relationship more fully we need to know what the engineer Oscar Faber brought to the collaboration with the architects.

Oscar Faber was first trained as an electrical engineer, but soon became enthusiastic in the new construction technique of reinforced concrete, choosing it as his research subject in postgraduate study at Civil and Mechanical Department, City and Guilds College (part of Imperial College

[55] Saint, *Architect and Engineer: A Study in Sibling Rivalry*, p. 241.

London). After City and Guilds, he took a job as a concrete specialist for construction companies, first at the Associated Portland Cement Manufacturers Ltd and then the Indented Bar Company, before becoming the Chief Engineer of the contracting firm George Trollope & Sons and Colls & Sons Ltd. In 1921 Faber started his own practice; one of his early works was the design of the new Bank of England in collaboration with the architect Herbert Baker, and it was this project that gained him his reputation.[56]

Before Easton and Robertson brought in Oscar Faber as engineer for the Royal Horticultural Hall, he was well-known as an expert in the use of reinforced concrete, due to his book *Reinforced Concrete Design: Vol.1 – Theory*, which he co-authored with P. G. Bowie whom he met while working at the Indented Bar Company. However, his work at the Royal Horticultural Hall was also an experiment. None of his previous works were equivalent to the structural problems of the Royal Horticultural Hall. And, although the Royal Horticultural Hall is reminiscent of the Gothenburg Exhibition Hall in character, the two buildings are not the same, for essentially they were not built in the same materials. Nor was the structural principle of the Gothenburg Hall simply reproduced at the Royal Horticultural Hall. It is not simply the laminated timber arches of the Gothenburg Hall were transferred into reinforced concrete at the Royal Horticultural Hall, but the structural principle of the latter differs significantly.

Though no direct evidence from the engineer's side as to what he thought about the structural principle of the Royal Horticultural is to be found, except for his involvement in an experiment on the progressive deformation of a reinforced concrete arch after the completion of the Hall, the

[56] John Faber, *Oscar Faber: His Work, His Firm & Afterwards* (London: Quiller Press Limited, 1989)

articles published in *Engineering* and *Concrete and Constructional Engineering* give a good account of what the engineer Oscar Faber brought to the architects' design.[57]

At Gothenburg, we see the sections of laminated timber arches relatively fatter at the bases than at their apex. But at the Royal Horticultural Hall, where the main hall is divided into seven bays by six monolithic ribs of reinforced concrete, the section of each parabolic arch is around 6 feet in depth at the top, then as it curves downwards it becomes shallower and shallower and turns into rectangular columns of 3 feet by 1½ feet at floor level, contrary to a usual expectation that the lower part of a structure should be fatter, and therefore more stable. The parabolic arches are structurally arranged in co-ordination with other elements. The spring sections, as they arch over the hall, blend the horizontal slab roofs and clerestory windows all together in one stroke. The higher the arch, the smaller the clerestory windows, but the wider the slab roofs, as they extend towards the central axis of the hall. This unusual and complicated arrangement, in which the heavy parts on the top are rested on the relatively slender piers, was surely the architect's ideas so as to fulfil the demand for optimum space of the hall with the minimum obstruction. This elegant but complicated structure for the Royal Horticultural Hall needed an ingenious engineering solution appropriate to the architects' design – one that was hardly possible to obtain from standard solutions under proprietary systems [fig 4.10, 4.11].

[57] For the experiment on the progressive deformation of a reinforced concrete arch, see Building Research Station, "The Progressive Deformation of a Reinforced Concrete Arch at the New Horticultural Hall, London", ed. Department of Scientific and Industrial Research Building Research (November 1936). The articles published in *Engineering* and *Concrete and Constructional Engineering* were probably with the help and approval of the architects and the engineer; see Anon., "The Royal Horticultural Society's New Hall", p. 763-764., Anon., "The New Horticultural Hall: 150-Feet Span Girders Carrying 270 Tons", *Concrete and Constructional Engineering* XXII, no. 8 (August 1927): p. 469-478., and Anon., "The New Royal Horticultural Hall: A Reinforced Concrete Design", *Concrete and Constructional Engineering* XXI, no. 5 (May 1926): p. 365-368.

4.10 *Top* The Royal Horticultural Hall Main Hall, from John Faber, *Oscar Faber : his work, his firm, & afterwards*, 1989.

4.11 *Bottom* Ground Floor Plan, from *Concrete & Constructional Engineering* XXI, No.5 (May 1926), p.368.

In terms of engineering, the difficulty of the Royal Horticultural Hall's parabolic structure lies in its lack of abutment, requiring resolution of the problem of lateral thrust. Although the parabolic arches of the Royal Horticultural Hall look as if they spring from the floor, creating the smooth continuation curves of the parabolic arches, structurally they spring off vertical columns at the height of 13 feet above the ground.[58] Unlike the Gothenburg Exhibition Hall, where the thrust of the laminated arches presented at floor level, the thrust of reinforced concrete arches here is critical at the level of the side aisles' roofs. *Engineering* pointed to this problem,

> Had the arches been parabolic from the ground floor upwards, their thrust could, of course, have been taken by a suitable tie from side to side at ground level, but any such arrangement applied to arches on the desired line would have been inadequate to resist the bending moment at the first floor without the use of reinforced-concrete sections far too heavy for elegance, and in addition involving an extravagant cost. The rigidity of the side aisles was, moreover, much too small to allow them to sustain the thrust of the arches at the level of their flat roofs, and for architectural reasons no ties from the aisles across the arches were permissible.[59]

To solve this structural problem, while keeping the outline of the arch section as given by the architects, Oscar Faber endeavoured to construct the slab roofs of both side of the aisles as horizontal reinforced concrete beams, of 26 feet deep by 150 feet span and of 11 inches thick, to 'take the horizontal thrust of the arches and transfer it to ties in the end walls of the building at each end of the girders'.[60] What is happening inside the aisles' roof here is that the steel reinforcement for carrying the trust to the ties at the end walls starts at the middle of the girders, and as it reaches towards the end walls the amount of steel reinforcement gradually increases.[61]

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[58] For engineering details of the main arch Rib, see "The New Horticultural Hall: 150-Feet Span Girders Carrying 270 Tons", *Concrete and Constructional Engineering* XXII, no. 8 (August 1927): p. 478 ; Anon., "The Royal Horticultural Society's New Hall", p. 764.
[59] Anon., "The Royal Horticultural Society's New Hall", p. 763.
[60] Ibid.: p. 763. These huge horizontal concrete girders were reinforced with 33 1 ¼ inches main tension rods on their tension sides and with 15 1 ¼ inches on the compression sides.
[61] See 'Part Section of Thrust Girders' for details of steel reinforcement. "The New Horticultural Hall: 150-Feet Span Girders Carrying 270 Tons", p. 477.

This caused some alteration during the construction, as it was reported in October 1927 that the skylights at both end of the aisles' roofs needed to be reduced and reshaped from circular into hexagon, so that there would be more space for the steel reinforcement necessary to form the ties [fig 4.12, 4.13].[62]

4.12 Structural Details of the Main Arch of the Royal Horticultural Hall, designed by the engineer Oscar Faber. From Anon,'The Royal Horticultural Society's New Hall', *Engineering* (Dec 21,1928) p.764

[62] RHS's Council Minutes, October 18, 1927

4.13 *Left* Rebars of RHH's main arch and the north aisle's roof slab in construction, photographed in July 1927. The extra reinforcing bars, laid diagonally, were cast into the aisles' roof slabs to carry the thrust of the main arches and led to the change of the skylight's shape. From RHS, Lindley Library.

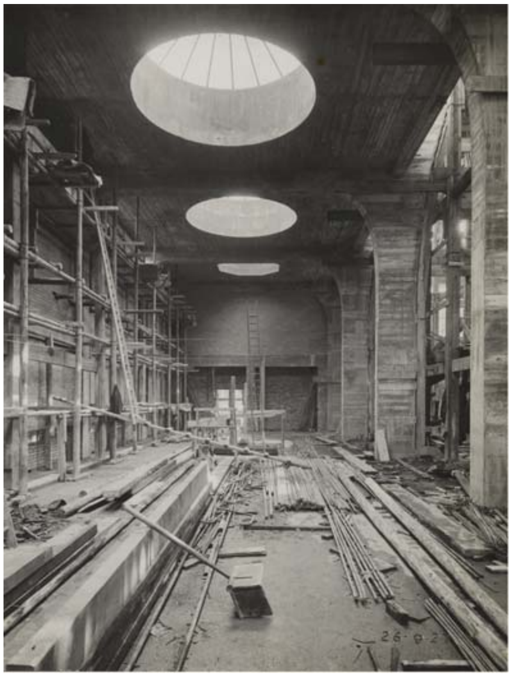
4.14 *Above* Details of 'Screwed Joint', designed by Oscar Faber From *Concrete and Constructional Engineering* XXII, No.8 (August 1927),p.471.

If treating flat roofs to the side hall as horizontal girders caused some alteration of the skylights, the limited space of the roofs required another engineering invention. Rather than using the normal joint detail of lapping and hooking to join the main rods – a solution that required adequate space to allow for the overlapping and so thickening the section – Oscar Faber invented the special detail of a 'screwed joint' to bolt the rods, in order to keep the size of the slabs down as the architects provided [fig 4.14]. [63] As the photographs of the Royal Horticultural Hall under

[63] As *Engineering* described the detail of the screwed joint in details,
'[…] as the space available was not sufficient to allow the main rods to be jointed by lapping and hooking, and it was, of course, impossible to make them the full length of the girder without joints, screwed joints was provided for the 1 ¼ in. rods. As against their cost a saving was effected at each joint of 5ft. to 6ft. of rod, as well as the cost of forming the hook. The rods were so arranged as to use as few joints as possible in the same place, and not more than two out of eleven rows are screwed at any one section.

Tests of the screwed joints as shown were in good arrangement with the ultimate calculated strength of 28.4 tons. At the end adjoining the administration block the ties in the end wall which connect the large horizontal girders are reinforced with 18 1 ¼ in. rods with screwed connections.

At the other end, where the tie has also to take the wind pressure on the end wall of the hall, the tie is made 3ft. 6 in. wide by 1ft. 6in. deep, and reinforced with 38 1¼ in rod'. As quoted in "The New Horticultural Hall: 150-Feet Span Girders Carrying 270 Tons", p. 473.



4.15 The Royal Horticultural Hall North Aisle, under construction. From RHS, Lindley Library.

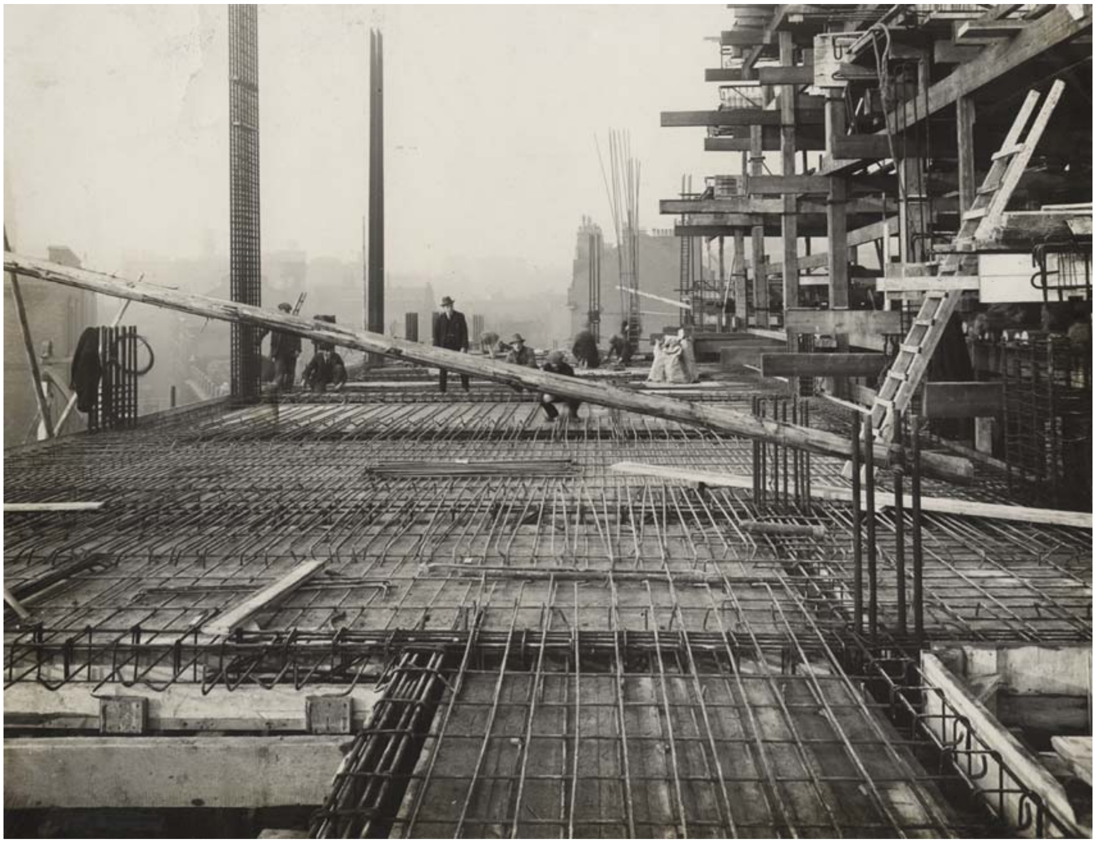
4.16 The North Aisle's Roof Slab under construction, photographed in July 1927. The aisles' slabs act as 'transfer beams' carrying the thrust of the arches before transferring it to the ties of the end walls. From RHS, Lindley Library.

construction show, the exceptional large amount of steel reinforcement in relation to the mass of concrete, employed in order to achieve the slenderness of the structure according to the architects' design, made the building under construction looked more like a steel edifice, rather than a concrete building [fig 4.15-4.16].

While Easton and Robertson's proposal was 'Swedish' in origin, the construction of the Royal Horticultural Hall, involving structural and material experimentation, made it far more than just a replica. Once the parabolic arches and stepped roof of the Gothenburg hall had been translated into reinforced concrete, the engineering solutions required for the construction: the horizontal slab roofs, the ties at the end walls and the screwed joint, are significantly different from those of its original. Since the innovative aspects of the work derived from their collaboration with the engineer, one can say that the success of the Royal Horticultural Hall lay essentially in Easton and

Robertson's understanding of the nature of what was needed from an engineer's contribution. It is most unlikely that if Easton and Robertson had gone to a concrete firm to design the structure for them, they would have got these ingenious solutions specific to their design. And it is in this quality that suggests an answer to the question posed by Morton Shand, quoted earlier in this chapter, as to whether this work is 'English' or 'Foreign'. If there is one thing in particular that allows the maker to express his 'spirit' as dissimilar to others peoples, it is through the collaboration between architects and an engineer, without resort to foreign specialist firms, that gives the materials of the Royal Horticultural Hall 'Englishness' [fig 4.17-21].

4.17 Rebars of the Royal Horticultural Hall's Ground Floor in construction. The photograph was taken from the rear towards the front of the building. From RHS, Lindley Library.

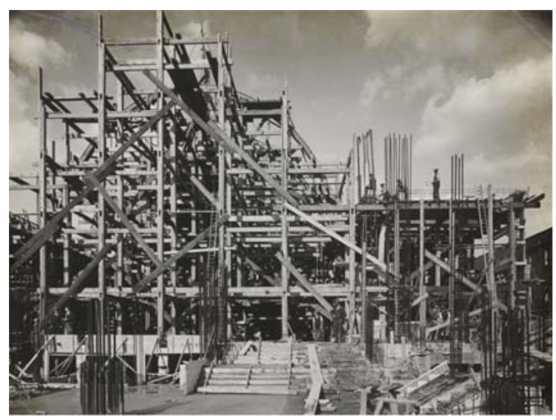


4.18 Steel fixers positioned and secured reinforcing bars of the Upper Floor over the Dais of the Royal Horticultural Hall. From RHS, Lindley Library.

If we turn to look at the Royal Horticultural Hall more closely, we can see its materials manifesting a particular view of the English architects towards the ‘structure’. Let us start from the main parabolic arches. While most of surfaces of reinforced concrete arches are left as bush-hammered concrete, but marks of shutter-boards are left visible, not entirely removed by bush-hammering, at the lower parts of the arches we see an attempt to give the piers a surface treatment.[64] Originally they were clad in ‘Manu-Marble’ or artificial marble, as can still be seen lining the internal walls of entrance hall and the lower parts of the dais above the entrance hall, but this artificial marble proved disappointing, becoming detached from the body of the piers.

[64] As this imprint of shutter broads becomes untidy, there had been attempts to remove this, ‘such as scrabbling to remove the laitance (with or without the use of a chemical retarder) or “bush-hammering”’. As quoted in “The Royal Horticultural Society's Second Hall (1928)”, in *National Building Studies. Special Report. No.33* (London: H.M.S.O., 1948-1966.), p. 9.

4.19 *Above* Skylights on top of the roof slabs of the Royal Horticultural Hall under construction. From RHS, Lindley Library.



4.20 The Royal Horticultural Hall under construction, seen from West. The steel reinforcement and temporary wooden scaffolding were prepared for the concrete work. From RHS, Lindley Library.

4.21 The Royal Horticultural Hall under scaffolding, photographed in November 1927. The exceptional large amount of steel reinforcement used in the making of Royal Horticultural Hall made it looked more like a steel edifice, rather than a concrete building. From RHS, Lindley Library.

The piers were then resurfaced with terrazzo finish.[65] But whether they were artificial marble claddings or terrazzo finishes, the attempt to cover the piers with another layer of materials and to make them appear as if they were valuable stones, rather than to left as bare concrete, is to offer a more agreeable treatment for the parts close to human occupation [fig 4.22].

The partial-concealment, partial-exposure of structural material such as this continues at the horizontal girders, making us, if anything, puzzled by their structural expression. While the two flat roofs of the aisles are the main structure carrying the thrust over to the ties and uniting a series of reinforced concrete ribs all together, Easton and Robertson did not attempt to show them as structural elements. Their sides are integrated with ventilation apertures, while their underside

4.22 Plant Exhibition in the Royal Horticultural Hall Main Hall. The artificial feature of interior building fabric, on which artificial marbles were rendered as real marbles and plaster work as sand stones, appeared in contrast to the natural feature of the plant exhibited. From RHS, Lindley Library.

[65] For the report of the restoration process of the Royal Horticultural Hall, see Ibid., p. 3-9.

surfaces are covered with a thin layer of white plaster, through which the trace of rough boarding used as formwork remains visible.

Nor is the reinforced concrete tie at the eastern wall fully exposed. At the eastern end, where a series of window openings, arranged in three columns, together with the four pilasters attached to the wall with pronounced vertical forms, the reinforced concrete tie runs across the wall, going through the infill-walls, the pilasters and windows altogether. But where it lies across the infill and pilasters, it appears as a beam whose surface is cover with acoustical plaster the same as that of the wall; when it penetrates through the series of windows, however, it reveals itself as an exposed reinforced concrete beam, whose surface is of bush-hammering like that of the arches. It seems as if this reinforced concrete tie is camouflaged according to its surroundings [fig 4.23].

4.23 The Royal Horticultural Hall Main Hall, looking towards East Wall. From RHS, Lindley Library.

4.24 At the eastern wall, the 'chameleon' concrete tie camouflages itself according to where it is present on the building fabric, photographed in 2010.

Rather than making visible the legibility of structure, concrete here is almost like a chameleon, changing itself according to where it is in the building. At the parabolic arches, it appears as pure structure, then becomes less structural element at the aisle slabs and then when it transumes in Gothic-like windows at the end wall, the concrete becomes a completely secondary element, being disguised and covered with acoustic plaster, although actually the concrete tie here is the single most important structural element in the building [fig 4.24].

The way in which the materials are played out in the interior contradicts to that of the exterior. While on the front facade of the exterior, various materials are employed, none behaves to mimic properties of other materials: Portland stones appear as stonework, bricks as brickwork and fascia marbles as unmistakably marbles and the same manner is applied to lead, wrought iron and gold paint. Once we are inside, where materials used are reduced to just a few: brick, reinforced concrete and plaster, the frank usage of materials disappears; they are all synthetic. Here at the Royal Horticultural Hall, we experience a bewildering array of contradiction. Not only does the inconsistency lies in the structural expression but also in the range and selection of materials.

Confronted by the fabric of the Royal Horticultural Hall, we face an object that clearly rejects the theory of Structural Rationalism. With this appearing and disappearing of structure, it seemed that Easton and Robertson attempted to keep the appearance of the structure as secondary to overall effect of the architecture. What was done here anticipates what Robertson was to express in his ideas about 'structure' in architecture sixteen years after the completion of the Royal Horticultural Hall.

> The very important part played by engineering in building is apt to be exaggerated to the point where even technicians become blind to the fact that a building's structure is only means to an end. Structure is sometimes glorified as something comes first; it has even been said by some architects that 'structure is the first interest of the architect'. Surely that is misleading; it is building – plan, section, elevation and constructional realization in all three dimensions of an idea – that is the prime interest of the architect.
>
> This is not to denigrate engineering, which does however need to be placed in its right position as a means to an end, as the servant and not the master in the field of architecture-building.[66]

Robertson's concern here is that while the engineering aspect of the work is fundamental to the creation of architecture, he saw it necessary to subordinate the structure under 'building'.

Easton and Robertson's handling of the structural aspect of a building had been consistent. Their letter to the Council proposing to employ the engineer under their authority, their architecture of the Royal Horticultural Hall whose structure is half-concealed and half-exposed, and Robertson's

[66] Howard Robertson, *Architectural Arising* (London: Faber and Faber, 1944), p. 27.

remark of the secondary role of the structure in architecture, all are deliberate attempts to make the engineering aspect subordinate to the architects' presence [fig 4.25].

