Hugh Strange

ARCHITECTURE AT THE BUILDING SITE

Challenging the Separation Between Design and Construction.

This thesis makes the case for an architecture that emerges through the process of construction. The research investigates how, within the context of industrialised England from 1830 to 1980, the historic separation between designing and building in the production of architecture developed, and how it continues to define our contemporary building culture. It focusses on the impact of this development on labour and construction, and examines both the agency of those who construct, and the role of the architect, particularly as understood through drawings and related documentation. The research reviews critiques of this 'partitioning' and looks at ways in which it has been challenged through alternative models of architectural practice. The research is structured around studies of three buildings sites. I have read the construction of the Great Stove at Chatsworth in the 1830s, to Joseph Paxton's design, as exemplar of the impact of the factory system and machinery on the production of architecture, with the resulting replacement on site of skilled craftsmen by unskilled labour. Following this, William Lethaby, working within the context of the Arts and Crafts in the 1890s and early 1900s, changed his working methodology, producing fewer drawing before construction, to integrate craftsmen into an ongoing design process at the building site. And from the 1960s onwards, Walter Segal, in developing a radically simplified construction methodology, sought to make designing and building accessible to all. In arguing that architects (and architecture) should re-embrace construction, the temporal process and labour of building, and the creative space of the building site, the thesis proposes – despite all the obstacles - both a political project of renewed agency within the production of architecture, and a parallel revitalisation of the architectural artefact.

Hugh Strange (1969) studied architecture at Edinburgh University, graduating in 1994, and established his London-based practice, Hugh Strange Architects, in 2011.

ISBN 978-82-547-0372-4
ISSN 1502-217X

PhD thesis 128

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PhD 128
AHO

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AHO Arkitektur- og designhøgskolen i Oslo
The Oslo School of Architecture and Design

PhD thesis

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Summary

This thesis addresses the relationship of construction to design in the production of architecture. To approach this, the research examines the distance that exists between the two, charting how this has developed and how it continues to define our contemporary building culture. The text focusses in turn on examples of resistance and challenge to this tendency and proceeds to argue more broadly for an architecture that emerges through, and from, the process of construction. Developing from themes within my own work, this research aims to position the ideas of the practice within a wider context. More broadly it aims to develop an argument that architects (and architecture) should re-embrace construction, the temporal process and labour of building, and the creative space of the building site.

The methodology is thus informed by my experience as a practitioner concerned with the processes and details of construction. My investigation of the issues surrounding how buildings come into being starts from precise readings of construction details developed through professional experience, rather than from theories, and leads on to broader conclusions. The chapters comprising this thesis are undertaken as close readings of construction. I cross-reference the critical interrogation of archive-based historical construction documentation with the examination of actual buildings and bibliographic research, varying to the extent that these are available in each case. A supplementary chapter takes a different approach, interviewing a key participant; excepts from this transcript combine with their own site images to form a photographic essay.

Situated between an earlier discourse relating to the culture of construction (tectonics), and a more recent 'turn to labour' and material discourse, the thesis seeks to simultaneously consider architectural artefact and architectural production. In this, the research is led by a sustained effort to situate each figure and study in their historical moment, yet each study may also be considered to operate allegorically. At the same time, the thesis follows a tradition of established practitioners who have written in parallel to their own design work, internationally and within a British context, from Alison

and Peter Smithson onwards, that has addressed construction within a cultural context. The thesis has also benefitted from the supervision of Pier Vittorio Aureli, whose consistent concern for the relationship between architectural history and political theory has informed the spirit of the whole.

When first contemplating the structure of the thesis I considered a series of architects preoccupied with the nature of 'building', some of whom I felt close to in my own practice – Sigurd Lewerentz, Sverre Fehn – but also some as counterpoints - Carlo Scarpa. While this might have related closely to my own practice, I wanted to address underlying themes, and proceeded to cases that represented more overt relationships between designing and making. These included Michelangelo's development from a sculptor handling material directly, to an architect instructing workmen at one remove, and of the Perret brothers, operating both a concrete construction company, and through Auguste, an architectural practice. This might have brought geographic breadth and allowed the thesis to develop apart from the British discourse led by John Ruskin and William Morris on the relationship of designing and making.

But, after completing a first text on William Lethaby in January 2020, and concerned with embarking on archival research outside my mother tongue, the pandemic forced my hand. Unable to leave my immediate neighbourhood to visit buildings or archives, and not knowing how long such restrictions might last, I chose to research Walter Segal, whose key buildings were close to where I lived. His former assistant Jon Broome also lived nearby and was happy to share archival documents across the distance of a park bench. This study, together with that of Lethaby's work, provided a geographical focus to the thesis. Seeking historical breadth, and aware that the time between these two was approximately the same as that between Segal and my own practice, I decided to look for an earlier case study, alighting on Joseph Paxton's first greenhouses at Chatsworth of the 1830s.

Thus, the choice of three historic building sites allows for comparative investigation of these themes within the context of industrialised England from 1830 to 1980. The focus is on labour and construction, and examines both the agency of those who construct, and the role of the architect.

Acknowledgements

I wish to thank AHO, The Oslo School of Architecture, for generously funding my research. In particular I would like to express my gratitude to Thomas McQuillan for his perceptive advice as academic supervisor, Beate Hølmebakk for continual friendship and encouragement, Tim Ainsworth Anstey for providing a supportive environment throughout, Erik Fenstad Langdalen for welcoming me into the school, and Mari Hvattum for insightful criticism at key moments. I also thank my AHO colleagues Luis Callejas and Espen Vatn for sharing the experience, and the AHO library staff who throughout the pandemic provided essential texts that allowed me to continue my work.

I owe a great deal to my supervisor Pier Vittorio Aureli, whose discerning and generous advice has been critical in the development of the thesis.

I also wish to thank the various archives and editorial teams who have supported this research: RIBA Archives, Niall Hobhouse and the Drawing Matter team, Chatsworth Archives, Archives & Collections at Library of Birmingham, the Archive of Art & Design at the Victoria & Albert Museum, Maria Sheherazade Giudici and Rory Sherlock at AA Files, and Katie Lloyd Thomas and the TFTK team. I am also enormously appreciative of all those who have shared advice, expertise and assistance throughout the course of the studies, in particular: Ellis Woodman, Trevor Garnham, Jon Broome, Phil Christou and Arthur Prior-Palmer, and for those who kindly shared their houses, drawings and experiences in relation to the Segal work: Muriel Holland, Angela Kerry-Williams, Patrick Keiller, and Alice Grahame.

My colleagues at Hugh Strange Architects, and the clients, builders and collaborators we work with, have all been essential and valued in producing the architectural projects that form the backdrop to this research, and I thank them all for their encouragement. Finally, thanks for my family, Adriana, Santiago, and Cecilia for their support, and for giving me time and space to pursue this endeavour.

Nigel Henderson, Construction site in Hunstanton. 1953.

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Introduction

Drawing, Construction and Labour

Located in a tight urban site in London, the Strange House was my first completed project on establishing an architectural practice, and was eventually home to both my family and my practice, for over ten years. As such, it was perhaps inevitably a labour of love.

A typical window/wall construction detail can be seen to encompass many of the practical requirements of the building envelope in relation to thermal performance, airtightness, rain protection, structural stability etc, together with certain assumptions about how the construction would be sequenced on site. But it also reveals some of the projects key design aspirations (fig. 1).

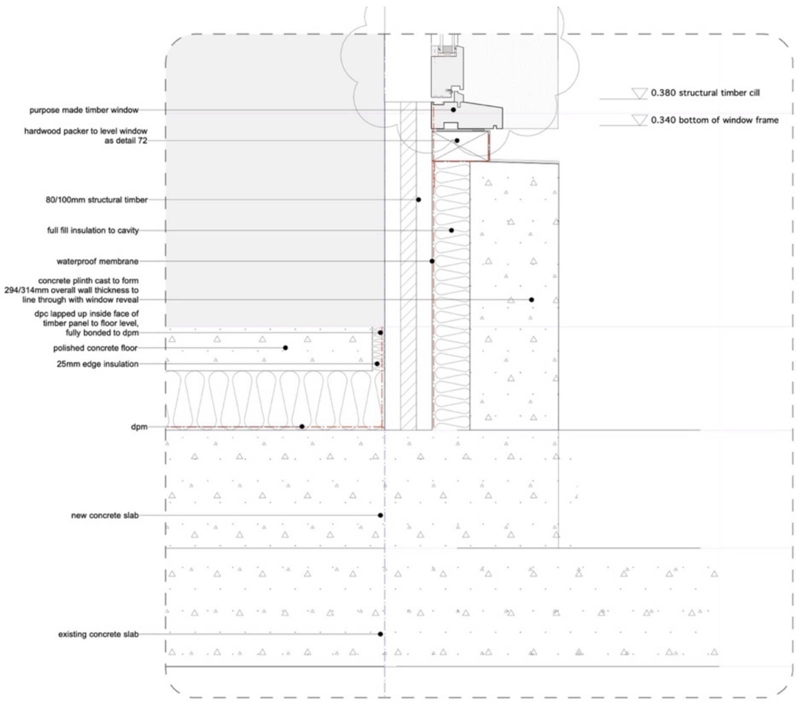

Figure 1. Wall / window construction detail
Strange House, London, Hugh Strange Architects. 2010.

At the base of this working drawing, rather than excavating foundations, a new concrete slab can be seen to form a raft that sits on the existing concrete slab that was already on site. The new house thus inhabits the site of a derelict warehouse rather lightly, retaining the existing slab and perimeter walls, and their presence provides a constant backdrop to the life of the house.

Above this floor build-up can be seen the cross-laminated timber structure that is left exposed, without any additional internal linings. The structure defines the interior of the building, its panel form clearly articulated throughout, and, with a light translucent coating, the timber surface is both revealed and toned down. Outside and above the structure can be seen a hardwood window frame. The depth of the window reveals, drawn in elevation beyond, together with the width of the CLT fin walls, allows an extended threshold between inside and out, both diffusing the natural light as it enters, and mediating one's experience of the existing brick walls beyond.

The depth of the concrete wall in section aligns in the drawing with the timber window reveal in elevation, resulting in a flush façade where moments of depth are emphasised. In clamping the glazing between the two timbers in the areas of fixed glazing, from the interior the windows appear frameless at top and bottom, and a sense of simplicity and material directness is expressed in the architectural design. These then, were some of the primary aesthetic and tactile aspirations of the project.[1]

While I had previously worked in an office as a salaried architect, my role in this project was significantly different. Throughout the works, together with my wife and newly born son, I lived adjacent to the site, in a ground floor flat that later became my practice office. From here, in view of the construction works, if any site queries required additional drawings, I would sit and draw, attentive to when responses were needed.

Building to our own very tight budget made me acutely aware of the cost implications of design decisions. With a keen eye on an economy of means, I appreciated that savings were made not just through

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[1] The project was published in DETAIL magazine, the counterpoint of cleaned-up drawings and photographs of the completed building suggesting a seamless relationship between the two. "House in London," in *DETAIL*, 2 (2012): 128-131. See Appendix 1.

using cheaper and/or less materials, but also though consideration of efficiencies of construction processes and forms of contractual relationships. This led me to consider the project in a strategic manner, focussing on these considerations with an attention equal to that given to spatial and formal concerns, and I aligned the design as much as possible with the construction methodology.

While I employed a main contractor to oversee the works, appreciating the day-to-day management skills they brought with them, I also separated out two key packages of works that I developed independently alongside specialist sub-contractors. The quality of these two areas - both timber – forms much of the visible character of the built architecture.

The construction therefore had three main components, each contractually independent. The cross-laminated timber frame provided the house's structure and was machine-fabricated in a Swiss factory, delivered to site in a lorry and assembled in just 48 hours by a specialist CLT firm who also provided the frame's detailed design drawings and structural calculations (fig. 2).

Figure 2. CLT, fabricated in a factory in Switzerland, erected on site in 48 hours.
Strange House, London, Hugh Strange Architects. 2010. (Photo: Hugh Strange)

All the joinery, comprising windows, external and internal doors, and built-in furniture, was sourced from a timber company in Nicaragua. We used hardwood felled by a hurricane and I travelled to Central America to talk my drawings through with the firm's own draughtsmen and amended these as required to suit their local skills (fig. 3). These were primarily informed by hand-craft tradition, supplemented by power machinery. The joinery was shipped to the UK in a container, with the large units assembled on site in part by the main contractor, and in part by me, working alongside a joiner on site.

Figure 3. Hardwood joinery, fabricated in a workshop in Nicaragua, for site assembly.
Strange House, London, Hugh Strange Architects. 2010. (Photo: Matthew Falkiner)

Figure 4. Concrete slab poured on top of existing slab by the main contractor.
Strange House, London, Hugh Strange Architects. 2010. (Photo: Hugh Strange)

While these two packages – factory-made in Switzerland, and handmade in Central America – comprised different forms of timber, both highly skilled in contrasting ways, a main contractor undertook the remainder of the work: pouring the concrete ground slab, positioning insulation and laying the flat roof, installing electrics and plumbing, and fixing cladding panels (fig. 4).

My proximity to the building site, both literal, and relational, revealed aspects of the process, and characteristics of the relationship between my designing and the builder's construction, that I had not formerly fully appreciated. Most obviously, there was a sense of immediacy with my involvement: I was able to walk out onto site when I needed to check any dimensions or review any buildability issues with the builders. As such I developed an awareness of what was happening day-to-day, and the consequences of my design decisions in relation to the men working there and the ongoing construction activities.

Through this I appreciated a truth to which I had previously been rather blind, particularly apparent on private commissions: for me the building site represented an extended arrival of the completed house, the time on site understood as either a difficult interlude between the design drawings and the finished building, or a drawn-out, rather ephemeral, and transitory prelude to the real event, that was the finished architecture.

Yet to everyone else involved, the time before and after the site works were of minimal consequence, their concerns, their livelihoods, and the fulfilment in the work they were doing, to the extent the project provided this, were wholly centered on this time of emergence.

I also became more alert to the significance of the relationship between the works produced off-site and those constructed on site. In many respects the house could be understood through its constructional hybridity: much of it was prefabricated, but equally, much was built on site. Some of the on-site works were constructed, such as in-situ concrete walling, and some were assembled works, such as the fixing of cladding sheets. Similarly, there were two main forms of off-site work involved. Prefabricated joinery works in Nicaragua had been carried out in similar ways for centuries – windows having generally been made in workshops away from building sites - and ours utilised largely traditional craftmanship. Meanwhile, the CLT was a relatively new technology, carried out off-site using recently developed fabrication techniques.

I appreciated that the areas of works completed off-site involved the greatest skills, and as a result, the voices of those involved, at least the senior staff of these firms, had very specific and essential detailed design-input through their expertise, while the works completed on site, which still required project management skills, were of a simpler constructional nature and the discussions were of a different character. I also recognised when design changes could be made – whether corrections or improvements – in relation to the off-site / on-site character of the works, and therefore appreciated what could be changed on site, at what point, and what couldn't.

Returning to my detail drawing I was now able to appreciate it not just as communicator of practical requirements, and embodiment of aesthetic and tactile ambitions. In addition, it now read as an index of production processes, skills and techniques, economies and contractual relationships. The drawing became a composite of other, perhaps more important drawings that had been produced through more collaborative practices – the CLT and window fabrication drawings – whose information became absorbed, and to some degree simplified in their combination. As such, the detail acted as a form of negotiation between the various skills and locations of production involved in the project.

I believe the architecture of the completed house attests to my close involvement with the site and off-site works. There is, with the building, a sense of closeness of artefact and process, one the index of the other, and in the term used by Peter Smithson, a sense that it has been 'palpably built.' [2]

Yet I was left wondering about the sense of immediacy I had experienced, and the proximity I had sensed of design and building. If this was an exception, I wanted to understand how the more normal condition had arisen and operated. I queried the relationship that the detailed drawing of the wall and window, with its various abstractions and implications, had with the people and processes involved in the project. And yet in asking these questions I was keen to avoid any sense of either over-romanticising my own involvement on site, or of fetishizing either the details, or the building site itself. This thesis forms an extended examination of these questions.

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[2] 'For us, an architecture which is palpably built is the most pleasurable of all. An architecture thought-out in terms of actual materials, its actual processes of fabrication and its actual means of assembly.' Peter Smithson, "Think of it as a Farm," BOX PS PUBLICATIONS PENDING (Undated), 4-5, Smithson Family Collection. In, Christine Boyer, *Writings Around Alison and Peter Smithson* (Cambridge, Mass: MIT Press, 2017) 383.

Distanced Practice

> Originally, design was of the building site, produced on the building site as a preparation for construction, usually at full scale (except for simple preliminary or models), but it becomes separated and quickly turns into the essential support for the domination of productive capital.[3]

At Wells Cathedral, the tracing floor is located within a chamber above the entrance of the north porch that was constructed in the early Thirteenth century. While many tracing floors were located off site in masonry workshops, this ‘tracing house’, as that at York Cathedral, forms an integral part of the building. Within a low-ceilinged, yet generous room, onto the wooden floor have been cast fine layers of plaster, running fully to the edges of three sides of the room. Evident on the surface of the plaster are inscribed a complex array of partial and intersecting lines. The simple window to the north side of the room provides an even light across the surface of the plaster, highlighting the faint variation of profile (fig. 5).

Figure 5. Wells Cathedral, the tracing floor
(Photo: Hugh Strange, 2023)

[3] Sérgio Ferro, “Dessin/Chantier: An Introduction,” translated by Ricardo Agarez and Silke Kapp, in *Industries of Architecture,* ed. Katie Lloyd Thomas, Tilo Amhoff, and Nick Beech (London: Routledge, 2016), 102.

Working directly onto the plaster surface, master masons at Wells drew various elements of the stonework in preparation for construction works. Constricted access suggests the room was not used for working the actual stones, but rather operated as a drawing office for the master-masons; a location on site to work through specific problems at a one-to-one scale, the proximity allowing direct engagement with problems as they arose.[4]

Historians believe the current top surface of plaster dating from the late thirteenth century might not be the first one, suggesting that layers of fine plaster were overlaid and reworked over a period.[5] Some of the marks apparent on the floor have been traced to windows and vaults of the cathedral cloister, also suggesting they were in use through to the fourteenth century. In this 'tracing house' the drawings were not undertaken by a separate designer or carried out in a separate location. Nor were the drawings oriented towards either representing the building as a whole or positioning the defined elements within that whole. Rather they were drawn by the masons themselves as a part of their integrated practice of working through the required design and construction of the various parts of the building, and carried out on site, at the location of building erection.

On site, the drawing can be seen as an index of the changing operation and role of design: comparison with a further drawing form, separated by over three hundred years of English architecture, is revealing in this respect. The case of Robert Smythson (1535-1614) presents a useful counterpoint and an indication of the gradual emergence of the role of both architect and drawing in the production of architecture. Early in his career, Smythson, having trained as a mason, spent twelve years on the reconstruction of Longleat House. From 1568, initially as chief mason, he was responsible himself for carving many of the most important areas of work and for overseeing a team of masons.

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[4] Mark Jarzombek notes in relation to these drawings that: 'Before Alberti's times, representation was mostly in the hands of the tekton, who deployed geometries that were inward focusing. They were not meant to be seen by the layperson; at best they were a curious, ghostly trace left on a cathedral wall or floor'. Mark Jarzombek, *Architecture Constructed: Notes on a Discipline* (London: Bloomsbury Visual Arts, 2023), 173.

[5] Alexander Holton, "The Working Space of the Medieval Master Mason: The Tracing Houses of York Minster and Wells Cathedral," in *Proceedings of the Second International Congress on Construction History, Volume II*, (2006): 1592.

While he also undertook some parts of the design, and there are certainly detailed drawings of areas of stonework by his hand, many aspects of the design were equally attributable to others, especially the client, Sir John Thynne. The buildings of this era appear to have developed through the multiple, and sometimes un-ascribed, contributions of the many participants, not least the clients and craftsmen involved; the former often an aristocratic gentleman having developed a taste for amateur design, and the latter often the more experienced master-masons, expanding their role. In the absence of an identifiable architect, very few professionals involved themselves in this design process, some as surveyors, and others directly employed by the families of larger estates in managerial roles.[6]

Mark Girouard suggests of this transitional period in the role of the designer that:

> This lack of enlightened patronage of the visual arts, and the small estimation in which they were held, meant that there were no Elizabethan architects. In England at the time 'architect' both as a word and a concept was so alien and unfamiliar as to be meaningless.[7]

The next major house that Smythson was involved in was the construction of Wollaton, outside Nottingham. Here his role had progressed, and he was considered surveyor rather than mason. Girouard identifies authorship of the original plan arrangement elsewhere, and in truth, work of the designs commenced two years before Smythson's arrival at the estate.

Yet the overall design, from plan development, through external modelling, detailing and historic references now appear to be significantly more attributable to one man: Robert Smythson. Crucially, while a mason, Smythson appears to have produced detail drawings of specific elements at Longleat, such as window bays, to assist in the production of the stonework.

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[6] Mark Girouard, *Robert Smythson and The Elizabethan Country House* (New Haven: Yale University Press, 1983), 11.
[7] Girouard, *Smythson*, 6.

But here at Wollaton, he produced a broader range of drawings, including more holistic views, such as the study of the three-dimensional modelling of the corner block as it turns towards the entrance (fig. 6), in what Girouard suggests to be 'probably the earliest surviving perspective drawing by an English architect.'[8]

Having progressed through his life from mason to chief mason to surveyor, it appears that it was at the end of his life that his more familiar role was signified, Smythson identifying himself in his will as 'architecter', while his grave at Wollaton describes him as, 'archector and surveyor.'[9]

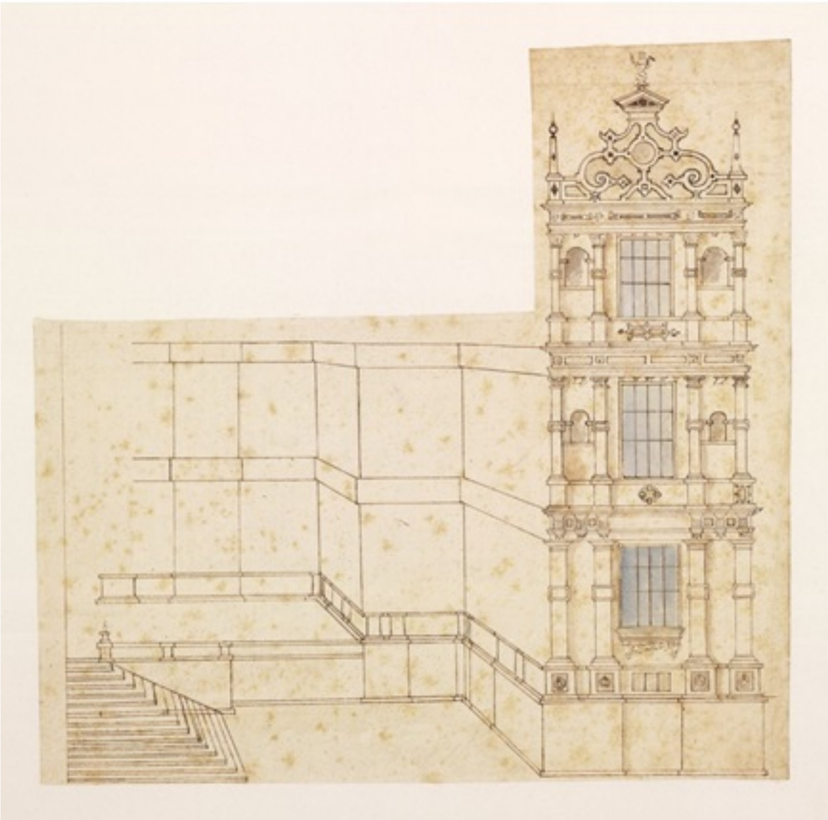

Figure 6. Perspectival Drawing. Robert Smythson. Wollaton, outside Nottingham. Smythson Collection of drawings, RIBA Archive.

[8] Girouard, *Smythson*, 101.
[9] Girouard, *Smythson*, 168.

Robert Smythson's trajectory from skilled mason who worked with his hands, and occasionally drew, to architect who primarily drew as he designed, was not exceptional however, and related to a wider transformation of role. Time, or more precisely, a change in a cultural conception of time, Marvin Trachtenberg has argued, was the primary cause of a separation between architectural design and construction that occurred in the fifteenth century. Trachtenberg suggests that humanist ideas of authorship were integral to the reinvention of the liberal arts. These, in turn, developed in response to new ideas of temporality, and consequently, grew out of a new consideration of mortality, succinctly phrased by Petrarch: 'We are always dying. I while I write, you while you read, and others while they listen or stop their ears, they are all dying.'[10]

In attempting to resist the passing of time, the idea of the immutable design was borne. By aligning the design with the designer, the architect now personified the architecture, and, like the humanist literary figures such architects sought to emulate, they might outlive death.[11] As such, the codification of architectural design, distinct from building, and practiced by the designer through the authority of the drawing, was now understood to precede, and be dissociated from construction. In place of an alignment between design and construction, building – now, 'mere building' - was considered an activity from which architecture sought to free itself. The previously integrated realms were, conceptually at least, disengaged.