With the regard to the problem of the emergence of a structural engineer as a collaborative partner of architects in the early-twentieth century, we have now realised that French Rationalists and British architects presented rather different solutions as to how to get along with engineers. Whereas French Rationalists came up with the theory of Structural Rationalism to retain their authority over engineers, in Britain architects came up with a practice. It would have been unacceptable to resort to the Rationalists' doctrine in Britain, but the new form of practice allowed an equivalent opportunity for British architects to maintain their responsibility over the structural work. Unlike in France, where the Rationalists' insurance policy was to mimic the role of engineers by demonstrating the legibility of structure on outward appearance of their buildings, British architects like Easton and Robertson treated the structure of a building as a piece of collaboration. 'Practice' was to Easton and Robertson what Structural Rationalism was to the French Rationalists. However, their approach is unlike French Rationalists in that they dealt with the structure as a secondary feature rather than a primary. The reason why the structure of their building was not particularly true to its structural expression is partly due to their insurance policy to make the structure recognisable at best as a work of collaboration between two kinds of experts, not in anyway as the work for which only the engineer was responsible.

To return to our original question, as to what the theoretical proposition of the Royal Horticultural Hall is, it is odd to find that its 'theory' lies essentially in its collaborative 'practice'. No matter that 'theory' and 'practice' were treated separately elsewhere, what is remarkable about the Royal Horticultural Hall is that they are brought close together, and treated as one and the same.

4.25 The Royal Horticultural Hall South Exit Doors, photographed in 2010. The building hides its remarkable structure with brick facades. Wasn’t this particular feature of the building an indirect result of the architects’ insurance policy to maintain their status in building?

5

Representation

5.1 2 Willow Road Axonometric Projection of Construction, from Ernö Goldfinger, 'Three House at Willow Road', *Architectural Review* 87 (1940), p.128.

In his article titled 'Three House at Willow Road', published immediately after their completion, the architect Ernö Goldfinger wrote on the construction of the central house as follows:

> The construction is reinforced concrete throughout with a red brick facing to the elevations. The floors are carried on reinforced concrete columns and on the cylindrical drum from which the spiral staircase is cantilevered. The construction is fully expressed in the façade in the predominantly horizontal lines almost entirely glazed on the south elevation and at first floor level overlooking the Heath. The columns are left free-standing in the rooms on the south side, forming a natural sub-division in the space of the rooms on the first and second floors.[1]

Together with the text, he illustrates an axonometric projection of construction, showing 'the structural framework of the centre house' in which all floors, slab roof and structural core are in reinforced concrete, so as to convey the structure of 2 Willow Road in terms of reinforced concrete monolithic building [fig 5.1].[2] There is, nevertheless, no mention of the steel columns at first floor level on the northern façade, nor are they depicted in the axonometric. Was Goldfinger's claim that the house's structure is a single system of construction correct?

[1] Ernö Goldfinger, "Three Houses at Willow Road", *Architecture Review* 87 (1940): p. 128.
[2] Ibid.

5.2 First Floor Dining Room under construction, 2 Willow Road, Hampstead, London, 1936-40. Ernö Goldfinger, architect. H.R. Tasker of Bierrum & Partner Ltd, engineer. Leslie Bilsby Ltd, general contractor. From Ernö Goldfinger, 'Three House at Willow Road', *Architectural Review* 87 (1940), p.128.

The omission of the steel structure in Goldfinger's article is intriguing. Why did Goldfinger omit them from his description and axonometric of construction? Are they structurally necessary, or in fact non-load-bearing elements? Looking at the photograph of the house under construction, one cannot fail to see constructive expression of the steel columns. These four columns rise from the floor, and, as they go up before ending at the ceiling, penetrate through the window-sill and the concrete transom at their rear edges, leaving the inner sides of the columns thoroughly open. Placed at intervals in the 27′-10″ space between the walls of studio on one side and of dining room on the other side, and without any other sign of supporting structures were there, the steel columns appear to fulfil a load-bearing function of the house [fig 5.2].

In this respect, Goldfinger gives the steel columns the appearance of structure. But then, if the steel columns perform a real structural task, as they would seem to do, the fact that they co-exist with the other structural material, reinforced concrete, would contradict Goldfinger's desire to present the house's structure as having a single system of construction – thereby causing confusion whether this is a pure reinforced concrete building, or in fact a composite structure of concrete and steel. So, why did he adopt steel especially for these columns? Why not substitute concrete for steel, and that would certainly justify an idea of monolithic structure more vividly, making all structural components unified, as they were built out of the same single structural material? The existence of the steel columns, particularly visible in the building, induces a contradiction between Goldfinger's desires to represent the house as being built out of a monolithic construction of reinforced concrete, and at the same time to give the steel a rendering of constructional expression. Or is what Goldfinger managed to do with the steel here is something beyond structural integrity, something 'beyond the Rationalist Paradigm', to use Rejean Legault's phrase? Are the steel 'real' or 'false' columns, representational of something apart from structural logics? What was the justification behind Goldfinger's decision to express the appearance of the columns? It is the question concerning the relationship between 'representation' and 'raw matter' of construction that this chapter calls into question.

But why, we might ask, should we be able to grasp immediately the fundamental structural principle of the whole building at once? The idea that a building should demonstrate the structure on its appearance, and this was to be achieved through the legibility of structure and the visibility of structural materials lay in Viollet-le-Duc's doctrine and later developed through architectural works of Rationalist architects such as Anatole de Baudot and Auguste Perret. Underlying the whole concept was a moral, *deterministic* notion that in any building there is always an abstract, structural system, and it is the necessary task for architects to make revelation of that system visible on their buildings if the buildings are to have integrity. Only if the skeleton of a building is clearly revealed would the building be free from treachery. As Auguste Perret put it in 1928: 'Whenever possible let us try not to conceal any essential organ of the construction like posts and beams […] Let us wish that the numerous materials, natural and artificial, that can be used to fill the structural skeleton be also left visible on the outside, without any coating'.[3] Such an underlying assumption, that the building appearance should be the truthful expression of its internal structure, had been used by French architects to defend their work as more 'rational' than architectural works whose structure was not revealed. And it is this demand for the exposure of structure that Goldfinger recalled when he quoted Perret's axiom after his death in 1955: 'He who hides any part of the framework deprives himself of the only legitimate and most beautiful ornament of architecture. He who hides a pillar makes a mistake. He who erects a false pillar commits a crime'.[4] It is in this context, in one way or another, that prompted peoples to see Goldfinger's work as belonging to the French tradition of Structural Rationalism. Thus the architect James Dunnett, who worked in Goldfinger's office, pointed out Goldfinger's indebtedness to Perret's Structural Rationalism as understood through Russian Constructivism[5], and Alan Powers has also written: 'The influence of Auguste Perret is evident in the concrete construction of 1-3 Willow Road. Perret developed the French Rationalist tradition, which valued the elegant expression of structure and the clear articulation of load-bearing members'.[6] But how could a building whose structures are so unclear be said to be Structural Rationalist in tone? This claim of Goldfinger's attachment to Structural Rationalism therefore needs further examination.

Another way to make out the extent to which Goldfinger engaged with the Rationalist discourse, or distanced himself from it, is to look at the practice of Auguste Perret from which the debate about 'tectonic truth' emerged. According to Rejean Legault in his Ph.D thesis, the debate as to whether a building should demonstrate the truthful use of building materials developed out of the debate around Perret's architecture in the late-1920s, especially his residence-studios.

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[3] As quoted in Réjean Legault, "L'appareil De L'architecture Moderne : New Materials and Architectural Modernity in France, 1889-1934" (PhD thesis, MIT, 1997), p. 346.
[4] Ernö Goldfinger, "The Work of Auguste Perret", *Architectural Association Journal* 23 (January 1955): p. 150
[5] James Dunnett, Jim Cadbury-Brown, and John Winter, "Erno Goldfinger: A Tribute", *RIBA Transactions* 1, no. 2 (1982)
[6] Alan Powers, *2 Willow Road* (London: National Trust, 1996), p. 19.

Rejecting an architecture of coating, such as Andre Lurçat's Villa Seurat whose external white-coating on the walls hides all building materials underneath it, Perret sought the truthful use of building materials by not only exposing them, but also making a distinction between the structural skeleton and the revetment of a building in a way that both elements are treated according to their structural tasks. At Perret's Atelier Chana Orloff, designed in 1926, for example, the concrete frame of the building is exposed, showing its brush-hammering surfaces, while the brickwork of infill is laid diagonally, suggesting that the infill is merely non-load-bearing wall [fig 5.3].

5.3 Auguste Perret's Chana Orloff, 1926, from Karla Britton, *Auguste Perret*, 2001, p.111

Goldfinger's 2 Willow Road is reminiscent of Perret's Atelier Chana Orloff in at least two aspects. First of all, both have dual programme: a private residence and an artist's studio including a gallery. Secondly, as each programme requires a particular characteristic and lighting condition, Goldfinger, like Perret, separates the two programmes by splitting them into different levels, one resting on top of the other. What is more is that he renders the interplay between these two distinctive volumes on their street façade. Thus the external building appearance gives an idea of the way its interior space came to be used: the studio on the first floor, designed for his artist wife, Ursula Goldfinger, is clad with a large area of transparent windows to maximise natural light deemed for working, while the private zone on the second floor is enclosed by brick walls and has smaller windows to satisfy the need for privacy in the bedrooms.

What makes Goldfinger's house differs sharply from Perret's residence-studios, however, is the treatment of the structure. At Atelier Chana Orloff, Perret's structure is a clear articulation between the trabeated frame and infill; at Willow Road, the construction expression is obscure. Unlike Perret's Atelier Chana Orloff, at 2 Willow Road, almost all of the structural elements are hidden behind the brick skin; only the four concrete pilotis on the ground floor and the four steel columns on the first floor are visible signs of the house's structure. Looking at the façade of the house, we do not quite know what the internal structural logic of the buildings really is. The fact that most of the structural frames of 2 Willow Road are concealed, and that the two apparent structural elements – the concrete pilotis on the ground floor and the steel columns on the first floor – do not correspond to one another either in terms of materials or of forms emphasise the difficulties of understanding the Willow Road houses in terms of Structural Rationalism.

Since judging the structure of 2 Willow Road, as seen from its appearance, does not make sense in Rationalist terms, let us leave it now and try to understand the other building component: the 'photobolic' frame – the rectangular concrete frame that ties the front façades of the three houses all together, and its concrete transom apparently stabilised by the steel columns.

From their appearance, it is unclear how the steel columns carry the concrete transom structurally. What is clear is that the photobolic frame is a free architectural device, independent from the rest of building structure. Removing it from the house would have not affected the whole structure; nevertheless, we cannot separate it from the whole work of architecture. It is significant to point out that this framing device is one of the few elements in the building which serves dual function, responsive both to outsiders and occupants. Its shape and form are determined by the conditions of the interior and exterior. Thus, when Goldfinger described the front façade of architecture, using 2 Willow Road as his example, he drew attention to the dual task: i.e. the façade of a house should be responsive to both the private requirements of individual dwellings and the public concerns. In 'Urbanism and Spatial Order', published immediately after the completion of 2 Willow Road, he wrote:

> […] buildings may fulfil a dual purpose; while inside them enclosed space are provided for certain functions, their outsides form part of another, a civic, order for another set of functions. The same applies from the point of view of spatial order: on the one hand, inside the buildings a sequence of delimited space is provided; on the other hand, the outside of these same buildings becomes part of streets, squares, etc., forming urban spaces. So we come to consider not only the spatial arrangements in the buildings themselves, but those created by the juxtaposition of buildings in which each self-contained edifice is a mere brick in the spatial order of the town. One and the same edifice performs this dual and somewhat contradictory function.[7]

And in the caption of 2 Willow Road, Goldfinger explained the peculiarity of the front elevation: 'The façade, however, is also part of the screen or wall which separates the urban space from those beyond, the public urbanity from the unknown of the individual privacy'.[8]

5.4 1-3 Willow Road Front Façade, from James Dunnett and Gavin Stamp, *Ernö Goldfinger, Works 1*, 1983, p.52

[7] Ernö Goldfinger, "Urbanism and Spatial Order", in *Ernö Goldfinger, Works 1*, ed. compiled by James Dunnett and Gavin Stamp (London: Architectural Association, December 1941), p. 52.
[8] Ibid.

5.5 The photobolic frame frames and re-frames the ‘subject’ and the ‘object’, photographed in 1940. From RIBA Library Photographs Collection.

Beatriz Colomina’s Analysis of Architectural Representation

Beatriz Colomina argues in *Privacy and Publicity* (1996) that modern architecture was conceived in terms of a viewing mechanism, through which subjects and objects are produced and re-produced. Though she never makes this argument about an actual built work, for she is more interested in the general nature of architectural representation, our reading of the steel structure at 2 Willow Road can be informed by her analysis. The photograph, which was taken just after the house was completed, was made for publication in the *Architectural Review* in 1940, but was not printed, yet it illustrates particularly well not only Goldfinger’s remark about the duality and the contradictory nature of the façade. As such, it also lends itself to Colomina’s way of analysis of modern architecture as ‘a mechanism of viewing’ [fig 5.5].[9]

[9] Beatriz Colomina, *Privacy and Publicity: Modern Architecture as Mass Media*, 1st ed. (Cambridge, Mass; London: MIT Press, 1996), p. 7.

5.6 Close Up Photo. Ernö Goldfinger and his wife, Ursula, sit on the window-sill of the first floor. The man looks towards the outside world; the woman, the inner world – the interior of the house; The photograph conforms to Colomina's reading of modern architecture as 'a viewing mechanism'. From RIBA Library Photographs Collection.

In the photograph, Goldfinger, sitting with his wife, Ursula Goldfinger, on the window-sill at the first floor, looks over the landscape outside. Being inside, one's attention is drawn outward to a spectacular view of Hampstead Heath, while at the same time, he is seen, framed by the public view [fig5.6]. Goldfinger drew attention to the dual function of elevations, responsive to both the public and the private requirements, but can the structure, which is an inherent part of the façade, contribute to a similar dual function? If the photobolic frame plays a role in framing and re-framing the subject and the object, what is the role of the steel columns, apart from their technical structural duty? As the steel columns stand 'where object and subject exchange places', and are carefully positioned on the boundary of the duality of their context, might there be a theory of structure which facilitates the exchange between subject and object? Might structure be a mechanism of reproduction in its own right in the similar way as drawings, photographs films and buildings? If, architecture is like mass media, capable of producing publicity, what can this tell us about the nature of structural principles? These are not questions to which Structural Rationalism – a theory which lays down a consistent universal rule and treating structure as something fixed, incapable of the sorts of alteration implied here – can really offer any solution. What makes the structure of 2 Willow Road so interesting in this context is that not only our reading of the steel structure can be informed by Colomina's analysis of architectural representation, but that her reading about the dual perception of subject and object can also inform an argument about construction.

It is thus the purpose of this chapter to look at the development of 2 Willow Road's structure, not as an application of Structural Rationalism, but as a response to activities, requirements and particular constrain between 'individual privacy' and 'public urbanity'. An understanding of how private/public concerns play in the house may help us to understand the ambivalent character of its building structures. By retracing their origin in the design and construction process, we hope to find out the role of the structural frameworks of the house and on what basis were judgments being made about them.

2 Willow Road

In October 1936, the design of 1-3 Willow Road began. Goldfinger was commissioned by his wife, herself an heir of food manufacturers Crosse & Blackwell, to design a house for their own family on a corner site of the Downshire Hill overlooking the Hampstead Heath. Ursula's request for a family's house was turned out to be a single block consisting altogether of three houses in a row; the centre of which and the largest one, No.2, was the Goldfingers', while two others, No.1 was built for an investment for Contemporary Company, a company formed by Ursula's Trust, and No.3 was to be resided by a civil servant, Stephen Wilson.

5.7 The plans of 2 Willow Road, dated on 3 Sep 1937. On the first floor, the living room was located at the front of the house, while dining room at the back, facing the back garden. From RIBA Drawings and Archives Collections.

There are two significant events which determined the conditions for the structure of 2 Willow. The first is to do with internal planning [fig 5.7]. In October 1937, Goldfinger rearranged the first floor plan of No.2, moving the dining room and studio to the front and turning the living room to the rear facing the back garden. By this time that Goldfigner had consulted a concrete contractor to figure out the possibility of building the structure of the project in reinforced concrete. The firm he first contacted was Kier & Company Ltd. But Kier delivered a structural solution at cost price, so Goldfinger then approached a different concrete contractor, Bierrum & Partners, who offered

5.8 The plans of 2 Willow Road, dated on 14 October 1937 and signed by Dr. Reever. The possible structural framework is marked in black ink. From RIBA Drawings and Archives Collections.

to reduce the overall cost on concrete work substantially, as they managed to reduce the thickness of the floors from 8″ to 5″. In the drawing of 14 October 1937, as drawn by Dr. Reever (presumably an engineer of Kier's firm), all the floors of 1-3 Willow Road are indicated in pencil, over which lie dots and strip lines in black ink [fig 5.8]. The superimposed plan suggests a possible structural framework of load-bearing columns and walls.[10] In the drawing, it is apparent that the entire structure was proposed to be in reinforced concrete. Nowhere is there a sign of other structural materials. However, one month later, from 19 November 1937 at least, it is evident that Goldfinger was rethinking of modifying the structure – particularly that of the front façade at the first floor level.

[10] RIBA Drawings & Archives Collections, "Plans", (14 October 1937)

5.9 The plans of 2 Willow Road, dated on 17 May 1938 and revised on 7 September 1938, it appears that the structure at the first floor front façade was modified. From RIBA Drawings and Archives Collections.

In his plan, dated 20 November 1937, the trace of the concrete columns at the first floor front façade, as proposed by Dr. Reever, had gone and was replaced instead by four spots, apparently smaller than the black-ink circles representing concrete columns in the previous plan.[11] Further, in the plan of 4 January 1938, those modified structures, just four tiny spots, were modified into boxes of around 5 centimetres by 10 centimetres[12], but without indicating their material or appearance.[13] [fig 5.9] No description was written about them either. It was not until February 1938 that the modified structures were described as 'Channels'. This was the first time that 'steel' emerged as part of the house's 'structure' – the structure which had, from the outset, conceived in terms of monolithic reinforced concrete.

[11] RIBA Drawings & Archives Collections, "Plans", in *PA 613/1 (30)* (20 November 1937)
[12] RIBA Drawings & Archives Collections, "First Floor Plan", in *PA 613/1 (35)* (4 January 1938)
[13] RIBA Drawings & Archives Collections, "First Floor Plan", in *PA614/1 (39)* (20 November 1937)

Before discussing the nature of 2 Willow Road's structure further, it might be worth asking why Goldfinger wanted to modify the structural solution at that particular place: i.e. the front windows in dining room and studio. In the absence of any direct evidence from the architect, I will propose a possible explanation of why Goldfinger wanted that structure to be different from the rest of the structure of the house. What was the motive for substituting steel for concrete?

'The View from Within'

Because the design of the structure changed after Goldfinger had moved the dining room and studio to the front, and then pulled the living room to the back, we might assume that the structural adjustment perhaps resulted from this functional re-arrangement of the plan. While Goldfigner designed the studio for the personal use of his artist wife, it was designed to be used, together with dining room, as a social space – indeed the most 'public' space of the house, where the owners received visitors and exhibiting art work.[14] Not only do these rooms have the highest ceilings in the house, but they also have a large area of window openings, in order to bring natural north light into the space as well as to allow occupiers to be able 'look out over the Heath'.[15] Compared to other areas of the house, the dining room and studio are conceived to be most elegant and most open to the outside. From these spaces, Goldfinger wanted to make a visual connection between inside and outside. Unlike what Le Corbusier's recall of Adolf Loos that: 'A cultivated man does not look out at the window', Goldfinger, by contrast, asserted, as recalled by James Dunnett, that: 'The most significant thing about a house is the view from

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[14] In the draft of the article titled 'THE HOUSE ON THE HEATH', Goldfinger's account of 2 Willow Road reflects an element of gender: 'Two things in particular thrill you immediately. There is a truly three-dimensional quality together with a sense of complete balance and control of space. And here, no woman could say with hopeless resignation, "Oh! A man must have thought of that!" as she does when so many clumsily designed fittings and arrangements exasperate her needlessly and make her work thrice damned. The Architect visualized a woman's need from the very beginning, ~~and even from this point of view alone, it is indeed~~ '~~une machine à habiter~~' '. (cross in the original) As quoted in RIBA Drawings & Archives Collections, "The House on the Heath", in *GolEr/243/10 WR Articles on No. 2.*

[15] As quoted in RIBA Drawings & Archives Collections, "Goldfinger and Gerald W. Flower's Letter to the Chairman, the Town Planning Committee, L.C.C., County Hall, London", in *GolEr 240/18* (10 January 1938)

5.10 **‘The most significant thing about a house is the view from within’**, wrote Goldfinger. Sketch of the Front Window of House No.3, Willow Road. From RIBA Drawings and Archives Collections.

within’.[16] His sketch of the interior of house No. 3 anticipated this counter-argument as it shows a man standing right next to the window, looking out through it [fig 5.10]. Arriving in dining room and studio space, one enters into an ‘open’ space – an interior space that connects to the outside world.

The functional requirement and its visual relationship that Goldfinger wanted to create with the outside come into play in the design of the house, and could as well be the driving force behind the structural re-arrangement in the dining room and studio. As we look at the drawings, it is clear that this programmatic alteration also caused Goldfinger to change the structure system further. Previously, concrete had been proposed for all structures; however, once the ‘public’ concern was introduced to the dining and studio spaces, and as these two rooms become a place of connection to the Heath, the structure which stands in the conjunction between external and internal sphere needs to acquire a special character suited to the new conditions.

[16] As quoted in Nigel Warburton, *Erno Goldfinger: The Life of an Architect*, 1st ed. (London: Routledge, 2004), p.79.

Let us leave the issue of visual connectivity at the moment and consider the other event which also had a consequent on a structural solution of the house. While the first incident that led to a change in structural design of the house came from owners' individual requirements, the second incident, however, came from their neighbours.

While the first floor front elevation was purposed to be clad entirely with large windows of transparent glass, satisfying the demand for 'the view from within', the transparent facade is also exposed to outsiders' views from the street. The view from inside towards the landscape outside was no doubt significant for occupiers, but the use of large areas of glass caused controversy, as it was one of many objections made by the neighbours against the proposed houses [fig 5.11]. The controversy is well known, but no account links the dispute to the changes in the house's structure. The following stories, drawn from the correspondences between Goldfinger and London County Council (L.C.C.), supply a reliable account for the transformation of the structure of 2 Willow Road.

5.11 Perspective, drawn by Jim Cabury-Brown, 1938. That the first floor façade is clad entirely in glass was opposed by Goldfingers' neighbours. From RIBA Drawings and Archives Collections.