Trachtenberg's argument refers, of course, to an earlier building culture where prior to this separation, it has often been argued, the roles of designer and maker were wholly integrated. In this premodern condition, design and building operated in parallel, or rather were entwined, and the processes of conception and realisation evolved together through continuous iteration; as the building slowly took physical form on site, design decisions were made. This relationship resulted in architecture that displayed a close relation between process and artefact. While it is no longer argued that the Medieval Cathedrals were results of an altogether anonymous practice with no drawings whatsoever, there is, nevertheless, a consensus view that these buildings were produced in a context outside that which

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[10] Francesco Petrarch, *Letters on Familiar Matters* (Rerum Familiarum Libri) Vo. 3: Books XVII-XXIV. Translated by Aldo S. Bernado (Baltimore: John Hopkins University Press, 1985), 312.
[11] Marvin Trachtenberg, *Building-in-Time: From Giotto to Alberti and Modern Oblivion* (New Haven: Yale University Press, 2010), 60.

privileges the modern idea of an architectural design, by a sole author, that was communicated primarily through drawings.

Crucially, within this culture of construction, buildings took a great many years to 'complete'. In part as result of the craft-based technology available, but also due to broader social, economic, and political factors, not least the availability of funds, the structures of the age can be understood to have been realised through 'slow building'. Against this background - where buildings of great scale were constructed over many decades, often centuries, and where there was no continuity of personnel involved from start to finish, where few drawings, and no single 'author', or 'authored' design were evident – one might ask, how could such projects retain such an overwhelming sense of coherence?

The answer lies in several construction strategies distinct from our contemporary building culture; that is, from building culture as conceived and evolved over the last five hundred years. At project commencement it appears that only the most outline of designs existed, enough to get started on site. Indeed, this principle of 'only enough design' appears to have continued throughout the progression of works, such that issues were resolved for current requirements only, not in anticipation of a future stage of works. Additionally, the builders utilised the considerable length of time required for construction as a positive factor in the development of works - time worked for them, not against them – such that they adapted designs towards better solutions as they progressed on site through continuous redesign and continuous iteration. Similarly, the design could respond to inevitable changes in forms of funding and governance.

As such the works were not represented by an 'original' design, but might, and certainly would, evolve throughout the construction period. But rather than resulting in buildings that might be characterised by the fragmentary, a process of integration and reintegration during the progress of building work made each of the various stages comprehensible with those preceding and led to a sense of coherence to the whole. To some extent, each phase of works can thus be seen to regard previous stages at the site for design.[12]

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[12] These principles are referred to by Trachtenberg as: Myopic progression, Concatenation and Retrosynthesis. Trachtenberg, *Building-in-Time*, 130-143.

Central to the above strategies were certain key concepts, considerably at variance to later models of practice. There was little sense of authorship, or more precisely, the recognized identity of a single author, at least in the way now understood; rather, the buildings were creatively produced by countless contributions, the product of the social rather than the individual, and as such an expression of collective identity.[13]

There appears to have been only the slightest sense of an 'original' design, as the architecture developed instead through continual iteration. There were few design drawings, as the design decisions were worked through and resolved in the moment, on the building site, rather than beforehand in a separate process. And critically, the works were undertaken within a very different conception of durational time. This last point was related to the sense that the building design/construction might not begin or finish, in the manner that we now consider these terms: the works might in many cases be developed out of the existing fabric of a previous building or ruins already on the site, and the combined and not altogether separate operations of successive adaption and repair might be an ongoing, continuous activity with no end point.

> In other words, if one discards the distinction between pre- and post- "completion" design – suppresses the very idea of a "completion" and hence an "original" in the absolute sense – one can merge the two methods into a single, unbroken process of continuous change from the first appearance of architecture on site, the building through all its formal stages, even theoretically to its inevitable disappearance.[14]

According to Trachtenberg's analysis, the subsequent split, the divorce of designing and building, can be understood to have been initiated during the early Italian Renaissance through the parallel impacts of Brunelleschi's practice and Alberti's theories in establishing a distinction between the two. In fact, Trachtenberg places Alberti, and his theoretical text, *De re aedifacatoria*, at the centre of this rupture in both respects: In Alberti's *De re aedificatoria*, the author can

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[13] Robert A. Scott, *The Gothic Enterprise: A Guide to Understanding the Medieval Cathedral* (Berkeley: University of California Press, 2011), 235-236.
[14] Trachtenberg, *Building-in-Time*, Preface XIX.

be seen to establish the concept of the design as independent from the building, but according to a long analytical tradition, Alberti also identifies Brunelleschi's assumption of the role of architect, and sole architectural author, of the dome of the Cathedral in Florence, as an exemplar of this distinction.[15]

In this text, Alberti does appear to identify the architect as a single author of the design and, Mario Carpo has suggested, the building as identical facsimile achieved through notational drawing. The significance of this function is of course indicated by the oft quoted fact that the Italian word 'disegno' signifies both design and drawing.[16]

Thus, a fundamental split occurred between designing and making. Carpo elucidates, noting, 'In Alberti's theory, the design of the building is the original, and the building is its copy.'[17]

The consequence of this distinction is, he suggests, that: 'After all, Alberti posits the complete disembodiment of the process of making objects.'[18]

This process of disembodiment laid the ground for a discipline of architecture where design might be relocated outside time and space. With the development of the printing press and the increasing dissemination of treatises, where buildings could now exist within the ideal space of the printed page, rather than the specificity of a building site, the theoretical "Albertian" model suggested that no change be made to the formulated design at its point of realisation. Any alteration would upset the sanctity of its inherent unity, the sense that: 'the harmony and concord of all the parts achieved in such a manner that nothing could be added or taken away or altered except for the worse.'[19]

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[15] Anstey examines Alberti's dedication to Brunelleschi in detail and questions previous assumptions, noting, 'Brunelleschi is saluted here by Alberti for his potential to motivate action, rather than for a skill in completed composition'. Tim Anstey, *Things That Move: A Hinterland in Architectural History* (Mass: MIT Press, 2024), 205.
[16] Jonathan Hill, "Design Research: The First 500 Years," in *Design Research in Architecture: An Overview. Design Research in Architecture*, ed. Murray Fraser (Farnham: Ashgate, 2013), 15.
[17] It has been suggested that all art forms originated from the hands of their authors in a single original form – they are 'autographic', while some developed to be 'allographic', that is, executed by others to allow multiple copies. This argument was considered in relation to architectural production by Mario Carpo, with reference to Nelson Goodman. Mario Carpo, *The Alphabet and the Algorithm* (Cambridge, Mass: MIT Press, 2011), 16.
[18] Carpo, *The Alphabet and the Algorithm,* 26, 77.
[19] Alberti, *On the Art of Building in Ten Books*, 156.

The implication was that time on site should be reduced as much as possible to operate in effect outside of time, to limit any possibility of amendment during realisation, and thus the erosion of a particular notion of architectural authorship.

The result was an established distance, initially theoretical, between the architect and the building site. But the inference was also that agency should be removed from those involved on site to avoid any risk of their making alterations; that any creativity on the part of the construction labour would, by definition, be at the expense of the design. Yet, while his text established a new conception of design both outside time and divorced from execution, in practice it appears Alberti himself was dedicated to building realisation. While his theory suggested the primacy of the drawn design, he nevertheless appears to have believed the design required fulfilment through enaction on site.[20]

The realities of building culture through this period remained in many ways as before, and the declared separation was primarily theoretical. What did change was the biographies of individuals who came to have significant responsibilities for building projects. Accounts of the practice of the architectural profession during the High Renaissance in Italy of the early sixteenth century suggests that key figures, many of whom had moved into the profession having previously established reputations as painters and sculptors, often lacked substantial technical knowledge of construction. They therefore developed their position and prestige through the establishment of distance between themselves and the craftspeople and artisans on site, yet still largely relied on the skill culture of these workers to realise their designs.[21]

If the drawings of Renaissance architects communicated with both patrons and builders and operated as tools for design development, certain figures appear to have developed a practice that resonates with later questions about the separation of the architect from the site of architectural work.[22]

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[20] Tim Anstey, "Authority and Authorship in L. B. Alberti's De Re Aedificatoria," *Nordisk Arkitekturforskning* 4 (2003): 23.
[21] James Ackerman, “Architectural Practice in the Italian Renaissance,” (1954), *in Distance Points: Essays in Theory and Renaissance Art and Architecture* (Cambridge, Mass: MIT Press, 1991), 376.
[22] Cammy Brothers, “What Drawings Did in Renaissance Italy,” in *The Companion to Early Modern Architecture*, ed. Alina Payne (Blackwell Press, 2017), 2.

Cammy Brothers considers the case of Michelangelo, suggesting his earliest architectural works at San Lorenzo might be thought of as mere frames for his own sculptural works. Despite the mythologizing of Michelangelo's life and work that presents him as a solitary genius, his progression to role of architect seems to have involved a rather different operative manner. Michelangelo appears, rather, as a canny manager of a team that included the various artisans, craftsmen and labourers involved in projects of shared endeavour.[23]

Brothers also suggests Michelangelo's distinctive architectural authorship arrived later, with the project for the Laurentian Library, where his architecture no longer framed sculpted figures. Here the architecture became figure itself, but also, for the first time, was wholly realised by others, rather than by his own hands. Having worked directly with stone and marble as a sculptor, his hands making form, his practice as architect was fundamentally impacted by this earlier experience of immediate contact with material, the earlier projects retaining this aspect through integration of his own sculptures, and later through a transformed creative process. Brothers asserts that his iterative methodology in these, including the use of quickly produced clay architectural models and the dynamic practice of sketching throughout the course of a project as design process (fig. 7), allowed him to maintain a proximity to qualities of volume, motion and light within the works on site.[24]

Interestingly, while Trachtenberg considers a duality of forms of practice - the medieval model as one that utilises time on site, Building-in-Time, and the Post-Albertian model as one that opposed time on site, Building-outside-Time – he proposes an entirely separate model of practice to describe how Michelangelo worked; Building-against-Time. In this, Michelangelo, in contrast to Alberti's theory, is seen to have recognized the inherent and inevitable changefulness of process, yet clung to his role as sole creative originator, and thus sought techniques to ensure his authorship in the face of future iterations beyond his control. [25]

[23] William E. Wallace. *Michelangelo at San Lorenzo: The Genius as Entrepreneur* (Cambridge: Cambridge University Press, 1994)
[24] Cammy Brothers, *Michelangelo, Drawing, and the Invention of Architecture* (New Haven, Conn: Yale University Press, 2008), 158.
[25] Trachtenberg, *Building-in-Time,* 95-101.

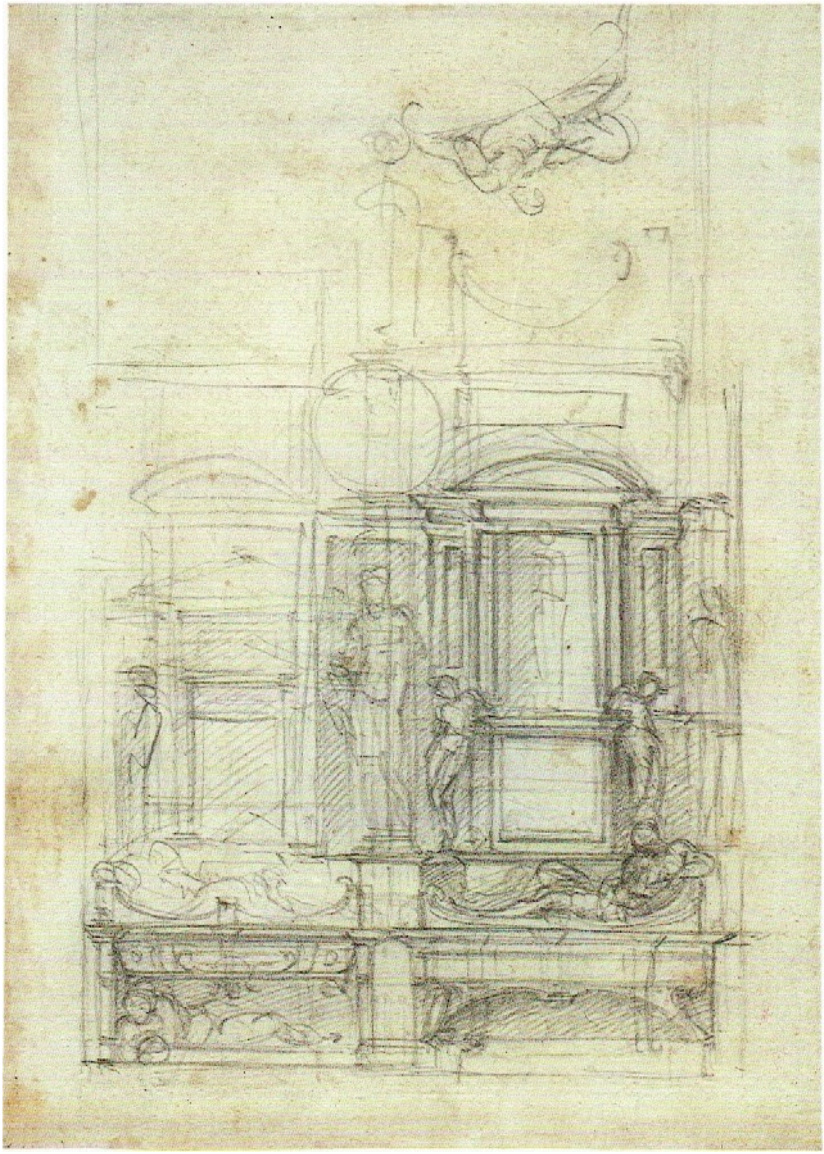

Figure 7. Design Sketch, Medici Chapel tomb design, Michelangelo.

While critical texts within the Italian Renaissance established a theoretical distance in the fifteenth century between designing and building, the impact on practical building cultures was gradual.[26] However, this was to change with the emergence of industrial capitalism during the 18th and early 19th centuries, that radically transformed societies throughout the world, and entirely altered the characteristics of the operation of labour.

Eric Hobsbawm has remarked on the historical importance of this moment, significantly also noting its English geographic specificity:

> The Industrial Revolution marks the most fundamental transformation of human life in the history of the world recorded in written documents. For a brief period, it coincided with the history of a single country.[27]

The emerging factory system of capitalist enterprise was predicated on two key developments.[28] Firstly, the development of mass production through the introduction of technology into the labour process. Here, machinery replaced the workman, who, in place of 'handling' a tool, was now to 'operate' a machine.[29]

Secondly, the organization of work was transformed through the separation of tasks and the specialization of roles: each productive operation painstakingly broken down into component tasks. According to the authoritative model of Karl Marx, these developments comprised the division of labour, the separation of manual and mental work into distinct processes. While earlier societies maintained diverse and separate occupations, termed by Marx, the 'social division of labour', a distinct mode of production now developed under the factory system that operated in an entirely different manner, termed the 'technical division of labour.'[30]

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[26] Leon Battista Alberti, *On the Art of Building in Ten Books*, trans. Joseph Rykwert, Neil Leach and Robert Tavernor (Cambridge, Mass: MIT Press, 1991), 7.
[27] Hobsbawm, E. J., *Industry and Empire: From 1750 to the Present Day,* ed. Chris Wrigley (London: Penguin, 1999), xi.
[28] John Roberts, *The Intangibilities of Form: Skill and Deskilling in Art after the Readymade* (London: Verso, 2007), 85.
[29] Marx, Karl, *Capital: A Critique of Political Economy: Vol. 1,* ed. Ernest Mandel (London: Penguin, 1990), 497.
[30] Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century* (New York: Monthly Review Press, 1998), 49

The impact on the mass population was colossal, entirely changing the structure of working life for the great majority of the population. It feels important to avoid too great a sense of academic abstraction when describing the subsequent transformation of work, for it was also a time of enormous social upheaval and personal suffering, E.P.Thompson noting: 'For most working people the crucial experience of the Industrial Revolution was felt in terms of changes in the nature and intensity of exploitation.'[31]

The effects of the Industrial Revolution were cataclysmic, utterly transforming Victorian society, but the impact on the culture of building and on the building site, with the introduction of industrial processes and the logic of the factory system to the production of architecture, was both slower and more unevenly felt. However, the division of labour, developed to foster profits through greater economic efficiency, but also to allow greater control over the workforce, now aligned with Alberti's theories to radically alter the character of the separation between design and building.

While the uncoupling of roles following Alberti's critical intervention was gradual, and in some ways largely theoretical, the effects of the division of labour during the industrial revolution can be seen to have cemented the break.

1851 marked both the opening of Paxton's Crystal Palace, and the publication of John Ruskin's *Stones of Venice*.[32] Two years earlier, with *The Seven Lamps of Architecture*[33], Ruskin had already challenged a generation of architects with a call to honest building. But here, and specifically within the key chapter, *The Nature of Gothic*, Ruskin rails against the industrialisation he saw everywhere, particularly as represented by the Crystal Palace.

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[31] Thompson, E. P. *The Making of the English Working Class* (London: Penguin, 1991), 218
[32] The appendix of Ruskin's text notes in fact makes brief reference to the Hyde Park structure, although it was in a later text that Ruskin more specifically addresses the building. The appendix also suggests, prefiguring the satisfactions of Walter Segal's self-builds, 'Make for yourself a table or a chair, and see if you ever thought any table or chair so delightful, and what strange beauty there will be in their crooked limbs.' A more complete critique of Paxton's structure was provided by Ruskin in 1854, coinciding with the structure's relocation to Sydenham, and the building, in many respects, became representative of the many evils of modern society and culture that he, and later William Morris, railed against and that were later so influential on William Lethaby. John Ruskin, *The opening of the Crystal Palace considered in some of its relations to the prospects of art* (London: Smith, Elder, and Co., 1854), 6.
[33] John Ruskin, *The Seven Lamps of Architecture* (New York: Wiley, 1886), 29-52.

> We want one man to be always thinking, and another to be always working, and we call one a gentleman, and the other an operative; whereas the workman ought often to be thinking, and the thinker often to be working, and both should be gentlemen, in the best sense. As it is, we make both ungentle, the one envying, the other despising, his brother; and the mass of society is made up of morbid thinkers and miserable workers. Now it is only by labour that thought can be made healthy, and only by thought that labour can be made happy, and the two cannot be separated with impunity.[34]

A Christian and a Tory, his attack, initially at least, was not on capitalism as a system, but on the resulting effect of the factory system on the building worker and the work of architecture. He suggested the contemporary factory system, and particularly the division of labour, was debasing and de-humanizing to the workforce, and when applied to construction, inevitably lead to debased architecture. The Gothic, as presented by Ruskin, and represented by the values of Savageness, Changefullness, Naturalism, Grotesqueness, Rigidity, Redundance, was here a literal reference, understood by a reflection on the qualities of the architecture and art produced during the Medieval period.

But for Ruskin the Gothic also operated as metaphor of a correct relationship between humans within society, and between humans and nature. This then was not to be a literal return to the past, but a device through which he could critique all he saw wrong with the fast-changing world around him, specifically the materialism and alienation he considered central to the emergent industrial capitalism.[35]

His text counselled that in place of the soul-destroying character of work reduced to machine operation, there might be meaningful work, and highlighted for the succeeding generation of architects the alienating tendencies implicit within the division of labour; a message most clearly heard and re-communicated by William Morris.

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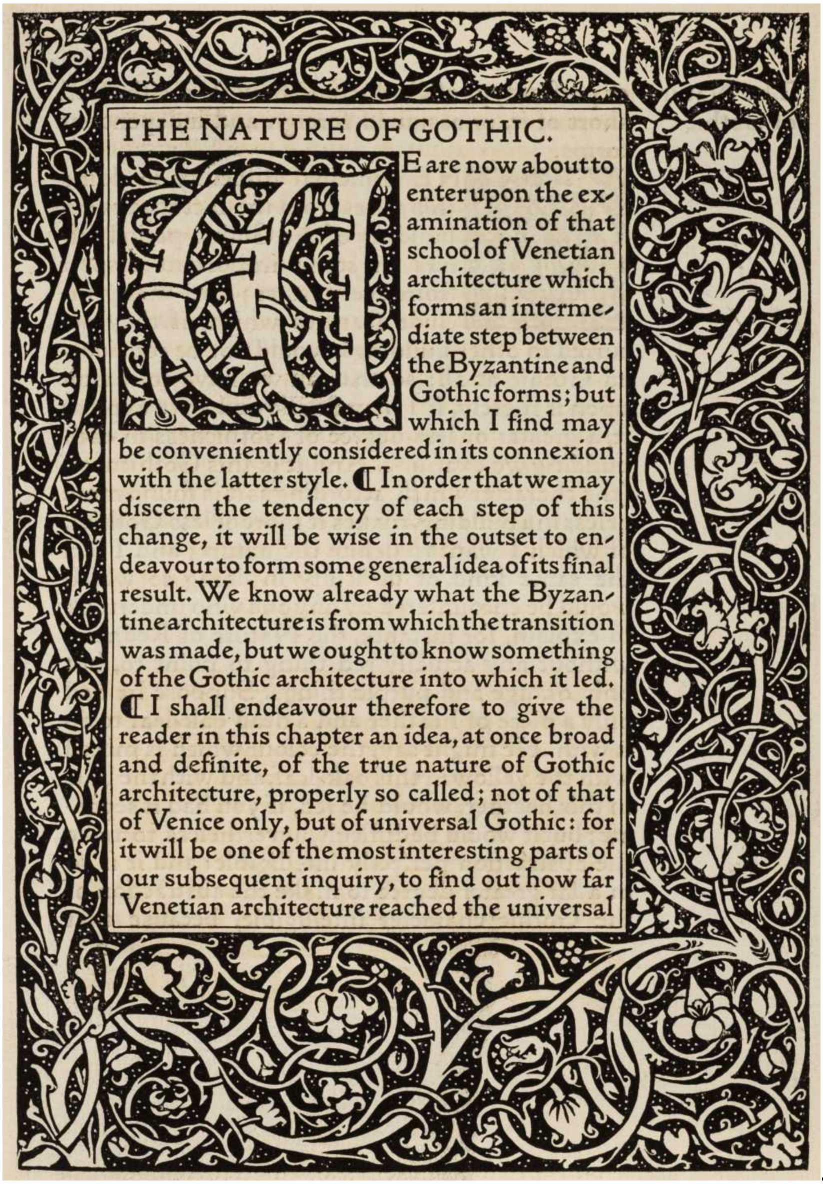
[34] John Ruskin, *The Nature of Gothic: A Chapter of the Stones of Venice* (London: Pallas Athene, 2011), 29.
[35] Robert Hewison, “Ruskin and the Nature of Gothic,” in *The Nature of Gothic* (London: Pallas Athene, 2011), 137.



THE NATURE OF GOTHIC.

WE are now about to enter upon the examination of that school of Venetian architecture which forms an intermediate step between the Byzantine and Gothic forms; but which I find may be conveniently considered in its connexion with the latter style. ¶ In order that we may discern the tendency of each step of this change, it will be wise in the outset to endeavour to form some general idea of its final result. We know already what the Byzantine architecture is from which the transition was made, but we ought to know something of the Gothic architecture into which it led. ¶ I shall endeavour therefore to give the reader in this chapter an idea, at once broad and definite, of the true nature of Gothic architecture, properly so called; not of that of Venice only, but of universal Gothic: for it will be one of the most interesting parts of our subsequent inquiry, to find out how far Venetian architecture reached the universal

Figure 8: The Nature of Gothic, John Ruskin. Kelmscott Imprint

For Morris, *The Nature of Gothic* suggested nascent ideas that he developed, or perhaps emphasised, in his preface to the Kelmscott Press re-printed edition of this chapter (fig. 8). In this Morris notes: ‘For the lesson which Ruskin here teaches us is that art is the expression of man’s pleasure in labour,’ but continues to point towards the ‘new birth of Society.’[36]

Morris’s conversion to revolutionary socialism, an active and animated conversion, is suggested here, and described at length through multiple other texts. His vision for a new society, where creative labour is no longer divided, and by implication, design no longer separated from construction, is most clearly illustrated within his utopian novel, *News from Nowhere*. Here a new society is described, based on broadly communist grounds, largely but not altogether free of machines, where people freely engage in both manual and mental labour; labour itself no longer commodified.[37]

Against the backdrop of a political awakening sparked by Ruskin but led by Morris and his vision, architects of the Arts & Crafts movement in England would grapple with the implications on practice, including the problematics presented by the role of drawings in establishing authorship. These architects understood the paradox that the carefully detailed drawings they produced might both express their belief and delight in construction, while at the same time representing their own distance - located within offices, at drawing boards - from the building site. Thomas Graham Jackson’s text is representative here of views widely held by this group at the time:

> The profession of architecture is an absurdity, and the sooner the cobwebs that surround it are swept away the better. Any man whose calling is to design buildings and carry them out is an architect, a master-builder, an artist; and he owes it to Society to do it well and beautifully. The distinction between architect and builder is purely conventional and should disappear.[38]

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[36] William Morris, *News from Nowhere and Other Writings*, ed. Clive Wilmer (London: Penguin, 1994), i, v.
[37] William Morris, *News from Nowhere,* 125-128.
[38] T.G. Jackson, “On True and False Ideals in the Education of an Architect,” in *Architecture, a Profession or an Art*, ed. R.N. Shaw and T.G. Jackson (John Murray: London, 1892), 228.