Outsiders' Views

In December 1937, after Goldfinger had submitted the plan of 1-3 Willow to the L.C.C. for the purpose of building permission, the Hampstead Heath and the Hampstead Protection Society, led by Henry Brooke, launched a protest against the proposal. Their protest was made on the grounds that the houses had a 'modern' look, that they were made of concrete and had large areas of glass; all would contribute in one way or another to 'damage irretrievably the "atmosphere" of the approach from the Heath to Downshire Hill, one of the most beautiful roads in Hampstead'.[17]

Goldfinger was upset by this conservative, ill-considered protest and the way they used the press to turn public opinion against the design. He, and his assistant, Gerald Flower, responded by writing to several newspapers and the L.C.C.. To the Chairman of the Town Planning Committee of L.C.C., their defence was that, first of all, the houses were built in reinforced concrete but only for the structural purpose; the concrete, while used for the structure, were invisible to the public view, for the external walls were faced with bricks. Secondly, regarding the criticism of the general appearance of the houses and the use of straight lines, they claimed that these manners were inspired by some of the existing houses in the neighbourhood, and so the charge that their houses were 'out of place' was merely unfounded. Thirdly, they confirmed the use of glass on the first floor to allow the inhabitant to have a view towards the Heath, and found it difficult to understand the objection to this issue: 'We fail to see why it is to be reproached that people shall be able to look out over the Heath'.[18] Fourthly, they drew the attention to the fact that Willow Road was 'not one of the old Hampstead Roads' as understood by the preservationist, but

[17] RIBA Drawings & Archives Collections, " 'Concrete Houses Facing the Heath' Protest by the Hampstead Protection Society", *Hampstead & Highgate Express*, in *GolEr/241/241* (18 Dec 1937)
[18] RIBA Drawings & Archives Collections, "Goldfinger and Gerald W. Flower's Letter to the Chairman, the Town Planning Committee, L.C.C., County Hall, London", in *GolEr 240/18* (10 January 1938)

nevertheless, they said: 'We are very willing to meet local wishes and last of all do we want to spoil the beauties of the Heath'.[19]

While the architect's defence was well-argued, it was clear that the objections from the Hampstead Heath and the Hampstead Protection Society became a necessary part of architect's concern in the design process since then, for his design was required to adjust to pass the vigilant control of the L.C.C. before the building permission could be given. Looking at the correspondence and negotiations between the architect and the L.C.C., who represented the public interest, reveals further the extent to which the design and the construction of the houses were modified. Although it is difficult to point out exactly where the objections caused changes in design, the modifications were certainly connected with the conservative climate of Hampstead in the 1930s. Required by L.C.C. to adjust the front façade of 1-3 Willow Road to meet building regulations, Goldfinger wrote to the L.C.C. on 26 February 1938 to explain his new solutions to the front façade as follows.

> We have altered considerably the proportion of the elevation in introducing four columns on the Ground Floor and also reducing the height of the first floor (still leaving internally at least 8'6" room heights). This has lessened the areas of glass and brought the elevation into the requirements of the District Surveyor with regard to area of wall space.[20]

But the reduction of the height of the first floor and the areas of glass would have gone against Goldfinger's desire to make the spaces of dining room and studio as high-ceilinged and 'open' as possible. The lower the height of the rooms, the lesser the effects of openness and elegance. It is at this point that we can begin to understand why he saw the need to modify the structural design for the first floor front façade. Demands from the L.C.C. to lower the height of the rooms diminished the area of transparent windows, so any large piece of structural elements in the front

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[19] Ibid.

[20] RIBA Drawings & Archives Collections, "Erno Goldfinger's Letter to L.C.C.", in *GolEr/240/18* (23 February 1938)

windows would have destroyed the whole aesthetic of visual connectivity he wanted to connect with the Heath. Out of the desire to make a visual connection between the interior of dining room and studio and the landscape beyond through the transparency of the windows, Goldfinger asked an engineer H.R. Tasker of Bierrum & Partner Ltd. to design a special solution of the structure over the façade as well as other parts of the houses.

> As discussed, we have included for the cross beams supporting the party walls and the side walls of the houses to be up-turned beams. In accordance with the L.C.C. regulations requiring the panel walls to be supported for 2/3 of their width, we have included for all wall beams to be 9" wide except where your design includes for the projecting nib. This means that you will require special 2" facing bricks in front of these beams. With regard to the external colums [*sic*], we have arranged for these to be 6 ½ " thick so that the normal 4 ½ " brick work can carry through.[21]

At this stage, what Goldfinger managed to do here was to turn the beam running just above the front windows into an 'up-turned beam'. The beam, required to carry the weight of the front part of the second floor, was now designed to be 'embedded' in the front wall, and covered with brick skin. As a result, the structural solution of the hidden up-standing beam makes the space underneath the beam – the entire façade of the first floor – totally clear of structure, while hiding the beam out of sight. [22]

Since all structural tasks were resolved by the hidden upstand beam, there is no need to have any supporting element for the front floor façade. But this does not explain why the steel columns stand there. Why are they appearing in the forms of the columns where there was no longer a need for any load-bearing element?

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[21] RIBA Drawings & Archives Collections, "A Letter of H.R. Tasker (the Engineer of Bierrum & Partners Ltd) to Goldfinger", in *GolEr 242/10 WR Reinforced Concrete* (24 June 1938)

[22] RIBA Drawings & Archives Collections, "Concrete Frame Plans (Centre)", in *PA 616/1* (5 January 1938). See also correspondences between Ernö Goldfinger and Bierrum & Partners Ltd in relation to 'the upstand beam' in Appendix C2.

The design development of the steel columns may offer some explanations. In the earlier design for a complete reinforced concrete structure, suggested by Kier, the steel components were proposed to stand not from the floor as built, but from the top of the window-sill, and only end at the underside of the concrete transom. In Kier's design the steel elements do not appear as columns, but more like studs. They were in total eight elements, lying between the upper part and the lower part of the photobolic frame, to stabilise the frame, so that it would not ripple. Later on, after Goldfinger changed the concrete contractor from Kier to Bierrum & Partners, their design, however, was not far from Kier's. Like Kier, Bier suggested to place the steel studs on the window-sill, but extending the top of the elements to end at the ceiling, rather than at the concrete transom. Considering both structural designs by Kier and Bierrum, the steel elements were neither designed to perform nor to appear as primary structural elements.

But there is more to it than this. In Bierrum's drawing, there is evidence of a correction – appearing as a red colour line, presumably corrected by Goldfinger himself – in order to extend the lower part of the steel channels to reach the floor, so that they would appear as full columns as they stand at the front façade nowadays. The final design of the steel columns emerged as late as November 1938, when the steel columns were specified as '4"*3" STANCHION'. Moreover, in the specification for reinforced concrete work, it was written: 'Building in only the necessary steel supports for the reinforced concrete transom to the studio windows'.[23] In fact, the steel upright columns here have nothing to do with the weight of the second floor; they are only 'secondary' structure whose sole structural function is to carry the concrete tramsom.

If, in Kier's and Bierrum's drawings before correction, the steel structure had been conceived unmistakably as non-structural, leaving us with no doubt about their minor structural task, by

[23] RIBA Drawings & Archives Collections, "Specification for Reinforced Concrete Work", in *GolEr 242/10 WR Reinforced Concrete* (24 June 1938). See Appendix C1 for more details.

extending the steel channels to stand firmly on the floor, Goldfinger gave them a full definition of structural members. Curiously enough, the steel columns, whose only structural duty was the trivial one of acting as load bearers for the concrete transom, are made to appear as if they were real structure for the house, as if they are carrying the weight of the floor above, and without which the building would have looked unstable. The emphasis Goldfinger placed on giving the steel columns the appearance of structure leads us to understand them wrongly as load-bearing structures; and sufficiently misleading to cause Alan Powers to write: 'the weight of the second floor is carried behind the wide window on thin steel stanchions'.[24] What is happening here is that the apparent structure does not follow the logic of actual structure, causing Powers to misunderstand them as structural members [fig 5.12].

5.12 The photograph shows the steel columns at the front façade that Alan Powers mistakenly believed a 'real' structure. From Alan Power, *2 Willow Road*, 1996, p.27

[24] As quoted in Powers, *2 Willow Road* p. 19: 'At Willow Road, the floors, stairs and inner leaf of the walls are of concrete, with concrete columns bearing the floor slabs. On the street front the columns appear on the ground floor while the weight of the second floor is carried behind the wide window on thin steel stanchions. The back of the building is more logical, with two concrete columns running through from basement to second floor, slightly set back from the first-floor windows so that they can be seen in the round and leave space for a curtain track between columns and window'.

Considered in this light, the steel columns are not principle structural elements, but in the perception they seem to be parts of architectural expression in a constructive sense. When Goldfinger wrote: 'The construction is fully expressed […] at first floor level overlooking the Heath',[25] what he really meant here is a matter of appearance, not of structural necessity, based on considerations of constructive expression, rather than of structural logic. What we see here is the building in which apparent construction means of expression counts more than actual construction. The peculiar structure of 2 Willow Road poses a question about the relationship between the 'appearance' and the 'truth' of structure. Yet, if the apparent structure did not follow the logic of construction, does it invalidate structural 'truth'?

The tension between the 'appearance' and the 'truth' of structure as happening at the steel structure of 2 Willow Road is not unlike the issue which Robin Evans dealt with in his essay 'Mies van de Rohe's Paradoxical Symmetries'. Written in 1990, Evans' essay offers a significant alternative to Kenneth Frampton's *Tectonic* theory of 1995. While both engage with the structure of a building, their attitudes towards it are altogether different, depending on how they set out their argument. A quick survey of their theories about structure will generate contradictory views as to whether the structural logic of a building is discovered *within* the actual physical manifestation of construction, the raw matter, or *outside* it.

Robin Evans' Theory, *1990*

In his essay, Evans set up the discussion about the relationship between the illusion of structure as perceived and the reality of construction as built through Mies van de Rohe's architecture. According to Robin Evans, the peculiarity of Mies' Barcelona Pavilion is that it refrains from conforming to the clarity and rationality of structure. Evens explained that rather than separating the elements of walls from those of slab roofs so that it would become clear that the roofs rest on

[25] Goldfinger, "Three Houses at Willow Road", p. 128.

the columns, whereas the walls are merely non-structural, standing freely on the platform without supporting anything, Mies decided to make the overall effect of the structure ambiguous. 'Either the walls are interfering with the roofs, or the columns are interfering with the walls', as Evans put it. At this point, Evans drew our attention to the visual experience obtained from the structure of Mies' pavilion:

> When you look at the pavilion instead of its plan, when you see those little steel posts, cruciform and cased in chrome so as to dissipate their meagre substance into attenuated smears of light, you cannot seriously regard them as the sole means of support (which they are not), or even as the principle means of support (which they are). Considered thus, they do indeed look 'dangerous'.[26]

Evans made it clear that the structure he was talking is neither concerned with 'concrete physical things', nor with 'material or weight', but with its expressive property – an abstract property that is not an integral part of the actual construction – which, for him, counts more for our understanding of the structure of a building than anything else.

For Evans, Mies' work must be understood, not through the reality of construction, but through its abstraction: 'Mies was not just interested in the truth of construction, he was interested in *expressing* the truth of construction'.[27] What Mies does in his work, Evans stated, is to dematerialise its structure – that is to make the structure appear as being weightlessness, devoid of any idea that the structure of a building must render its load-bearing function. 'Instead', Evans wrote, 'everything in the pavilion gives the implication of being implicated in the transmission of structural force. We begin to lose track of what does what, and already the building refuse to declare the download trust of its own mass'.[28] Similarly, at Mies' Lake Shore Drive apartments, Evans observed its structural effect of weightlessness as follows:

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[26] Robin Evans, "Mies Van De Rohe: Paradoxical Symmetries" [1990], in *Translations from Drawing to Building and Other Essays* (London: Architectural Association, 1997), p. 241.
[27] Ibid., p. 240.
[28] Ibid., p. 245.

> The towers at Lake Shore Drive do not represent a remission of mass. They do not rise against the pull of gravity; gravity does not enter into it. They make you believe, against reason, that they do not partake of that most pervasive and relentless of all natural forces. So the result is not the exhilarating levitation of an object (a familiar effect), but a gentle, dreamy disorientation in the observer.[29]

'In Mies's architecture', Evans wrote, 'this trivial confusion of thought is turned into an incredible apparition'.[30] He then went on to observe that the presence of the structure does not necessarily lies in the actual construction, but in the eyes of the observer. Evans' suggestion is that in order to make sense of the 'sublime rationality' of Mies' peculiar structure, we need to 'relinquish the official explanation'[31] – by which he meant the Rationalist view of what make the structure 'rational' – and open to other explanations, however unorthodox it may be.[32] Evans' theory points the way to the understanding that a building is not only capable of conveying a common, Rationalist view that the building must seem to be supported, but also capable of conveying the *oneiric*, and that, for him, makes such a building more interesting than one whose structural presence rests merely upon solidity and gravitation. The dematerialisation – to remove all material contingency – in Mies' work is, for him, a mere preparatory stage before the building is to convey its representational significance. Evans' prioritisation of the representational aspect over the constructional, in this respect, recalls Gottfried Semper's urge to forget about the material property of the building in order to arrive at its symbolic meaning. Evans' analysis of the complexity and ambivalence of the Barcelona Pavilion's structure is particularly useful for our discussion, for it suggests a different model about the structure of a building from Kenneth Frampton's *Tectonic* theory.

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[29] Ibid., p. 246.
[30] Ibid., p. 244.
[31] Ibid., p. 242.
[32] Ibid., p. 244.

Kenneth Frampton's *Tectonic* Theory

Unlike Evans, who appealed to the abstract qualities in Mies' architecture, Kenneth Frampton based his theoretical proposition on the corporeal quality of architecture. Some criticisms of Frampton's *Tectonic* theory have been discussed earlier in the thesis; there remains here however to look in more details how he formulated his theory.

Frampton's purpose in conceiving of architecture, not in terms of representation, but in terms of constructional significance – the real substance of materials and building process, or as he put it, 'the built is a thing rather than a sign' – was a rare concern to the circle of architects associated with post-modern discourse in the 1990s.[33] He formulated his 'tectonic' approach as a reaction against the preoccupation with trendy styles and post-modern theories, and was drawn from two German thinkers in particular, one an architect and theorist, Gottfried Semper (1803-1879), and the other a philosopher of phenomenology, Martin Heidegger (1889-1976). From Semper, Frampton derived the idea that primitive building techniques and the articulation of joints embed an intrinsic logic of structural principles. As Frampton wrote: 'Semper's emphasis on the joint implies that a fundamental syntactical transition is expressed as one passes from the stereotomic case of a building to its tectonic frame, and that such transitions are of the very essence of architecture'.[34] Semper's theory gave Frampton a way of thinking about craftsmanship as an essential basis of architecture, but it was Heidegger who provided Frampton with a philosophical basis from which his counter-argument to post-modernist theory developed.

The first Heideggerian idea that Frampton was attracted to is his idea of *place*. From Heidegger's notion of *place* – that '*spaces receive their being from locations and not from "space"*', as Frampton regarded *place* 'as opposed to the space endlessness of the megalopolis' – he derived the idea that

[33] Kenneth Frampton, *Studies in Tectonic Culture: The Poetic of Construction in Nineteenth and Twentieth Century Architecture* [1995], Third printing ed. (Cambridge, Massachusetts; London: The MIT Press, 2001), p. 2.
[34] Ibid., p. 86.

architecture must be made to acknowledge the character of its place 'in such a way as to offset the rapacity of development as an end in itself', as by doing so, he believed, its inhabitants could be able to connect themselves with locality.[35]

The second idea Frampton's *Tectonic* theory derived from Heidegger is of *thingness*, or, as Frampton called it, 'the phenomenological presence of things in themselves'.[36]

> To the extent that architecture remains suspended between human self-realization and the maximizing thrust of technology, it must of necessity become engaged in discriminating among different states and conditions; above all perhaps among the durability of a thing, the instrumentality of equipment, and the worldliness of human institutions. The tectonic presents itself as a mode by which to express these different states and thereby as a means for accommodating, through inflection, the various conditions under which different things appear and sustain themselves.[37]

'Under this precept', Frampton proposed, 'different parts of a given building may be rendered differently according to their ontological status'.[38] Frampton went on to argue that the corporeal quality of architecture, whose ontological aspects are in sharp contrast to the abstraction, would increase bodily experience with buildings, and that this would render human existence possible. It is at this point that Frampton elaborated Semper's theory into Heidegger's phenomenology, as he sees the detailed construction, the articulation of joint and the engagement with tactility of materials, as a revelatory process of human existence in architecture, in which their bodily experience is regained through their experience with the tectonic quality of the building. Referring to the philosophy of Giambattista Vico, he wrote: 'the body reconstitutes the world through its tactile appropriation of reality. This much is suggested by the psycho-physical impact

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[35] All quotations in this paragraph are from Ibid., p. 22; the first quotation is originally from Martin Heidegger, "Building, Dwelling, Thinking" in *Poetry, Language, Thought* (New York; Toronto: Harper & Row; Fitzhenry & Whiteside Limited, 1975), p. 154.
[36] Frampton, *Studies in Tectonic Culture: The Poetic of Construction in Nineteenth and Twentieth Century Architecture*, p. 22.
[37] Ibid., p. 23.
[38] Ibid.

of form upon our being and by our tendency to engage form through touch as we feel our way through architectonic space'.[39] Seen in these terms, Frampton's polemic turn to building craft is two-fold: not only does it give rise to tectonic quality in building, but building craft is also an embodiment of human dimension, capable of resisting the alienation of humanity in the capitalism and consumerism culture. 'For all of its marginality', he put it at the end of the book, 'tectonic culture still possesses a vestigially resistant core, particularly as this is manifest in its proclivity for the tactile', and then he continued: 'This dimension resists the maximizing thrust of capitalism, determined now, as never before, on the process of global commodification'.[40]

For Frampton, the absence of tactility in building is a serious threat to the decline of architecture as much as of human culture because of its failure to restore human existence in building. The characteristic of such a bodily association with architecture made possible through its tectonic feature is particularly evident when he describes Alvar Aalto's Säynätsalo Town Hall as follows:

> […] from entry to council chamber, the subject encounters a sequence of contrasting tactile experiences. Thus, from the stereotomic mass and relative darkness of the entry stair, where the feeling of enclosure is augmented by the tactility of the brick treads, one enters into the bright light of the council chamber, the timber-lined roof of which is carried on fanlike, wooden trusses that splay upward to support concealed rafters above a boarded ceiling. The sense of arrival occasioned by this tectonic display is reinforced by various nonretinal sensations, from the smell of polished wood to the floor flexing under one's weight together with the general destabilization of the body as one enters onto a highly polished surface.[41]

Frampton's insistence on corporeal quality in building is so strong that he would not accept any architectural theoretical proposition that does not rest upon this. While Frampton is fully aware of the representational, atectonic aspect of Semper's theory, he is, in general, indifferent to it.

[39] Ibid., p. 10.
[40] Ibid., p. 377.
[41] Ibid., p. 12.

Although he refers to Eduard Sekler's account on atectonic quality of Josef Hoffmann's Stoclet House, and to Semper's distinction between *representational* and *ontological* aspects of construction, Frampton never takes anything from atectonic, representational aspect of construction to make his argument about tectonic ('*tectonic* […] cannot be brought into being where the structure is masked or otherwise concealed'[42]). His tectonic theory is more or less rested upon the ontological, corporeal aspects of construction, although he never fails, whenever necessary, to acknowledge atectonic aspects.[43] A characteristic of his concern about the binary opposition between tectonic and representation constructions is the following sentences:

> I am alluding here to the difference between the representational face of a building's surface and the phenomenological (ontic) depth of its space. And while the two may be more easily reconciled in a pantheistic world, this becomes problematic in a secular age, as August Schmarsow was prompt to recognize in his fundamental critique of Semper's *Bekleidung* theory which he saw, in 1893, as having placed an undue emphasis on the representational façade. This stress, for Schmarsow, was at the expense of the experiential body of the building considered as a whole.[44]

Since Frampton argued that the logic of structure is merely to be realised through construction and given visual expression through tectonic, the removal of corporeal contingency inherited in Semper's theory in order to arrive at the symbolic value caused Frampton to question the dual emphasis of both representational and tectonic aspects of construction of the theory, because, for him, an emphasis upon the first must immediately cause the loss of the other's effect. While Frampton took August Schmarsaw's criticism of Semper's theory in order to justify his proposition, it was Heidegger's theory which provided a theoretical justification for his *Tectonic* theory. Part of the reason why Frampton lacks an interest in representational aspect of

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[42] Kenneth Frampton, "Towards a Critical Regionalism: Six Points for an Architecture of Resistance" [1983], in *The Anti-Aesthetic: Essays on Postmodern Culture*, ed. Hal Foster (Seattle, Washington: Bay Press, 1993), p.27. (italics in the original)
[43] For Frampton's passing acknowledgement of construction in representational terms, see Frampton, *Studies in Tectonic Culture: The Poetic of Construction in Nineteenth and Twentieth Century Architecture*, p. 16, 20, and 131.
[44] Ibid., p. 89.

construction is because he formed his tectonic argument as a reaction against the scenography of post-modern architecture; and because Semper's theory contains both the scenographic, symbolic aspect and the ontological, tectonic aspect of construction; he would, for this reason, have seen Semper's theory as partly advantageous, partly 'problematic' – i.e. as being suitable in part to his argument but at the same time being too much associated with post-modernist theory. It is the association of post-modernism with the representational aspect in Semper's doctrine that makes it not wholly suited to Frampton's framework. Heidegger's phenomenology, particularly his notion of *thingness* – that '[t]he thing is formed matter' – is pertinent to Frampton's theory, for it helps to reinforce his emphasis on tectonic, while at the same time dissociating his proposition with atectonic, representational aspect of Semper's theory, because he sees it as unjustified in Heidegger's terms.[45] In other words, Frampton's *Tectonic* emerges out of Semper's theory, but is seen through Heidegger's eyes.

Knowing this, it comes as no surprise that while Frampton agrees with Evans' account of the Barcelona Pavilion (he quoted Evans' observation on the reflectiveness and symmetry of Mies' pavilion), and thus he sees Mies' works as merely one of the modernist models of productive engagement with the tectonic. The selection of Mies' work, as well as those of the other modernist architects in his book, is primarily because of their exceptional qualities in detailed construction and tactility, which Frampton finds encouraging to promote as an alternative to post-modern architecture. What he neglects to promote in those modernist architects' work – because of his anti-post modernism framework, which, in turn, desiccated his theory – is that qualities of abstraction evident in some of those works could convey the bodily association with buildings just as well as their 'tactility'. Evans' following account is particularly suited to be seen as a prior counter-argument to Frampton's theory.

[45] Martin Heidegger, "The Origin of the Work of Art" [1950], in *Poetry, Language, Thought* (New York; Toronto: Harper & Row; Fitzhenry & Whiteside Limited, 1975), p. 26.

> Western tradition and modernist polemics have together conspired to convince us that abstraction is achieved by the removal of corporal properties. That is why Arthur Drexler conjured up Plato to help explain why Mies's architecture seeks 'an absolute and unvarying principle, assumed to be independent of the senses through which its manifestations are perceived. […] Experienced directly, they could hardly be said to draw attention to their own solidity. It is nevertheless quite false to portray their physical incarnation as merely the sign of something beyond.[46]

For Evans, what is considered 'abstract' in building was conditioned by the process of dematerialisation; however such a process does not necessarily render the building imperceptible. The dematerialisation is not, for him, the absence of our perception. There are some other works, and Mies' work in particular belongs to this category, which 'adopt the procedure of abstraction in order to reveal properties that are neither formal nor material'.[47] A building, whose actual physical manifestation such as mass and tactility may be suppressed, though unlikely to conform to Frampton's *Tectonic* doctrine, does not necessarily fail to communicate with our thought and perception.

If, then, the structure of a building really does matter for our perception, the question that remains to ask is that: is there a theory of construction which is determined essentially by the visual? It is perhaps this question that prompted Evans to pose a question about the paradox between the illusion and the reality of structural 'truth'. And it is because, as he showed through the dematerialised effect of Mies' pavilion, whatever counts for the construction of Barcelona Pavilion, the eye-level of the horizontal line dividing the upper and lower of Onyx panels, the patterning of the stone panels and of paving slabs, and the particular choices of the polished marble, chrome, and tinted glass; for example, all had taken the *optical* symmetry into account,

[46] Evans, "Mies Van De Rohe: Paradoxical Symmetries", p. 255.
[47] Ibid., p. 256.

why then, Evans may ask, does '[w]e tend to assume that appearance lies some distance from the truth'? [48]

Returning to Goldfinger's article mentioned at the beginning of this chapter, Goldfinger was right not to include the steel columns within the principle structure; they are 'false' columns. This is the opposite case of Mies Van de Rohe's stainless steel columns at the Barcelona Pavilion, where all structural columns are deliberately dematerialised, being made to appear devoid of any load bearing function. At 2 Willow Road, by contrast, the steel columns – the pseudo-structure – are made to be understood as 'actual' structural members, to convey the illusion of structural stability. While the real structure, the upstand beam over the front windows, was designed to be hidden under the brick skin, the idea that a building must seem to be supported was to be achieved through the visual devices of steel components, made to be seen as if they were carrying the weight of the second floor. By compensating the visibility of the steel structure for the invisibility of the real structural beam, what Goldfinger did here anticipated what he was to say about apparent structure later: 'It must always be possible to see, and feel, how a building is supported'.[49] The purpose of steel columns is not constructional, but to deceive our perception to understand them as 'real'. They are apparent structure without being a structure.

While those columns are artificial, they are neither necessarily 'untrue' to themselves, nor imperceptible to us. The successive changes in the development of their design – from concrete columns to non-structural steel studs to artificial columns – we see not only a reversal of dematerialisation, but also an optical illusion that the windows were beyond the building. If the columns had been in the line with the wall, it would have seemed that the windows were inside, not protruding from the building. By setting the columns back into the building, it gives a sense

[48] Ibid., p. 248.
[49] Ernö Goldfinger in conversation with James Dunnett, as quoted in Gavin Stamp, "Goldfinger – the Early Years", in *Ernö Goldfinger, Works 1*, ed. compiled by James Dunnett and Gavin Stamp (London: Architectural Association, December 1941), p. 12.

5.13 The optical illusion at 2 Willow Road first floor front façade. The steel columns are positions inside the wall line towards the building, making the windows seem as if they were projected. From James Dunnett and Gavin Stamp, *Ernö Goldfinger*, *Works 1*, 1983, p.56.

that the windows were outside the building (even though actually they are not), since it implies that the line of the window plane were where these columns stand. What the changes Goldfinger made to the structure here is to trick our perceptions, so that the wall plane looks as if lying further back and the windows are projected [fig 5.13].

At the same time, Goldfinger's revisions to the steel structure may have something to do with its relationship with the other optical devices: the windows and the concrete frame and their location. It must be recalled that the dining room and studio at the first floor level of 2 Willow Road are an almost 'public' space, whereas all the other rooms are private. Designed with a free plan, and clad in transparent windows and 'structured' by the steel columns, the dining room and studio are the most remarkable spaces in the house. Entering to the first floor, they appear bright and open, and then their windows draw our attention to the outside view. The light that floods into the rooms dematerialises the steel columns into a mere silhouette, and, for a brief moment, they are obscured from view. Once our eyes adjust to the lighting condition, the columns become more distinct, pronouncing their appearance. The peculiarity of the steel columns for the first floor front façade of 2 Willow Road is that while they are conceived to be appearing as load-bearing 'structure', they also needed at the time to be thin enough, so that they

5.14 **'The optical mechanisms'**, 1-3 Willow Road Front Façade, photographed by Dell & Wainwright for the *Architectural Review.* From Ernö Goldfinger, 'Three House at Willow Road', *Architectural Review* 87 (1940), p.129.

would not cause any obstruction to the vision through the windows. Were the structure at the front floor made out of concrete instead of steel, the view from the first floor level towards Hampstead Heath could hardly be satisfactory, for large components of concrete would go against the demand to optimise the visual connectivity between the inside and the outside.

Together with the windows and the concrete transom, or what appear to be the 'protruding' windows, the steel frames a spectacular view towards Hampstead Heath. Whoever is passing the street in front of the house is also captured through these optical mechanisms. But while we, the occupants, are an observing subject, we are, in turn, seen [fig 5.14]. The protruding frame surrounding the windows outside the building capture pedestrians' attention into the interior of the house, turning, as Colomina would say, what is once private, domestic into the public view.

The effect of the optical device is to encourage the subject to stand before it, and therefore being exposed to the object from the other side of the view, allowing the subject and the object to exchange their places. If 'a mechanism of reproduction' resides anywhere in the building, it is through the windows, the concrete frame and the steel columns that convey Colomina's argument about modern architecture as mass media. What underlies the nature of the steel structure has nothing to do with a commitment to the integrity of structure, so much as to do with the subject and the object that the views are presented by the inside-out and the outside-in.

In this regard, the choice of material to be used for the first floor front elevation and the combination of concrete and steel structure of the house can be understood, neither in terms of Perret's Structural Rationalism nor Frampton's *Tectonic* theory. The determining factor in the house's structure is not purely technological and ontological, but in terms of the desire to satisfy for internal functional activities and above all visual effects – the concerns which are as much a determinant of the structure as any argument about its tectonic character. Critical here is that the building's role as a viewing mechanism determines the nature of the structure.

What is remarkable at 2 Willow Road is that it is a building that allows us to address the theoretical issue of the dialectics between 'representation' and 'raw matter' of construction at once. Now can we explain the tension between 'representation' and 'things' by some kind of theoretical construct? Despite not being part of the 'real' structure in technical terms, the steel columns at 2 Willow Road cannot be considered separately from the structure, if we are to understand them theoretically together. The differentiation and tension between the 'representation' and the 'reality' of construction necessitates some kind of 'theory' in order to link them together, and this necessity is supplied by the feature of the house as a 'viewing mechanism' in Beatriz Colomina's sense of the terms. Without being aware of this mechanism – which employs an 'artificial' structure and which brings the 'subject' and 'object' of the house into play –

it is hardly possible to grasp the paradoxical logic of 2 Willow Road's structure. What is happening at 2 Willow Road is opposite to what the Rationalists usually regarded as 'rational', for, here in this building, it was the purpose of representational imagery to generate a 'theory' of construction – and one that allows us to understand the intricate relationship between what actually exists and what exists only in the virtual world, enabling us to think about one in terms of the other, without privileging one over the other.

6

'Theory in Practice'

Unlike spoken and written theories, the constructional 'theories' explored in this thesis are drawn essentially from 'practice'. While occasionally drawing upon what architects said and wrote, this thesis has concentrated on the often unspoken theoretical groundwork developed empirically *within* the construction process. However, to think of a practice like construction as having theoretical content is not without contradiction. Construction is a labour-intensive activity of bringing materials and labour into conjunction in anticipation of a work of architecture. It is commonly thought of as a domain that involves practical exertion, rather than purely intellectual one. This condition, of being a domain involving a great deal of practicality, leads to construction seeming to be defined rather by an absence of theory. What could these technical and labouring processes possibly have in common with the work of the mind? How can we talk about this contradiction?

There have been various attempts to address this problem and to articulate the intellectual dimension of essentially practical activities. It would be useful, at this stage, to look at parallel discussions concerning 'theory in practice' in other fields, not necessarily architecture. This will allow me to present a bigger picture of what has been so far identified as 'theory in practice'. What follows focuses on bodies of work found in philosophers of knowledge and of science, who have put forward suggestions on how 'practice' could be thought to constitute 'theory'. To be more specific, there are at least three particular propositions that bring us closer to a new definition of 'theory' as an emergent framework for 'practice': firstly, the proposition that theorising is not an isolated activity that belongs exclusively to the mind, but is accompanied by physical actions, and so 'thinking' and 'doing' are not independent but parallel activities; secondly, the proposition that 'practice' can be judged in its own terms, regardless of preconceptions about it; and thirdly, that any theoretical proposition of the work lies in the person who makes it – the body. This last proposition, it should be stressed, may be applicable elsewhere, but is not satisfactory when applied to a collective practice like architecture. After surveying these three propositions, I will move on to such discussions of 'theory in practice' as there have been in relation to architecture. At the end of this chapter, I will then summarise my case studies of British architecture of late-nineteenth and early-twentieth centuries, and show how far it is possible to develop an alternative 'theory' of construction.

Of all propositions that share the same purpose of rebutting Technical Rationality and Positivism – philosophies that lead to a separation between theory and practice – Jürgen Habermas' historical account of the origin of theory-practice separation is worth noting here. According to Habermas, the separation of theory and practice is a modern phenomenon. Prior to the eighteenth century what was regarded as 'theory' was hardly separated from *praxis*. Both were always considered together as 'a theoretically guided praxis of life'.[1] However, with the rise of modern science, theory became more and more directed towards the objective, depriving *praxis* of all other interests apart from those justified by scientific rationality, so that it 'no longer embraces the natural, authentic, or essential actions and institutions of a human race constant in its essential nature'.[2] The positivist separation of pure instrumental reason from normative elements of human understanding has not only caused a departure of 'theory' from *praxis*, but it also demoted human actions from enlightened practice to the level of controlled technical activities, subject to a division of labour.[3] Habermas wrote:

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[1] Jürgen Habermas, "Dogmatic, Reason, and Decision", in *The Habermas Reader* ed. William Outhwaite (Cambridge: Polity Press, 1996), p. 77.
[2] Ibid.
[3] Ibid., p. 78.

> When theory was still related to praxis in a genuine sense, it conceived of society as a system of action by human beings, who communicate through speech and thus must realize social intercourse within the context of conscious communication. Through this communication they must form themselves into a collective subject of the whole that is capable of action – otherwise, the fortunes of society ever more rigidly rationalised in its particular parts must slip away as a whole from that rational cultivation, which they require all the more urgently. On the other hand, a theory which confuses control with action is no longer capable of such a perspective. It understands society as a nexus of behavioural modes, for which rationality is mediated solely by the understanding of sociotechnical controls, but not by a coherent total consciousness – not by precisely that interested reason which can only attain practical power through the minds of politically enlightened citizens.[4]

For Habermas, 'theory' does not come before *praxis*, but, historically speaking, *praxis* – a state within which 'theory' and 'practice' are equal and inseparable – is the origin, and only later did 'theory' become abstracted from it. Habermas' suggestion is that by considering 'theory' and *praxis* as interrelated, as they once were, and by re-including the normative elements into consideration, we might begin to realise 'knowledge' which is both objective and subjective.

The book generally regarded as the starting point for a 'theory of practice' is *The Concept of Mind*, published in 1949 by the British philosopher Gilbert Ryle. Ryle's main purpose was to call into question the convention of a 'local geography of knowledge' in human life. He argued that previous philosophers have made a mistake in postulating an invisible entity called 'mind' as something situated 'in' a body, governed by mechanical laws. Challenging the mythical secret about the mind – 'that theorizing is the primary activity of minds and that theorizing is intrinsically a private activity, silent, or internal operation', he asserted that such a 'place' of the mind – as lying 'inside our heads' – is merely metaphorical.[5] The 'mind', for Ryle, does not exist

[4] Ibid., p. 78-79.
[5] Gilbert Ryle, *The Concept of Mind* [1949] (Middlesex, England: Penguin Books, 2000), p. 28.

in that abstract, internal-operative form, and therefore the intellectualists' assumption that intelligent practice can be predicated on its mental source is unfounded.

> Champions of this legend are apt to try to reassimilate knowing *how* to knowing *that* by arguing that intelligent performance involves the observance of rules, or the application of criteria. It follows that the operation which is characterized as intelligent must be preceded by an intellectual acknowledgement of these rules or criteria; that is, the agent must first go through the internal process of avowing to himself certain propositions about what is to be done ('maxims', 'imperatives', or 'regulative propositions' as they are sometimes called); only then can he execute his performance in accordance with those dictates. […] To do something thinking what one is doing is, according to this legend, always to do two things; namely, to consider certain appropriate propositions, or prescriptions, and to put into practice what these propositions, or prescription enjoin. It is to do a bit of theory and then to do a bit of practice.[6]

Ryle's criticism of the mythical bifurcation of 'mental causes' and their 'physical effects' is clear. His counter-argument is based on the fact that no abstract knowledge, however well-described it may be, can entirely account for an intelligent performance: 'Knowing how to apply maxims cannot be reduced to, or derived from, the acceptance of those or any other maxims'.[7] For him, it is possible for 'practice' to be performed intelligently without any prior theoretical operation instructing how it should be performed.

In his book, Ryle's aim was to show that 'there are many activities which directly display qualities of mind, yet are neither themselves intellectual operations nor yet effects of intellectual operations. Intelligent practice is not a step-child of theory. On the contrary theorizing is one practice amongst others and is itself intelligently or stupidly conducted'.[8] In this regard, Ryle shifted attention away from preconception as a starting point of an intelligent action, and paid

[6] Ibid., p. 30.
[7] Ibid., p. 32.
[8] Ibid., p. 27.

attention instead to the procedure of that action, through which 'skill, habits, liabilities and bents' are intelligently performed. He noted:

> What distinguishes sensible from silly operations is not their parentage but their procedure, and this holds no less for intellectual than for practical performances. 'Intelligent' cannot be defined in terms of 'intellectual' or 'knowing how' in terms of 'knowing *that*'; 'thinking what I am doing' does not connote 'both thinking what to do and doing it'. When I do something intelligently, i.e. thinking what I am doing, I am doing one thing and not two. My performance has a special procedure or manner, not special antecedents.[9]

In this perspective, possibilities of theorising emerge essentially in 'practice'. According to Ryle, the action is not preceded but *accompanied* by an intellectual performance.

In relation to theories, moreover, Ryle made a distinction between 'having a theory' and 'building a theory'. Having-theories, he stated, is being 'in a position to tell a theory' to oneself or to someone; building-theories, on the other hand, involves those processes of exertions and observations, which constitute a 'theory', and without which the 'theory' would not have been built.[10] While those who have theories can deliver theoretical lessons through spoken or written words, the act of building-theory is not necessarily created in literary or verbal form, nor is it necessarily intelligible at all, but this does not meant that its activity, purely physical and unaccompanied by any colloquy though it may be, does not entail thought and thinking. For Ryle, it is important not to keep the 'mental' and the 'physical' as separate entities, but to treat the 'mind' as operational performance – i.e. the mental and the physical are parallel in operation.

Ryle's idea that the mind is operational performance has had a parallel in the philosophy of science, notably Donald Schön's theory of reflection-in-action; the latter's theory illustrates well the proposition that 'practice' on its own constitutes a 'theory'. In his book *The Reflective*

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[9] Ibid., p. 32. (Italics in original)
[10] Ibid., p. 270.

Practitioner: How Professionals Think in Action, published in 1983, Schön explored the practical knowledge which is implicit in professional practices, and called into question the accepted validity of knowledge that derives from the model of Technical Rationality. For Schön, the dominant view of 'what professionals do' is so influenced by the model of Technical Rationality that science and technology come to be seen as only legitimate sources of knowledge, and thus 'what practitioners do' is generally regarded as merely a matter of technical application, and not worthy of intellectual consideration. As he wrote,

> In the light of such Positivist Doctrines as these, practice appears as a puzzling anomaly. Practical knowledge exists, but it 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 […] Practical knowledge was to be construed 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.[11]

Denying the model of Technical Rationality, which isolates and elevates the scientific knowledge from real-world situations – the 'messy world' – Schön's aim was to offer an alternative approach to an epistemology of practice based on a close examination of professional practices.

Following Ryle, Schön argued that intelligent practice is not about an *application* of knowledge to instrumental decisions, but that implicit in it is an element of 'knowing': 'In real-world practice, problems do not present themselves to the practitioners as given', and so practitioners often find themselves confronting situations that are 'puzzling, troubling, and uncertain'. A practitioner's task is therefore not so much about problem *solving*, but about problem *setting*, by which 'a

[11] Donald Schön, *The Reflective Practitioner: How Professionals Think in Action* [1983] (Aldershot Ashgate, 1995), p. 33-34.

practitioner must do a certain kind of work' to become capable of converting 'a problematic situation to a problem', and this process of problem *setting* is not itself a technical problem.[12]

Looking at the professional practices of engineers, architects, managers, psychotherapists, and town planners, Schön identified their spontaneous knowledge learned on the job. He analysed ways in which practitioners respond to 'back-talk' – a process of framing a problematic situation that requires actions, recognitions and judgements of practitioners to reflect on what to do, and can do, with the materials at hands – and he went on to argue that it is not the use of formal or technical formulas derived from applied research that drive practitioners to success, but it is rather through the process of 'reflection-in-action' that allows practitioners to 'organize and clarify both the ends to be achieved and the possible means of achieving them'.[13] He added,

> […] inquiry, however it may initially have been conceived, turns into a framed experiment. What allows this to happen is that the inquirer is willing to step into the problematic situation, to impose a frame on it, to follow the implications of the discipline thus established, and yet to remain open to the situation's back-talk. Reflecting on the surprising consequences of his efforts to shape the situation in conformity with his initially chosen frame, the inquirer frames new questions and new ends in view.[14]

According to Schön, even though a task is preconceived according to existing theories and techniques, when it comes to practice, emerging problems in the real-world situation requires practitioners to adjust their performance.

Rejecting the positivists' dualism between knowledge and action, Schön argued that the underlying activity of professional practice is 'knowing-in-action', by which he meant 'knowledge' is embedded in 'action'. In this regard, Schön discouraged us from turning to established theories and techniques for theoretical explanation for the work. Instead, he urged us

[12] Quotations in this paragraph are from Ibid., p. 40.
[13] Ibid., p. 41.
[14] Ibid., p. 269.

to pay attention to reflective performances of those professional practitioners, for it is only through these processes that 'a new theory of the unique case' can be constituted.[15]

Another scholar in the field of philosophy of science who has made important contributions to 'theory in practice' is Andrew Pickering. In his 1995 book *The Mangle of Practice*, Pickering argued that science is not merely 'an activity that seeks to represent nature, to produce knowledge that maps, mirrors or correspondences to how the world really is'.[16] For him, science is more complex than that reported by scientists, but that, science, as material agency, can also have an impact on people's ideas and behaviour. Pickering wrote that the world 'is continually *doing things*, things that bear upon us not as observation statements upon disembodied intellects but as forces upon material beings'.[17] For Pickering, science therefore must be understood not just as *representational*, but as *performative*, in that is a process which acts, performs, and does things in the world. Pickering's proposition is that science is not only concerned exclusively with human agency, but also dealing with material agency, and that both agencies must be considered together in terms of *posthumanist* space – 'space where the human actors are still there but now inextricably entangled with the nonhuman, no longer at the center of the action and calling the shots'.[18]

In his book, Pickering has proposed a theory of the 'Mangle' in which the roles of both human and material agency are recognised and discussed in terms of *temporal emergence.* Without privileging human over nonhuman agency as modernist scientists did, Pickering started off his theory from the concept of actor-network, developed by Michel Callon and Bruno Latour, but, unlike them, he does not treat human and nonhuman agency as equal and interchangeable. For Pickering, humans can have intentions, and as such they are not the same as material agency

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[15] Ibid., p. 68.
[16] Andrew Pickering, *The Mangle of Practice* (Chicago and London: The University of Chicago Press, 1995), p.5.
[17] Ibid., p. 6.
[18] Ibid., p. 26.

which has no intentions. Regarding the relationship between human and material agency as asymmetrical in this way, he proposes that they are 'tuned and interactively stabilized in practice', rather than separate entities.[19] Considering scientific practice in *performative* terms, he went on to declare:

> Scientists are human agents in a field of material agency which they struggle to capture in machines. Further, human and material agency are reciprocally and emergently intertwined in this struggle. Their contours emerge in the temporality of practice and are definitional of and sustain one another. Existing culture constitutes the surface of emergence for the intentional structure of scientific practice, and such practice consists in the reciprocal tuning of human and material agency, tuning that can itself reconfigure human intentions.[20]

For Pickering, human intentions, however well-planned in advance they were, do not transcend the practical constraints of material agency, but they too, like material agency, are *temporally emergent*.[21] Even though a scientist may start his or her experiment with one goal, the demands for accommodating material resistance can coerce the old goal, causing it to be revised and a new goal invented.[22] In this regard, he argued that science practices are far from deterministic in any real sense, but are better understood as 'an *evolving* field of human and material agencies, reciprocally engaged in the play of resistance and accommodation'.[23]

Central to Pickering's Mangle Theory, as we have seen, is the concept of *temporal emergence,* which he saw as an underlying property both in human and material agency. With his analysis of scientific practice 'that practice at any level of aggregation can be understood in terms of emergent and posthuman mangling',[24] he makes a claim to universal validity of his concept as

[19] Ibid., p. 17.
[20] Ibid., p. 21.
[21] Ibid., p. 17.
[22] Ibid., p. 20.
[23] Ibid., p. 23.
[24] Ibid., p. 34.