In relation to drawing, Philip Webb can perhaps be seen as exemplar here. Webb drew every detail meticulously because he understood that the craft basis of construction had been decimated by the onset of industrialisation, and the skills required to deliver well-crafted architecture no longer existed. As such he considered detailed construction drawings as unfortunate, yet necessary. Webb was, of course, an extraordinarily accomplished draughtsman, and understood the resulting distancing, yet his drawings struggle against it at every turn. Each line seeks an understanding of practical construction, a sensitivity to materials as used by craftsmen, and a deep-rooted sympathy for that skill.[39] As Webb became involved with the Society for the Protection of Ancient Buildings (SPAB), his drawings relied more and more on survey skills and his drawings can be understood to be increasingly in dialogue with the building site (fig. 9). For instance, between 1892 and 1893 at East Knoyle in Wiltshire, close to his contemporaneous domestic project at Clouds, Webb remotely undertook works to the church tower, with the younger architect Detmar Blow acting as site architect / clerk of works. Details were worked through on site and in correspondence between the two architects, in large part as the project involved an existing building. Extensive correspondence between Webb and Blow, comprising letters that incorporate detailed construction descriptions and carefully produced sketch drawings, describe a practice of shared care in the building's repair. The works went well and the tower, that would otherwise have been demolished, was successfully repaired and saved, without major problem.[40]

Theirs however was not the only response at the time, and the introduction of new materials within industrial processes to the production of architecture, mainly steel and concrete, led to the incremental deskilling of the building site.[41] While the Arts and Crafts architects embraced traditional materials and traditional techniques, other designers sought to respond to the transformative character of industrialisation by integrating these new materials within an understanding of the cultural production of construction. Architects like Schinkel and Labrouste looked to utilise steelwork within their architectural output, in a more or less explicit manner.

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[39] Andrew Saint, "I had to refrain," Review of *Philip Webb: Pioneer of Arts & Crafts Architecture* by Sheila Kirk. *LRB* 27, no. 23 (1 December 2005).
[40] Michael Drury, *Wandering Architects,* 36-37.
[41] Sérgio Ferro, "Concrete as Weapon," trans. Alice Fiuza and Silke Kapp, in *Harvard Design Magazine* No. 46, F/W (2018): Insert, 17.

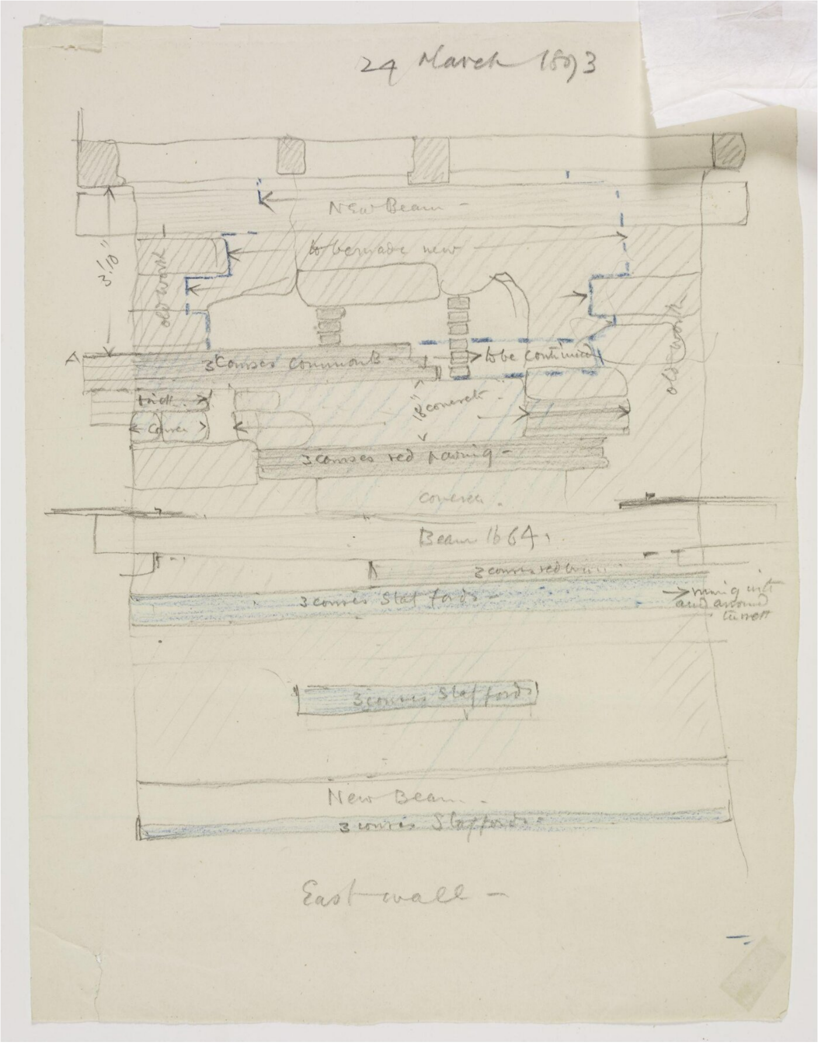

Figure 9. Philip Webb, Annotated sketch of repairs to East Knoyle Church tower.

The case of Auguste Perret and his two brothers, later in the century, is of particular interest here. The three Perret brothers looked at the turn of the century to integrate the architectural practice and the concrete contracting firm that they ran together; the brother's office stamp - Architectes, Constructeurs, Béton Armé – suggesting their shared contribution in multiple roles. Spanning the transformation, following their father's death, of the family's general building firm towards specialist concrete contractors, the years 1903-13 appear of particular significance. This period starts with the construction of the 25 bis rue Franklin, Paris (1903-04), a concrete-framed housing block, designed by Auguste Perret but not built by the family building firm. Soon after the firm designed and built their first expressed concrete frame at the Garage in rue de Ponthieu, Paris (1906-07). The largest of their buildings during these years was the project for the Théâtre des Champs-Élysées (1910-13). Here the brothers were initially brought in solely as concrete contractors to realise the construction of the structural frame (fig. 10), but as the project progressed, they replaced the previous architect, and provided architectural design services.[42]

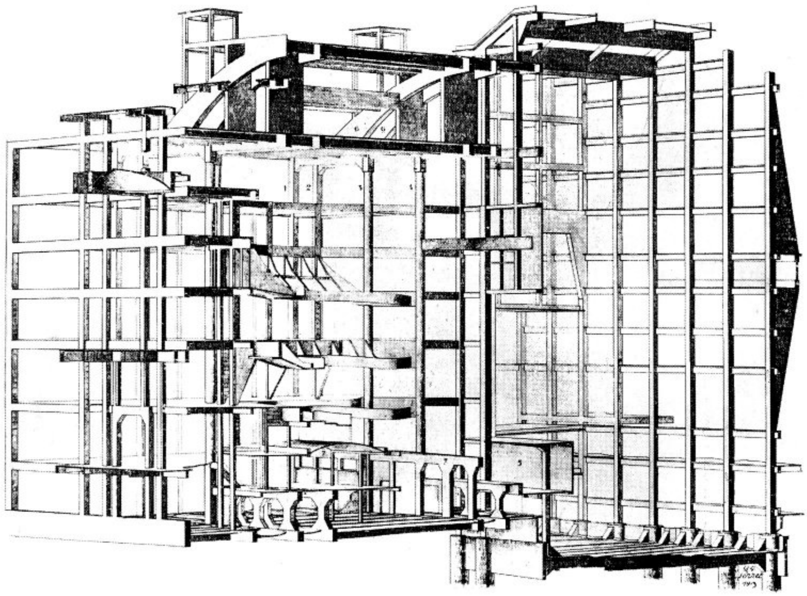

Figure 10. Les Frères Perret / Drawing of the structural system for the Théâtre des Champs-Élysées. 1913.

[42] Peter Collins, *Concrete, the Vision of a New Architecture: A Study of Auguste Perret and His Precursors* (London: Faber & Faber, 1959), 188.

Kenneth Frampton dedicates a chapter of *Studies in Tectonic Culture* to Auguste Perret, examining in detail the construction and tectonic implications of his work, and marrying the innovative use of concrete with his regard for classical tradition. Frampton describes, '…a situation in which A&G Perret Constructeurs, the title of his architectural practice up to 1945, were always complemented by the building firm of Perret Frères that was invariably charged with the execution of the work.' [43]

This appears to be a significant simplification, as the two businesses developed in parallel, yet were not always fully aligned, with the construction firm developing from general contractor to concrete specialists, often constructing others architects' works, and the architectural firm sometimes using other contractors to construct their buildings, perhaps most importantly at the building that was to house their own business, and which heralded their concrete expertise: 25 bis rue Franklin, Paris. While a fuller alignment between the two firms was achieved later, their earlier relationship suggests a more complex understanding of the relation between their architectural designs and technical realisations.[44]

However, the Perret's case of an integrated architecture and construction firm remained the exception, and it is telling that most texts feature Auguste Perret at the expense of his two brothers, focussing on him as authorial architect.[45]

Within the twentieth century, attitudes towards an integration of designing and building were in large part framed through modernist ideology, exemplified by Siegfried Giedion's Machine Age rhetoric, while teaching at the Bauhaus under Gropius was directed towards an integration of sorts, but the challenge was there understood to be of a union of art and design.

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[43] Kenneth Frampton, *Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture*, ed. John Cava (Cambridge, Mass: MIT Press, 1995), 155.
[44] Andrew Saint, *Architect and Engineer: A Study in Sibling Rivalry* (New Haven: Yale University Press, 2007), 239.
[45] In this, Karla Britton's monograph is symptomatic, but not alone. Karla Britton, *Auguste Perret* (London: Phaidon Press, 2001); Adrian Forty, *Concrete and Culture: A Material History* (London: Reaktion Books, 2012), 26; Karla Britton, *The Poetic Economy of the Frame: The Critical Stance of Auguste Perret.* Journal of Architectural Education 54, no. 3 (2001): 176-84; Joseph Abram, "An Unusual Organisation of Production: The Building Firm of the Perret Brothers, 1897-1954," *Construction History* 3 (1987): 75-93.

Subsequent efforts at integration can in large part be regarded through the diverse political and economic environments that they were undertaken in: notably within the expansionist market economy of America, like the efforts of Konrad Wachsmann and Walter Gropius to design and mass-produce a factory-made house (fig. 11),[46] and within the social democracy of post-war Europe, such as the attempts to establish a programme of school building at scale in England, in each case with design closely oriented towards production.[47]

Yet the occasional successes but frequent failings of such enterprises pointed towards the increasingly distanced cultures of design and construction.

Figure 11. Walter Gropius and Konrad Wachsmann on site with the prototype Factory-made House

[46] Gilbert Herbert, *The Dream of the Factory-Made House: Walter Gropius and Konrad Wachsmann* (Cambridge, Mass: MIT Press, 1984); Russell, Barry. *Building Systems, Industrialization, and Architecture*. London: Wiley, 1981.
[47] Andrew Saint, *Towards a Social Architecture: The Role of School-Building in Post-War England* (New Haven: Yale University Press, 1987); Christine Wall, *An Architecture of Parts: Architects, Building Workers and Industrialisation in Britain 1940-1970* (London: Routledge, 2013)

However, it is in the last decades of the 20^{th} century and the beginning if the 21st that this distance has become most fully comprehensible, and in which Alberti's model has found its consummation. Trachtenberg laments the domination of our contemporary architectural culture by what he terms, 'crypto-Albertianism.'[48] Alberti's theoretical denial of time on site as creatively productive time can now be seen in alliance with industrial capitalism's pursuit of ever faster delivery. Retention of the 'original' design and reduction of production and development costs unite, with the result that construction time is perceived solely as 'risk' time; time itself, it appears, must be killed.

In the day-to-day business of producing the built environment, multiple systems and frameworks now operate that enforce the separation, and seek a design divorced from its realisation: from client and contractor organisations, public regulatory bodies, and architects and architectural culture. Client bodies keen to ringfence budgets, and developers and real estate speculators, adverse to financial risk in the face of stockholder comeback, look to tendering and pricing works that either fix as many design decisions as possible before starting on site, or allow flexibility only in so far as costs can be reduced through substitution of cheaper products. Medium and larger firms of contractors have developed layers of directors, project managers and in-house quantity surveyors who mediate contact between designers and the workers on the building site. In addition, to reduce overheads and financial responsibilities, the majority of site operatives are now often formed by sub-contractors, further thinning and distancing lines of communication.[49]

Meanwhile, planning authorities seek definitive descriptions of building forms and materials far in advance of construction, at a stage in most projects when builders are not involved in any form whatsoever: in effect officially sanctioning the complete disengagement of the two processes. Often sites will be sold on by developers once a design has been developed only so far as required to achieve planning permissions, the added value completely detached from realisation.

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[48] Trachtenberg, *Building-in-Time*, 419.
[49] A recent summary of the consequences of an overriding emphasis on profit in building production was provided in the Guardian Newspaper by Oliver Wainwright on 21 October 2023, referring to Mark Farmer (of the Farmer report): He thinks the problems begin on site, and the atomised, fractured way buildings are made.' https://www.theguardian.com/lifeandstyle/2023/oct/21/cracked-tiles-wonky-gutters-leaning-walls-why-are-britains-new-houses-so-rubbish

Building Regulations require the submission of structural calculations as part of the approval process, resulting in the tendency for building designers to prioritise the use of forms of structure – such as steel – that may be calculated precisely by engineers in advance, rather than forms that a builder might determine through experience and rules of thumb on site.

To secure public and commercial projects, architectural practices increasingly need to grow and employ more staff, resulting in a stratification that resembles a division of labour: directors engaged in front-end design, PR and client contact, while mid-level staff focus on management, and juniors, often with little site experience, are stuck behind computer screens, required to specialize in competition or visualisation work, and at times package production. This too might be sub-contracted to an executive architect, splitting the profession into those responsible for design and those for construction. The resulting scales of offices, and pigeonholing of activities, repeatedly results in disillusioned and frustrated staff, subject to the precarity of the modern workplace, and totally divorced from the realities of construction and building production.

The distancing effect of drawings, not least through the abstraction of orthogonal projections and now CAD, has long been recognised.[50] As the practice of drawing has migrated from the hand to the computer, it further abstracted the representation of building, further distanced the architect from the work site, and introduced a level of accuracy and precision, both prescriptive and inherently limiting.[51] With the development of sophisticated rendering tools, and more recently AI programmes, life-like renditions of buildings on screen suggest a form of accurate conceptualisation whereby production is entirely abstracted and building construction becomes invisible, irrelevant or merely representative.

Finally, because of the distance that has developed between practice and architectural theory, little academic research encompasses the dynamics of the building site within its analysis: builders, and the act of building are treated with incomprehension, and perhaps disdain, to

[50] Pier Vittorio Aureli, *Architecture and Abstraction* (Cambridge, Mass: MIT Press, 2023): 44-50.
[51] Richard Sennett, *The Craftsman* (New Haven: Yale University Press, 2008), 43.

such an extent that it has generally suited writers to consider architecture apart from this 'chaotic mess'.[52]

The results of all these various forms of distancing affect architecture and architects profoundly. Primarily understood now as a location of financial anxiety, the building site becomes a place of conflict. In place of collaboration, historic cultures of distrust on site, deeply associated in England with issues of class, are augmented by economic, institutional and cultural pressures of dissociation. Architects accordingly appear disengaged from production and the ethics of production.[53] The resulting architectural projects are dominated by the image, by the banality of gesture, entirely divorced from meaningful relationship with building production and those who construct.

Research Context

In *Building-in-Time*, the author Trachtenberg identifies and describes in detail a premodern condition in which design and building were wholly integrated, operating in parallel, with the processes of conception and realisation evolving together through continuous iteration.[54] Against this tradition he argues that a break, initiated through the developing humanist conception of time and subsequent attempts to resist the passing of time through fame, lead to the establishment of ideas of authorship, that in turn produced a separation between the previously integrated realms of design and building. A key part of Trachtenburg's thesis, evidenced through the book's sub-heading, *From Giotto to Alberti and Modern Oblivion*, is the possible projection forward of this condition into the present, although he notes that this is not an avenue that he fully explores. In focusing on Alberti's conception of drawn perfection, Trachtenberg could be considered, as Cammy Brothers suggests in reviewing his text, to be ignoring the significant sections of *De Re Aedificatoria* that relate to construction.[55] Similarly, Trachtenburg's text gives minimal

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[52] Marc-Antoine Laugier's description of the building site was brought to my attention by Rebecca Williamson, who later wrote: "Other Lives: Charles Eisen and Laugier's Essai sur L'architecture." *Drawing Matter*. Dec 26, 2019. Accessed Nov 29, 2023. https://drawingmatter.org/other-lives-charles-eisen-and-laugiers-essai-sur-larchitecture/

[53] Alberto Perez Gomez, "Introduction," in *Architecture, Ethics, and Technology,* ed. Louise Pelletier and Alberto Perez Gomez (Montreal: McGill-Queen's University Press, 1994), 11.

[54] Trachtenberg, *Building-in-Time*.

[55] Cammy Brothers, review of *Building-in-Time*, by Marvin Trachtenburg, *The Art Bulletin*, Vol. 94, No. 2 (June 2012): 300.

attention to drawings in his analysis, with a broadly made statement of their minimal role in the design and execution of buildings during the period studied. Yet the rigour with which the author pursues his study, examining the culture of building execution in extraordinary detail, makes a convincing case, and has provided a key reference point for this thesis.

With reference to the development of architect as author in the early Renaissance period, in *The Alphabet and the Algorithm,* Mario Carpo also addresses this separation. Here, together with the shift in production processes of the industrial revolution, the text locates the contemporary separation in relation to Alberti's treatises. With the architect as single author of design, and the building as identical facsimile achieved through notational drawing, there develops, Carpo suggests, a fundamental split between designing and building. Also addressing the Italian Renaissance, and with greater nuance, James Ackerman's text from 1954, *Architectural Practice in the Italian Renaissance,* gives an excellent overview of the architects' role at the time, highlighting amongst other issues how their drawings were used, and how they communicated their intentions with builders.[56] Importantly, Ackerman suggests, 'Perhaps the character of Renaissance architecture owes much to the fact that its monuments started, not from a complete idea, fixed in the symbolism of the blueprint, but from flexible impressions constantly susceptible to change. The ultimate statement, like that of the sculptor, evolved in the process of creating the mass itself.' [57]

Writing of the same period, but also projecting forwards, the texts of architect, educator and writer Pier Vittorio Aureli provide a thorough investigation of architecture as it relates to urban design, political theory and domestic space. Particularly in his essay, *The Rise and Fall of the Architectural Project of the City*, and more recently *Architecture and Abstraction,* through rigorous example and argument, Aureli provides a sustained and coherent examination of the political dimension of the separation of design and construction.[58]

[56] Cammy Brothers also examines the relationship of drawing to design development in the work of Michelangelo. Cammy Brothers, *Michelangelo, Drawing, and the Invention of Architecture*. (New Haven, Conn: Yale University Press, 2008), 158.
[57] James Ackerman, "Architectural Practice in the Italian Renaissance," in *Distance Points: Essays in Theory and Renaissance Art and Architecture* (Cambridge MA: MIT Press, 1991): 376.
[58] Pier Vittorio Aureli, "Means to an End."; Pier Vittorio Aureli, *Architecture and Abstraction* (Cambridge, Mass: MIT Press, 2023).

While these texts address an Italian Medieval and Renaissance context and form a background to the research carried out here, the historical and geographical scope of my work is particularly connected to the context of industrialised England as it developed between 1830 and 1980. This focus, combined with the thematic direction of the thesis, locates my analysis within a tradition very much defined by the works of John Ruskin and William Morris. While Robert Hewison[59] and E.P. Thompson[60] write on each of these respectively in detail, and Marcel Proust[61] provides a very particular reading of Ruskin, several texts also set the two writers within wider historic contexts.

With *Pandaemonium, 1660-1886: The Coming of the Machine as Seen by Contemporary Observers,* Humphrey Jennings provides a kaleidoscopic and patchworked overview of the era, combining social, political, scientific and cultural perspectives to remarkable effect.[62] Focussing on a literary tradition, Raymond Williams places Ruskin and Morris within a broad lineage that can perhaps best be described as Romantic anti-capitalist. Primarily English in origin and developing out of the Romantic poets' disgust at the Industrial Revolution and all it represented, together with their adoption of vernacular language, this tradition was described in detail by Williams in *Culture and Society*, connecting a lineage of politically motivated creative production from William Blake and Shelley through to Lawrence and Orwell. Significantly, Williams suggests Morris as the 'pivotal figure of this tradition.'[63]

Within the context of architectural history, Nikolaus Pevsner can, to some extent, be seen to have framed Ruskin and Morris within an understanding of the emergence of the modern movement,[64] Mark Swenarton instead has focussed on the two in relation to the Arts and Crafts architects who followed, in what he describes as the Ruskinian Tradition in Architectural Thought.[65] Swenarton highlights the central

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[59] Robert Hewison, "Ruskin and the Nature of Gothic," in *The Nature of Gothic* (London: Pallas Athene, 2011); Robert Hewison, ed. *New Approaches to Ruskin: Thirteen Essays* (London, Boston, and Henley: Routledge & Kegan Paul, 1981)
[60] E. P. Thompson, *William Morris: Romantic to Revolutionary* (London: Merlin Press, 1977)
[61] Marcel Proust, *On Reading Ruskin,* trans., Jean Autret, William Burford and Phillip J. Wolfe, ed., Phillip J. Wolfe and William Burford (New Haven: Yale University Press, 1989)
[62] Humphrey Jennings, *Pandaemonium, 1660-1886: The Coming of the Machine as Seen by Contemporary Observers* (London: Icon Books, 2012)
[63] Raymond Williams, *Culture and Society 1780-1950* (New York: Harper & Row, 1966), 215.
[64] Nikolaus Pevsner, *Pioneers of Modern Design: From William Morris to Walter Gropius* (Harmondsworth: Penguin, 1986), 39.
[65] Mark Swenarton, *Artists and Architects: The Ruskinian Tradition in Architectural Thought* (London: Macmillan, 1989), 31.

role this group placed on 'labour' in their thinking, yet in his conclusion is sceptical of various elements of the Ruskinian tradition: the emphasis on producers rather than consumers/users, the focus on a particular type of worker – the artisanal craftsman – over others, and the attention given to male 'workers' over unseen female labour. Others have recently considered the contemporary relevance of Ruskin's work in a renewed consideration of 'thinking-making.' Irénée Scalbert for instance suggests the importance of the Gothic to 21st Century architecture in a manner apart from 20th Century indifference.[66] Similarly, Bart Decroos considers the relevance of the Ruskinian notion of imperfection to the work of Belgian practice architecten de vylder vinck taillieu.[67]

Interestingly, the works of William Morris, and particularly his focus on the idea of *Joy in Labour*, finds common ground in the texts of Brazilian architect and writer Sérgio Ferro.[68] A student of the architect Vilanova Artigas, Ferro was a key member of Arquitectura Nova, together with Flávio Império and Rodrigo Lefèvre, between 1960-1970 and was then exiled from Brazil during the dictatorship years due to his political activities. In part through his experiences of the terrible working conditions at the Brasilia construction sites of the 1950s, Ferro developed a Marxist approach that fundamentally encompassed the experience of labour in the consideration of architectural production (fig. 11). Pedro Fiori Arantes has suggested of this collaboration: 'The *Arquitetura Nova* would be the fruit of constant dialogue amongst all those executing the project so that thinking, and action would be reunited.'[69] The challenge in Sérgio Ferro's writings to the autonomy of architectural design is in encompassing the experience of labour in the production of architecture. His texts during the years of *Arquitetura Nova*, and since, suggest a realignment of architectural critique away from the aesthetic towards the relations within production and the process of building: Architecture from Below.[70]

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[66] Irénée Scalbert, "The Nature of Gothic," in *A Real Living Contact with the Things Themselves: Essays on Architecture* (Zürich: Park Books, 2018), 10-59.
[67] Bart Decroos, "How Gothic is Contemporary Architecture? The Appreciation of Craftsmanship as a Ruskinian Aesthetics of Imperfection," in *Thinking-Making. When Architects Engage in Construction,* ed. Pauline Lefebvre, Julie Neuwels and Jean-Philippe Possoz (Brussels: Editions de l'Universite de Bruxelles, 2021), 115-131.
[68] Sérgio Ferro, "Dessin/Chantier: An Introduction," translated by Ricardo Agarez and Silke Kapp, in *Industries of Architecture,* ed. Katie Lloyd Thomas, Tilo Amhoff, and Nick Beech (London: Routledge, 2016), 102.
[69] Pedro Fiori Arantes, "Reinventing the Building Site," in *Brazil's Modern Architecture,* ed. Elisabetta Andreoli and Adrian Forty (London: Phaidon, 2004): 183.
[70] The title of a forthcoming collection of essays by Ferro, to be published in 2024.

Figure 11. Brasilia construction workers as described by Sérgio Ferro.
(Photo: Marcel Gautherot)

His text *O Canteiro e o Desenho,* first published in Portuguese in 1979 (Dessin / Chantier), roughly translates to English as *The Construction Site and the Design*.[71] Here Ferro suggests a complicity on the part of architectural design with capitalist development, that it 'has been part of the foundations of commodity production ever since it betrayed its origins by separating from the building site.'[72] Often referencing Sérgio Ferro, a number of writers have more recently adopted overtly political positions, in what some have termed, the

[71] This is one of Ferro's key texts, together with *Arquitectura e Trabalho Livre* of 2006, and has only recently been published in English in a condensed form. Ferro, Sérgio. *Dessin /Chantier: An Introduction.* in Thomas, Katie Lloyd, Tilo Amhoff, and Nick Beech. *Industries of Architecture. Critiques: Critical Studies in Architectural Humanities*. Vol. 11, London, New York: Routledge, Taylor & Francis Group, 2016.
[72] Sérgio Ferro, "Dessin/Chantier: An Introduction," translated by Ricardo Agarez and Silke Kapp, in *Industries of Architecture,* ed. Katie Lloyd Thomas, Tilo Amhoff, and Nick Beech (London: Routledge, 2016), 103.

'turn to labour.'[73] This has involved a re-assessment of the history of building and architecture through a reconfigured perspective, but also an attempt to engage with labour issues within contemporary architectural production.[74] Linda Clarke's book *Building Capitalism*[75] is of particular note here, although a more general evidencing of this new focus can also be seen in the extent to which recent magazine editions and Biennale/Triennale have prioritised questions of labour.[76]

Of course, Trachtenberg's outlook of the contemporary condition as critically marred by an Albertian paradigm is not universally shared. Some suggest that new technologies developed at the turn of the millennium offer an opportunity for a return to pre- Renaissance models of practice; that the integration of computer-based design and digital manufacturing processes point towards a new epoch of both bespoke 'one-off' productions, distinct from the serial production of industrialisation, and a technologically driven assimilation of design and making.[77]

However, in examining the 'digital turn' in architecture, Pedro Fiori Arantes makes explicit connections between digitally generated and fabricated architecture, the rise of the figure of the star-chitect, the culture of branding, and the neo-liberal financial structures of contemporary global corporatism. Fiori suggests the focus of work for contemporary star-chitects, and the subsequent attention of broader architectural culture, offers a marketable image for both the brands and the cities these architects work for, producing an architecture of spectacle, defined primarily by its easily branded, sculptural distinctiveness. He continues, examining the relationship between design and making in these practises through digital means, suggesting the unseen realities of these projects is that the essential labour of production in the built reality remains present in the

[73] Andrew Ross, foreword to *Architecture and Labor*, by Peggy Deamer, ed. Jane Rendell (New York: Routledge, 2020), viii.
[74] Deamer, Peggy. *Architecture and Labor.* Edited by Jane Rendell. New York, NY: Routledge, Taylor & Francis Group, 2020; Thomas, Katie Lloyd, Tilo Amhoff, and Nick Beech. *Industries of Architecture. Critiques: Critical Studies in Architectural Humanities*. Vol. 11, London, New York: Routledge, Taylor & Francis Group, 2016; Aggregate, Aggregate. *Governing by Design: Architecture, Economy, and Politics in the Twentieth Century.* Culture, Politics, and the Built Environment. 1 ed. Pittsburgh: Pittsburgh: University of Pittsburgh Press, 2012.; Osman, Michael. *Modernism's Visible Hand: Architecture and Regulation in America*. Minneapolis: University of Minnesota Press, 2018.
[75] Linda Clarke, *Building Capitalism: Historical Change and the Labour Process in the Production of Built Environment* (London: Routledge, 2011).
[76] Andre Tavares, *The Form of Form* (Zurich: Lars Muller, 2016); *Harvard Design Magazine* 46: No Sweat F/W 2018
[77] Mario Carpo, The Alphabet and the Algorithm, 79.

operating processes but becomes less visible and more alienated; that the exploitation of the workforce, often migrant in ever more distant building sites, continues, indeed grows, unabated.[78]

This question of labour seems to have posed something of a problem to the culture of tectonics. At the end of the twentieth century the response to post-modernism through a reappraisal of construction in architecture appeared during the 1990s in different guises, perhaps most visibly in European practice[79] and in North American academia.[80] Central to this approach, and still its key author, is Kenneth Frampton, exemplified most coherently and in depth in his 1995 book, *Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture.*[81]

In this text Frampton explores the culture of construction in modern architecture, though the book is markedly not a history of building technology or construction technique; instead the author identifies the craft of making as one underpinned by intellectual thought and ideas. The suggestion that architectural culture lies as much in how buildings are built as in the abstract geometry of space can be seen to legitimize, and encourage, a close reading of structure and construction. As such the book claims a certain intellectual territory, siding with the tactile, and promoting an architecture of substance and material presence, seemingly as a counterpoint to the image-oriented and scenographic qualities that Frampton would suggest characterised post-modern buildings, but also in opposition to the immateriality of the developing 'Digital turn'.

To an extent Frampton mounts what he terms a 'rear-guard action' towards the commodification of culture within global capitalism, that could be read as a form of resistance to the neo-platonic ideal

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[78] Arantes examines on the high fashion world, focussing on Koolhaas – and the post-Bilboa use museums and galleries as magnets for city finance – particularly on Gehry. Pedro Fiori Arantes, *The Rent of Form: Architecture and Labor in the Digital Age* (Minneapolis: University of Minnesota Press, 2019), 75.
[79] Irina Davidovici, *Forms of Practice: German-Swiss Architecture 1980-2000* (Zürich: gta Verlag, 2018) Andrea Deplazes, *Constructing Architecture: Materials Processes Structures: A Handbook* (Basel: Birkhäuser, 2005)
[80] Academics based in the United States writing who might be considered to follow Frampton include, among others, Edward Ford, David Leatherbarrow, Gevork Hartoonian, and Michael Cadwell. Edward R. Ford, *The Details of Modern Architecture: Vol.1* (Cambridge, Mass: MIT Press, 1990) Gevork Hartoonian, *Ontology of Construction: On Nihilism of Technology and Theories of Modern Architecture* (Cambridge: Cambridge University Press, 1997) Michael Cadwell, *Strange Details* (Cambridge, Mass: MIT Press, 2007)
[81] Kenneth Frampton, *Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture* ed. John Cava (Cambridge, Mass: MIT Press, 1995)

associated with Alberti's conception of architecture, with an emphasis on the built over the abstract. However, although Frampton's text is undoubtedly underpinned by a political conviction, the specifics of this are at times elusive.[82]

To a certain extent, this might be understood as resulting from the manner in which his analysis of the cultural content of construction appears devoid of a sense of process, time, and labour: the carefully wrought details he describes seemingly appearing perfectly formed primarily through authorial will. The key might be in Frampton's earlier text, *The Status of Man and the Status of his Objects,* where he notes: 'This wilful creation of distance between conceiving and building pervades the entire Renaissance.'[83] He proceeds to reflect on the effect of Enlightenment thinking to, 'distract architecture from the task of realization and project it into either an archaeological past or an unobtainable future.' In this text, as elsewhere, Frampton references Hannah Arendt's *The Human Condition*, identifying her distinction between labour and work, yet while he recognises in her text implications for the process of building through labour, the connections between this and his larger tectonic thesis is however rather harder to pin down.[84] The focus is somehow still 'the architecture', rather than the production of architecture, and all that implies.

Extending a discussion of tectonics to examine the relationship between building construction and building siting, in *Uncommon Ground: Architecture, Technology, and Topography,* David Leatherbarrow suggests that a broad assumption exists that in modern architecture, technology and site existed in opposition - the new, location-less factory-made artefact on the particular, local ground - and refutes by example the simplicity of this view. Chapter 4, *The Topographical Horizon of Dwelling Equipment*, is pertinent in examining the prevalence of ready-made systems and mass-produced proprietary products in contemporary construction and reflecting on their effect on contemporary practice and the modern building site. Of note is his observation that the architect as specifier

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[82] Kenneth Frampton, Stan Allen, and Hal Foster, "A Conversation with Kenneth Frampton," *October* 106, no. 106 (2003): 50.
[83] Kenneth Frampton, "The Status of Man and the Status of his Objects," in *Labour, Work and Architecture: Collected Essays on Architecture and Design* (London: Phaidon, 2002), 32-34.
[84] Kenneth Frampton, *A Genealogy of Modern Architecture: A Comparative Critical Analysis of Built Form,* ed. Ashley Simone (Zürich: Lars Müller Publishers, 2015), 21-23.

of pre-designed products adopts a new form of creativity, while builders become more and more aware of risk through the prominence of warranties these products carry.[85]

This new territory of building products and their associated documentation relates to the discussion of drawings. The changing relationship between designing and building was manifested through transformations in the characteristics of the production documents that architects used to communicate with the building site. A concern with the multiple purposes of drawings, not least as regards their limitations, has been much discussed and written about in recent years.[86] Significantly, Katie Lloyd Thomas and others have extended this research to incorporate an appreciation of the importance of text-based architectural modes of communication, particularly specifications.[87]

This focus appears as part of a larger development. At the start of his introduction to *The Image of an Architect*, Andrew Saint, in 1983, noted a broad shift away from 'architectural history' towards 'building history', with a concomitant shift in emphasis from aesthetics, design and authorship towards social and economic preoccupations.[88] In the following decades this tendency has become ever more apparent, with an increasing emphasis on 'Building Culture.'[89] Decrying the 'absence of studies of the social meaning of building process,' Brian Hanson describes the relationship of architects and builders in England in the period immediately preceding that studied in this thesis. His sub-heading concisely communicates one of his book's central themes: 'Constructing Authority.' [90] Subsequent writers have

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[85] Leatherbarrow considers this book a development from his earlier texts, On Weathering, and Surface Architecture. The text looks at three modern architects working in the years 1930-1960, Richard Neutra, Antonin Raymond, and Aris Konstantinidis, who practiced in the United States, Japan, and Greece respectively. David Leatherbarrow, *Uncommon Ground: Architecture, Technology, and Topography* (Cambridge, Mass: MIT Press, 2002.); David Leatherbarrow, *Surface Architecture* ed. Mohsen Mostafavi (Cambridge, Mass: MIT Press, 2002); Mohsen Mostafavi and David Leatherbarrow, *On Weathering: The life of buildings in time* (Cambridge, Mass: MIT Press, 1993)

[86] Robin Evans, Translations from Drawing to Building (Cambridge, Mass: MIT Press, 1997); Bruno Latour and Yaneva Albena, "'Give Me a Gun and I Will Make All Buildings Move': An Ant's View of Architecture," in *Explorations in Architecture: Teaching, Design, Research,* ed. Reto Geiser (Basel: Birkhäuser, 2008): 80-89.

[87] Katie Lloyd Thomas, "'Of Their Several Kinds': Forms of Clause in the Architectural Specification," *Arq* 16, no. 3 (2012): 229-37. Tilo Amhoff, "'Except Where Herein Otherwise Directed': Building with Legal Documents in Early Nineteenth-Century England," *Arq* 16, no. 3 (2012): 238-44. Mhairi McVicar, Precision in Architecture: Certainty, Ambiguity and Deviation (London: Routledge, 2019)

[88] Andrew Saint, *The Image of the Architect,* preface ix.

[89] Howard Davis, *The Culture of Building* (New York: Oxford University Press, 1999).

[90] Brian Hanson, *Architects and the "Building World" from Chambers to Ruskin: Constructing Authority* (Cambridge: Cambridge University Press, 2003), 6.

looked to locate architecture within a wider culture, seeking to gain a better perspective on how buildings operate in the world outside the autonomy of its own discipline. While some of these focus on how architecture fits within a wider construction industry,[91] many start from a position within architectural culture, seeking to work outwards.[92]

In this broadened horizon of building culture, it is at the building site where this thesis identifies both the revelation of the separation of design and construction, and an absence of extended study. Yet there is also a growing awareness of the necessity of redressing the lack of research directed towards the building site, with a number of writers responding from differing perspectives.[93] Timothy Hyde has written and lectured on the research he is undertaking with his MIT students in, *The Building Site, Redux*, making a compelling case for the architectural historian to 'return' to the building site.[94]

Of especial note in responding to this dearth has been the work of Christine Wall. Through oral histories of construction workers, and detailed study of working conditions at the Barbican and South Bank Centre, she has provided tangible and well-evidenced perspectives of the builders involved in projects that have generally been viewed from the perspective of design. In, *An Architecture of Parts,* she focusses on an area that closely overlaps with the scope of this research – *Architects, Building Workers and Industrialisation in Britain 1940-1970* – and the text has provided a key reference point for this thesis.[95]

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[91] Michael Ball, *Rebuilding Construction: Economic Change in the British Construction Industry* (London: Routledge, 2014); Steven Groák, *The Idea of Building: Thought and Action in the Design and Production of Buildings* (London: E & FN Spon, 1992)
[92] Adrian Forty, *Words and Buildings: A Vocabulary of Modern Architecture* (New York: Thames & Hudson, 2000); Jeremy Till, *Architecture Depends* (Cambridge, Mass: MIT Press, 2009); Adam Sharr, ed. *Reading Architecture and Culture: Researching Buildings, Spaces and Documents* (London: London: Routledge, 2012), 8.
[93] Hugh Campbell, *Space Framed: Photography, Architecture and the Social Landscape* (London: Lund Humphries, 2020), 156-167; Adrian Forty, *Concrete and Culture: A Material History* (London: Reaktion Books, 2013), 225-251; Prue Chiles, "At home on site: expanding the field of architectural research," in eds. Ashley Mason and Adam Sharr, *Creative Practice Inquiry in Architecture* (Abingdon: Routledge, 2023), 136-146; Nick Beech, Linda Clarke, and Christine Wall, "On Site," in *Industries of Architecture,* edited by Katie Lloyd Thomas, Tilo Amhoff, and Nick Beech (London: Routledge, 2016), 305-309.
[94] Timothy Hyde, "The Building Site, Redux," *Journal of Architectural Education* 75, no. 1 (January 2, 2021): 92.
[95] Wall, *An Architecture of Parts.;* Nick Beech, Linda Clarke, Christine Wall and I. Fitzgerald, "On Site," in *Industries of Architecture,* edited by Katie Lloyd Thomas, Tilo Amhoff, and Nick Beech (London: Routledge, 2016), 305-309.

Chapter Overview and Methodology

This thesis is structured around the study of three building sites. These have been selected on a thematic basis, although there is a certain geographic focus to them, in part due to the significance of England as the first industrialised nation, but also enforced through the limitations of travel and access imposed by pandemic lockdown. The sites were all in England, and the key protagonists were all, at one stage or other, based in London. While the introduction and afterword touch on the pre-history and contemporary condition, the studies encompass a historic span from 1830 to 1980, a period that was critical in relation to the impact of industrialisation.

The chapters each occupy distinct historic moments within this period, separated by approximately sixty years, yet there are nevertheless discernible threads of influence and interaction between them. These three building sites are by no means typical; in fact, they are all remarkable in the dynamics of labour, construction, and drawings that they demonstrate. In each case, these dynamics have been revealed by a triangulation between visits to the relevant buildings (a ruin in one case), through careful reading of the relevant literature, both primary texts by the protagonists and secondary texts by others, and finally, through the examination of archival documentation comprising drawings, specifications, and assorted paperwork. In the final study, this technique has been supplemented by interviewing one of the actors who participated in the building site studied. This last study is included as an additional chapter in which they provide a narration of their own site photographs.

The first chapter examines the construction of the Great Stove at Chatsworth in the 1830's, focussing on the series of innovations and labour-saving techniques Joseph Paxton originated to achieve a reduction in costs, specifically the design of the Sash-Bar Machine. This was a steam-powered machine, designed and developed by Paxton, that allowed a significantly greater efficiency of production of the glazing bars that made up much of the glass building, in turn considerably lowering his employer's financial outlay. The saving made was at the expense of the labour previously involved in this work. This study will lead to a reflection on the implications of this moment, analysing the relationship of labour to construction within the wider context of the building's construction, and in particular, the Industrial Revolution.

While the Great Stove no longer stands, both the foundation walls and remnants of the heating flues are still apparent on site in Chatsworth, and alongside these I was also able to visit the two remaining glasshouses constructed by Paxton on the estate. Poignantly, while his built works have largely passed, the great landscape interventions he masterminded have remained, and those involving trees have matured. During his time at Chatsworth, Paxton edited two botanical magazines, and these have been used as a primary archival source. While there are several biographical studies of Paxton,[96] and numerous texts focusing on the Crystal Palace, the 1961 monograph by George Chadwick remains the sole career-spanning study of his works, and, together with Chadwick's essay of the same year focusing on the Great Stove[97], this has been a key source of information, with additional texts providing the historical development of glasshouse structures,[98] and the social and political context.[99]

Chatsworth is also the home to the Devonshire Collection Archives & Library that house the drawings and letters relating to the estate. It was of some surprise to me on examining the archive contents that there were no drawings in existence for the earliest greenhouses of Paxton's tenure, and of the Great Stove itself only a few, and not of Paxton's hand: primarily a small series by the architect Decimus Burton. Once engaged in the study I grew to understand that this absence was in fact an important part of the story to be told. The archives do however contain the estate account books, including labour records, and while these had been documented by Chadwick, direct study of these revealed previously unremarked detail in relation to the Paxton's machine for making sash-bars.

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[96] Violet Markham, *Paxton and the Bachelor Duke* (London: Hodder& Stoughton,1935); Kate Colquhoun, *A Thing in Disguise: The Visionary Life of Joseph Paxton* (London: Fourth Estate, 2003)
[97] George F. Chadwick, *The Works of Sir Joseph Paxton: 1803-1865* (London: Architectural Press, 1961)
George Chadwick, "Paxton and the Great Stove." *Architectural History* 4 (1961): 77-92.
[98] John Hix, *The Glasshouse* (London: Phaidon, 1996); Georg Kohlmaier, *Houses of Glass: A Nineteenth-Century Building Type,* ed. Barna von Sartory (Cambridge, Mass: MIT Press, 1986); Stefan Koppelkamm, *Glasshouses and Wintergardens of the Nineteenth Century* (London: Granada, 1981)
[99] Isobel Armstrong, *Victorian Glassworlds: Glass Culture and the Imagination, 1830-1880* (Oxford: Oxford University Press, 2008); Eric Hobsbawm, *Industry and Empire: From 1750 to the Present Day,* ed. Chris Wrigley (London: Penguin, 1999); Karl Marx, *Capital: A Critique of Political Economy: Vol. 1* (London: Penguin, 1990); Thompson, *The Making of the English Working Class;* Ellen Meiksins Wood, *The Origin of Capitalism: A Longer View*, (London: Verso, 2002)

It was through a note in Chadwick's account, noting the source of the steam engine that Paxton utilised, that I was led to the Boulton and Watt Collection, housed at the Wolfson Centre for Archival Research within the Library of Birmingham. Here, as well as the drawing and letter Chadwick cited, I discovered an additional drawing and letter that further established the background to Paxton's machine. This careful archival work underpins the broader methodology of this study, which is to simultaneously look at the previously remarked upon incident – Paxton's innovation – in greater detail, while also encompassing a wider historical, social, and political perspective.

An examination of the radical transformation in approach by the architect William Lethaby to the construction of his first and last built works, Avon Tyrell in Hampshire, and All Saints' Church, Brockhampton, is provided in the second chapter. In the period between these two projects, 1891-1902, Lethaby produced several texts that considered the role of the craftsman in design and construction, and he subsequently looked at how this might relate to his own role. Through changes in how he documented the design of these two projects, in drawings and specifications, Lethaby sought to establish the central role of the building site in the evolution of the project's design, integrating labour more directly into the design process.

I was able to visit both buildings studied, and while All Saints' Church, Brockhampton is in excellent condition, Avon Tyrell has for several decades been used as an outbound centre for youth groups, that has resulted in some unfortunate architectural interventions, though the large private house has survived the rough and tumble of years of misuse remarkably well. It also meant that, under the guise of outbound activities with my son, I was able to stay two nights in the house, studying the building at length.

William Lethaby wrote extensively throughout his career and these texts have provided a primary source for the comparison in methodology between the two buildings studied.[100] Godfrey Rubens's

[100] Lethaby was a prolific writer producing numerous texts throughout his life. These texts, spanning from 1889 to 1935 (posthumous), are often historical, though often also polemical, in character. Summary studies of several Lethaby's key texts have been produced by the author and are available online on the Drawing Matter website:
https://drawingmatter.org/w-r-lethaby-architecture-mysticism-and-myth/
https://drawingmatter.org/w-r-lethaby-the-builders-art-and-the-craftsman/
https://drawingmatter.org/w-r-lethaby-the-church-of-sancta-sophia-constantinople/

excellent study of 1986, though less than ideally illustrated, remains the sole monograph of Lethaby, while Trevor Garnham has produced a number of texts of particular value, and kindly advised me in this area of research.[101]

While numerous other texts were examined in this study,[102] the specific line of enquiry was triggered by former RIBA Curator Margaret Richardson's book on the Arts and Crafts Movement through the lens of the RIBA drawings collection, in particular, her remarks on both Philip Webb's drawings:

> Webb designed every detail himself, to the smallest moulding, and his drawings are outstanding in as much as they are the first architectural drawings to convey elaborate and exact specifications about material and craft. Shaw's drawings are clear and have notes on materials but leave a lot to the builder. Webb's leave nothing to the builder. He knew everything about materials, and acted the part of the "upper foreman" on paper.

and on Lethaby's for All Saints' Church,

> There are, too, fewer drawings extant for Brockhampton. This may be chance, for many may be lost, although Lethaby's drawings, like Webb's, were assiduously collected by his friends. The drawings are tentatively, almost roughly drawn. The preliminary design has lost the ink presentation of the Shaw office and is in faint pencil; the detail takes the form of a sketch: a skeleton diagram for the craftsman.[103]

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https://drawingmatter.org/w-r-lethaby-apprenticeship-and-education/
https://drawingmatter.org/w-r-lethaby-philip-webb-and-his-work/

[101] Godfrey Rubens, *William Richard Lethaby: His Life and Work 1857-1931* (London: Architectural Press Ltd, 1986); Trevor Garnham, *William Lethaby and Late 19th Century Architecture.* Unpublished MPhil, Essex University, 1980; Trevor Garnham, "William Lethaby and the Two Ways of Building." In *AA Files*, no. 10 (1985): 27-43.; Trevor Garnham, *Melsetter House* (London: Phaidon, 1993); Trevor Garnham, "Architecture and the Eclipse of Reason." In *Scroope*, Cambridge Architecture Journal, no. 12 (2000): 84-89.

[102] Peter Blundell Jones, "All Saints, Brockhampton," in *Architects' Journal* CXXII (15 August 1990): 24-43.; Swenarton, *Artists and Architects,* 96-125.

[103] Margaret Richardson, *Architects of the Arts and Crafts Movement* (London: Trefoil Books, 1983), 15,45.

Indeed, the comprehensive collection of Lethaby's drawings, sketchbooks and specifications held in the RIBA Drawings archive at the Victoria & Albert Museum, London, allowed a detailed study of all the key material in one place.

Meanwhile, reviews of drawings and sketchbooks by Philip Webb and Detmar Blow within the Drawing Matter archive provided comparative analysis of relevant material by key colleagues. Research was primarily based on two key activities. Firstly, an analysis of the texts written in the years between the construction of the two buildings that revealed a considerable intellectual shift that is then brought to bear on the two construction methodologies. And secondly, detailed comparison through site study of All Saints' Church as built, and the small number of design drawings and the construction specification, that revealed the specific relationship between documentation and construct.

The third chapter examines a series of timber framed projects designed by the architect Walter Segal and constructed from the 1960s to the 1980s. These projects span from the construction of his own temporary house in Highgate, through a series of private houses, to the later self-build projects, constructed at the end of his career in Lewisham. Exploring the role of the private house commissions in refining the architectural principles established in his own house, this study focusses on one of these houses, built in 1971 by the Hollands. This house was noteworthy for being the first time one of Segal's clients offered to take on the majority of the construction work themselves, and the text examines the wider implications of this shift in roles.