TOE (Theory of Everything), whose effect, he says, is to liberate all practices, not just of science, but of all other fields, from a fixed, deterministic definition given by instrumental rationality.[25]

For our purpose, what is so interesting about Schön and Pickering's analysis of praxis is that it reverses the conventional understanding of theory-practice relation as 'theory preceding practice' into 'practice constituting a new theory'. Ultimately, we are encouraged to see intelligent performances as constituting the possible set of 'thought' through which 'practice' can establish itself and which it acts upon.

The third proposition that has contributed to a notion of 'theory in practice' is based on phenomenological understanding that in our perception, both consciously and unconsciously, lies 'an instance of tacit knowing'. This proposition originated in a theory of tacit knowing, proposed by Michael Polanyi in his 1967 book, *The Tacit Dimension*, in which he argued that we rely on our bodies for all our doing and perceiving, and therefore we can understand theory only by immersing ourselves in a bodily practice. Polanyi explained how our body encapsulates theory as follows:

> Our body is the ultimate instrument of all our external knowledge, whether intellectual or practical. In all our walking moments we are *relying* on our awareness of contacts of our body with things outside for *attending* to these things. Our own body is the only thing in the world which we normally never experience as an object, but experience always in terms of the world to which we are attending from our body. It is by making this intelligent use of our body that we feel it to be our body, and not a thing outside.[26]

Against the dominant position of modern science that its ultimate aim was to establish a strictly detached, objective knowledge, purified of personal elements, Polanyi argued that creative acts are not necessarily derived from objective propositions, but can also be driven by strong personal

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[25] Ibid., p. 246-252.
[26] Michael Polanyi, *The Tacit Dimension* [1967] (Gloucester, Mass: Peter Smith, 1983), p. 15-16. (Italics in original)

feelings and commitments, though these are not necessarily presented in propositional or formal positions. By arguing that 'we can know more than we can tell', Polanyi drew our attention to types of tacit knowledge, such as personal judgment, belief and commitment, on which peoples rely to make sense of things.[27] As he wrote:

> To hold such knowledge is an act deeply committed to the conviction that there is something there to be discovered. It is personal, in the sense of involving the personality of him who holds it, and also in the sense of being, as a rule, solitary; but there is no trace in it of self-indulgence. The discoverer is filled with a compelling sense of responsibility for the pursuit of hidden truth, which demands his services for revealing it. His act of knowing exercises a personal judgement in relating evidence to an external reality, an aspect of which he is seeking to apprehend.[28]

For Polanyi, this tacit comprehension, which is at the root of all thought and creativity, both intellectual and practical, plays a crucial role in the making of scientific knowledge, and as such is therefore an indelible component of science.

The centrality of the body, as proposed by Polanyi, has been a characteristic of an emergent framework for all sorts of practical activities that involve personal skills and knowledge in making, notably in craft practice, and it has sometimes been assumed that architecture can satisfactorily be judged in the same terms as crafts, as if an architectural work were equivalent to a work done by a sculptor. A recent demonstration of tacit knowledge as a new potential meaning for crafts is Richard Sennett's *The Craftsman*, published in 2008, in which he discussed how the thinking of a craftsman is embedded within his or her own experience of 'craft'. It may be worth discussing Sennett's book briefly here, as an example of attempts to address the problem – and of the relative lack of success of such ideas when it comes to architecture.

[27] Ibid., p. 4.
[28] Ibid., p. 25.

In his book, Sennett argues that in crafts 'thinking and feeling are contained within the process of making'.[29] The basis of Sennett's argument is that craft is organised by the craftsman's experience with materials at work. The technical skills which craftsmen acquire step-by-step through direct contact with materials allow the makers to understand the working procedure better than those who have not, and it is this direct encounter with the practical nature, technical flaws and limitations of the work, which reside only in his or her own activity upon given material, and are known through the craftsman's bodily experience, that provides his or her insight into the mental dimension of craft. As he put it:

> The craftsman has been able to call to his or her aid a capacity and a dignity ingrained in the human body: signifying acts as simple as human grip and prehension, as complex as the lessons of resistance and ambiguity that give human tools and physical constructs an intelligible form. […] Physical acts of repetition and practice enable this *Animal laborans* to develop skill from within and to reconfigure the material world through a slow process of metamorphosis.[30]

According to Sennett, the more skill the craftsman acquires through their work, the more intelligent he or she becomes. Only by understanding how something is done is it possible to know the *inherent* logic of the work. 'Plodding craft-labor', as he put it, 'is a means to discover it'.[31] Physical activity thus serves as much the practitioners' developments of intellect as of skills. Central to Sennett's argument is this co-existence of the 'making' with the 'thinking' within a craftsman's experience at work.

In his discussions on how a craftsman might gain control of the tools through his or her own repetitive exercises of particular skills in long hours of monotonous work, Sennett is concerned to show that the 'knowledge' lies in individual, not in collective, form. Of all his accounts of various craftworks, addressing the tacit knowledge contained within the action and consciousness of

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[29] Richard Sennett, *The Craftsman*, 1st ed. (London: Penguin Books, 2008), p. 7.
[30] Ibid., p. 293.
[31] Ibid., p. 128.

individual craftsmen, ranging from making clay pots to practicing musical instruments, from cooking food to child-caring and from glassblowing to writing computer manuals, he is not so much interested in ideas that are transferred through collaboration between one person and another, as usually is the case in architecture. Even though some of his examples include buildings, he discusses them only in terms of individual architects, regarding their buildings as if they were the craftwork of a competent craftsman. In, for example, his comparison of Lugwig Wittgenstein's house in Berlin with Adolf Loos' Villa Moller in Vienna, Sennett paid attention to the difference between the uncompromising approach of the philosopher Wittgenstein, who fixed the execution of building according to the formal design, and the more flexible approach of the modernist architect Loos, who after the error in the laying of Villa Moller's foundations, was open to readjust the design of the building in order to accommodate that mistake. Or in another architectural example, that of Frank Gehry's Guggenheim Museum in Bilbao, Sennett told the story of how the architect derived his new idea about the expression of stability in the building only after learning exactly how titanium cladding panels, used for the building's external skins, were fabricated. Sennett's implication is the more that architects operate like a craftsman, the more likely are they to produce a work which is both practical and theoretical.[32]

Yet is it enough to look only at the part of a practitioner if we wish to understand the theoretical proposition of an architectural work? For all its persuasiveness, Sennett's analysis of craft as a theoretically embedded practice stops shorts of dealing with architecture as such. The procedures of architecture are not those of a single practitioner like a painter or sculptor carrying out his or her own art, but involve many more occupations as well as architects. The difference between 'craft' and 'building-craft' is that in craft the same person conceives the work and makes it, whereas in architecture, the separation between the architect and the work is a reality. There are

[32] Ibid., p. 262.

always areas in architecture which, however conceived and designed by architects, have to be executed by other peoples' hands; hence, one should not assume that the processes particular to a craft, in which a practitioner has sole responsibility for the work's conception and production, also apply to a collective craft like architecture. Far from being a work that can be carried out by one body, the practice of architecture consists of thoughts, expertise and labours that are collectively put into conjunction by different groups of occupations – a social relationship of which architects are only part. In the field of architecture, even if architects have secured a privileged status over other occupations, architects are not the only occupation that contributes to the intellectual dimension of the work built. With architecture, where a division of labour is always present, the problem is not so much to do with the relation between materials and human bodies, as it is to do with another kind of tacit knowledge – knowledge that is shared implicitly between different groups and individuals – which cannot be made explicit because of its very nature.

None of the three propositions about 'theory in practice' that we have so far described satisfactorily addresses this particular problem of implicit knowledge in the making of architecture. However, other philosophers have sometimes been referred to in the context of 'theory in practice' and should therefore be mentioned here: they are Bruno Latour and Pierre Bourdieu. In his book *We Have Never Been Modern*, Bruno Latour questions the binary oppositions of modernist practice as a form of purification that causes the separation of nature and culture, science and politics, and argues that, in fact, these modernist theoretical dualisms do not really exist. Even in the practice of modernism itself, there were always hybrid situations which were a mixture between humans and nonhumans. Aiming to give voice to hybridity, Latour proposes that all human actions, both theoretical and practical, are the products of the 'network' to which they belong, and not to be valued on the basis of formal 'established' category, whether it be 'nature', 'culture', 'science' or 'politics'. While Latour does not add anything whatsoever to what might be regarded as 'theory in practice' in the sense with which we are concerned, his argument for 'hybridity' and against binary distinction provides another basis for the interrogation of the theory-practice division.

More useful to the understanding of 'practice' are Bourdieu's philosophical accounts of *habitus* and *field*. Bourdieu developed the concept of *habitus* as an attempt to overcome the impasse of objectivism and subjectivism in social theory, and he did so by returning to the concept of 'practice'.[33] Bourdieu observed that the pragmatic world of practice is too complex to be understood either subjectively or objectively, but demands both modes of thought. While what occurs in the practice of our daily experience may appear to be intentionless, improvised, and unconscious, Bourdieu suggested that there exist certain 'regularities', based upon habits, skills, and past experience of individuals, even though these 'regularities' are unknown to the individuals who possess them. Referring to Émile Durkheim, he wrote: 'In each of us, in differing degrees, is contained the person we were yesterday, and indeed, in the nature of things it is even true that our past *personae* predominate in us. […] It is just that we don't directly feel the influence of these past selves precisely because they are so deeply rooted within us. They constitute the unconscious part of ourselves'.[34] Rejecting a rationalist account of practice-following-theory, in which objective rules are seen as determining social life, Bourdieu proposed to return to 'real activity as such', arguing that practices 'have as their principle not a set of conscious, constant

[33] Pierre Bourdieu, *The Logic of Practice*, trans. Richard Nice (Cambridge: Polity Press, 1990), p. 52. 'The theory of practice as practice insists, contrary to positivist materialism, that the objects of knowledge are constructed, not passively recorded, and, contrary to intellectualist idealism, that the principle of this construction is the system of structured, structuring dispositions, the *habitus*, which is constituted in practice and is always oriented towards practical functions. It is possible to step down from the sovereign viewpoint from which objectivist idealism orders the world, as Marx demands in the *Theses on Fruerbach*, but without having to abandon to it the 'active aspect' of apprehension of the world by reducing knowledge to a mere recording. To do this, one has to situate oneself *within* 'real activity as such', that is, in the practical relation to the world, […] without ever unfolding as a spectacle'.

[34] Ibid., p. 56.

rules, but practical schemes, opaque to their possessors, varying according to the logic of the situation'.[35] For Bourdieu, individual practices are governed by unknown, opaque rules, or what he called *habitus*, which individuals apply without thinking and without really knowing, such that, as he wrote, 'what they do has more meaning than they know'.[36] According to Bourdieu, this 'unconscious', plays a hidden role in determining the way individuals see the world and act within it.

> The *habitus* – embodied history, internalized as a second nature and so forgotten as history – is the active presence of the whole past of which it is the product. As such, it is what gives practices their relative autonomy with respect to external determinations of the immediate present. This autonomy is that of the past, enacted and acting, which, functioning as accumulated capital, produces history on the basis of history and so ensures the permanence in change that makes the individual agent a world within the world. The *habitus* is a spontaneity without consciousness or will, opposed as much to the mechanical necessity of things without history in mechanistic theories as it is to the reflective freedom of subjects 'without inertia' in rationalist theories.[37]

In this respect, what Bourdieu regarded as 'theory of practice' lies in the 'practice' itself, whose 'logic' is not determined by any formal rule, but by the unknown – the *habitus.*

As a concept, the *habitus*, however, is not without its difficulties. For one thing, Bourdieu's claim for the existence of unconsciously learned rules governing practice seems to suggest that the *habitus* exists outside people's heads and bodies, thus evoking, in a sense, an element of idealism. Moreover, the sociologist Anthony King has cast doubt on the validity of the concept, and indeed has provided a critique of the *habitus*. First of all, King argues that the *habitus* does not perpetuate itself by imposing its logic onto the body of individuals, but only exists in the course of social relations where 'individuals maintain and transform their mutually constraining relations with

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[35] Ibid., p. 12.
[36] Pierre Bourdieu, *Outline of a Theory of Practice*, trans. Richard Nice, *Cambridge Studies in Social Anthropology* (Cambridge: Cambridge University Press, 1977), p. 79.
[37] Bourdieu, *The Logic of Practice*, p. 56-57.

other individuals'.[38] Secondly, he asserts that while Bourdieu claimed that the *habitus* could overcome the subject-object dualism in social theory, the concept is not wholly satisfactory in doing so. King argues that since the *habitus* transforms 'the interactions between individuals into objective, systemic properties which are prior to individuals',[39] the *habitus*, which is deterministic and objectivist, not only falls into 'the very form intellectualizing reification',[40] but can provide an account merely for social reproduction, but not for social transformation, though this is not the sense that Bourdieu had intended for the term. King wrote:

> If the habitus were determined by objective conditions, ensuring appropriate action for the social position in which any individual was situated, and the habitus were unconsciously internalized dispositions and categories, then social change would be impossible. Individuals would act according to the objective structural conditions in which they found themselves, and they would consequently simply reproduce those objective conditions by repeating the same practices.[41]

To be able to account for the complex negotiation of relation between individuals, as Bourdieu intended, King proposes to return to Bourdieu's earlier concept of 'practical theory'. This is because, he says, 'it recognizes that appeals to the existence of objective social structure or culture are reifications of particular moments in the social process which consists, in fact, of individuals interacting meaningfully with other individuals'.[42] King adds,

> On this "practical theory" social life is the mutually negotiated network of interactions and practices between individuals which is always necessarily open to strategic transformation. However, the dissolution of objective structure into complex figurations of practices between individuals does not involve a retreat into subjectivism. On the contrary, all individual practice and the understandings which inform that practice are always social; they are always learnt from others and performed in reference to others,

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[38] Anthony King, "Thinking with Bourdieu against Bourdieu: A 'Practical' Critique of the Habitus", *Sociological Theory* 18, no. 3 (2000): p. 425.
[39] Ibid.: p. 426.
[40] Ibid.: p. 425.
[41] Ibid.: p. 427.
[42] Ibid.: p. 431.

> requiring the understanding of other individuals, even if a particular individual might reject and ignore that interpretation.[43]

For King, intersubjective struggle and change, which 'can never be reduced to a static timeless model', are fundamental to social life, and it is these aspects that Bourdieu's 'practical theory' can account for, but which the *habitus* cannot.[44]

Another concept of Bourdieu's, which is in fact more useful for thinking about architectural 'practice' than the *habitus,* is the notion of *field.* The architectural historian Hélène Lipstadt, for example, suggests that Bourdieu's notion of *field* has implications for considering architecture within socio-economic conditions, in which different individuals and occupations struggle for control. According to Bourdieu, the *field* is a 'veritable social universe where, in accordance with its particular laws, there accumulates a particular form of capital and where relations of force of a particular type are exerted'.[45] Within the *field*, its members, each of whom has his or her own *habitus*, *logic*, *stakes*, *capitals*, and specific area of *interests*, struggle with each other for particular goods and rewards. 'This universe', Bourdieu wrote, 'is a place of entirely specific struggle'.[46] And it is this particular aspect of the *field* that Lipstadt considers as useful for thinking about architecture. In her view, the *field* 'contains not only the history of the struggles, but their present state, and the explicit acceptance that they are everlasting and ongoing'.[47] Emphasising the nature of architecture as a co-made object, Lipstadt sees the *field* as a useful mechanism to get away from 'reductionism, and positivism, or traditional art history's charismatic ideology of the autonomous architect' – a kind of history that has a tendency to exaggerate the architect's role, giving them sole responsibility for the entire process of an architectural work, while, at the same time,

[43] Ibid.
[44] Ibid.: p. 428.
[45] Pierre Bourdieu, *The Field of Cultural Production: Essays on Art and Literature*, 1st ed. (Cambridge: Polity Press, 1993), p. 163-164.
[46] Ibid., p. 164.
[47] Hélène Lipstadt, "Sociology: Bourdieu's Bequest", *Journal of the Society of Architectural Historians* 64, no. 4 (Dec 2005): p. 434.

subordinating other occupations involved in the process: 'This is the work that forms the subject of the celebratory monograph and keeps us enthralled to the aesthetic tradition that many of us believe we forswore long ago'.[48] For Lipstadt, Bourdieu's notion of *field* 'enables us to encompass in our analyses all the different types of engagement of all the various agents of architecture'.[49] Then when she writes: 'For Bourdieu, the ultimate author is not an individual creator, but the field itself', Lipstadt implies that it is more sensible to consider architectural practice as a result of complex network of social relations, rather than something that is exclusively produced out of the innate ability of architects.[50] In this regard, a strategic, theoretical proposition of an architectural work must account for not only the practice of architects, but also the relationship between all 'practices' and the *field* within which those practices occur.

Regarding Bourdieu's notion of *field*, Helena Webster, in her 2011 book on *Bourdieu for Architects*, further adds that in the course of struggle between competing agents in the field of cultural production, it is common that 'Those in positions of legitimacy also employed strategies […] to maintain their position against any competition'.[51] Referring to Bourdieu's notion of *field*, Webster noted,

> […] artists existed in relation to each other in the social space of the field and their relative positions reflected the quantity and configuration of their capital (social, economic and cultural). Those with the most cultural capital, which was recognised internally as the pre-eminent capital in the field, had the power to define what constituted legitimate culture (form and content) and those with less cultural capital fought to gain legitimacy for their beliefs and thereby overturn those in power.[52]

Like Lipstadt, Webster's suggestion is that what is present in the *field* is the 'history of the struggles' where 'strategies', used by social agents, or what Bourdieu later called 'symbolic

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[48] Ibid.
[49] Ibid.
[50] Ibid.
[51] Helena Webster, *Bourdieu for Architects*, 1st ed. (London: Routledge, 2011), p. 77.
[52] Ibid.

violence', are aimed at maintaining their dominance or advancing their relative position in the given fields.

Insofar as architecture consists of exchanges and negotiations between different groups of occupations within the building industry, whose social relations with each other can never be constant, Bourdieu's notion of the *field* – as pointed out by Lipstadt and Webster – is particularly useful when considering architects' anxiety in the late-nineteenth and early-twentieth centuries as they struggled for authority in the building industry, and found themselves having to employ 'strategies' to maintain or readjust their status in relation to new emerging occupations, such as the general contractors, materials specialists and structural engineers.[53] The question that concerns us here is to what extent such 'strategies' employed by architects in the act of maintaining their authority, and transforming their relation with other occupations in the 'field' of building production, can be thought of as constituting a 'theory'.

Could therefore the 'practices' of architects, whose career emerged as a distinctive from the other occupations in the building production, and whose own trade focused largely on design processes, rather than processes of execution, be considered as part of the means for maintaining or establishing their relation with other occupations? Might we also re-include 'practices' of those working in building trades who provide practical need for architects, as part of the same process of theoretical formation? Could architectural 'theory' be defined, not as an isolated activity developed exclusively in an architect's mind, but as part of complex network of negotiations and exchanges between different agents over the period of construction? If architecture is a work made by the labour of someone other than the architect, what place is there for a 'theory' in the construction of an architectural work?

[53] For the implication of Bourdieu's notion of *field* for architecture, see also Paul Jones, *The Sociology of Architecture*, 1st ed. (Liverpool: Liverpool University Press, 2011), p. 12-18.

Looking at traditions of 'theory in practice' as presented in philosophy, we might say that philosophers have done a better job of reconciling the split between 'theory' and 'practice' than has architecture. What philosophers like Ryle make obvious appears to have been obstinately resisted, or ignored, in the world of architecture. The fact that the traditions of 'theory in practice' have largely been passed by within architecture cannot however be dismissed as occurring out of mere ignorance. For good reasons, architects, as well as engineers, have established their occupations as being distinct from others in the building trades precisely upon the grounds, however illusory, of a theory-practice divide that has allowed them to think about architecture in terms which are independent from the production of building.[54] It has for so long been a convention for architects to regard this division, in which they first conceive the design for a building, then hand over that design to be executed by tradesmen, as fundamental to their thinking about architecture that to suggest that 'intelligent practice' is not an application of any previously existing theory, but is a 'theory' in its own right, would seem to threaten their own occupation, by making it appear theoretically insufficient. This conventional division of architecture into two categories – theory and practice – is so rooted in architectural discipline as to make it difficult for architects to think of 'theory' and 'practice' as integral. As the architectural theorist Diana Agrest wrote: 'Architecture tends to make an absolute separation between theory and practice, between analysis and synthesis, […]. Most theories are developed within the first category, while practice falls into the latter'.[55] However, there are some architectural thinkers and historians who have, on different occasions and in different circumstances, put forward arguments that are useful for thinking about 'practice' as a sort of 'theory'; their account,

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[54] For the development of architectural drawings in Italian Renaissance, see Adrian Forty, *Words and Buildings: A Vocabulary of Modern Architecture* (London: Thames & Hudson, 2000), p. 30; for the development of calculus in eighteenth-century French engineering, see Antoine Picon, *French Architects and Engineers in the Age of Enlightenment* [1988], trans. Martin Thom (Cambridge: Cambridge University Press, 1992), p. 134-136.
[55] Diana I. Agrest, *Architecture from Without: Theoretical Framings for a Critical Practice* (Cambridge, Mass ; London MIT Press, 1991), p. 1.

suggestive in some respects of what has been discussed as 'theory in practice' in philosophy, is the subject to which we now turn.

In thinking of 'building practice' as a sort of 'theory', the thesis has followed some of the lines of the 'sound building' argument that Andrew Saint suggested in *The Image of The Architect,* published in 1983, in which he suggested two kinds of theories: one based on artistic discourse; another which lies in 'practice'. In his book, Saint pointed out that architects use the first type of theories as self-justification, but it is really the second that determines what they are. The self-images of architects, Saint stated, are constituted as much by their practice as by abstract theories. Saint's suggestion is that, to understand architects' 'truer' nature, we should shift attention away from what architects said or what they thought of themselves, and look instead at what they did – a proposition that he applied in his later book *Architect and Engineer: A Study in Sibling Rivalry*.[56] Indeed, it is from Saint's initial premise that this thesis has set out to examine a 'theory' of construction of late-nineteenth and early-twentieth century British architecture.

Another line of argument comes from the philosophy of phenomenology, through the proposition that ideas cannot be separated from things. By its nature, construction is an activity that produces permanent things, by the processes of making, labouring, assembling – literally, according to John Ruskin, turning what was otherwise inert and unstable into something of use and permanent.[57] Once 'thought', 'labour', 'materials', and 'means of building' are poured into the production process, they become embedded in the tangible form of architecture, which offers the possibilities of tracing each component's origin. A building reveals what it was made of, by whom or by what means its material substances were produced, and how it was then put together. The use of materials, the constructive manner in which they are used, and the

[56] Andrew Saint, *The Image of the Architect* (New Haven and London: Yale University Press, 1983), p. 161-176.
[57] John Ruskin, *The Seven Lamps of Architecture* [1849] (New York: John Wiley&Son, 1865), The Lamp of Life.

articulation of materials in architectural forms are the tangible signs of the processes through which the work is created. Just as its physical manifestation makes visible the process of production, so too the work of architecture in turn produces and preserves traces of its own past. It bears a recollection of an 'active historical process' through which it was built, and which remains in its being – a process which Robert Atkinson and Hope Bagenal believed to be the test of architectural history.[58] This durability gives architectural works, no less than spoken and written theories, the capacity to preserve the intentions of the persons who made them.[59]

Construction may customarily be seen as practical and not purely theoretical because of its labour-intensive activity, but in fact that there is an intellectual quality which lies deep within that can neither be found outside its own territory, nor substituted by any other kind of work. Nor can it be removed from the work of architecture unless the construction is destroyed. And it is this unique feature of architecture, in that its conception cannot be examined independently of its substance, which provided Heidegger with the grounds to criticise the Platonic view that things could be formed in the mind before their existence. As he put it, 'The truth that discloses itself in the work can never be proved or derived from what went before. What went before is refuted in its exclusive reality by the work'.[60]

Heidegger's criticism of preconceived ideas and Saint's concept of 'practice' which is a 'theory' are both particularly pertinent to an activity which is engaged with material substance such as architecture. It is our tendency, however, to think of theory as separate from practice that really prevents us from seeing 'practice' in theoretical terms. Some of these difficulties have been

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[58] Robert Atkinson and Hope Bagenal, *Theory and Elements of Architecture* 1st ed., vol. 1, Part 1 (London: Ernest Benn Limited, 1926), p. 3.
[59] For a useful philosophical discussion on the 'durability' of works, see Hannah Arendt, *The Human Condition* [1958] (Chicago; London: University of Chicago Press, 1998), p. 137.
[60] Martin Heidegger, "The Origin of the Work of Art" [1950] , in *Poetry, Language, Thought* (New York; Toronto: Harper & Row; Fitzhenry & Whiteside Limited, 1975), p. 75.

discussed earlier in the thesis, and some further aspects, discussed at *Further Reading Required* conference held recently at the Bartlett, UCL, are also worth mentioning.

Generally speaking, architects have been much more interested in theory than the other occupations involved in building; discussion of theoretical statements like the rationalist's aim 'to render the legibility of structure', or even John Ruskin and his followers' desire 'to make visible the human labour in the work', generally remain restricted to the architectural realm. Whatever significance they hold for architects, however, architectural theories tend to lose their prestige as soon as they get into the territory of construction, carrying little weight for other occupations apart from architects. To illustrate the argument, William Lethaby, one of the most theoretically-minded of British architects at the turn of the nineteenth-century, wrote on his drawing for the construction of All Saints, Brockhampton, a question to (presumably) his site-architect: 'How much room [to] allow on top of concrete for floor finishing?'[61] (fig 3.17, p. 148) While this case might seem banal, it exemplifies a situation where however much intellect an architect may use to anticipate construction in a design, the building remains a hypothesis until confirmed by practical verification. The problem of any explicit theory is that when it comes to the moment of deciding what to do in construction, it frequently fails to provide feasible building strategies, and soon turns instead into 'disinterested and detached intelligence'.[62] Thus while outside the construction industry, architects may attempt to elevate themselves over the others by means of theory, their position within the realm of construction is compromised by the fact that to constitute the work they need to rely on the practical knowledge, judgement and experience of other occupations like engineers, contractors, material specialists, craftsmen and builders who are engaged with construction directly. It is ultimately through the act of construction, which is generally the

[61] In square brackets added.

[62] The phrase 'disinterested and detached intelligence' is borrowed from B. J. F. Lonergan, *Insight: A Study of Human Understanding* [1958] (London: Darton, Longman and Todd, 1983)

responsibility of these members of the building trades, rather than through theories, that a building achieves its potential as a work of architecture.

Moreover, it is fair to say that what can be described in written form may be less than what can actually be done with things – a problematic issue which Adrian Forty presented in his paper at *Further Reading Required*. In his talk, Forty drew attention to the difficulty that architects in post-war Britain had had in writing an exact specification for concrete work. He went on to observe that, however detailed and well written the specifications might be, they were never a sufficient means to provide satisfactory instruction for concrete work, and the only way in which architects could ever be certain of achieving the result they wanted was by reference to a test sample. As he put it: 'ultimately, the only way of ensuring the desired quality in concrete work lay beyond language. Language actually proved incapable of specifying what was to be built'.[63] Hence it was these architects' reliance on practicality, supplied by others, through the act of making, which may itself remain beyond description in words, that points to the fact that 'practice' contains an element of 'theory'.

These kinds of judgement, which circulate in practical domains, calculated and intelligent though they may be, are not generally presented as a comprehensive architectural theory, or even necessarily made explicit. Unlike architectural theories which exist in the form of written treatises and are disseminated to multiple audiences through architectural discourse, the record of judgements made in construction appear only infrequently, in the form of architects' anecdotes and correspondence, or instructions to site workers, and occasionally in construction documents such as building contracts, drawings, specifications, price schedules and bills of quantities, which are transmitted exclusively to the operatives in charge of the business. But in a great many cases,

[63] Adrian Forty, "Beyond Words", in *Further Reading Required* (The Bartlett School of Architecture: 17 February 2011)

they are simply never recorded, and are instead expressed through demonstration as the work progressed. While architectural theories deal both with building activity and with broader non-architectural matters, connecting architectural meanings to a wider range of references, construction documents are exclusively meant for building activities, referring only to the matter in hand and generally avoiding any external connotations. The judgements made in construction are therefore of a different order to those in architectural theories. It is precisely the implicit, non-articulated characteristic of these pragmatic judgments that prevents them from being regarded as a body of general theory.

This leads us to the decisive question for this thesis. Which are closest and most relevant to the architectural 'work': the ideas formed prior to construction, mostly by architects, or what goes on during construction as a result of exchange and interaction between architects and site workers? The argument proposed here is that while architectural theories may inspire architects to think and talk about architecture as a cultural construct, the judgements made in construction – implicit in communication and negotiation between architects and other trades – gives as much insight both into the processes of construction and the understanding of the finished architectural result. The act of construction may not bear any resemblance to what we usually regard as architectural theories, but the reliance of architects upon construction is greater than simply as a medium through which their ideas are expressed, and hence it is no less a 'theory' than verbally articulated statements.

This thesis is not about a theory of construction in a way that a theory is normally understood; it is an attempt to recognise as 'theory' intelligent building practices, which take place within well-understood processes, but are usually understood in terms of 'pragmatism'. The constructional 'theory' that this thesis put forward is an intellectual understanding, implicit in, and occurring in parallel with, practical action, whose aim was a comprehensive anticipation of how to build an architectural work in such a way that goes beyond customary ways of building. Characteristic to its formation is that it is not about preconception, but, like *praxis*, constructional 'theory' emerges from the actual historical process of construction, where a large part of the processes for formulating an architectural work during construction must go through material constraints and tensions between practitioners in order to constitute a 'theory'. No 'practice' of architects in any country demonstrates this sort of practical 'theory' better than that of late-nineteenth and early-twentieth century British architects, as discussed in this thesis.

Architects in Britain in that period faced conditions brought into the production of building by industrialisation and the development of capitalism. The capitalist logic of the division of labour caused a transfer of responsibility for building work from architects to other newly emerging occupations – namely general contractors, independent structural engineers, and material specialists, over whom architects had limited control. Architects who accepted this situation without re-adjusting their position were likely to find themselves subordinated to working merely as building designers. During the course of this socio-economic change, however, there were some British architects who were more prepared to innovate and were more conscious of the new values of building than their predecessors had been. Apart from recognising Ruskin's insistence about not separating the mental process from the manual one, what led to the relative success of these exceptional architects was their ability to *think* that 'practice' might generate its own 'ideas' or 'theory'. As such they were able to retain, or recover, some hold over the aspects of building work that they were in danger of losing. Their 'strategic practice' here is reminiscent of what Bourdieu has referred to as 'symbolic violence' occurring in the field of cultural production.

At a time when most branches of building trades were becoming increasingly specialised activities, what set these insightful British architects apart from their peers in other nations in this period was their ingenious use of construction to ensure not only their active participation within the capitalist construction process, which in some sense helped them to protect their own careers against other occupations, but also allowed them to preserve some sense of the continuity of architecture. This second feature is noticeable in the particular emphasis on the connection of new building practices with traditional systems of construction. From the 1870s onwards, a development can be traced for emerging building practice which incorporated new conditions of production, brought about by capitalist development, into existing modes of building construction. Waterhouse's insertion of a craft-based system into the general contract, with its complete dominance over craft production, or Lethaby's and Bentley's uses of older forms of building in their concrete buildings without adopting any of the proprietary systems offered by concrete firms, or Easton and Robertson's participation with the structural engineer Oscar Faber without surrendering control over the design of structure to Faber, all illustrate in one way or another composite building systems in which new techniques and traditional modes of building were combined. Certainly for these architects architectural creation did not necessarily exclude the modification of traditional building systems so that they could synchronise with new ones. These architects believed that innovation, whether it be pursued through new materials, technologies or systems of building organisation, could be humanly controlled without necessarily alienating workers from the product of their labour. Unlike the values of Structural Rationalism – a principle which, as Adrian Forty remarked, allows structure to be conceived abstractly as 'the system of support independent of material substance',[64] and whose progressivism tends towards a single result – what we can see instead in these British architects is the belief that construction is an active mechanism that makes possible the coexistence of the

[64] Forty, *Words and Buildings: A Vocabulary of Modern Architecture*, Chapter on 'Structure'; the quotation is in p.280.

process of thinking with the process of making, and whose flexible nature, open to a variety of solutions, is able to absorb progressive enthusiasm and desire for change within a historical perspective.

Such a counter-argument to Structural Rationalism provided at least part of the basis for major developments in British architecture between the 1870s and 1930s. By the late-1930s, and especially after the outbreak of the Second World War, when innovation and technological progress were recognised as inescapable and indeed desirable, British architects became much more inclined to adopt the modernist rhetoric of European practitioners, and themselves tried to contribute to its progressive development. In terms of theory, a book like Robert Atkinson and Hope Bagenal's *Theory and Elements of Architecture*, in 1926, which considers architecture in terms of historical processes, soon became regarded as old-fashioned, whereas Walter Gropius's and Le Corbusier's forward-looking texts were more widely read. The modernist rhetoric of rejecting the past made it increasingly difficult for British architects to maintain a model of construction reliant upon ideas such as 'common-sense' and 'non-division of labour' as the basis of their architectural practice. The other aspect of modernist thinking that made 'practical theory' seem inappropriate was the enthusiasm for industrialised modes of production, in which, of course, all the intellectual labour belonged to the designer and the production engineer, and none to the operative. As soon as modernist architects started to claim that a building site should be run like a factory, the practical and empirical knowledge of building ceased to be their concern.[65]

While acceptance of the modernist precepts that an articulated theory is a necessary precondition of architecture, and that practice is simply the direct application of a verbally developed theory, resulted in the disintegration of 'practical theory' in British architecture after the 1930s, resistance

[65] I owe this interpretative account to Adrian Forty.

to a distinction between 'theory' and 'practice' has nonetheless persisted – particularly in the work of those architects who had been brought up in the Arts and Crafts tradition, traces of which continued in Britain after the Second World War. Architects like FRS Yorke, John Winter and Edward Cullinan, to name but a few, have generally avoided architectural theory and instead prefer to identify themselves with 'pragmatism' and 'common-sense'.[66] This has allowed them more freedom to reflect upon their own situations than an approach based upon *a priori* theories would otherwise tolerate. What makes this so fascinating is that the modernist precept that that one could not properly call oneself an 'architect' without having a 'theory', has never been entirely accepted in Britain. Indeed, for many architects, their resistance to it can be said to be the equivalent of a 'practice' which is a 'theory', in Saint's second sense of the term. This *atheoretical* approach, which started in Britain around the late-nineteenth century, therefore reached its peak at the turn of the century and began to break down after the 1930s, but still persisted in post-war Britain. The latter era offers a rich source of future research, but this study however has focused on the earlier period when such an approach was more active than it has latterly become in Britain.

From the outset of this thesis, part of the difficulty has been how to discuss something that is not a theory in any recognisable sense. There are some aspects of the problem which we can now see more clearly. What made 'construction' so much more than a medium, that was simply expedient to the purposes of late-nineteenth and early-twentieth century British architects, was their understanding of the nature of 'theory' and of 'construction' as being dialectically related. Not only does construction create a physical framework through which financial, technical and material resources are processed, but it is an activity which in itself constitutes the 'constructive possibility' – this is a 'process' which does not occur in language or drawings, but one which is

[66] For a fascinating account of John Winter's career and his thought, see Adrian Forty and Thomas Weaver, "In Conversation with John Winter", *AA Files* 63 (2011): p. 19-31.

the single most decisive for the 'coming into being' of the architectural work. As a form of work, construction shapes new patterns of social relations between the different groups of peoples involved in building, and acts as a process whereby dynamic dialogue and action between these groups can be exercised through attention to practical aspects of building. By relying upon *praxis*, construction enables architects to define their role in relation to site workers, making it possible for them to enlist the practical knowledge, judgment, and labour of the other workers deemed essential for anticipating an architectural work. In this respect, the ability to think about the possible ways of building in a given situation was more valuable to architects than necessarily being able to make it happen, and it is precisely this 'building-practice' characteristic of the British architects under discussion that exemplifies the significance of 'technical imagination'. For every building, there are many constructive possibilities that are the result of material constraints and of tensions between the actors in the construction industry. And it is the capacity of architects to conceive of, and to speculate about, these constructive possibilities, rather than their resort to theories lying outside construction, which is instrumental to the success of an architectural work.

Rather than a passive given, as presented for instance by Frampton, construction is ultimately an active agent – a 'thought-embedded-action' process – that serves as much 'a mode of knowing' as a way of building. In similar fashion to Marshall Mcluhan's understanding of the empirical nature of communication media (his famous slogan was 'the medium is the message'), construction can be seen as an internal mechanism within the larger architectural whole, and through which it constitutes the work's 'substance'.

Conclusion

What I have aimed to do in this thesis is to identify an alternative approach to Kenneth Frampton's *Tectonic* theory, and to do this I have suggested that 'construction', considered in terms of four components ('labour', 'building', 'material', and 'representation') might provide the basis for such an enquiry. The way in which some British architects worked – which was by its character experimental, craft-based, and concerned with the process of building as integral to the process of design – indicates that an 'immanent theory' could emerge out of their calculated employment of construction. Unlike the articulated theories of other architects, 'immanent theory' does not reside at the abstract level of mental processes, nor does it have the privilege of offering a set of unified principles, isolated from the practical conditions of building and outside space and time. Rather, the 'immanent' comes to life only when the act of construction occurs, and it is shaped by actors' understandings and theoretical interpretations of the situation – or 'back-talk', to put it in Schön's terms. Central to the idea of the 'immanent' is that the actor's theoretical formation remains open all the while that the building is being realised.

It is for this reason that one can say that, according to this formulation, architectural theory does not fulfil the same role as say a mathematical calculation, where a problem is solved according to a given formula. British architecture did not privilege theories of this kind; instead the 'thinking' in each of our cases operated over the entire course of the work's production. In this regard, works of architecture cannot satisfactorily be judged in relation to any pre-existing discursive theory, but only in relation to the way they were actually built, because their 'theory' is not manifested until construction begins. The philosopher Hannah Arendt once stated: 'The specific work quality of intellectual work is no less due to the "work of our hands" than any other kind of work', and so too 'theories' of the kind we have looked at in this thesis only take form during construction, and indeed only through construction can they develop.[67] To write about theory of construction without taking into account the conditions that produce it, and to give primacy to the doctrine of preconceived theory, as Frampton does in *Studies in Tectonic Culture*, is almost like

[67] Arendt, *The Human Condition*, p. 91.

talking about a theory as a thing in itself and the building as another thing – such an approach overlooks the complexity of construction, reducing it to the mere servant of theory, as well as neglecting the possibility that construction itself can be both a product and also a manufacturer of 'theory'.

Theory, let us be clear, is something which is practiced. It is important to stress that even if a theory were thought to be a prerequisite for construction, once it enters the building site, the practice swallows it up. Whatever has hitherto been meant by construction soon takes on a new socially-constructed meaning under these circumstances. It is not that a given theory dictates the act of construction, but that 'construction' itself offers a 'theory' in the process of becoming. Neither can exist without the other, nor can it have a separate identity of its own. It is in this sense that we can say that no 'theory' of architecture is valid without 'construction'.

Hence, this thesis has suggested that in building the analysis of what might be regarded as 'theory' must begin by removing an assumed theory/practice division, and then needs to consider 'practice' in essence as an indispensable body of 'theory'. In a broader sense, the notion of 'theory' that is being advanced here clearly does not rest upon the Platonic view that treats theory as something abstract, and practice as a mere manual labour activity, nor is there any basis for insistence upon keeping the two apart. Far from being two distinguishable entities, 'theory' and 'practice' have to be seen as inextricably bound. It is this simultaneous existence of theoretical formation and building processes, so evident in British architecture in the examples we have looked at, which throws into confusion the conventional assumption about architectural theory as being something predominately found in written form, and as an articulated ideological conception that exists in opposition to the empirical realm.

If the tension that hitherto kept 'theory' and 'practice' apart is allowed to disappear, and if we stop trying to find a 'theory' of construction exclusively in the minds of architects, we can concentrate instead on analysing the interaction and exchange between architects, production processes and the finished result of the architectural work itself. Only by dealing with these complex site processes, in which practical exigencies and material relations of the work are immanent, will we be able to get closer to understanding constructional 'theory' as a constituent of architecture.

Pages 288 – 328 are removed for copyright reasons.

Bibliography

Archival Materials

On *The Natural History Museum, London*

The National Archives, Kew, 'Memorandum of the Terms of Appointment of Architects of Public Buildings', P.R.O., WORKS 17-16/2 (144-146)

--------, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (1), 27 November 1871

--------, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (4-5), 19 December 1871

--------, 'H.M. Works' letter to Alfred Waterhouse', P.R.O., WORKS 17-16/3 (13-17), 5 January 1872

--------, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (70-71), 12 August 1872

--------, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (79), 30 August 1872

--------, 'H.M. Works' letter to Alfred Waterhouse: Excess of lowest tender over estimate', P.R.O., WORKS 17-16/3 (91-92), 18 September 1872

--------, 'Waterhouse's letters to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (94, 98), 4 October 1872 and 7 October 1872

--------, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (102), 15 October 1872

--------, 'George Baker and Son's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (109) 5 December 1872

--------, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (167), 27 May 1873

--------, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (177), 2 July 1873; and

--------, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-16/3 (196), 15 January 1874

--------, 'Waterhouse's letter to F.C. of H.M. Works', P.R.O., WORKS 17-17/1 (2), 14 January 1876

--------, P.R.O., WORKS 17-17/1 (13), 16 March 1876

--------, P.R.O., WORKS 17-17/1 (17), 'Certificate No. 13', 13 January 1876

--------, 'Baker & Son's letter to F.C. of H.M. Works', P.R.O., WORKS 17-17/1 (23), 27 March 1876

--------, 'Baker and Son's letter to Waterhouse', P.R.O., WORKS, 17-17/1 (265), 4 January 1877

--------, 'Waterhouse's letter to Baker and Son', P.R.O., WORKS, 17-17/1 (292), 22 January 1877

On *All Saints, Brockhampton*

RIBA Drawings & Archives Collections, "Specification of Works by W. R. Lethaby for Building a Memorial Church at Brockhampton, Hereford & Worcester, April 1901", in *WILLIAM LETHABY PAPERS*/ Ref no. LeW/2/12

On *The Royal Horticultural Hall, London*

RHS Lindley Library", Council Minutes", Royal Horticultural Society, 1925

Building Research Station. "The Progressive Deformation of a Reinforced Concrete Arch at the New Horticultural Hall, London", edited by Department of Scientific and Industrial Research Building Research, November 1936

On *2 Willow Road*

RIBA Drawings & Archives Collections, "Bill No. 2", in *GolEr*/239/10, May 1938

———, "Bill of Reductions. House No.2 Reduction of P.C. Sum for Concrete Structure", in *GolEr* 240/1

———, "Concrete Frame Plans (Centre)", in *PA* 616/1, 5 January 1938

———, "'Concrete Houses Facing the Heath' Protest by the Hampstead Protection Society", Hampstead & Highgate Express 18 Dec 1937
———, "Drawings for the Reinforced Concrete Structure by J. L.Kier", in *PA* 18-27
———, "Erno Goldfinger's Letter to L.C.C.", in *GolEr*/240/18, 23 February, 1938
———, "Erno Goldfinger's Letter to L.C.C.", in *GolEr*/240/18, 26 January, 1938
———, "Erno Goldfinger's Letter to John W. Rowand", in *GolEr* 240/14, 9 June 1939
———, "Estimate for the Erection and Completion of Proposed Block of Three Houses at Willow Road, Hamstead, N.W.3 for the Contemporary Construction Company Ltd", in *GolEr* 239/7, May 1938
———, "First Floor Plan", in *PA* 613/2 (27), Dated on 29-31 August 1938 and 21, 26 September 1938
———, "First Floor Plan", in *PA*614/1/(39), 20 November1937
———, "First Floor Plan", in *PA* 613/1 (35), 4 January 1938
———, "Floor Plans", in *PA*613/1(30), dated on 20 November 37
———, "Front Elevation", in *PA* 613/1 (31), 19 November 1937
———, "Goldfinger and Gerald W. Flower's Letter to the Chairman, the Town Planning Committee, L.C.C., County Hall, London", in *GolEr* 240/18, 10 January 1938
———, "Goldfinger's Letter to L.C.C", in *GolEr* 240/18, 18 April 1939
———, "The House on the Heath", in *GolEr* 243/10_WR Articles on No. 2
———, "A Letter of H.R. Tasker (the Engineer of Bierrum & Partners Ltd) to Goldfinger", in *GolEr* 242/10 WR Reinforced Concrete, 24 June 1938
———, "Plans", 14 October 1937
———, "Plans", in *PA* 613/1 (30), 20 November 1937
———, "Specification for Reinforced Concrete Work", in *GolEr* 242/10 WR Reinforced Concrete, 24 June 1938
———, "Ursula Goldfinger's Letter to C. H. Drayton", in *GolEr* 240/12, 4 July 1938

Articles and Books

Dates in square brackets after Titles are of original publication; where a second date is given, it refers to the date of the edition citied in this thesis.