There is no centralised archive for Segal's drawings and documentation, and sadly, Walter Segal's own house in Highgate of 1962 no longer exists: having long outlived its original temporary status, it eventually lasted until 2016. However, the film-maker Patrick Keiller has shared with me his film recording of the house together with historic BBC footage from 1972 that featured the Hollands in their house.[104] I have been able to visit houses in both Segal Close and Walter's Way, hearing from current residents of their experiences living in the houses, one of who was able to share a project folder with

[104] Patrick Keiller, dir. *The Dilapidated Dwelling*, UK, 2000. 78 min.

paperwork from the original Walter's Way build.[105] I received much support and advice from Jon Broome, assistant to Walter Segal, who has written many of the key texts on Segal and was one of the Lewisham self-builders himself.[106] Jon generously shared original drawings and documents of several important projects.

I also visited Angela Kerry-Williams, owner - since it was sold by the original residents in 1978 - of the house that forms the centrepiece of the study. She kindly shared the original drawings for this project, a few of which had been previously published, but the majority of which had not, and this new material forms an appendix to the thesis.

Segal features little in the wider histories of architecture, particularly those with an international scope, yet is well known within a particular strand of British architectural criticism, and often referred to in accounts of 'alternative approaches' to housing procurement. The key texts used for this study, beyond Segal's own writings, are those of John McKean, who reported on the majority of Segal's building for the architectural press while they were constructed, and since Segal's death has gone on to write a number of books on his life and work.[107] McKean's article in the Architects' Journal from 1975, centred on the house the Hollands built, has provided a key reference point for the particular focus of this chapter.[108]

Walter Segal was himself a prolific writer throughout his life. A close friend of the editor of the Architects' Journal, Colin Boyne, Segal published several articles in the magazine over an extended period, including the duration of the study.[109]

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[105] The house at Walter's Way was that of Alice Grahame and her partner: Alice Grahame, *Walter Segal: Self-Built Architect,* ed. John McKean (London: Lund Humphries, 2021); Alice Grahame and Taran Wilkhu, *Walters Way & Segal Close: The Architect Walter Segal and London's Self-build Community* (Zürich: Park Books, 2017)
[106] Jon Broome and Brian Richardson, *The Self-build Book: How to Enjoy Designing and Building Your Own Home* (Dartington: Green Books, 1995); Jon Broome, "The Segal Method," *Architects' Journal* (5 November 1986): 31–68.
[107] John McKean, *Learning from Segal: Walter Segal's Life, Work and Influence* (Basel: Birkhäuser, 1989)
[108] John McKean, '"A Certain Basic Satisfaction in Building a Shelter for Oneself,"' *The Architects' Journal* (3 September 1975): 458–61.
[109] Segal was a regular contributor to journals, but the only book that he authored, published in 1948, preceded the buildings featured by several years. Walter Segal, *Home and Environment* (London: Leonard Hill, 1948)

Perhaps of most use have been the documentation of two key talks Segal gave in which he clearly articulated his architectural position and described the key projects of the later years.[110]

It was these transcriptions that prompted the particular focus of this study, for while most accounts of Segal's work centre on the later self-build houses of Lewisham, and perhaps his biographical background or extended legacy, in his own telling the architect appeared to identify the significance of the private houses built between his own temporary house project and the later works. Segal notes the Hollands as the first to build their own house, and the provocation for me to pursue this further lay in his suggestion in one of these talks, not altogether correct as it later transpired, that,

> 'Here is a self-built house, built by two young teachers, husband and wife, in Suffolk…The two carpenters that helped were sent away after the first day, and husband and wife continued and finished making the frame, which, if you think that two laymen, never having used tools in their lives, did rather undertake a bold affair.'

The study records detailed comparison of construction drawings, and, in so doing, documents previously unpublished material on the Hollands' house, while also considering Segal's work in a broader sense, outside the significance of self-build.

The final chapter, in part a continuation of the third study, provides a photographic record from the building site of the house that the Hollands built for themselves. Giving voice to the self-builder, the original images are accompanied by Muriel Holland's transcribed narration of the construction works she and her husband Michael undertook. Through the current owner of the house, I was able to find and meet Muriel at her new home, where she talked through the slides that the couple took at the time. A few of these had been published in the years immediately following the house's construction, but the majority of which have not been previously documented.

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[110] Walter Segal, "Low-Cost Housing and User Participation," in *Architecture and Social Sciences: Selected Papers*, ed. Dr P.G. Raman (Edinburgh: University of Edinburgh, 1973): 96–131.
Walter Segal, 'Learning from the Self-Builders'. Tape/slide package, Pidgeon Audio Visual, PAV9/8301, 1983.

Significantly, in a thesis that examines and challenges prevalent forms of architectural agency, this last chapter departs from the figure of the architect or designer on site, directing the focus rather on lay people as they take ownership of their building site. In a thesis overwhelmingly dominated by white males, I was also keen that the last voice be female.

In each study I have sought to produce close-read studies of academic rigour, that are nevertheless informed by my perspective as an active practitioner conversant with the day-to-day issues of the contemporary building site. As such, I have not started from a theoretical position, but have rather sought, through attentiveness to the specific construction documentation, to discern the issues at play. As much as possible the studies have sought to include others involved in the projects as well as the lead designer, presenting a history of building, rather than an architectural history from the viewpoint of an architect.[111]

I have sought to combine the technical and theoretical, and the politically and poetically oriented; integrating these qualities within a broadly narrative structure, founded on the belief in the power of a good story.

[111] Through involvement as Affiliated Researcher with the TFTK project - Translating Ferro / Transforming Knowledges of Architecture, Design and Labour for the New Field of Production Studies – I have been fortunate enough to have met Brazilian theorist Sérgio Ferro and had access to previously unpublished texts that have been particularly influential in developing the text. https://tftk.iau.usp.br/en/about/#team

Chapter 1

Modern Times

Economy and Labour at Joseph Paxton's Great Stove of Chatsworth

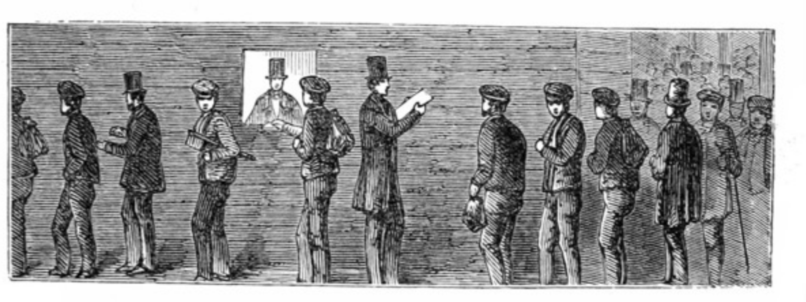

Figure 1. Men taking their wages at the Crystal Palace pay office. Illustrated London News (1851).

> No period of British history has been as tense, as politically and socially disturbed, as the 1830s and early 1840s, when both the working class and the middle class, separately or in conjunction, demanded what they regarded as fundamental changes.[1]

In 1835, at a time of political tension and great social hardship, the gardener Joseph Paxton began work on the Great Conservatory at Chatsworth. The structure would become the largest greenhouse in the world; its design a summation of all the technical developments Paxton had introduced to glasshouse construction in the preceding years. But it also operated as precursor, indeed as incubator, to the transformation of work in architecture fully realised in the Crystal Palace: the commodification of the labour force (fig. 1).

Here, through technical innovations that commanded the architectural logic, the labour that constructed was wholly alienated, divorced entirely from any sense of creative agency. The division of labour was now made explicit within the production of architecture: workers who in earlier times might have contributed skill and knowledge, who might have operated as active participants, were reduced to cogs in the great machine of assembly, all knowledge, all creative agency, now withdrawn from the building site.

[1] Eric Hobsbawm, *Industry and Empire: From 1750 to the Present Day* (London: Penguin, 1999), 55.

While overshadowed within histories of architecture by the ubiquitous fame of the Hyde Park structure, the Great Conservatory, more commonly known as the Great Stove, is nevertheless highly important within the development of glasshouses: for its scale, its technical proficiency, and for its professed beauty. Mark Girouard for instance, in *Country Life* magazine, described the building as, 'a superbly glassy, grooved and rippling monster, as elegant as it was efficient.'[2]

History has been similarly generous to Paxton who has been characterised as the quintessential Nineteenth Century genius, a man of unbounded energy, multifarious interests and brilliant inventiveness, the ultimate Victorian self-made man, whose endeavours epitomised the rags to riches tale, taking him from humble beginnings to national hero.

However, constructing conservatories at this extraordinary scale, and particularly at this time, was prohibitively expensive, and Paxton turned his mind to reducing the build costs, particularly through his labour-saving Sash-Bar machine. Where recorded, the development of the Sash-Bar Machine has been regarded as evidence of his genius, the descriptions, following Paxton, always numerically fixated: the machine saving £1200 on manual labour, performing the labour of twenty men, and producing forty miles of timber bars in total, and approximately 500 units per day of 1.2m length.[3]

Noteworthy is that these observations are always from Paxton's perspective and, by proxy, that of his employer, a typical example being, 'Paxton saved thousands of hours of work with his sash cutting machine…'[4]

No acknowledgement is made in these histories of anyone other than Paxton and his employer involved in the process, particularly of those who constructed the great edifice. Which surely leads one to ask: how might Paxton's labour-saving machine appear to the labour involved?

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[2] Mark Girouard, "Genius of Sir Joseph Paxton," *Country Life* 138, Part 2 (December 9, 1965): 1608-1610.
[3] Joseph Paxton, "No. XIV. Machine for making Sash-bars," *Transactions of the Society, Instituted at London, for the Encouragement of Arts, Manufactures, and Commerce 53,* Part 1 (1839-1840): 97.
[4] John Hix, *The Glasshouse* (London: Phaidon,1996), 91.

Gardening as a Science

Joseph Paxton was born in 1803 in Bedfordshire and left home at the age of 15, seemingly with little formal education, to be employed in physical work as a gardening boy. After various apprenticeships he was taken on in 1823 by the Horticultural Society, established in 1804, and recently relocated to Chiswick Gardens. Paxton's formal job title was initially, 'labourer under the Ornamental Gardener' though he progressed rapidly and was eventually promoted to the post of foreman of the Arboretum.[5]

It was at Chiswick that, in 1826, Paxton met William Cavendish, the sixth Duke of Devonshire, one of the country's richest men. Chiswick House, originally constructed in 1727 by Lord Burlington together with William Kent, was one of Cavendish's three London houses, the others being Devonshire House and Burlington House. From 1821 the duke had leased land from the garden of Chiswick house to the Horticultural Society, for a rent of £300 a year, the agreement to last sixty years.[6]

The duke had insisted in the lease negotiations that he have a private door into the Horticultural Society gardens such that he might visit the gardens whenever he chose. The portrayal by Paxton's granddaughter, Violet Markham, of the meeting of these two men during one of these visits indicates some of the later romanticisation of the event,

> A gate divided the Duke's garden from the grounds of the Horticultural Society. It was a pleasant stroll from one to the other. Though not at that time an enthusiast, he found much to interest him in the Society's plants and flowers, for new varieties were very fashionable and the curious were interested in such things. During his strolls his attention was drawn to a short, pleasant-looking man.[7]

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[5] Fiona Davison, *The Hidden Horticulturists: The Untold Story of the Men Who Shaped Britain's Gardens* (London: Atlantic Books, 2019), 23.
[6] Davison, *The Hidden Horticulturists,* 4.
[7] Violet Markham, *Paxton and the Bachelor Duke* (London: Hodder& Stoughton,1935), 21.

The duke, temporarily lacking a gardener at his Chatsworth estate, made a bold decision and offered the young and relatively inexperienced Paxton the job as Head Gardener. Two weeks later Paxton had moved north to Chatsworth, in Derbyshire, and from here, deep within the Derwent Valley, his experiments in glasshouse construction began. At first, Paxton's energies were directed towards general garden maintenance, repairs, and the laying out of new paths, progressing in 1827 to the upkeep of the kitchen gardens and the planting of a new orchard there. The kitchen gardens were located uphill and a little apart from the main house at Chatsworth. Enclosed by a boundary wall, an area of twelve acres was divided into four sections, with the gardener's house also sited here.[8]

By the duke's own admission, a number of the existing glasshouses within the kitchen gardens were in a state of disrepair,

> At the kitchen-garden he found four pine-houses, bad; two vineries, which contained eight bunches of grapes; two good peach houses, and a few cucumber frames. There were no houses at all for plants, and there was nowhere a plant of later introduction than about the year 1800.[9]

The repair of the houses initially absorbed all Paxton's attention, but in 1828 he began to undertake a series of experiments in small to medium-sized timber forcing-houses and glasshouses, arriving at incremental improvements in their performance. Following his visit in 1831, the gardener and garden writer J.C. Loudon, while generally negative in his comments regarding the estate's grounds, was more positive towards the kitchen gardens, and remarked that Paxton, with his team of twenty-two men, had 'greatly improved it', and had constructed, 'an extensive range of wooden forcing-houses.'[10] Indeed, by the middle of the decade, Paxton had constructed there, 'mushroom houses, forcing-houses, a strawberry house, a large pine house, a melon and cucumber house, several vine ranges, and a peach house.'[11]

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[8] Tony Musgrave, *The Head Gardeners, Forgotten Heroes of Horticulture* (London: Aurum Press Ltd, 2009), 168.
[9] Markham, *Paxton and the Bachelor Duke*, 38.
[10] Musgrave, *The Head Gardeners,* 170.
[11] Kate Colquhoun, *The Busiest Man in England: A Life of Joseph Paxton* (Boston: David R. Godine, 2006), 49.

The purpose of the various improvements was a bettering of performance, for improved cultivation and yield. It is necessary to recall at this point that Paxton was a gardener, a role historically involving both mental and manual labour. And in respect to these glass structures, he was not, strictly speaking, operating as architect, builder, or client. Rather, his role in these exercises was akin to a blend of the three; an untrained, yet practical and quick-learning designer, a wholly trusted agent of the client, and seemingly, a hands-on constructor.[12]

These early glasshouse structures were clearly not considered architectural by those involved in their production, and neither were they viewed as such by the wider public or the established architectural community. Instead, it is fair to assume that the designs were deemed utility structures, free of architectural content, and of a simplicity whereby drawn information was considered unnecessary - rectangles of certain dimensions, with pitched roofs of certain angles – and their construction being of such an evolutionary nature that details could always be referred to in relation to previous built examples on site. Notably, there are no working drawings for these structures in existence.

Despite working within a context of extraordinary wealth, cost was already a key concern for Paxton, who noted in 1836 of these early structures,

> For these few years past we have directed particular attention to the construction of all sorts of hot-houses and green-houses. In doing so, we have always had four things in view – namely, utility, stability, convenience, and though last not least, economy.[13]

And so, with the growing trust of his patron, Paxton's role was gradually expanding beyond the initial focus on horticulture to include construction, although, at this stage, in an unspecified form as to whether he was designer or builder, both or neither. In parallel with the expanded role within his employment, he was also developing as

[12] George F. Chadwick, *The Works of Sir Joseph Paxton: 1803-1865* (London: Architectural Press, 1961), 116.
[13] Joseph Paxton, "Observations on the Construction of Hot-house roofs," *Paxton's Magazine of Botany,* no. 2 (1836): 80.

both writer and publisher on an independent basis. Given Paxton's remarkable industriousness, the duke clearly allowed his favoured employee leeway to diversify and pursue his interests. In 1831 he launched a new gardening journal, the *Horticultural Register and General Magazine,* with pricing and content aimed to attract a broad readership. Initially edited together with Joseph Harrison, although from 1832 by Paxton alone, the magazine remained under his editorship until 1834.[14]

This same year he launched another journal, the *Magazine of Botany and Register of Flowering Plants*, that continued in print until 1849 and provided Paxton with a platform for his developing ideas. Published monthly, again the magazine was oriented for mass consumption. Nevertheless, it clearly also emphasised gardening not as a craft, but as a science, a subject to be understood through the empirical practice of precise observation. An article from the magazine in 1843 titled, 'Gardening as a Science', is representative of this orientation, and ties these empirical values with a methodology for establishing the optimum angle of glazing,

> Viewing the perfect maturation of the fruit, and intensity of flavour, as points of the greatest consequence, he endeavoured to give a slope to the different forcing-houses, which should be at a right angle with the sun's rays, at the season when the fruit was expected to ripen.[15]

While there are few archival records of the glasshouses that Paxton developed during these early years, we can appreciate their most important features that evolved within them through his later recollections, through articles in the *Magazine of Botany*, and from a lecture given on 13th November 1850 to the Society of Arts, where he identified a series of key innovations.

All these innovations were predicated on the use of timber, and indeed, throughout his life he favoured wood as a construction material for glasshouses. The common view at the time, including that of the great innovator of hothouses J.C.Loudon, was that, on account of its potential thinness of profile, iron was better suited to the

[14] Colquhoun, *The Busiest Man in England,* 40.
[15] Joseph Paxton, "Gardening as a Science," *Paxton's Magazine of Botany*, no. 10 (1843): 9.

construction of glasshouses.[16] But Paxton was resistant, believing wood to be superior, not least in its cheapness relative to iron.

The first of these improvements was the refinement of the sash bar profile that held the glazing units in place. Paxton reduced the glazing bars' profile from a simple rectangular timber section by chamfering the sides to let in more natural light, without any effect on the bar's structural performance. Additionally, grooves were added to the sides of the profile, so that glass could be fitted without the use of putty, obviating the expansion and contraction resultant from temperature changes and moisture, and facilitating installation.[17]

Tellingly, Paxton's use of the term, 'evil', in his later description of this development suggests a moralisation of the technical, transforming his work to a quest:

> In 1828, when I first turned my attention to the building and improvement of glass structures, the various forcing-houses at Chatsworth, as at other places, were formed of coarse thick glass and heavy woodwork, which rendered the roofs dark and gloomy, and, on this account, very ill suited for the purposes they were intended to answer. My first object was to remove this evil, and, in order to accomplish it, I lightened the rafters and sash-bars, by bevelling off their sides; and some houses which were afterwards built in this manner proved very satisfactory.[18]

The second key development of this period was the practical application of ridge-and-furrow roofing. Involving the angling of roof glazing in a serrated manner, this had first been proposed in outline form by J.C. Loudon in 1817, but had not been developed further, and was now realised by Paxton for the first time. There was much discussion, and many competing theories, within the gardening community as to how best to angle glasshouse glazing to maximise incidence of light from the sun, and the ridge-and-furrow principle was based on the understanding that light oblique to the plane of glazing reflected more than light perpendicular to it. This innovation therefore set the roof as a saw-toothed profile, the planes of glass at alternating

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[16] Chadwick, *The Works of Sir Joseph Paxton,* 74.
[17] Paxton, "Observations on the Construction of Hot-house roofs," 84.
[18] "The Industrial Palace in Hyde-Park. Mr Paxton's Lecture, at the Society of Arts," *Illustrated London News*, Nov 16, 1850, 385-6. The British Newspaper Archive.

angles increasing the amount of morning and evening light that entered the glasshouses, while reducing the heat of the midday sun. Paxton was thus able to utilise sunlight for a greater portion of the day, resulting in turn in better performing plants. In addition, the profile increased both structural rigidity and bearing capacity relative to glazing configured in a single plane. Paxton's first application of the ridge-and-furrow principle was in 1832, with the re-roofing of an existing greenhouse, and in the following year he constructed an experimental pine house using the system.[19]

In 1834 he completed a larger greenhouse at Chatsworth that utilised the system, and this was published in 1836 in the *Magazine of Botany*, with a perspective illustration, not of Paxton's hand.[20] Clear in the drawing are a rear masonry wall, together with a series of chimneys associated with heating the building, and along the middle of the space and at the front, a series of cast iron pillars (fig. 2).

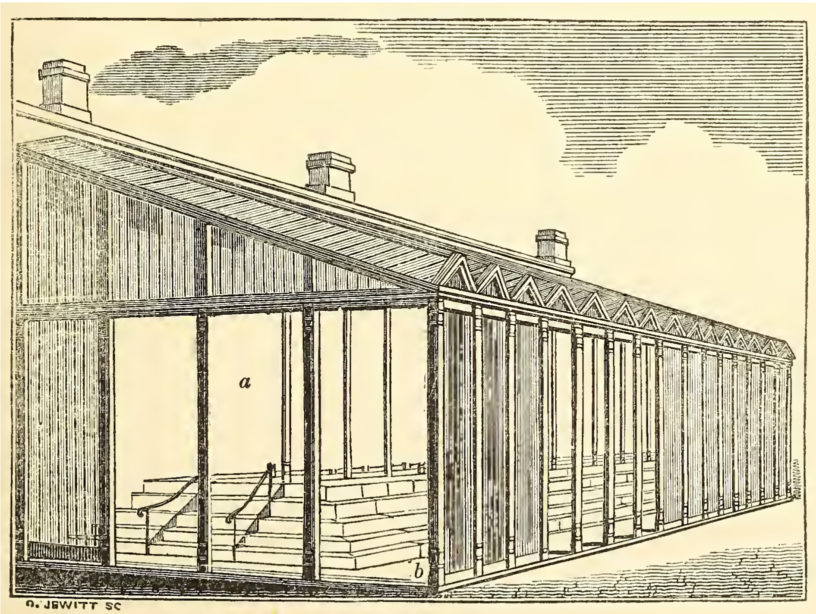

Figure 2. Magazine of Botany (1836).

[19] Chadwick, *The Works of Sir Joseph Paxton,* 75.
[20] Paxton, "Observations on the Construction of Hot-house roofs," 81.

Spanning between the wall and pillars, the roof formed a series of high points, 'ridges', and low points, 'furrows', the façade revealing the saw-toothed appearance at the ends to the fifteen bays. The greenhouse was 97 feet long by 27 feet wide, and Paxton later noted that this span without the structural efficiency of the ridge-and-furrow roof would have required much larger timber sections, of both sash-bar and rafter, and as a result his design was both a lighter and more cost-effective solution.[21]

The third key innovation during these years was the invention of the famed 'Paxton gutter'. Here, a gutter formed of a single piece of timber was cambered, using adjustable wrought iron rods, to form a single integrated element to both channel the collected rainwater and provide a structural truss able to span around 24 feet. Additionally, side channels cut into this timber collected and directed away any condensation from the underside of the glazing. With the Paxton gutter providing structural support to the roofing system, in effect acting as the 'furrow' of the ridge-and-furrow, and the sash-bars, of improved profile, spanning between ridge and furrow, Paxton was able to integrate his various innovations into a comprehensive roofing system that resolved structure and drainage while admitting plentiful sunlight, and all in a cost-effective manner. He was, one might say, ready for a larger challenge.

Gardens of Eden

These forcing houses and glass houses were located within the defined area of the kitchen garden and were primarily associated with plant cultivation, and with providing fruit and vegetables for consumption. But the expansion of global trade and colonialism at the time resulted in the import of ever larger and more exotic specimens, and this was to radically alter the character of the structures that housed them. The development of the glasshouse had run in parallel with that of colonialism and overseas trade from their beginnings: during the fifteenth century and the Renaissance, seafaring voyages of discovery by European travellers resulted in the import of exotic new plants, and rapidly expanding collections at home.

[21] "The Industrial Palace in Hyde-Park," 385.

The increasingly scientific approach to these plant collections led to the establishment of the first European botanical gardens, with sites in Pisa, Padua, and Florence operational by the middle of the sixteenth century. In parallel, the development of colonialism and global trade, and the subsequent foundation of trading companies to manage commercial empires, introduced a new market of exotic fruits to the wealthy European aristocracy.[22]

Following these centuries of exploration and conquest, the specific nature of the exploitation of foreign lands was further transformed during the Industrial Revolution in England in the eighteenth century and, by the early Nineteenth Century, the relationship between colonialism, global trade, and industrial production, was well-developed. English industrialists and the state operated in tandem throughout this period to dominate foreign markets; government policy ensured a preeminent navy operated aggressively to assert control over trade routes and maintain free access for British manufacturers to the overseas 'undeveloped' markets that were under either direct or proxy colonial rule.[23]

Leadership in industrialisation, to the extent that it comprised a national monopoly, allowed the factory owners to produce large quantities of goods lower than the price of domestic production in the colonised lands, decimating the local producers, who in turn, were forcibly barred access to the British market. While the British navy remained dominant, and other European nations lagged in industrial development, Britain's economic growth and industrial production were unchallenged, and able to continue expanding at pace.

These conquered lands represented a market for British industrial manufacturers to export goods to and a source for the forceful extraction of labour and materials. Thus, the colonies yielded slaves and minerals, but also a range of plants for consumption, such as coffee and sugar, and for manufacturing transformation, such as rubber and cotton, all of which fed Britain's growing economy.[24]

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[22] Stefan Koppelkamm, *Glasshouses and Wintergardens of the Nineteenth Century* (London: Granada, 1981), 10-11.
[23] Eric Hobsbawm, *Industry and Empire: From 1750 to the Present Day,* ed. Chris Wrigley (London: Penguin, 1999), 26.
[24] Koppelkamm, *Glasshouses and Wintergardens of the Nineteenth Century*, 15.

The effects of these global market developments on a region such as Derbyshire, where Chatsworth is located, were multiple. On one hand the day-to-day life of the population in the countryside of the Derwent Valley would during this period have been transformed by what Eric Hobsbawm has referred to as the ‘commercialisation of rural life’. Where rural communities had up to this time been largely economically contained, and families had consequently been, to a significant degree, self-sufficient in what they consumed, the integration into the everyday life of the general population of a wide range of imported commodities, such as tea and tobacco, now brought them, on the side of consumption, into a market economy.[25]

On the other hand, the lives of the rich were also being transformed, and the age-old wealth and privilege of the English landed aristocracy, preserved through the system of peerages, was joined by the new wealth of international trade and commercial enterprise. The great glasshouses of the age, constructed by both old and new wealth, resulted from, and celebrated, this transactional economy borne of colonialism, global trade, and industrialisation. Imports of exotic plants from overseas served as impetus for Victorian glasshouses, made necessary to nurture the plants in their transplanted environment, but also to exhibit the botanical bounty of colonialism. Artificial environments were required that replicated the environments of the conquered lands. This act of environmental re-creation seemingly both enacted the capture of foreign land and suggested an idealisation of nature and the ‘exotic’.[26]

And through this idealisation there was certainly a broader sense of a representation of the Garden of Eden, a paradise of man’s, rather than God’s, making.[27] While the plants for these reconfigured Edens were obtained at cost through, in turn, travel, conquest and trade, the artificial environments that preserved them were also only achievable at great expense, not available to earlier generations. The glass constructions that housed the plant collections were realised through expensive new material processes achievable through industrial production, while the climatic environments that maintained them were only achievable through the coal that was now being extracted from nearby mines and was burned at scale in the creation of heat.

[25] Hobsbawm, *Industry and Empire,* 6.
[26] Georg Kohlmaier, *Houses of Glass: A Nineteenth-Century Building Type.* ed. Barna von Sartory. (Cambridge, Mass: MIT Press, 1986), 14.
[27] Mark Pimlott, *The Public Interior as Idea and Project* (Prinsenbeek: Jap Sam Books, 2016), 32-35.

Early orangeries were often heated by a visibly located iron stove, resulting in the use of ‘stove’ as a common name for the building type. However, later developments of increasing complexity required a much greater heating capacity, and this became fully integrated into the structures’ design.[28]

Paxton, and his patron, Cavendish, were directly involved in these developments and from the 1830’s the two men enthusiastically expanded Chatsworth’s horticultural collections towards the exotic. Following the fashion for collecting rare plants, a symbol of status amongst the wealthy, in 1833 the duke purchased his first orchid, *Oncidium papilio*, for £100, and soon after acquired a collection of *Orchidae* for £500, a great sum at the time. With their enthusiasm lit, in 1834 Paxton constructed Chatsworth’s first orchid house, a glasshouse dedicated to the duke’s growing collection, and in 1835 organised an exploratory expedition to India. With the intention of obtaining a wide selection of plants, but particularly focussed on acquiring orchids from the Himalayan foothills beyond Assam, the voyage was enormously successful. It eventually returned in 1837 with reportedly over seventy or eighty orchid species new to Britain, making the duke’s collection at that point the greatest in Britain.[29]

While the orchids were small and delicate, many of the most valued exotics were of great scale, particularly the palms and giant lilies that each held a special place in nineteenth century botanical collections. More expansive spaces were needed to house ever-larger specimens, and a sense of showmanship and spectacle became associated with these symbols of a transplanted Eden.

The buildings were subsequently located away from the working kitchen gardens and integrated within the ornamental landscapes of the aristocracy. In his *Magazine of Botany*, Paxton theorised the buildings’ placement in stylistic terms, suggesting the larger glasshouses not be associated with kitchen gardens, as they were so different from the residences in style and material that any simultaneous views or perception of the two together would be entirely incongruous,

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[28] Hix, *The Glasshouse*, 29-41.
[29] Colquhoun, *The Busiest Man in England*, 55, 74-77.

> One of the most prominent preliminaries to the erection of a conservatory, or a group of plant-houses, is the choice of a suitable site… there is a kind of edifice, which may be of a character totally opposite to that of the residence, that requires a more complete and decided isolation, and must be situated in a spot where its own influence alone can be felt, and where it is quite unassociated with buildings of another description. This class includes the conservatory, in all its numerous varieties.[30]

But the siting of these large new structures apart from the main houses of the wealthy could also be understood in relation to their inherent theatricality. For these were not extensions of the private realm, but were social spaces, designed for public entertainment.[31]

The 'Table' and the 'Tablecloth'

In 1835 Paxton started working on a project of an altogether different scale to his earlier structures and set apart from both the kitchen gardens and the main house of Chatsworth: The Great Conservatory, more commonly known as the Great Stove. Construction started in 1836, and was largely complete in 1840, with final works following in 1841. The building was conceived on an entirely unprecedented scale, its huge span preceding both the larger glasshouses of Kew, and the great train stations of the age. The most obvious precedent would instead be the earlier published but unbuilt designs of J.C. Loudon in 'Sketches of Curvilinear Hothouses,' and more immediately, the Jardin des Plantes conservatories, completed in 1833: a series of glasshouses, both rectilinear and curvilinear, that Paxton had visited with the duke in 1834.[32]

The Great Stove's layout was simple, a rectangular plan of 277 feet by 123 feet, and 67 feet high, with a route along the centre, wide enough to accommodate a carriage, crossed midway down its length by a narrower route, the *Musa Avenue*. To accommodate the great

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[30] Joseph Paxton, "Garden Architecture," *Paxton's Magazine of Botany,* no. 8 (1841): 183.
[31] Isobel Armstrong, *Victorian Glassworlds: Glass Culture and the Imagination, 1830-1880* (Oxford: Oxford University Press, 2008), 183.
[32] J.C. Loudon, *Sketches of Curvilinear Hothouses* (1818) reprinted in Kohlmaier, Georg. *Houses of Glass: A Nineteenth-Century Building Type* (Cambridge, Mass: MIT Press, 1986), 141-142.

size of the planned specimen trees, the volume was configured as a central nave with side aisles, each of these with a curved roof form. The glazed structure was on a sandstone wall that provided a basement for concealed services. Paxton's design implemented the various developments he had innovated to that date: the profiled sash bars, the ridge-and-furrow roofing profile, and the Paxton gutter. While he had already developed and built the profiled roof forms to improve light transmission, he had also written on the advantages of curved roof forms in presenting a glazed façade that followed the sun's trajectory through the day.

Prompted by the spans involved, Paxton now looked to combine the ridge-and-furrow principle with a great curving roof, suggesting the combination would result in the optimum admittance of sunlight. While performance improvements had previously been all, and his descriptions at this stage were still largely technical, the aesthetic now enters his vocabulary, with Paxton remarking that, 'Nothing need be advanced regarding their greater beauty, as it is universally conceded that a curved line is more elegant than a straight and angular one.'[33]

The results were spectacular: the combination of a curvilinear overall form and the ridge-and-furrow roof profile gave the building a remarkable and distinctive appearance, combining grandeur and fragility in a manner both prescient and unprecedented (fig. 3).

Indeed, the significance of both the leap in scale and the introduction into Paxton's constructional grammar of a curved roof, were clearly understood, for following the initial design, a smaller forcing house of 60 x 26 feet, with an elliptical roof, was developed in 1836 as a prototype.[34] This 'stove', used for 13 years following construction as a lily house to accommodate the *Victoria Regia*, was constructed with a similarly curved roof structure of laminated ribs. The rafters were formed by nailing together a series of wood boards, set on templates, and cut to the required profile.[35]

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[33] "The Industrial Palace in Hyde-Park," 385.
[34] At about the same time Paxton also designed a large palm house in Hackney for the Loddiges Brothers nursery that incorporated a curved roof formed of wood. Chadwick, *The Works of Sir Joseph Paxton,* 77.
[35] "The Industrial Palace in Hyde-Park," 385.

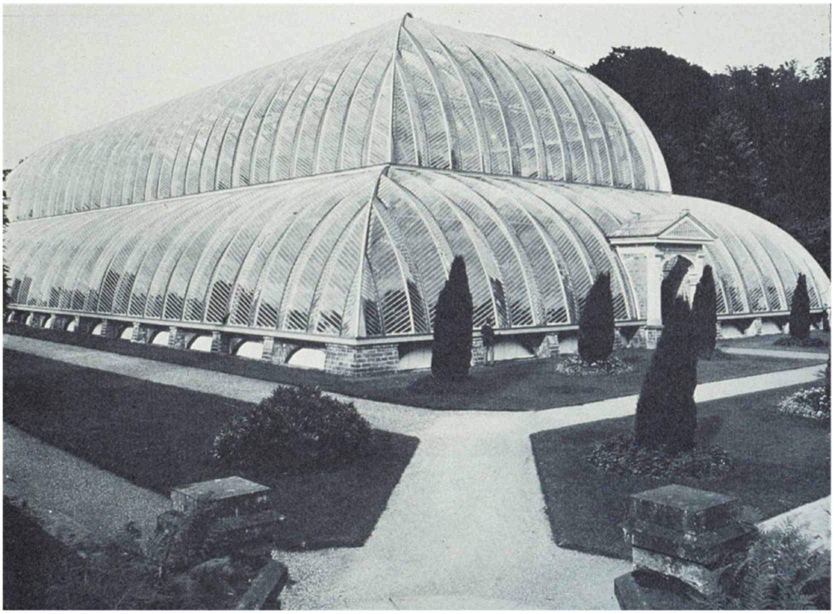

Figure 3. The Great Stove, Chatsworth.

In accordance with Paxton's lifelong preference, the Great Stove was primarily a wooden structure, comprising the curved timber rafters, which as per the ridge-and-furrow principle also incorporated curved gutters, and timber sash bars (fig. 4).

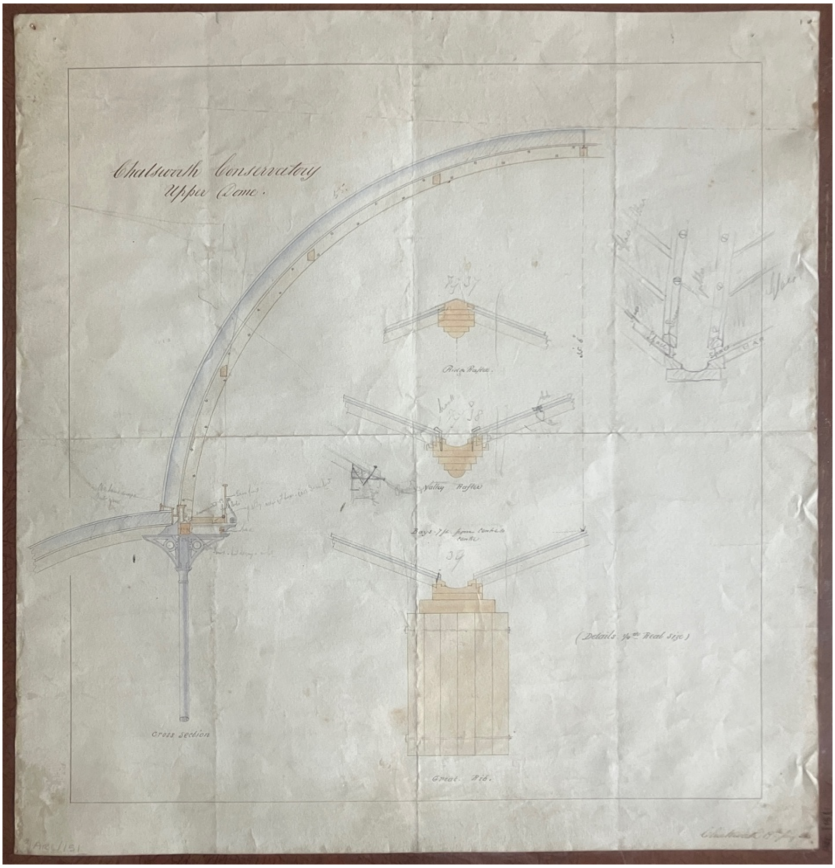

Figure 4. The Great Stove, Chatsworth, Section and details, signed Decimus Burton. Devonshire Collection Archives.

A similar principle was utilised on the larger roof as in the smaller prototype ‘stove’, Paxton later writing:

> The difficulty that has heretofore beset the builder in making strong curved rafters of solid wood, of any considerable length and size, has been the impossibility of warping them, and having them, concurrently, of an adequate power to resist a given pressure from, without. This has been overcome by the employment of numerous long thin pieces of wood, cut to the required width, and, after being bent and attached to a frame of the proper curve, nailed and braced to each other till the desired thickness is attained. Rafters thus formed are found to be even stronger than solid ones.[36]

The Chatsworth accounts record a trip by Paxton to Hull in 1836 that appears to be associated with the wood selection, Hull at the time being the main port for the import of timber from the Baltic. Further entries record both the carriage of ‘Riga timber’ in 1837, and in 1838 to a series of carpentry firms – John Wildgoose & Co., Francis Staley & Co., Horatio Egginton & Co., George Siddal & Co. - for making the ribs.[37] It appears then that the majority of the timber used was Riga Deal, imported from the Baltic to Hull, although elsewhere Paxton does note that some oak was also used.

Paxton also broke new ground with the building’s glazing. In the decades up to the 1830’s, glass in England was predominantly produced using the crown process, where glass was blown to a spherical form, then spun to create a stretched and flattened disk of glass. This production method resulted in a thin surface that was relatively clear but slightly distorted by a thickening in the middle. It also resulted in significant wastage in the cutting of square windows from a circular pane.

Nevertheless, in England the crown system was generally preferred to the traditional German cylinder process that blew glass cylinders, which were cut and flattened, as this method resulted in much thicker glass. The Glass Excise Tax, distinct from the approximately contemporary Window Tax, and in place from the 1740s, was levied

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[36] Paxton, “Garden Architecture,” 255.
[37] George Chadwick, “Paxton and the Great Stove,” *Architectural History,* no. 4 (1961): 85.

based on weight, and due to its relative thinness, the glass produced by the crown process was deemed more cost effective.

The Glass Tax inhibited the development of glazing technology in England at this time, during which French glazing manufacturers were making important advances to the cylinder production process, and glass sizes therefore were limited by the circular geometry of the crown production process. The relatively small sizes of glass obtainable in Britain, combined with the logic of single span structures, meant the overlapping of glazing units in glasshouse roofing was inevitable. Paxton knew that over time this overlapping resulted in stained joints and a reduction in light admittance and was keen to develop a way of avoiding this.

Based in Smethwick, near Birmingham, the glass manufacturers Chance and Hartley had to this time been producers of crown glazing but travelled in 1830 to France to study the latest cylinder process. They returned and converted one of their buildings to the new process, from then known as the ‘French House’, producing their own cylinder glass in 1832 by employing several skilled French workmen, who were reportedly averse to sharing their specialist skills.[38]

At the time when Paxton visited Smethwick in 1836, the largest glass obtainable through the crown technique was twenty-two inches long, but Chance had managed three feet long sheets by the cylinder process. Paxton, as ever sensing a technical opportunity, pushed for a yet larger four feet unit. Tests proved this was possible for the first time, and the larger sheets were ordered.[39]

Chance and Hartley’s new method produced cylinders of four feet by 30 inches, which were cut into thirds, providing three sheets of four foot by 10 inches; in total they provided 55,988 feet of glass to Paxton for the Great Stove.[40]

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[38] Paul Hollister, “The Glazing of the Crystal Palace,” *Journal of Glass Studies*, no. 16 (1974): 100.
[39] The length of four feet was provided by Paxton himself in his 1850 lecture to the Society of Arts. However, J.C. Loudon, on visiting the conservatory during construction, suggests the panes to be ‘3 ft.9in. in length, and 6 in. in width.’ J.C. Loudon, *Gardening tours by J.C. Loudon 1831-1842*.
[40] Hollister, “The Glazing of the Crystal Palace,” 102.

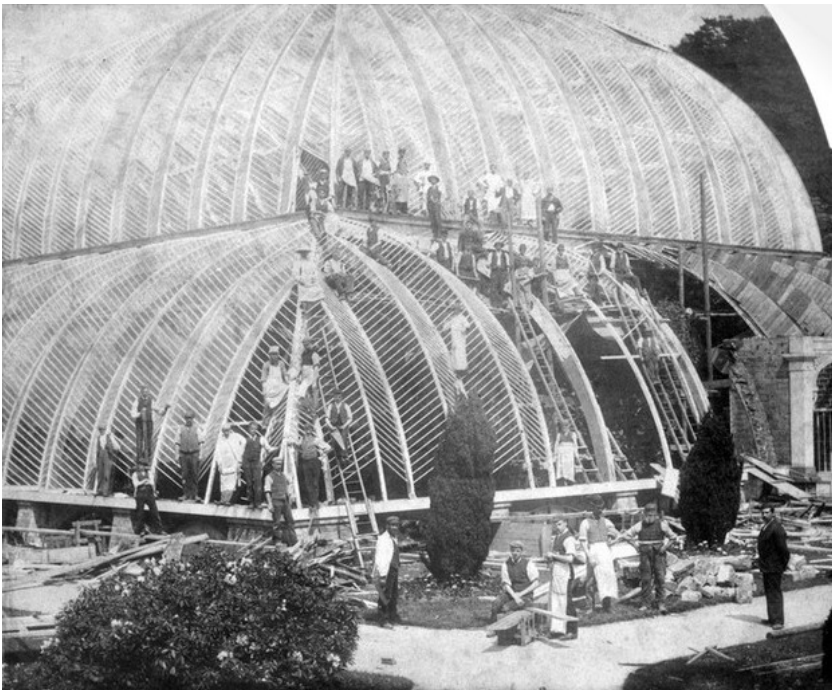

Figure 5. Repair work at the Great Stove, Chatsworth (Photograph from late nineteenth century).

Combined with the principle of the ridge-and-furrow roofing, the larger glass units Paxton obtained from Chance could span between top and bottom of the roof profiles, obviating the need for any overlapping whatsoever, while the same principle also permitted the use of flat glazing sheets to produce a curvilinear roofing form (fig. 5).

Up to this time Paxton's experiments had been of a scale such that the timber elements could act as the primary structure in a single span, initially as sash bars able to span onto the masonry wall of a forcing frame, and later as the Paxton gutter in a single span within the larger glass houses.

This was no longer possible at the scale of the Great Stove, and here an independent iron system was formed which supported the secondary timber structure. Cast-iron columns connected to a cast-iron ring beam, this metal framework supporting both the upper ends of the smaller wood ribs of the side aisles, and the larger wood ribs of the main span (fig. 6).

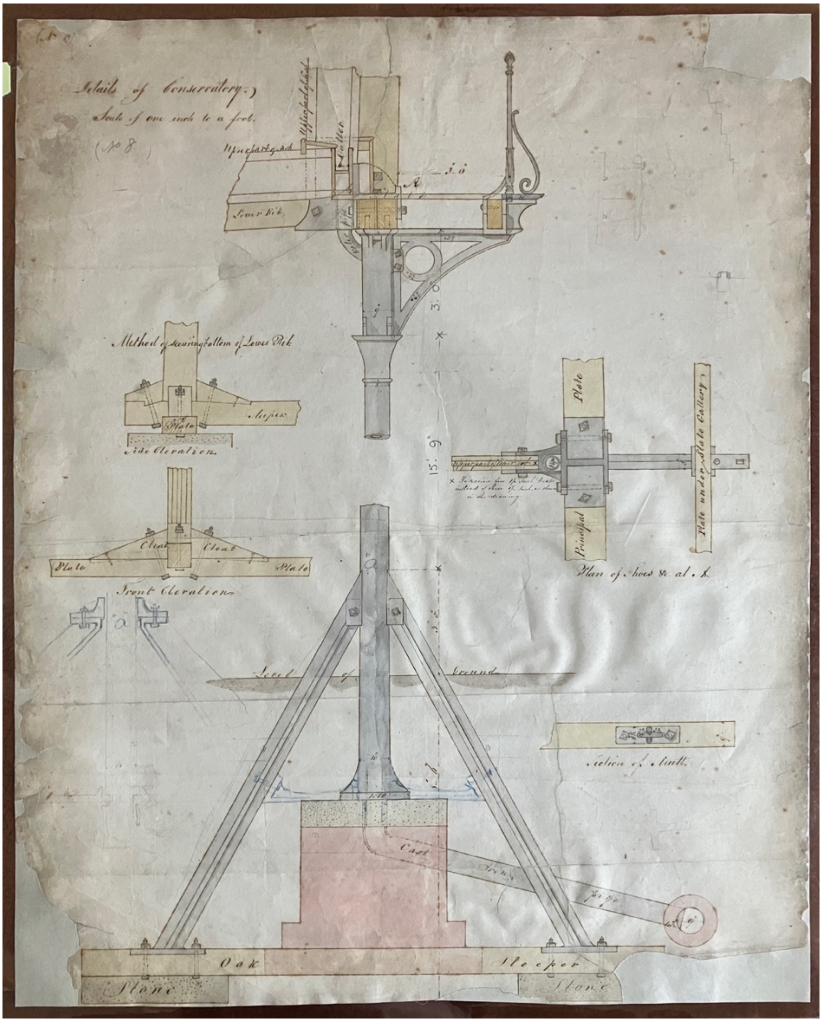

Figure 6. The Great Stove, Chatsworth, Hollow cast iron column detail, signed Decimus Burton. Devonshire Collection Archives.

The iron and timber systems operated independently and were later characterised by Paxton as the 'Table' and the 'Tablecloth'. In this analogy Paxton suggested that his system of timber glazing, providing secondary structure, protection from rain, and water collection, as the 'Tablecloth', was sufficiently flexible to cover any primary structural configuration, or 'Table'. In a similar manner to the way the Paxton gutters provided both structural support and drainage, the hollow cast-iron columns doubled as drainpipes, while the ring beam doubled as gutter. In turn, the rainwater was fed from the columns to a cistern at the base of the conservatory for future use, the structural framework – from timber Paxton gutters to Cast-iron ring beam to hollowed columns - thus collecting rainwater for irrigation, rainwater having an advantageous pH for plants.[41]

While the Great Stove was heated at enormous expense, considerable effort was expended on making the servicing invisible. This was, after all, a vision of paradise that nevertheless had to survive cold English winters, and key to this environmental theatre were the nearby mines of Derbyshire. That Chatsworth was in the Derwent valley was clearly fortuitous, this birthplace of the Industrial Revolution rich in the coal that was eagerly mined throughout this period to fuel the factories and steam trains of the age.

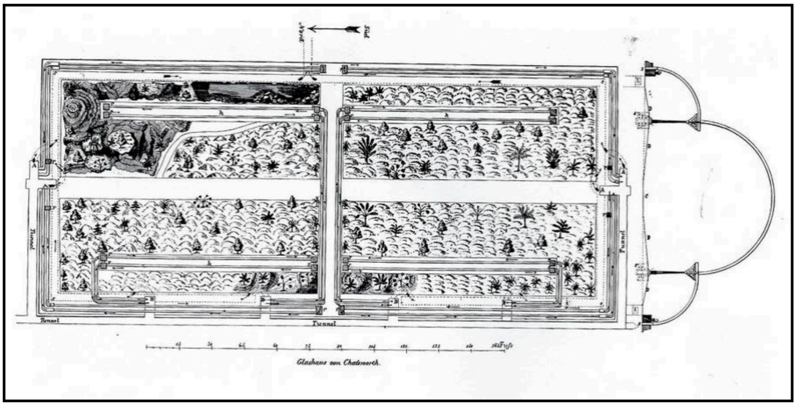

Figure 7. Plan of the Great Stove heating system. Devonshire Collection Archives.

[41] Hix, *The Glasshouse*, 45.

The glass structure of the Great Stove sat on a semi-basement, built with sandstone walls, that housed eight hot water boiler furnaces, these feeding a network of pipes providing heating to the space above (fig. 7). To maintain the illusion of effortlessness, one tunnel into the basement allowed regular supplies of coal for the boilers via wagons on an underground tramway: the boilers reportedly using a tonne of coal a day.[42] Meanwhile a second below ground tunnel took smoke out and up the adjacent hillside to a chimney hidden in the surrounding woodlands, the sandstone walls and hillside flue still evident on site today. Paxton was aware of the relationship between the import of non-native plant specimens and the requirement to manage artificial environments, noting in the *Magazine of Botany*:

> We talk of climate, country, and natural habits, and propose to study them as tutors. The curious in botanical and physiological research do well to indulge in these inquiries; but they are not essential to the practical English gardener. To him experience and observation of results will afford the surest guides on which to found a theory for, as every imported exotic is at once placed in a situation, which in no respect corresponds with that from which it was removed, its future prosperity must depend upon artificial appliances.[43]

Beneath this majestic glass and timber structure, plant specimens were arranged geographically rather than in relation to any botanical taxonomy, and to complete the sense of theatre, silver fish swam in water pools, while exotic birds flew overhead. The spectacle of the Stove was shared with both Royalty and the common man. In December 1843 Queen Victoria visited Chatsworth, and Paxton oversaw a grand performative spectacle: lights lit up all the fountains and waterfalls in choregraphed splendour, while the Great Conservatory was hung with thousands of lamps. The Queen and Prince Consort were carried by horse drawn carriages through the central avenue, designed for this width by Paxton with such largesse in mind. But Paxton, as well as enthusiastic Royalist, was always the alert propagandist, and the gardens and Conservatory were also open to public visitors, and readily accessible to the masses through the fast-developing rail network (fig. 8).