Anon. "Architectural Criticism", (April 20, 1878)
———. "An Architectural Symposium", *The Builder* (Oct 17, 1896): 307-08
———. "Angular" House Not Ugly, but the Present Ones Are", *Evening Standard* (December 22, 1937)
———. "Architects and the Public", *The Builder* (May 25, 1878)
———. "The Church of Saint-Jean-Baptiste De Montmartre, Paris, 1894-1904", *Rassegna* 68, no. 4 (1996): 46-49
———. "Compositions and Drawings of Viollet-Le-Duc", *The Builder* 43 (July 15, 1882): 68-69
———. "Concrete as a Building Material", *The Builder* (April 15, 1876)
———. "Concrete Building: Civil and Mechanical Engineers' Society", *The Builder* (March 28, 1874)
———. "Consistency and Refinement in Architectural Detail", *The Builder* (Jan 22, 1876): 76-77
———. "Construction and Combination in the Arts: The Successive and the Simultaneous", *The Builder* (1879): 92-93
———. "The Cost of Concrete Buildings", *The Builder* (June 24, 1871)
———. "The Decline and Fall of British Architecture", *The Builder* (Feb 24, 1877): 187-88
———. "A Fortnight in Switzerland with Viollet-Le-Duc", *The Builder* 54 (March 24, 1888): 207-08

———. “The Function of the Imagination in Structural and Decorative Art”, *The Builder* (July 7, 1877)

———. “Hope Bagenal”, *RIBA Journal* (December 1979)

———. “Industrial Partnerships: The Labour Question”, *The Builder* 40 (March 5, 1881): 271

———. “Iron and Steel for Building Purposes”, *The Architect* XXIII (May 29, 1880): 369-71

———. “Iron Architecture”, *The Architect* XXIII (May 29, 1880): 363

———. “Lancelles’s Cement Slab Cottages”, *The Builder* (Aug 31, 1878): 908-09

———. “Le Rationalisme En Architecture. Sa Part Dans Le Passé, Comparaison Des Édifices Anciens Et Modernes”, in *Encyclopédie D’ Architecture*, 1888-89

———. “The Logic of Architectural Design”, *The Builder* (Feb 8, 1879): 147-48

———. “On Massiveness in Architectural The Builder Design”, *The Builder* (April 11, 1874): 301

———. “Mixed and Homogenous Architecture”, *The Builder* (August 9, 1879): 875-77

———. “Modern Building Design”, *The Builder* (Nov.2, 1895): 312-13

———. “Modern Gothic Architecture”, *The Builder* (Aug 2, 1873): 597

———. “The New Horticultural Hall”, *The Architect & Building News* (June 29, 1928)

———. “The New Horticultural Hall: 150-Feet Span Girders Carrying 270 Tons”, *Concrete and Constructional Engineering* XXII, no. 8 (August 1927): 469-78

———. “The New Royal Horticultural Hall: A Reinforced Concrete Design”, *Concrete and Constructional Engineering* XXI, no. 5 (May 1926)

———. “On Mechanical Process for Producing Decorative Designs on Wood Surfaces”, *The Builder* (Dec 20, 1873): 1003-04

———. “On the Architectural Treatment of Portland Cement”, *The Builder* (June 24, 1871): 484-85

———. “The Programme of the Engineer and of the Architect”, *The Builder* (Sept 14, 1878): 951-52

———. “Refinement and Building”, *The Builder* (1876, July 8): 657-58

———. “Retrospective Architectural Study”, *The Builder* (Oct 19, 1878): 1087-88

———. “The Royal Horticultural Society's New Hall”, *Engineering* (Dec 21, 1928): 763-64

———. “The Student’s Column: Concrete-Steel”, *The Builder* 85 (July 4, 1903): 19-20

———. “Transition in Architectural Style”, *The Builder* (1874, Dec. 12): 1036

———. “Truth About 'Shams' ” *The Builder* (Sept 28, 1878)

———. “Viollet-Le-Duc and Boileau: St. Eugene and the Gothic Debate”, *Architectural Design* 3/4 (1980): 54-59

———. “Viollet-Le-Duc as Architect and Art Historian”, *The Builder* (May 10, 1884): 684

———. “Viollet-Le-Duc On “Architect and Engineer”“, *The Builder* (Dec 12, 1874): 1025-26

———. “Westminster Cathedral”, *The Architect’s Journal* (June 22, 1995)

———. “What Style Next?” *The Builder* (1876, Nov 11): 1099-100

———. “Work and Wages in the Building Trades”, *The Builder* (Feb 23, 1878): 184-87

———. *The Builder* 9 (November 1895): 329

———. *The Builder* 58 (January 18, 1890): 41

———. *The New York Herald Tribune* (June 28, 1959)

———. *The Builder* (Oct 12, 1872): 799

———. *RIBA Journal* 139 (1932): 410

———. *Architectural Review* 2 (1897): 240

———. *The Builder* (Oct 14, 1876): 1005-06

———. *The Builder* (Nov 4, 1876): 1067-68

———. *The Builder* (March 18, 1905): 290

———. *The Builder* (Oct 17, 1874)

A. Workman. "Artistic Individualism", *The Builder* (August 18, 1877): 842

Adam, Cole A. "Common Sense in Architecture", *The Builder* (Dec 27, 1879): 1426-27

Adam, Robert. "Craft Works", *RIBA Journal* (January 2009): 46-48

Adamson, Glenn. *Thinking through Craft* 1st ed. Oxford; New York: Berg, 2007

Agrest, Diana I. *Architecture from Without: Theoretical Framings for a Critical Practice*. Cambridge, Mass; London MIT Press, 1991

Allen, C. Bruce. "Art-Work in the Future", *The Builder* (Jan 14, 1865): 32

Allen, William. "Obituary: Hope Bagenal", *AJ* (May 30, 1979)

Arendt, Hannah. *The Human Condition* [1958]. Chicago; London: University of Chicago Press, 1998

Atkinson, Robert and Hope Bagenal. *Theory and Elements of Architecture* 1st ed. Vol. 1, Part 1. London: Ernest Benn Limited, 1926

Barry, E.M. "Architectural Lectures: Architectural Ornament" *The Builder* (Feb 14, 1880)

Bartholomew, Alfred. *Specifications for Practical Architecture: Preceded by an Essay on the Decline of Excellence in the Structure and in the Science of Modern English Buildings; with the Proposal of Remedies for Those Defects*. London: John Williams, Library of Fine Arts, 1840

Baudot, Anatole de. *L' Architecture Et Le Ciment Armé*.

Beattie, James. *An Essay on the Nature of Immutability of Truth, in Opposition to Sophistry and Scepticism*. Edinburgh: Publisher, 1770

Benhan, Reyner. *Theory and Design in the First Machine Age*. London: Architectural Press, 1960

Bøe, Alf. *From Gothic Revival to Functional Form: A Study in Victorian Theories of Design*. Oslo: Oslo University Press, 1957

Botticher, Carl. "In What Style Should We Build? : The German Debate on Architectural Style", Santa Monica, Calif: Getty Center for the History of Art and the Humanities, 1992

Boudon, Philippe. "Structures and Signs", *Architectural Design* 50, no. 3/4 (1980): 90-92

Bourdieu, Pierre. *The Field of Cultural Production: Essays on Art and Literature*. 1st ed. Cambridge: Polity Press, 1993

———. *The Logic of Practice*. Translated by Richard Nice. Cambridge: Polity Press, 1990

———. *Outline of a Theory of Practice*. Translated by Richard Nice, Cambridge Studies in Social Anthropology. Cambridge: Cambridge University Press, 1977

Bourdieu, Pierre and L. Wacquant. *An Invitation to Reflexive Sociology*. London: University of Chicago Press, 1992

Bowley, Marian. *The British Building Industry: Four Studies in Response and Resistance to Change*. Cambridge: The Syndics of the Cambridge University Press, 1966

Brandon-Jones, John. "The Use of Materials: A Study of Contradictory Attitudes", in *Craft History* One (1988): 109-14

Breassani, Martin. "The Tree and the Reason", *Rassegna* 28, no. 4 (1979): Translations of monographs

Bressani, Martin. "Viollet-Le-Duc's Optic", in *Architecture and the Sciences: Exchanging Metaphors* edited by Antoine Picon and Alessandra Ponte. Princeton, N.J.: Princeton University School of Architecture, 2003

Brunt, Henry Van. "Architecture and Society: Selected Essays of Henry Van Brunt", edited by William A. Coles. Cambridge, Massachusetts: The Belknap Press of Harvard University Press, 1969

Buchanan, Alex. "The Science of Rubbish: Robert Willis and the Contribution of Architectural History", in *Gothic to Gothic Revival: Papers from the 26th Annual Symposium of the Society of Architectural Historians of Great Britain 1997*, edited by Frank Salmon: The Faculty of Arts, University of Manchester, 1998

Buchanan, Alexandrina Caroline. "Robert Willis and the Rise of Architectural History", PhD thesis, University of London, 1994

Buckle, James Geo. “On Shams”, *The Builder* (Sept 28, 1878): 1021-22

Bucknall, Benjamin. “M. Viollet-Le-Duc as an Architect”, *The Builder* (Jan 10, 1874): 26

Cadbury-Brown, Jim, and James Dunnett, John Winter. “Erno Goldfinger: A Tribute”, *RIBA Transactions* 1, no. 2 (1982): 19-26

Carr, Wilfred, and Stephen Kemmis. *Becoming Critical: Education, Knowledge, and Action Research* [1986]. London: Routledge Falmer, 2002

Collins, H.M. “Review of We Have Never Been Modern by Bruno Latour; Catherine Porter”, *Isis* 85, no. 4 (Dec 1994): 672-74

Collins, Peter. “Auguste Perret”, in *The Rationalists: Theory and Design in the Modern Movement*, edited by Dennis Sharp. London: Architectural Press, 1988: 16-25

———. *Changing Ideals in Modern Architecture 1750-1950* [1965]. Montreal & Kingston, London, Ithaca: McGill-Queen's University Press, 1998

———. Concrete: *The Vision of a New Architecture*. 1st ed. London: Faber and Faber Limited, 1959

Colomina, Beatriz. *Privacy and Publicity: Modern Architecture as Mass Media*. 1st ed. Cambridge, Mass; London: MIT Press, 1996

———. “The Split Wall: Domestic Voyeurism”, in *Sexuality and Space*, edited by Beatriz Colomina. New York: Princeton Architectural Press, 1992

Colquhoun, Alan. “Rationalism: A Philosophical Concept in Architecture”, in *Modernity and the Classical Tradition: Architectural Essays 1980-1987*. Cambridge, Massachusetts; London, England: The MIT Press, 1989

Cooney, E. W. “The Origins of the Victorian Master Builders”, *The Economic History Review* 8, no. 2 (1955): 167-76

Craftsman, A. “Free Thoughts on Art and Handicraft”, *The Builder* (1874): 812

Crawford, Alan. “The Arts and Crafts Movement”, in *By Hammer and Hand: The Arts and Crafts Movement in Birmingham*, edited by Alan Crawford, 5-26. Birmingham: Birmingham Museums and Art Gallery, 1984

Crook, J. Mordaunt. *The Dilemma of Style: Architectural Idea from the Picturesque to the Post-Modern*. 1st ed. London: John Murrey, 1987

Cunningham, Colin. *Alfred Waterhouse, 1830-1905: Biography of a Practice*. Edited by Dennis Farr, Clarendon Studies in the History of Art. Oxford: Clarendon Press, 1992

———. *The Terracotta of Designs of Alfred Waterhouse*. 1st ed. London: WILEY-ACADEMY, 2001

Curtis, William J. R. *Modern Architecture since 1900*. Edited by 3rd ed., Rev., Expanded, and Redesigned. London: Phaidon Press, 1996

Cusack, Patricia. “Agents of Change: Hennebique, Mouchel and Ferro-Concrete in Britain, 1897-1908”, in *Early Reinforced Concrete*, edited by Frank Newby, 155-68. Aldershot: Ashgate, 2001

———. “Architects and the Reinforced Concrete Specialist in Britain 1905-08”, *Architectural History* 29 (1986): 183-96

Davey, Peter. Arts and Crafts Architecture [1980]. London: Phaidon Press Limited, 1995

———. *Arts and Crafts Architecture: The Search for Earthly Paradise*. London: The Architectural Press Ltd, 1980

Doyle, Peter. *Westminster Cathedral 1895-1995*. 1st ed. London; New York: Geoffrey Chapman, 1995

Drake, C. “Concrete V. Brickwork”, *The Builder* (April 22, 1871): 309

Dumont, Marie-Jeanne. “The Fortune of a Pioneer”, *Rassegna* 68 (Anatole de Baudot 1834-1915), no. 4 (1996): 6-13

———. “The Philosophers' Stone: Anatole De Baudot and the French Rationalists”, *Rassegna* 49 (Reinforced Concrete: Ideologies and Forms from Hennebique to Hilberseimer), no. 1 (March 1992): 37-43

Dumont, Marie-Jeanne and Martine Ramat. “Memories, Discourse, Definitions”, *Rassegna* 68 (Anatole de Baudot 1834-1915), no. 4 (1996): 70-71

Easton, Murray and Howard Robertson. “Short Description of the New Hall”, Journal of the Royal Horticultural Society LIV (Jan 1929).

Edgerton, David. *The Shock of the Old: Technology and Global History since 1900* [2006]. London: Profile, 2008

Elliott, Brent. “The Royal Horticultural Society's New Hall”, *Thirties Society Journal* 7 (1991): 15-19

Evans, Robin. “Mies Van De Rohe: Paradoxical Symmetries” [1990], in *Translations from Drawing to Building and Other Essays.* London: Architectural Association, 1997

———. “Translations from Drawing to Building” [1990], in *Translations from Drawing to Building and Other Essays*. London: Architectural Association, 1996

Faber, John. *Oscar Faber: His Work, His Firm & Afterwards*. London: Quiller Press Limited, 1989

Faber, Oscar. *Simple Examples of Reinforced Concrete Design*. 2nd ed. London: Oxford University Press, 1929

Faber, Oscar and P.G. Bowie. *Reinforced Concrete Design Vol. I. - Theory*. London: Edward Arnold & Co., 1924

Fergusson, James. *An Historical Enquiry into the True Principles of Beauty in Art*. London: Longman, 1849

———. *A History of Architecture in All Countries: From the Earliest Times to the Present Day*. Vol. 1, in three volumes. London: John Murray, 1865

———. *History of the Modern Styles of Architecture: Being a Sequel to the Handbook of Architecture*. London: John Murray, 1862

Forty, Adrian. “Beyond Words”, in *Further Reading Required*. The Bartlett School of Architecture, 17 February 2011

———. “Cement and Multiculturalism”, in *Transculturation : Cities, Spaces and Architectures in Latin America*, edited by Mark Millington and Iain Borden Felipe Hernández. Amsterdam Rodopi, 2005

———. “Common Sense and the Picturesque”, in *Architecture and the Sites of History : Interpretations of Buildings and Cities*, edited by Iain Borden and David Dunster. New York: Whitney Library of Design, 1995: 176-85

———. “Just Another Material”, *A&U* 425, no. 2 (2006 Feb): 10-16

———. *Objects of Desire: Design and Society since 1750*. London: Thames and Hudson Ltd, 1986

———. “Problems in the History of a Profession: Architecture in Britain in the Nineteenth and Early Twentieth Centuries”

———. *Words and Buildings: A Vocabulary of Modern Architecture*. London: Thames & Hudson, 2000

Forty, Adrian and Thomas Weaver. “In Conversation with John Winter”, *AA Files* 63 (2011): 19-31

Frampton, Kenneth. “Labour, Work & Architecture”, in *Meaning in Architecture*, edited by Charles Jencks & George Baird. London: Barrie and Jenkins, 1969

———. “Louis I Kahn and the New Monumentality, 1944-1972”, *Design Book Review*, no. 28 (Spring 1993)

———. *Modern Architecture: A Critical History* [1980]. Third ed, Revised and Enlarged. New York: Thames and Hudson Inc, 1992

———. “Rappel a L' Ordre: The Case for the Tectonic” [1990] in *Labour, Work and Architecture*: Collected Essays on Architectural and Design. London; New York: Phaidon Press, 2002

———. Studies in Tectonic Culture: *The Poetic of Construction in Nineteenth and Twentieth Century Architecture* [1995]. Third printing ed. Cambridge, Massachusetts; London: The MIT Press, 2001

———. “Toward a Critical Regionalism: Six Points for an Architecture of Resistance” [1983], in *Labour, Work and Architecture: Collected Essays on Architectural and Design*, London; New York: Phaidon Press, 2002: 76-89

———. “Towards a Critical Regionalism: Six Points for an Architecture of Resistance” [1983], in The Anti-Aesthetic: Essays on Postmodern Culture, edited by Hal Foster. Seattle, Washington: Bay Press, 1993

Frampton, Kenneth and Stan Allen, Hal Foster. “A Conversation with Kenneth Frampton”, October 106 (Autumn, 2003): 35-58

Freenberg, Andrew. *Alternative Modernity: The Technical Turn in Philosophy and Social Theory*. Berkeley; Los Angeles; London: University of California Press, 1995

Garnham, Trevor. *Melsetter House: William Richard Lethaby*. London: Phaidon, 1993

———. "William Lethaby and the Two Ways of Building", *AA Files* 10 (1993)

Gellner, Ernest. *Reason and Culture: The Historic Role of Rationality and Rationalism*. 1st ed. Oxford: Blackwell, 1992

Georgiadis, Sokratis. "Introduction", in *Building in France, Building in Iron, Building in Ferroconcrete*, edited by Harry F. Mallgrave. Santa Monica, CA: The Getty Center for the History of Art and Humanities, 1995

Giedion, Sigfried. *Building in France, Building in Iron, Building in Ferroconcrete* [1928]. Edited by Harry F. Mallgrave, Texts and Documents. Santa Monica, CA: The Getty Center for the History of Art and Humanities, 1995

Goldfinger, Ernö. "Three Houses at Willow Road", *Architecture Review* 87 (1940): 126-30

———. "Urbanism and Spatial Order", in *Ernö Goldfinger, Works* 1, edited by compiled by James Dunnett and Gavin Stamp. London: Architectural Association, December 1941

———. "The Work of Auguste Perret", *Architectural Association Journal* 23 (January 1955): 150

Grundy, Shirley. *Curriculum: Product or Praxis*. London: Falmer, 1987

Habermas, Jürgen. "Dogmatic, Reason, and Decision", in *The Habermas Reader* edited by William Outhwaite. Cambridge: Polity Press, 1996

———. "Modernity's Consciousness of Time and Its Need for Self-Reassurance", in *The Habermas Reader* edited by William Outhwaite. Cambridge: Polity Press, 1996

———. "The Positivistic Dissolution of the Claimed Unity of Theory and Praxis", in *The Habermas Reader* edited by William Outhwaite. Cambridge: Polity Press, 1996

———. *Theory and Practice*. Translated by John Viertel. London: Heinemann, 1974

Hadfield, Charles. "Westminster Cathedral", *RIBA Journal* X (1902-3): 249-72

Hall, Michael. "What Do Victorian Churches Mean? Symbolism and Sacramentalism in Anglican Church Architecture, 1850-1870", *Journal of the Society of Architectural Historians* 59, no. 1 (Mar 2000): 78-95

Hamilton, S. R. *A Note on the History of Reinforced Concrete in Buildings, National Building Studies, Special Report No.24*. London: Her Majesty's Stationery Office, 1956

Hanson, Brian. *Architects and the "Building World" From Chambers to Ruskin: Constructing Authority*. Cambridge: Cambridge University Press, 2003

———. "Mind and Hand in Architecture: Ideas for the Artisan in English Architecture from William Chambers to John Ruskin", PhD thesis, University of Essex, 1987

Heer, Jan de. *The Architectonic Colour: Polychromy in the Purist Architecture of Le Corbusier*. Rotterdam: 010 Publishers, 2009

Heidegger, Martin. "Building, Dwelling, Thinking" in *Poetry, Language, Thought*. New York; Toronto: Harper & Row; Fitzhenry & Whiteside Limited, 1975

———. "The Origin of the Work of Art" [1950], in *Poetry, Language, Thought*. New York; Toronto: Harper & Row; Fitzhenry & Whiteside Limited, 1975

Hems, Harry. "The Industrial Crisis", *The Builder* (Feb 15, 1879): 184-85

Herrmann, Wolfgang. *Gottfried Semper: In Search of Architecture*. Cambridge, Mass.: Mit Press, 1984

Higgott, Andrew. "Introduction", in *Travels in Modern Architecture 1925-1930*. London Architectural Association, 1989

Hill, Rosemary. *God's Architect: Pugin and the Building of Romantic Britain*. London: Allen Lane, 2007

Hope, Beresford. "The Common Sense of Art", *The Gentlemen's Magazine and Historical Review* (Feb 1859)

Jackson, T. G. "Introduction", in *Architecture: A Profession or an Art*, edited by R.A. and T. G. Jackson R. Norman Shaw, A.R.A. London: John Murray, Albermarle Street, 1892

Johnson, Paul-Alan. *The Theory of Architecture. Concepts, Themes, and Practices*. New York: Van Nostrand Reinhold, 1994

Jones, Paul. *The Sociology of Architecture*. 1st ed. Liverpool: Liverpool University Press, 2011

Jones, Peter Blundell. “All Saints Brockhampton”, *AJ* 192, no. 7 (August 15, 1990): 24-43

Jordy, William and Ralph Cox. “Architecture in Chicago”, in *Architecture and Other Writings*. Cambridge, Mass.: Belknap Press of Harvard University Press, 1961

Kaplan, David M. “Readings in the Philosophy of Technology”, Lanham, Md.; Oxford Rowman & Littlefield Publishers, 2004

King, Anthony. “Thinking with Bourdieu against Bourdieu: A 'Practical' Critique of the Habitus”, *Sociological Theory* 18, no. 3 (2000): 417-33

Leatherbarrow, David. “Review of Studies in Tectonic Culture”, *Journal of the Society of Architectural Historians* 56, no. 1 (March 1997): 98-100

Legault, Réjean. “L’appareil De L’architecture Moderne : New Materials and Architectural Modernity in France, 1889-1934”, PhD thesis, MIT, 1997

———. “Material and Modernity”, *Rassegna* 49 (Reinforced Concrete: Ideologies and Forms from Hennebique to Hilberseimer), no. 1 (March 1992): 58-65

Lethaby, W.R. *The Builder* (July 17, 1925): 98

———. *The Builder* (November 9, 1895): 329

———. “An Architectural Symposium”, *The Builder* (Oct 17, 1896): 307-08

———. “The Architectural Treatment of Reinforced Concrete”, *The Builder* (Feb 7, 1913): 174-76

———. “Architecture as Structural Geometry”, *The Builder* (January 11, 1929): 52-53

———. *Architecture: An Introduction to the History and Theory of the Art of Building* [1911]. 3rd ed. London: Butler & Tanner Ltd., 1955

———. “The Building Art: Theories and Discussion. - I”, *The Builder* (January 5, 1923): 8

———. “The Building Art: Theories and Discussion. - VI”, *The Builder* (June 1, 1923): 892-93

———. “The Building Art: Theories and Discussions. - III”, *The Builder* (March 9, 1923): 405-06

———. “The Building Art: Theories and Discussions. - V”, *The Builder* (May 4, 1923): 736-37

———. *The Church of Sancta Sophia Constantinople: A Study of Byzantine Building*. London and New York: Macmillan & Co., 1894.