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[42] Musgrave, *The Head Gardeners,* 51.
[43] Paxton, "Gardening as a Science," 10.


136 THE ILLUSTRATED LONDON NEWS. [August 31, 1844.

THE GREAT CHATSWORTH CONSERVATORY.

THE EXTERIOR, FROM THE ITALIAN TERRACE.

mates—the Italian cats, from the mountains near Rome—and the gems and crystals—combined with the rocks and seats—render the grand Chatsworth Conservatory the most luxuriant place yet raised in this country.

Around the Conservatory, beneath the building, is a railroad tunnel for the conveyance of fuel to the stoves, and for the removal of the ashes, &c. The plan of watering adopted is most efficacious: the building is supplied from the immense reservoirs on the hill, pipes being laid all around the interior, and the gallery, to various parts of which a rose hose can be fastened, throwing a jet of 80 feet in as complete and natural a shower as the leafy inmates could get in their natural open-air situations. The whole of the design, arrangements, and management of this splendid pile are under the direction of Mr. Paxton, head gardener to his Grace the Duke of Devonshire, whose "Magazine of Botany," and other works, are so well known.

THE INTERIOR, FROM THE CENTRAL WALK.

Figure 8. The Great Stove, Illustrated London News (1843)

The Machine for Making Sash-bars

The design of the Great Stove was a culmination of the various innovations at Chatsworth of the previous years, yet while its form and construction suggested nothing that Paxton had not already explored, the sheer size of the building did lead to an extremely significant shift in how these structures were realised and conceptualised. Until the abolition of the Glass Tax in 1845 by Sir Robert Peel, building conservatories at this extraordinary scale was prohibitively expensive and, despite the great wealth of his employer, Paxton turned his mind to reducing costs. While his earlier developments had looked at reducing material usage and enhancing design efficiency, he now looked at opportunities to reduce labour costs, specifically focussing on the number of sash-bars necessary for a glass construction of such magnitude.

In his analysis that focusses on the finances of the project, *Paxton and the Great Stove*, George Chadwick suggests, ‘The story of the Great Stove commences in the Chatsworth Accounts with an entry on 12 January 1836: John Marples - for making the Model - £38 I5 0.’[44] But it appears that before Paxton had even got to this stage, he was considering how to radically re-think the project’s construction to save money.

Paxton, through the Duke of Devonshire, had around this time purchased a steam engine from the renowned engineering manufacturers Boulton and Watt, of Smethwick, near Birmingham, the partnership between the manufacturer Matthew Boulton and the engineer James Watt, who had developed the greatly improved steam engine in 1776 that was so instrumental to the Industrial Revolution. The firm’s records show that a 3-horsepower steam engine had originally been ordered by another company, Joseph Clarke & Sons, and a detailed drawing of the engine was subsequently produced for this order in January 1835.[45] (Fig.9)

[44] Chadwick, "Paxton and the Great Stove," 82.
[45] In his correspondence with the Society of Arts leading to the award of the Silver Medal, Paxton notes the steam engine to be ‘four and a half horsepower’, and it is unclear whether this is incorrect, whether the engine was increased in output between order and delivery, or replaced by a larger machine, although there is no record in the Boulton & Watt order books of a second engine having been ordered. “Plans for a 3 horse power engine for Joseph Clarke & Sons,” January 1836, Boulton and Watt Collection, Library of Birmingham, MS 3147/5/1349/b.

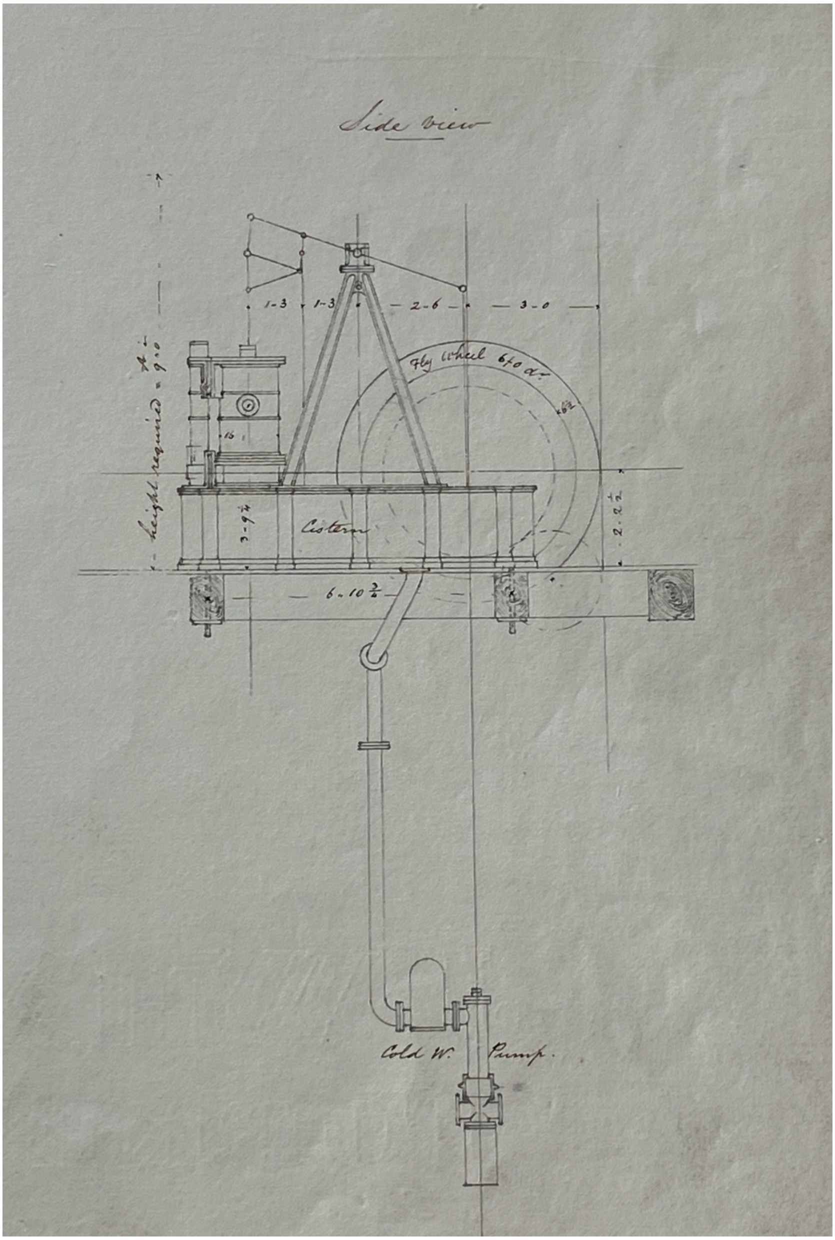

Figure 9. Boulton & Watt Steam engine drawing for Chatsworth, Original order. (1835).
Boulton & Watt Collection Archives.

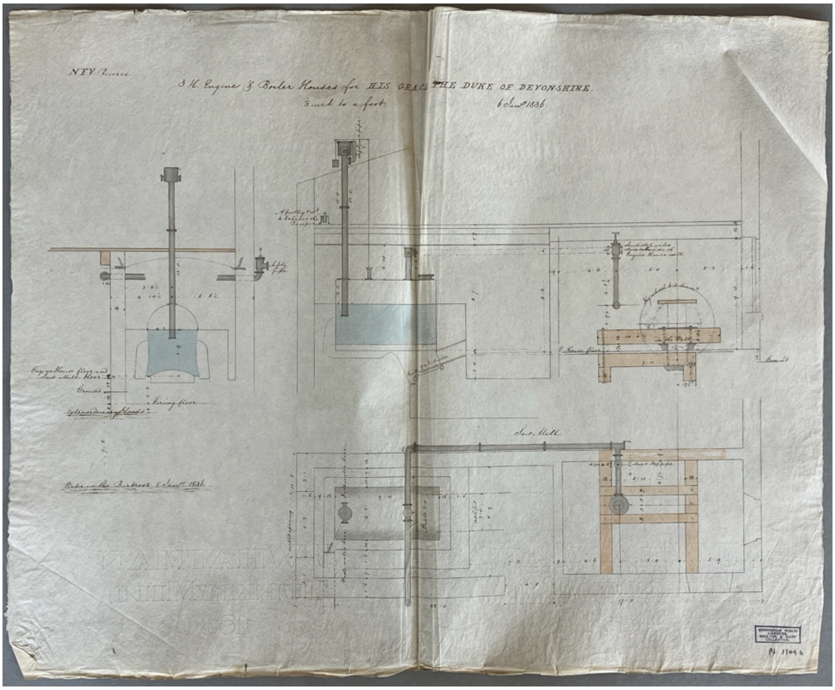

Figure 10. Boulton & Watt Steam engine drawing for Chatsworth, installation drawing (1836). Boulton & Watt Collection Archives.

However, the engine was eventually sold to the Duke of Devonshire,[46] and in January 1836 Boulton and Watt produced drawings (fig. 10) for how this same steam engine should be installed at the sawmill near Chatsworth, on the river Barbrook, a tributary of the Derwent.[47]

Paxton later recorded that in the following year, 1837, as construction commenced on the masonry foundation walls, he visited various workshops in London, Manchester and Birmingham, in search of a tool to assist in the production of the sash bars.[48] Finding nothing suitable, he purchased a grooving machine, which he installed at the Barbrook sawmill, and for two years experimented with how he might combine it with the steam engine effectively (fig. 11).

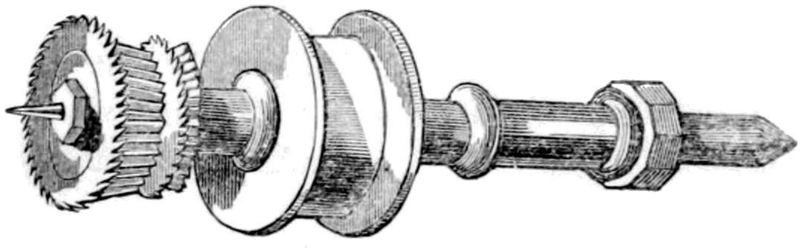

Figure 11. Cutters of the Sash-bar machine (1840).

[46] Order Book, Boulton and Watt Collection, Library of Birmingham.
[47] The Boulton and Watt Collection archives also document correspondence between Joseph Paxton (Chatsworth) and Boulton & Watt (Birmingham), with Paxton on 20 July 1836 writing, 'I shall be much obliged if you will send over Francis Wilcox to look at our steam engine – it has worked very irregular of late and makes a rumbling noise which we do not understand.' Joseph Paxton to Boulton & Watt, Letter, 20 July 1836, Boulton and Watt Collection, Library of Birmingham, MS 3147/3/451/16.
[48] "The Industrial Palace in Hyde-Park," 385.

The very adaptability of Watt's steam engine, such that it could be brought into combination with a variety of other machines was later identified by Karl Marx:

> The greatness of Watt's genius showed itself in the specification of the patent that he took out in April 1784. In that specification his steam-engine is described, not as an invention for a specific purpose, but as an agent universally applicable in industry.[49]

Eventually, in August 1838, Paxton's tests were complete, and he was able to use the machine on the glazing of the Conservatory's glass and timber covering. The sash-bar machine was operated by a single man and a boy and produced 500 bars of 1.2m length each day. In total 40 miles of sash bar were produced for the building using this machine, reportedly saving £1,200. In comparison Paxton reported the cost of his machine as £20, though it is unclear whether this price included that of the steam engine or was just for the grooving machine. He also suggested the machine, including attendance, cost just 5s a day to run.[50]

In its first simpler version, the machine only produced the grooves to the sash, but Paxton continued improvements until the machine was able to produce complete bars. It worked through three sequential operations: firstly, timber planks – in the case of the Great Stove these were predominantly of Riga deal – were passed through the angled cutter, producing lengths of the basic profile. These lengths were then passed two times through a grooving profile, once for each face, to produce the detailed final form of the bars. The axle revolved 1200 times a minute, guaranteeing a fine finish. In recognition of this invention, and based on his two letters of March 1840, with accompanying drawing, that described the machine, Paxton was awarded the Society of Arts' Silver Medal for design and innovation in 1840 (fig. 12). In referring to the medal in his 1850 lecture, Paxton suggests that his invention was the very first of its sort, noting: '…this machine is the type from which all the sash-bar machines found in use throughout the country at the present time are taken.'[51]

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[49] Karl Marx, *Capital: A Critique of Political Economy: Vol. 1.* ed. Ernest Mandel (London: Penguin, 1990), 499.
[50] Paxton, "No. XIV. Machine for making Sash-bars," 99.
[51] "The Industrial Palace in Hyde-Park," 385.

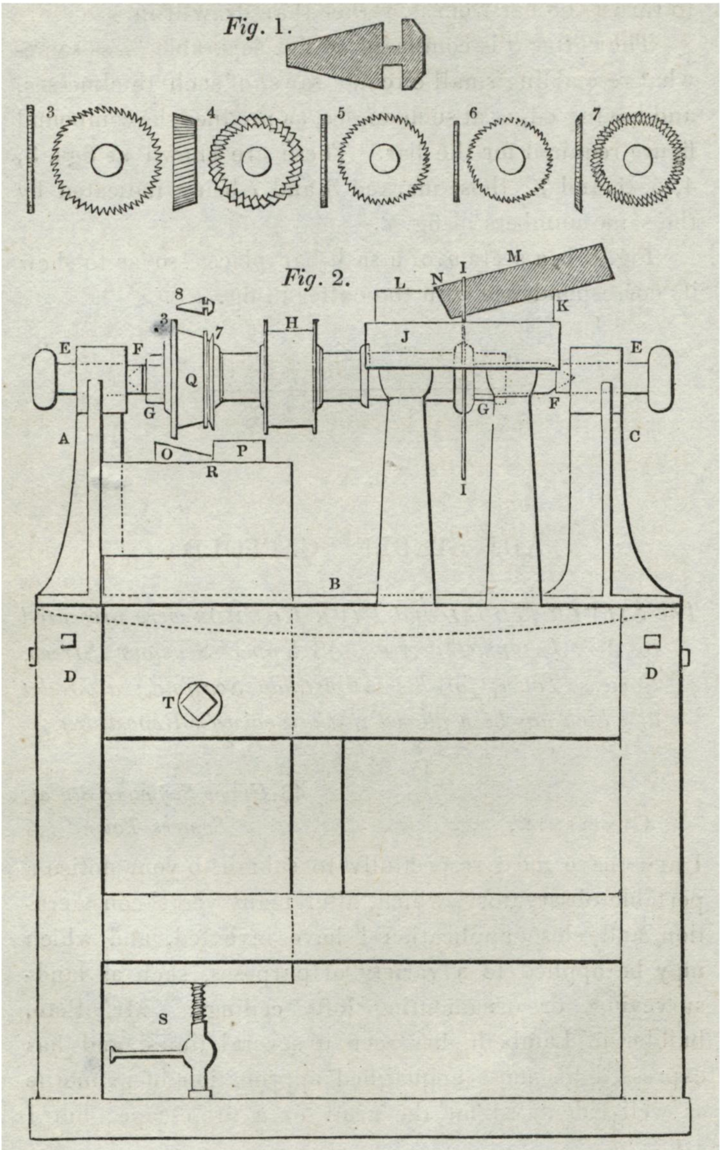

Figure 12. Machine for making sash-bars. Accompanying drawing to Paxton’s letter to the Society of Arts. (1840).

In his correspondence leading to the award, Paxton begins his first letter explaining the invention, not in terms of improved technical performance, but in relation to the quantity of labour used in the production of the building:

> Chatsworth,
> Derby,
> 13th March, 1840.
>
> Gentlemen,
> I beg to submit to your notice the accompanying drawings and description of a machine for making sash-bars, which is in use at this place, and an account of which has not yet been published.
>
> In constructing the great conservatory recently built here for His Grace the Duke of Devonshire, it was found desirable to contrive some means for abridging the great amount of manual labour that would be required in making the immense number of sash-bars necessary for a glass construction of such magnitude.[52]

Significantly, in his second letter of clarification of 31st March 1840, it becomes apparent that not only is the quantity of labour reduced, but also that the type of labour is transformed, as Paxton identifies the unskilled nature of the work involved, stating: ‘The attendants required for the machine are only a *labouring* man and a boy.’

[52] Paxton, “No. XIV. Machine for making Sash-bars,” 97.

Estate records (fig. 13) from the time of construction provide a list of workers involved in the Great Conservatory.[53]

As well as six sawyers attributed to the project, this list includes five joiners, noting that they were working at the kitchen gardens on making the ribs for the structure, by contract. This was evidently a problematic area of the construction as the account books of the time identify payments during 1838 to four separate companies for works producing ribs for the project.[54]

Also identified within these records are three workers at the Sawmill, associated with work both for the Conservatory and for the gardens. The first two of these workers are clearly the labouring man and boy noted by Paxton as operators of the machine for making sash-bars: John Downs and George Frost, the latter noted as ‘a boy’, and both from the nearby village of Beeley, that was set within the Chatsworth Estate and under the Sixth Duke’s ownership.

The last listed name in this section is George Heathcote, from the village of Baslow, who is recorded as attending to the engine. A labouring man, John Downs, was employed by the duke, and by proxy by Paxton, rather than a carpenter, because he would have earned much less, and a boy, George Frost, employed rather than a second labouring man, as he would have earned still less.[55]

The intention of Paxton’s machine here becomes apparent, rather than ‘abridging the great amount of manual labour that would be required’, or indeed, ‘saving labour’, the sash-bar machine had a threefold impact: firstly it removed the process of production from the immediate building site, secondly it greatly reduced the number of employees required, and finally, it exchanged the employee required from that of skilled carpenter to unskilled labour and child labour.

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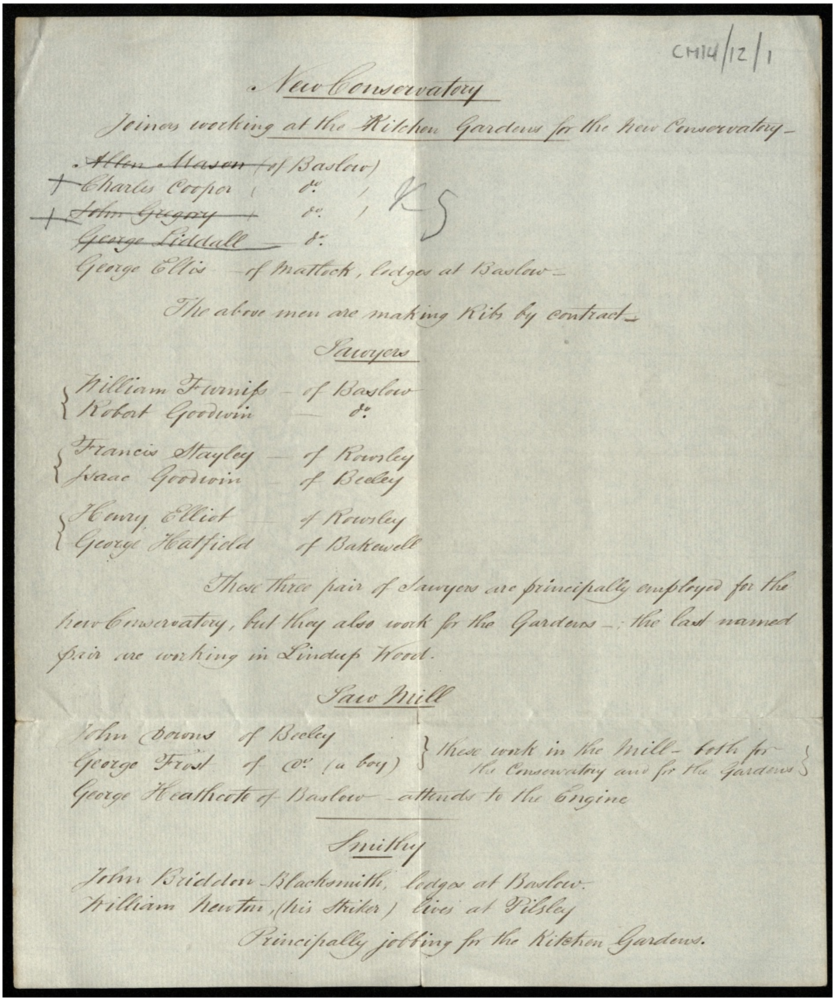
[53] “List of joiners working at the kitchen gardens for the Great Conservatory,” c.1838, Devonshire Collection Archive, Chatsworth, CH14/12/1.
[54] Chadwick, "Paxton and the Great Stove," 85.
[55] E.P. Thompson suggests the following difference between skilled and unskilled wages in 1832, ‘The disparity between the wages of an engineer (26s. to 30s.) or carpenter (24s.) and the spademan (10s. to 15s.) or weaver (say 8s.)’
E. P. Thompson, *The Making of the English Working Class* (London: Penguin, 1991), 346.



CH14/12/1

New Conservatory

Joiners working at the Kitchen Gardens for the new Conservatory –

~~Allen Mason~~ (of Baslow)
Charles Cooper (do.)
~~John Gregory~~ (do.)
~~George Liddall~~ do.
George Ellis – of Matlock, lodges at Baslow –

The above men are making Ribs by contract –

Sawyers

William Furniss – of Baslow
Robert Goodwin – do.

Francis Stayley – of Rowsley
Isaac Goodwin – of Beeley

Henry Elliot – of Rowsley
George Hatfield – of Bakewell

These three pair of Sawyers are principally employed for the new Conservatory, but they also work for the Gardens – ; the last named pair are working in Lindup Wood.

Saw Mill

John Downs of Beeley
George Frost of do. (a boy) } these work in the Mill – both for the Conservatory and for the Gardens
George Heathcote of Baslow – attends to the Engine

Smithy

John Briddon Blacksmith, lodges at Baslow.
William Newton (his Striker) lives at Pilsley
Principally jobbing for the Kitchen Gardens.

Figure 13. “List of joiners working at the kitchen gardens for the Great Conservatory,” c.1838, Devonshire Collection Archive, Chatsworth, CH14/12/1.

The Hour of the Machine

> At last the critical point was reached. The basis of the old method, sheer brutality in the exploitation of the workers, accompanied by a more or less systematic division of labour, no longer sufficed for the extending markets and for the still more rapidly extending competition of the capitalists. The hour of the machine had struck.[56]

In extending the territory of building production to incorporate the off-site facility of Barbrook sawmill, Paxton radically altered his own role in the process of construction, becoming increasingly divorced from direct involvement. Officially head gardener, and not yet recognised as architect, he was nevertheless becoming the distanced designer; associated with design conception and dictating the realisation by others in an increasingly abstracted manner.[57]

Work on the foundations had started in 1837, and while claiming in his later lecture to the Society of the Arts that 'the Conservatory was erected under my own immediate superintendence', Paxton was in fact, from October 1838 to April1839, abroad on a Grand Tour of Europe with his benefactor during a key nine-month period of the construction.[58]

Apparently, he kept in touch with progress through letters with his wife, Sarah, who appears to have actively monitored the works on site. It is relevant that this is the first of the many glasshouse projects undertaken under his direction for which there are recorded drawings in existence. The figurative distance created by the drawings between design and construction, between designer and builder, was it seems mirrored by Paxton's literal absence from the building site.

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[56] Marx, *Capital,* 601.
[57] Several others are known to have been involved in the development of the design, although the lack of full archival records and drawings had resulted in a certain degree of conjecture as to responsibilities. John Marples, a foreman carpenter employed on the estate, made a timber model of the project in 1835, predating any known design drawings, the only remaining evidence for this being a payment note in the Chatsworth accounts and a semi-concealed appearance in a painting from 1850 of 'The Royal Commissioner for the Exhibition of 1851'. The architect Decimus Burton was employed in relation to the project, and of the few design drawings in existence, four are signed by him. Yet, while there has been some dispute as to his possible authorship of the project, it appears more likely that they were produced by Paxton's assistant, the draughtsman Samuel Holden, and initialled only by Burton. Chadwick, "Paxton and the Great Stove: A Postscript," 106.
[58] Paxton, "No. XIV. Machine for making Sash-bars," 97.