———. “Correspondence to the Editor of the Builder: Designer and Craftsman”, *The Builder* (Oct 24, 1896): 336

———. “Correspondence: The Beauty of Structures and Make-Believe Styles”, *The Builder* (September 19, 1919): 287

———. *Form in Civilization: Collected Papers on Art and Labour*. London: Oxford University Press, 1957

———. “Modernism and Design - IX: Building Commonplaces the Substance of Architecture”, *The Builder* (September 2, 1921): 288-89

———. “Modernism and Design - VII: The Uses of Antiquity”, *The Builder* (July 1, 1921): 6

———. “Modernism and Design - VIII: The Mystery of Mouldings”, *The Builder* (August 5, 1921): 165

———. “Modernism and Design - X: Planning, Composition, and Block-Form”, *The Builder* (October 7, 1921): 450-51

———. “Modernism and Design - XI: Function, Finish, and Fitness”, *The Builder* (November 4, 1921): 608-09

———. “Modernism and Design - XII: Architectural Theory and Building Practice”, *The Builder* (December 2, 1921): 749-51

———. “Modernism Building Design: Positive Conditions”, *The Builder* (Nov 9, 1895): 334

———. “A National Architecture - IX: The Quick and the Dead”, *The Builder* 115 (November 29, 1918): 363

———. “A National Architecture - X: Question of Design”, *The Builder* 115 (December 6, 1918): 383

———. *Philip Webb and His Work* [1935] London: Raven Oak Press, 1979

———. “Professor Lethaby on 'Our Hope for the Future'“, *The Builder* (March 25, 1921): 379

———. “Westminster Cathedral”, *Architectural Review* 11 (1902): 3-19

———. “William Morris, Poet and Artist”, *Quarterly Review* 90 (1899)

L'Hopital, Winefride De. *Westminster Cathedral and Its Architect*. 2 vols. London: Hutchinson and Co., 1919

Lipstadt, Hélène. “Sociology: Bourdieu's Bequest”, *Journal of the Society of Architectural Historians* 64, no. 4 (Dec 2005): 433-36

Lonergan, B. J. F. *Insight: A Study of Human Understanding* [1958]. London: Darton, Longman and Todd, 1983

Mark, Robert. “Robert Willis, Viollet-Le-Duc and the Structural Approach to Gothic Architecture”, *Architectura* VII, no. pt.I (1977): 52-64

Marshall, John A. “Westminster Cathedral: Paper Read before the Architectural Association, on the 12th April, 1907”, *AA Journal* (May 1907): 117-27

Marx, Karl. “Theses on Feuerbach”, in *Marx/Engels Selected Works*, Volume One, 13-15. Moscow, USSR: Progress Publishers, 1969, written in the spring of 1845; first published as an appendix to Ludwig Feuerbach and the End of Classical German Philosophy in 1888

Matteoni, Dario. “Introduction”, *Rassegna* 68, no. 4 (1996): 5

Mcluhan, Marshall. *The Medium Is the Massage: An Inventory of Effects* [1967]. Corte Madera, CA: Gingko Press, 2001

Melvin, Jeremy. *Frs Yorke and the Evolution of English Modernism*. Chichester: Wiley, 2003

Meter. “On Shams”, *The Builder* (Sept 14, 1878): 970

———. “On 'Shams' ”, *The Builder* (Oct 5, 1878): 1047

Middleton, Robin. “The French Connection in 18th Century England”, *AA Files* 16 (1987 Autumn): 46-56

———. “The Rationalist Interpretations of Classicism of Leonce Reynaud and Viollet-Le-Duc”, *AA Files* 11 (1986 Spring): 29-48

———. “Viollet-Le-Duc's Influence in Nineteenth Century England”, *Art History* 4, no. 2 (June, 1981)

Middleton, R. D. “Viollet-Le-Duc and the Rational Gothic Tradition”, PhD thesis, University of Cambridge, 1958

Middleton, Robin and David Watkin. Neoclassical and 19th Century Architecture. New York: Harry N. Abrams, Inc., 1977

Middleton, Robin and Marie-Noëlle Matuszek-Baudouin. *Jean Rondelet : The Architect as Technician*. New Haven, Conn.; London: Yale University Press, 2007

Ramsey, Eric Ramsey and David James Miller. “From the Loving Struggle to the Struggle to Love: A Conversation with Calvin O. Schrag”, in *Experiences between Philosophy and Communication: Engaging the Philosophical Contributions of Calvin O. Schrag*, edited by Ramsey Eric Ramsey and David James Miller. Albany; [Great Britain]: State University of New York Press, 2003

Misa, Thomas J. “The Compelling Tangle of Modernity and Technology”, in *Modernity and Technology*, edited by Philip Brey Thomas J. Misa, and Andrew Feenberg. Cambridge, Massachusetts; London, England: The MIT Press, 2003

Molella, Arthur P. “Sigfried Giedion's Space, Time, and Architecture and Mechanization Takes Command”, *Technology and Culture* 43, no. 2 (April, 2002): 374-89

Moon, Francis C. “Robert Willis and Franz Reuleaux: Pioneers in the Theory of Machines”, *Notes and Records of the Royal Society of London* 57, no. 2 (May 2003): 209-30

Morris, William. “The Influence of Building Materials Upon Architecture”, in *Art, Industry and Wealth*. London: Longmans, Green and Co., 1902, originally delivered on 20th November 1891 at a meeting sponsored by the Art Workers' Guild at Barnard's Inn, London

———. “Preface”, in *The Nature of Gothic: A Chapter from the Stones of Venice* [1892]. London: George Allen, 1905

———. “The Revival of Architecture”, in *Art, Industry and Wealth*. London, 1902

Murphy, Kevin D. “Cubism and Collegiate Gothic: Raymond Duchamp-Villon at Connecticut College”, *Archives of American Art Journal* 32, no. 1 (1992): 16-21

Muthesius, Hermann. *The English House: In Three Volumes* [1904]. Translated by Janet Seligman and Stewart Spencer. Edited by Dennis Sharp. London: Frances Lincoln, 2007

Oliver, Paul. *Built to Meet Needs: Cultural Issues in Vernacular Architecture*. 1st ed. Oxford: Architectural Press, 2006

Holthoon, Frit van and David R. Olson. "Common Sense: An Introduction", in *Common Sense: The Foundations for Social Science*, edited by Frit van Holthoon and David R. Olson. Lanham: University Press of America, 1987

Otero-Pailos, Jorge. *Architecture's Historical Turn: Phenomenology and the Rise of the Postmodern*. Minneapolis, Minn.: University of Minnesota Press, 2010

Papworth, John W. "On Beauty in Architecture and Its Alliance with the Past", in *Paper Read at the Royal Institute of British Architect, Session 1856-57*. London: Published at the Rooms of the Institute, 16, Grosvenor Street, 1857

Peckham, Andrew, and Charles Rattray, Torsten Schmiedeknecht. "Introduction: On the Threshold of Rationalism", *Architectural Design* 77, no. 5 (2007): 6-9

Pérez-Gómez, Alberto. *Architecture and the Crises of Modern Science*. London, England: The MIT Press, Cambridge, Massachusetts, 1983

Pevsner, Nikolaus. *Buildings of England: Herefordshire.* Harmondsworth: Puguin, 1963

———. "Lethaby's Last", *Architectural Review* (Nov 1961): 354-57

———. "Patient Progress One: Frank Pick" [1942], in *Studies in Art, Architecture and Design*. London: Thames and Hudson, 1968

Pickering, Andrew. *The Mangle of Practice*. Chicago and London: The University of Chicago Press, 1995

Picon, Antoine. "Architecture Amd Constructive Expression: The Problem of Structural Rationalism", *Lotus* 47 (1985): 6-18

———. *French Architects and Engineers in the Age of Enlightenment* [1988]. Translated by Martin Thom. Cambridge: Cambridge University Press, 1992

———. "Towards a History of Technological Thought" [1996], in *Technological Change: Methods and Themes in the History of Technology* edited by Robert Fox, 37-49. Amsterdam: Harwood Academic, 1998

Picton, J.A. "The Position of Architecture (Address Delivered as President of the Liverpool Architectural Society at the Opening Meeting, Oct, 4th.)", *The Builder* (Nov 4, 1876)

Plaat, Deborah Van Der. "Symbolism Comprehensible to 'Great Majority of Spectators': William Lethaby's Architecture, Mysticism and Myth and Its Debt to Victorian Mythography", *Architectural History* 45 (2002): 363-85

Polanyi, Michael. *The Tacit Dimension* [1967]. Gloucester, Mass: Peter Smith, 1983

Powell, Kenneth. "Centenary Review: Westminster Cathedral", *Architects' Journal* 201, no. 25 (June 22, 1995): 24-37

Powers, Alan. in *Robert Atkinson, 1883-1952*, edited by Paul Spencer-Longhurst: Architectural Association, in collaboration with the Barber Institute, University of Birmingham, 1989

———. *2 Willow Road*. London: National Trust, 1996

Pugin, A.W.N. *Dublin Review* (May 1841)

———. *The True Principle of Pointed or Christian Architecture*. London: W. Hughes, King's Head Court, Gough Square, 1841

Pullan, R. Popplewell. "On Style and Proportion in Gothic Architecture" *The Builder* (May 13, 1876, Read at a meeting of the AA on Friday, the 5th inst.)

Rees, Verner O. *The Architects' Journal* (October 24, 1928): 566-73

Reid, Thomas. *Essays on the Intellectual Powers of Man*. Edinburgh: J. Bell, 1785

Rendell, Jane. *Art and Architecture: A Place Between* [2006]. London; New York: I.B. Tauris, 2008

Repton, Humphrey. *Observations on the Theory and Practice of Landscape Gardening*. London, 1803

Rescher, Niclolas. *Common-Sense: A New Look at an Old Philosophical Tradition, The Aquinas Lecture*. United States of America: Marquette Press, 2005

Rice, Peter. *An Engineer Imagines* 2nd ed. London: Ellipsis, 1996

Robertson, Howard. *Architectural Arising*. London: Faber and Faber, 1944

Robertson, Howard and F.R. Yerbury, "A Note on the Einstein Tower", in *Travels in Modern Architecture 1925-1930*. London: Architectural Association, 1989

Rouyer, Rémi. "Architecture Et Procès Techniques : Les Figures De L'imaginaire", PhD thesis, Université Panthéon-Sorbonne Paris, 2006

Rubens, Godfrey. "Introduction", in *Philip Webb and His Work*. London: Raven Oak Press, July 1979

———. *Willliam Richard Lethaby: His Life and Work*, 1857-1931. London: Architectural Press, 1986

Ruskin, John. *The Nature of Gothic: A Chapter from the Stones of Venice* [1853]. London: George Allen, 1905

———. The Seven Lamps of Architecture [1849]. New York: John Wiley&Son, 1865

Ryle, Gilbert. The Concept of Mind [1949]. Middlesex, England: Penguin Books, 2000

Saint, Andrew. *Architect and Engineer: A Study in Sibling Rivalry*. New Haven and London: Yale University Press, 2007

———. *The Image of the Architect*. New Haven and London: Yale University Press, 1983

———. "Notre-Dame Du Raincy", *AJ* 13 (Feb 1991)

———. "Pugin's Architecture in Context", in *A.W.N. Pugin: Master of Gothic Revival*, edited by Paul Atterbury. New Haven and London: Yale University Press, 1995

———. "Some Thoughts About the Architectural Use of Concrete", *AA Files* 21-22 (1991)

Sanabria, Sergio L. "Review of Studies in Tectonic Culture", *Technology and Culture* 38, no. 4 (Oct., 1997): 992-95

Satoh, Akira. *Building in Britain: The Origins of a Modern Industry* Translated by Ralph Morton. Aldershot, England; Brookfield, Vt., USA: Scolar Press; Ashgate Publishing Company, 1995

Schön, Donald. *The Reflective Practitioner: How Professionals Think in Action* [1983]. Aldershot Ashgate, 1995

Schwarzer, Mitchell. "Tectonics Unbound", *ANY* 14 (1996)

Scott, George Gilbert. *Remarks on Secular & Domestic Architecture, Present & Future*. London: John Murray, 1857

Scott-Moncrieff, W.W. *John Francis Bentley*. London: Earnest Benn, Ltd., 1924

Seldon, J. P. "Consistency and Refinement", *The Builder* (Jan 15, 1876): 59-61

Semper, Gottfried. *The Four Elements of Architecture and Other Writings* Translated by Harry Francis Mallgrave and Wolfgang Herrmann. Cambridge: Cambridge University Press, 1989

———. *Style in the Technical and Tectonic Arts, or, Practical Aesthetics* Translated by Harry Francis Mallgrave and Michael Robinson. Los Angeles: Getty Research Institute, 2004

Sennett, Richard. *The Craftsman*. 1st ed. London: Penguin Books, 2008

Shand, P. Morton. "Salute to Adventurers. The New Royal Horticultural Hall", *Architectural Review* LXV (January, 1929): 17-31

Signet. "The Making of Architects", *The Builder* (Feb 14, 1874): 136

Siry, Joseph. *Carson and Pirie Scott: Louis Sullivan and the Chicago Department Store*. Chicago, 1988

Shaw, R. Norman. *Sketches for Cottages and Other Buildings: Designed to Be Constructed in the Patent Cement Slab System of W. H. Lascelles*. London: W. H. Lascelles 121 Bunhill Row E.C., 1878

Stamp, Gavin. in *Robert Atkinson, 1883-1952*, edited by Paul Spencer-Longhurst: Architectural Association, in collaboration with the Barber Institute, University of Birmingham, 1989

———. "Goldfinger – the Early Years", in *Ernö Goldfinger, Works* 1, edited by compiled by James Dunnett and Gavin Stamp, 9-14. London: Architectural Association, December 1941

Stanton, Phoebe. "Pugin, Augustus Welby Northmore", in *Macmillan Encyclopedia of Architects*, Vol.3, 489-90

Statham, H. Heathcote. "The Logic of Architectural Design", *The Builder* (Feb 8, 1879): 147-48

Steiner, Frances H. *French Iron Architecture*. Ann Arbor, Michigan: UMI Research Press, 1984

Stratton, Michael. *The Terracotta Revival: Building Innovation and the Image of the Industrial City in Britain and North America*. 1st ed. London: Victor Gollancz, 1993

Summerson, John. "Heavenly Mansions", in *Heavenly Mansions and Other Essays on Architecture* [1949] London: Cresset Press, 1998

———. "Pugin at Ramsgate", *Architectural Review* (April 1948)

———. *The Turn of the Century*. University of Glasgow Press, 1976

———. "Viollet-Le-Duc and the Rational Point of View" [1949], in *Heavenly Mansions and Other Essays on Architecture*, 135-58. New York: W.W.Norton&Company, Inc., 1998

Swenarton, Mark. *Artisans and Architects: The Ruskinian Tradition in Architectural Thought*. 1st ed. Basingstoke: Macmillan, 1989

Taylor, Jeremy. *The Architect and the Pavilion Hospital: Dialogue and Design Creativity in England 1850-1914*. London and New York: Leicester University Press, 1997

Thomas, S. Knight. "Architectural Training for the Building Artisan", *The Builder* (July 4, 1913): 5-6

Thompson, Paul. *William Butterfield*. 1st ed. London: Routledge & Kegan Paul, 1971

———. "The Writings of William White", in *Concerning Architecture: Essays Presented to Nikolaus Pevsner*, edited by John Summerson. London: Allen Lane The Penguin Press, 1968

Treib, Marc. *Space Calculated in Seconds*. Princeton, N.J: Princeton University Press, 1996

Unwin, Raymond. *Cottage Plans and Common Sense*, Fabian Tract No. 109. London: The Fabian Society, March 1902

Unwin, W.C. "Professor Unwin on the Construction of Walls", *The Builder* 58 (March 18, 1890): 228

Viollet-le-Duc. "M. Viollet-Le-Duc on Architecture in the Nineteenth Century", *The Builder* (August 11, 1877): 814-16

Viollet-le-Duc, Eugene-Emmanuel. *Dictionnaire Raisonne De L' Architecture Francaise Du Xie Au Xvie Siècle*. 10 vols. Vol. 7. Paris: A. Morel, 1867-75

———. *Discourses on Architecture* [1889]. Translated by Benjamin Bucknall. 2 vols. Vol. 2. London: George Allen & Unwin Ltd., 1959

———. *Encyclopedie d' Architecture* 5, no. 6 (June 1, 1855)

———. *The Foundation of Architecture: Selections from the Dictionnaire Raisonne*. Translated by Kenneth D. Whitehead. 1st ed. New York: George Braziller, Inc., 1990

———. *Lectures on Architecture* (Translation of Entretiens Sur L'architecture,1863:Vol.1 and 1872:Vol.2). Translated by 1877 (vol.1) and 1881 (vol.2) Benjamin Bucknall. New York: Dover Publications, Inc., 1987

———. Rational Building: Being a Translation of the Article "Construction" in *The Dictionnaire Raisonne De L'architecture Francaise of M. Eugene-Emmanuel Viollet-Le-Duc*. Translated by George Martin Huss. New York and London: Macmillan and Co., 1895

Voysey, C.F.A. "The Carpenters' Company Lectures: Ideas in Things", *The Builder* 96 (March 6, 1909): 276-78

———. "The Carpenters' Hall Lectures", *The Builder* 96 (March 13, 1909): 307-08

Warburton, Nigel. *Erno Goldfinger: The Life of an Architect*. 1st ed. London: Routledge, 2004

Waterhouse, Alfred. *Building News* (1882): 245

Webster, Helena. *Bourdieu for Architects*. 1st ed. London: Routledge, 2011

Weston, Richard. *Material, Form and Architecture*. London: Laurence King Publishing Ltd, 2003

Wethered, Charles. "M. Viollet Le Duc, Architect", *The Builder* (April 29, 1874): 733

White, William. "Upon Some of the Causes and Points of Failure in Modern Design", *The Ecclesiologist* XII (1851): 305-13

———. *The British Architect* XXVII (March 25, 1887)

———. *The British Architect* XXI (March 28, 1884): 145

———. *RIBA Transaction* (1880-81): 188-89

———. "Architectural Uniformity and Its Claims", *The Building News* VI (February 17, 1860): 132-35

———. "Cheap Churches", *The Building News* XL (March 11, 1881): 258-60

———. "Ironwork: Its Legitimate Uses and Proper Treatment", *R.I.B.A TRANSACTION* (1865-66): 15-30

———. "St. Mark's, Battersea-Rise", *The Builder* (1875): 48-49

———. "The Wrought-Iron Work of the Great Exhibition of 1862", *The Building News* X (May 22, 1863): 390-91

White, William H. 'On "The Hope of English Architecture" ', *The Builder* (1874, Dec. 19): 1044

Wiebenson, D. *Architectural Theory and Practice from Alberta to Ledoux*: University Of Chicago Press, 1983

Willis, Robert. *Remarks on the Architecture of the Middle Ages Especially of Italy*. Cambridge, 1835

Yerbury, F.R. "Robert Atkinson", *AA Journal* (Feb 1953): 119-21

Yorke, F.R.S. *The Modern House* [1934] London: The Architectural Press, 1957

Zanten, David Van. "Sullivan to 1890", in *Louis Sullivan: The Function of Ornament*, edited by Wim De Wit. New York & London: Chicogo Historical Society, 1986

———. *Sullivan's City: The Meaning of Ornament for Louis Sullivan*. New York & London: W.W.Norton & Company, 2000.

Zurko, Edward Robert De. *Origins of Functional Theory*. New York: Columbia University Press, 1957

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