More significant than Paxton's changing role, the sash bar machine indicates how the Industrial Revolution impacted building practice, revolutionizing production through the introduction of modern machinery and methodologies within the construction process. The sash-bar machine greatly reduced costs by reducing the labour required on the project, and traditional histographies of architecture have presented this as politically neutral, indeed with tacit approval. But in reducing labour costs the machine also changed the type of work undertaken, transforming operations from hand-crafted carpentry towards machine operation. In place of twenty skilled craftsmen, one of the country's richest men was instead able to employ an unskilled man and a boy.[59]

The construction of the Great Stove occurred during a time of historic social and political turbulence and tension. Hopes of freedom and enfranchisement in Britain were fomented by the French Revolution of 1789, and repressed throughout the Napoleonic wars, but after 1815 these aspirations determined the political agenda. Held on an unprecedented scale to demand democratic rights, the peaceful demonstration at Peterloo of 1819, was brutally quashed by troops with the loss of eighteen lives, while the defeat in parliament of the first Reform Bill resulted in a revolutionary crisis, and riots through 1831. The eventual passing of the Reform Act in 1832 was considered by radicals as a betrayal, a pact between the upper and middles classes, between the old wealth of the landed aristocracy and the new wealth of industrial capitalism. It denied the masses voting rights by associating democratic privilege with property ownership, in the process increasing the franchised share of the population from 10% to just 18%. The subsequent discontent coalesced and found direction through the formation of Chartism, and specifically the drafting of the People's Charter, that demanded universal voting rights (for men) in 1838, the same year that Paxton's machine first became operational.

This political crisis played out in the context of a social crisis resulting from the Industrial Revolution. The fortuitous significance of the geographical siting of Paxton's innovations is extraordinary: just a few miles from Chatsworth, along the Derwent Valley, that is considered

[59] Karl Marx notes, very much within the thesis timeline: 'It would be possible to write a whole history of inventions made since 1830 for the sole purpose of providing capital with weapons against working-class revolt.' Marx, *Capital*, 562.

the birthplace of the Industrial Revolution, lie the earliest mill buildings of the era. From the 1720s onwards John Lombe's first silk mill, and later in the century, the cotton-spinning mills of Richard Arkwright, utilising waterpower from the river Derwent, revolutionised manufacture towards the factory system. The first Industrial Revolution is broadly understood to have been the period from approximately 1760 to 1840, a time of unprecedented speed of change and innovation, of population growth, and of forced re-structuring of livelihoods. The 1830s was then a decade when the consequences of this explosive change were both considered and intensely felt, though from remarkably different perspectives. Key texts were published during this decade by proponents of free trade in defence of the factory system, particularly by Andrew Ure in 1835 and Charles Babbage in 1832.[60]

These writers extolled the efficiencies of the new capitalist mode of production, coldly recognising the transformative effect on labour, Ure, for instance. wrote:

> The principle of the factory system is, to substitute mechanical science for hand skill, and the partition of a process into its essential constituents, for the division or graduation of labour among artisans. On the handicraft plan, labour more or less skilled, was usually the most expensive element of production – *Materiam superabat opus*; but on the automatic plan, skilled labour gets progressively superseded, and will, eventually, be replaced by mere onlookers of machines.[61]

The inherent exploitation in the adoption of machinery within the factories is seen by these theorists, and yet not acknowledged as such, Ure going on to write:

> It is in fact, the constant aim and tendency of every improvement in machinery to supersede human labour altogether, or to diminish its cost, by substituting the

[60] Charles Babbage, *On the Economy of Machinery and Manufactures* (London: Charles Knight, 1832), 131-137.
[61] Andrew Ure, *The Philosophy of Manufacture or an Exposition on the Scientific Moral and Commercial Economy of the Factory System of Great Britain* (London: Frank Cass & Co., 1967), 20.

> industry of women and children for that of men; or that of ordinary labourers, for trained artisans.[62]

And yet for those involved, the exploitative work practices were very real. Unfettered by legislation, the employers saw no limit to hours of work, or the ages of workers, and it was only with the gradual implementation of a series of parliamentary Factory Acts that some limits were set. However, until the Factory Law of 1833, these previous acts had proven unenforceable, and consequently, laws, such as the limitation of a child's working day in a factory to a maximum 12 hours, had been largely unheeded, and these hours were widely exceeded.[63]

The relationship of technological innovation to this social crisis had been a focal point of protest in Britain two decades earlier. The Luddites, so-called as followers of the probably fictive 'General Ned Ludd', were textile workers opposed to the growing introduction of machinery within the mills. Popular history has unfairly assumed the term 'Luddite' as one who opposes technological progress per se, yet the story of these textile workers is more complex and suggests in truth a certain prescience regarding the operation and effects of innovation.

New machinery installed by the mill-owners had allowed employers to replace skilled textile workers with machinery that was operated within the factory system by unskilled labour at lower wages. The Luddites recognised that their immediate jobs were at risk, and with them their ability to feed their families. But they also saw an epochal shift with the introduction of a new social logic, where long-developed reciprocal bonds within a working community, as well as traditions of skill, were replaced by the primacy of profit at all human cost.[64]

The Luddites, based primarily in Nottinghamshire, Lancashire and Yorkshire, attempted lawful change to the practices, ensuring

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[62] Ure, *The Philosophy of Manufacture*, 23.
In, *The Making of the English Working Class,* E. P. Thompson, wrote of this dislocation of labour through labour-saving processes and innovation, *'Manufacturers in the first half of the 19th century pressed forward each innovation which enabled them to dispense with adult male craftsmen and to replace them with women or juvenile labour.*'
Thompson, *The Making of the English Working Class*, 248.

[63] Admonishing the apologists, Thompson writes, 'We may be allowed to reaffirm a more traditional view: that the exploitation of little children, on this scale and with this intensity, was one of the most shameful events in our history.' Thompson, *The Making of the English Working Class,* 384.

[64] Thompson, *The Making of the English Working Class,* 597.

safeguards to their security, but were frustrated at each attempt by lawmakers operating in tandem with the mill-owners. Finally, they broke into the mills at night and smashed the frame machines, not as a symbol of new technology, but with a clear understanding of how these new technologies were being deployed against them, were being weaponised by the operators of the capitalist factory system. The British State, in wholehearted support of the mill-owners, used troops to protect the factories, at one point reportedly deploying more troops against the British protesters than were currently deployed by Wellington fighting Napoleon.[65]

Unable to break the Luddites' resolve, parliament then introduced The Frame Work Bill in February 1812 which made frame-breaking a capital offense. Indeed, it was in unsuccessful opposition to this Bill that Lord Byron gave his maiden speech in the House of Lords, highlighting the injustice of punishing with a death-penalty those who had been reduced to desperation to protect their livelihoods:

> These machines were to them [the proprietors] an advantage, inasmuch as they superseded the necessity of employing a number of workmen, who were left in consequence to starve. By the adoption of one species of frame in particular, one man performed the work of many, and the superfluous labourers were thrown out of employment.[66]

The Luddites had recognised the challenge to the autonomy of craftsmen by the machines, the challenge to the ability to independently earn a living through skills that had been developed over time. Artisans previously retained autonomy through the mastery of their craft, the detailed knowledge of their trade, and through the ownership of their tools. This autonomy guaranteed a bond between conception and execution of work. All of this was broken by the processes of industrial capitalism, primarily the division of labour and the introduction of 'labour-saving' machinery.[67]

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[65] 'In the summer of 1812 there were no fewer than 12,000 troops in the disturbed counties, a greater force than Wellington had under his command in the Peninsula.' Thompson, *The Making of the English Working Class,* 617.

[66] Michael Foot, *The Politics of Paradise: A Vindication of Byron* (London: Collins, 1988), 399.

[67] 'They are called "labour saving" machines – a commonly used phrase which implies what we expect of them; but we do not get what we expect. What they really do is reduce the skilled labourer to the rank of the unskilled, to increase the number of the "reserve army of labour"- that is, to

The workers' accumulated skill was no longer required, the introduction of science to the labour process, and the ownership of the machinery, shifting the workers' autonomy towards a slavery to the machine. Critically, the development of technology was, and is, continual, and so too are its effects. Marx thus identified the way in which such changes in technology could not be viewed as isolated changes, to be accommodated by society, but were representative of an ongoing process: 'But in any case, since machinery is continually seizing on new fields of production, its 'temporary' effect is actually permanent.'[68]

Thus, in developing and refining his machine for making sash-bars, Paxton was not operating in a political or social vacuum as might be assumed by prevalent architectural histories, fixated as they are on the brilliance of his innovations. Rather, he was actively involved in a broader historical process, and played a significant role in bringing factory logic to the building site; he was a dynamic agent in the commercial practices at play, characterised by Harry Braverman as: 'the incessant drive to enlarge and perfect machinery on the one hand, and to diminish the worker on the other.' [69]

Labour-saving technological innovation was inextricably associated with deskilling; the skills of trained artisans that guaranteed livelihood and autonomy were no longer required, substituted by the precarity of low-skilled simple labour. Here the Industrial Revolution had been introduced to building practices, both in terms of the introduction of machines and machine-use to the construction site, and in the introduction of the logic of capitalist production.

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increase the precariousness of life among the workers and to intensify the labour of those who serve the machines (as slaves their masters).' Useful Work *versus* Useless Toil, in,
William Morris, *News from Nowhere and Other Writings* ed. by Clive Wilmer. (London: Penguin, 1994), 304.

[68] Marx, *Capital,* 558.

[69] Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century* (New York: Monthly Review Press, 1998), 134, 157.

Afterword

The construction system that Paxton developed up to the Great Stove underwent one final refinement at Chatsworth. After a rare Victoria Regia giant water lily acquired in August 1849, had rapidly outgrown the glasshouse it had been placed within, the prototype elliptical stove, a new home was constructed to house it, the Victoria Regia house. Once again, as with the Great Stove, the timber glazing system was of a secondary structural order, supported on a light framework beneath of iron construction, but here the roof was flat, with the pitch of the ridge-and-furrow roofing providing for drainage. The Victoria Regia house, described as a 'diminutive structure' by Paxton, was completed in early 1850, and this became the model for the first version of the much larger Crystal Palace, designed in July 1850. Public concern over two existing elms on the Hyde Park site, that had not been recognised in this earliest design, led to a revised scheme with a barrel vault of curved timber trusses, as per the Great Stove, accommodating the height of these trees.

While most of his Chatsworth projects were constructed at great cost, and all funded by the duke's wealth, the extraordinary ambition of Paxton's vision for the Crystal Palace was only possible following the abolition of the Glass Tax by Prime Minister Peel in 1845. The elimination of tax and high import duties increased importation of French glass, transformed the domestic market both technically and towards larger producers, and resulted in much lower glass prices, such that glass construction was no longer a symbol of wealth, but could be embraced as a material for the masses.[70]

Following the initial work in 1850 for the Hyde Park project, but before the design had been published, Paxton was encouraged by his colleague Robert Chance, supplier of glass to these projects, to patent the design of the 'tablecloth'. Just days after Paxton's patent submission for 'Certain Improvements in Roofs,' his Crystal Palace designs were made public (fig. 14). While Paxton is often perceived as an innovator of iron and glass constructions, the great majority of his work was in fact carried out in wood, and the 'tablecloth', as expressed in the Patent drawings of 1850, was of timber and glass.[71]

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[70] Kohlmaier, *Houses of Glass*, 46.
[71] Joseph Paxton, *Patent specification for roofing improvements*. Submitted by Paxton 1850, enrolled by the Patent office 22 January 1851, printed by Eyre and Spottiswoode 1857.

The patent expresses a construction methodology where structural integrity, drainage and weather protection are integrated into a single system. As such, it represented the conception of an independent and standardised cladding system, free from compositional articulation, that could cover any form of structure in a potentially limitless manner. Rather than a specific building form, it is a system that represents a building process of serial production of repeated standardised components.[72]

The way the fabrication of a standardised system was subsequently conceptualised, as represented by the patent, transformed the idea of building as *craft-made* to building as *system*, and transformed the relationship of labour to construction. Relating directly to the remarkable Great Stove, the small and delicate Victoria Regia house and to the unprecedented scale of the Crystal Palace building for the Great Exhibition of 1851, the patent was also open-ended in its application.

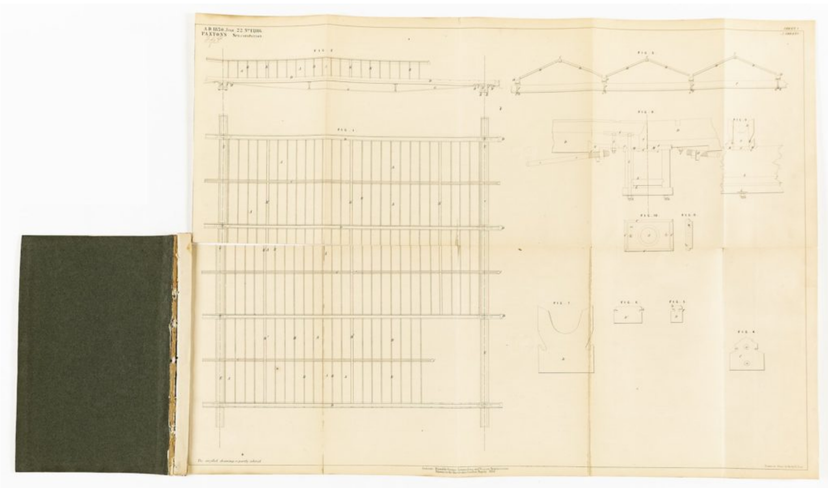

Figure 14. Sir Joseph Paxton, Patent specification for roofing improvements. Submitted by Paxton 1850, enrolled by the Patent office 22 January 1851. Drawing Matter Collection.

[72] Kenneth Frampton, *Modern Architecture: A Critical History*, 5th edition (London: Thames and Hudson, 2020), 34.

The Crystal Palace itself lies outside the scope of this study, although two incidents from its construction are relevant to the story of the Great Stove and Paxton's labour-saving machine. While the Great Stove can, among other interpretations, be understood as a spectacle of colonial exploits, the Crystal Palace is widely regarded as a celebration of both global free trade and capitalist consumption.[73]

But as well as the spectacle of the contents within the completed building, there was also a sense of popular spectacle associated with the construction process. Very few drawings exist of the Great Stove, and none by Paxton's hand, but there are a great many drawings of the Crystal Palace. Most famously there is Paxton's acclaimed early blotting paper sketch of 7th June 1850, the swiftly drawn vision, produced while distracted in a meeting, that encapsulated the key elements of the final design. There are also the extensive construction drawings, executed at haste by Fox and Henderson, the contractor of the project, before works on site commenced.

Significantly, the project was also depicted throughout the period of erection in a series of drawings published in the popular Illustrated London News. These drawings were executed by the artist Edward Duncan, a watercolourist who, from 1843 to 1851, was employed by the newspaper, and illustrated the construction site labour at work, presenting to the public the unprecedented wonder of a building of such scale being produced at such pace. The drawings clearly celebrate not the construction workers themselves, but the machines they can be seen to operate, essential to the production and erection of the great structure (figs.15 & 16).

In the short time since the construction of the Great Stove, numerous machines were now integrated within the process, and while they were predicated on Paxton's sash bar machine, for the Crystal Palace these machines were designed in detail by Edward Cowper, an engineer employed by Fox and Henderson.[74]

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[73] Douglas Murphy, *The Architecture of Failure* (Winchester: Zero Books, 2012), 14.
[74] Anthony Bird, *Paxton's Palace* (London: Cassell, 1976), 78.

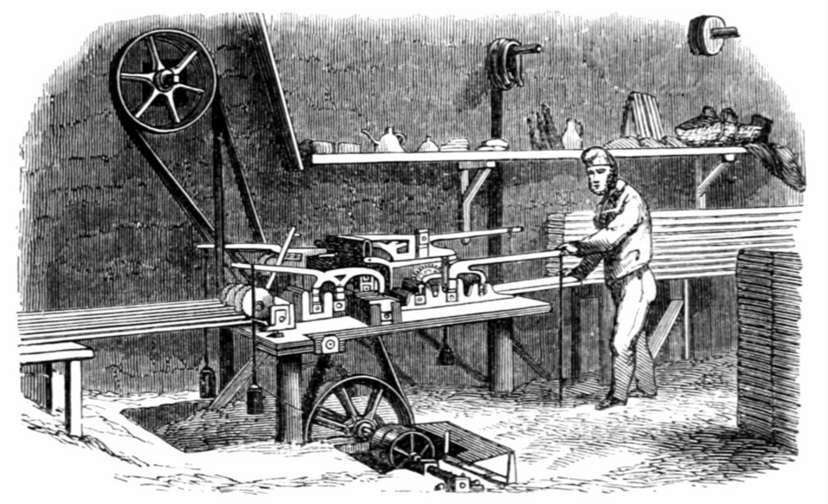

Figure 15. Drawing by Edward Duncan, illustration for the Illustrated London News of the sash-bar-making machine.

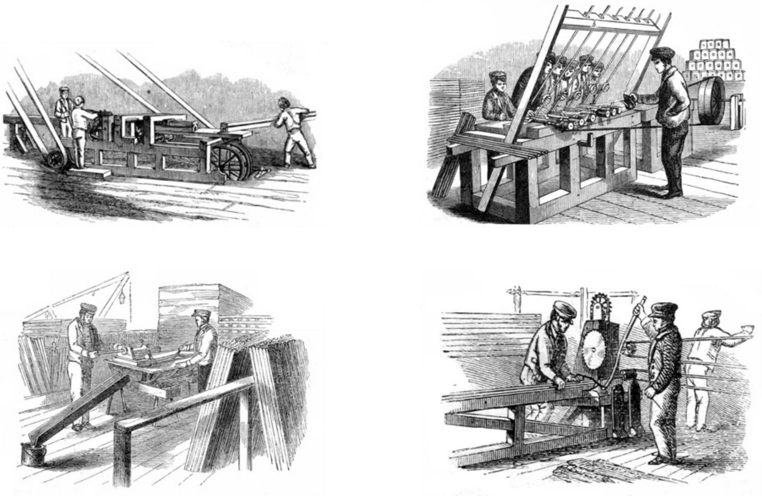

Figure 16. Machines at the Crystal Palace, The Illustrated London News (1850/1).
Clockwise from top left: Gutter-cutting machine, sash-bar drilling machine, machine for finishing ends of gutters and ridges, sash-bar painting machine.

Alongside Cowper's version of the sash bar cutting machine there were now numerous other machines, including ones for cutting the specific profiles in timber for the Paxton gutters, for finishing the ends to the gutters, for drilling holes in the ends of the sash-bars to allow fixing, and for painting the finished sash-bars. The process of substituting unskilled machine operators for skilled carpenters was complete.

Edward Duncan's drawings for the *Illustrated London News* also presented to the public scenes of the construction site workers receiving their pay, the intention clearly to suggest that this operation had also been reconfigured into an efficient system (fig. 1).

But the employment system wasn't without incident, and in November 1850 several of the glaziers went on strike. The glaziers installed the glass to the Crystal Palace at great height, operating in teams of two men and two boys from a trolley that traversed grooves within the great structure. The men's pay was set at four shillings a day on condition that a minimum of 58 panes were fitted, but the glaziers met on Friday 22 November and agreed that this was too low a salary and that fitting this number of panes in a day was impossible to achieve while maintaining good workmanship.

Thirty glaziers went on strike and wrote to Fox, head of the construction company, demanding an increase in salary to five shillings a day, and an end to the requirement for a set number of panes to be installed each day. Fox rejected the terms, and on the Monday, with the support of the Metropolitan police in countering the pickets, the striking glaziers were sacked and replaced, while their leader, William St Clair was arrested.[75] Stripped of skills, the workforce was demonstrably disposable.[76]

[75] "Crystal Palace glaziers strike, 1850," Trade Union Ancestors, Feb 11, 2016, accessed Nov 29, 2023, http://www.unionancestors.co.uk/crystal-palace-glaziers-strike-1850/

[76] This strike is remarkably redolent of the strike by the craftsmen working on the great dome of Florence. Unimpressed, by their activism, Brunelleschi had the workers replaced overnight by an inexperienced team from Lombardy, the explicit message being that if the workforce could be replaced so quickly, with so little effect, it was clearly the architect, not the builders, who were critical, and who determined the construction works. Antonio di Tuccio Manetti, *The Life of Brunelleschi* (University Park: Pennsylvania State University Press, 1970)

Figure 17. Paxton-designed East-India Orchid House, Chatsworth (Photo: Hugh Strange, 2022)

Paxton was to eventually spend over thirty years at Chatsworth, transforming the gardens with a series of increasingly ambitious grand projects: first the Pinetum from 1829, later the Rock Garden from 1843, and the Emperor Fountain of 1844. These landscape projects remain at Chatsworth but, along with Victoria Regia house and most of his other glass constructions there, the Great Stove has not survived to the present day. Only two of Paxton's glasshouses now stand in the grounds, the East India Orchid House of 1834, and the Conservatory Wall of 1848, neither of which currently have the innovative roofs that Paxton had pioneered (figs.17 & 18).

Figure 18. Paxton-designed Conservatory wall, Chatsworth
(Photo: Hugh Strange, 2022)

Ironically, given the significance of the cost-savings during its construction, while considered a triumph in the nineteenth century, in the twentieth the Great Stove was deemed too expensive to heat and maintain, most of its plants died and, without care and maintenance, its construction deteriorated (fig. 19). Finally, in May 1920, the glasshouse was destroyed to save money, blown up with dynamite by Paxton's own grandson.[77]

Figure 19. The Decayed state of the Great Stove, Chatsworth prior to demolition (1910's).

[77] Colquhoun, *The Busiest Man in England*, 257.

Chapter 2

The Craftsmen’s Drama

W.R. Lethaby and an Architecture of Incomplete Intentions

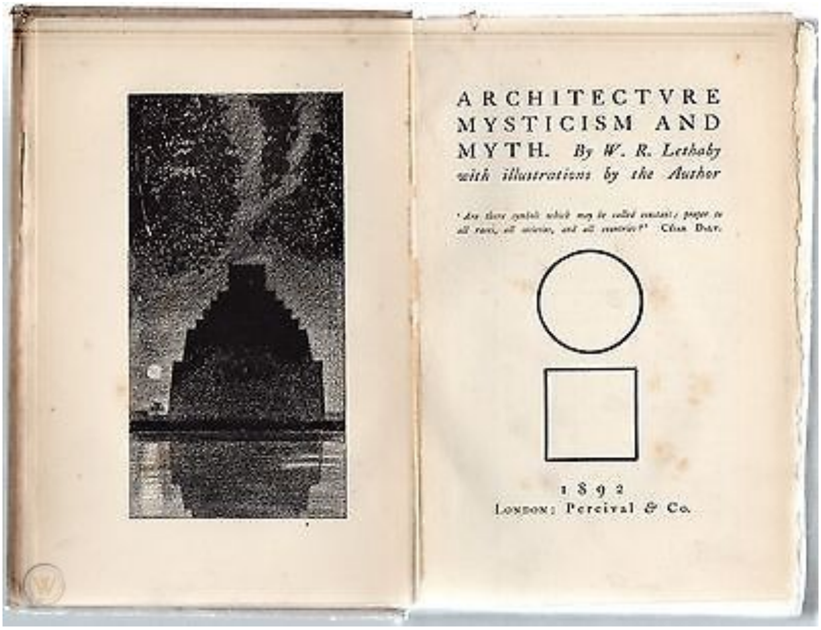

Figure 1. Frontispiece to *Architecture, Mysticism and Myth, 1891*

Origins

As architect, writer and academic, W.R.Lethaby (1857-1931) led a distinguished career by any measure, notably in his later life declining both the RIBA Gold Medal and a burial in Westminster Abbey, but in private practice he designed only six completed buildings, one of these now demolished. The drawings for the first and last of these projects, completed just ten years apart, are held in the RIBA Drawings Archive and represent an astonishing contrast in approach. For Avon Tyrell, a large country house in Hampshire, completed early in 1892 soon after establishing his own architectural practice, Lethaby produced 229 drawing sheets, many with multiple sketches and details, describing the project's layout, appearance, and construction comprehensively. The documentation for Lethaby's final project, All Saints' Church, Brockhampton, completed in 1902, in comparison, is remarkably limited, comprising just eleven drawings in total, together with a ten-page written specification.

In other cases, the reasons for such a dramatic shift in approach might only be conjectured.[1] Lethaby, however, was such a prolific writer throughout his life that a clear sense of the thinking behind this reversal in approach may be ascertained. The sense of a developing political engagement evident through these texts was to lead him to transform his practice, both reconsidering, and reconfiguring, the role of labour in the built works.

Born in Barnstaple, Devon, the young Lethaby moved to the Midlands to undertake apprenticeships in architectural practices in Derbyshire and Leicestershire, developing into an accomplished draughtsman. The publication of several of his drawings caught the attention of the eminent Victorian architect Norman Shaw, who subsequently invited Lethaby, aged just 22, to join his firm as chief assistant. Shaw's office was staffed by a dynamic group of architects who were to go on and become the younger generation of the developing Arts and Crafts Movement, and Lethaby's time there from 1879 was spent garnering both experience and professional friendships. He left Shaw's firm in May 1889 to establish his own practice but continued to work part-time with his former employer until February 1891.[2]

In a pair of texts written during this period Lethaby set out a series of ideas that, though relatively unstructured in writing style in relation to his later clarity and precision, nevertheless present an ambitious and coherent architectural position. The first of these, *'Of the "Motive" in Architectural Design'* was published in AA Notes in October 1889.[3] The title of the essay perhaps derived from Ruskin's 'Modern Painters', where 'Motive' refers to an overriding purpose to which all elements relate.[4]

In Lethaby's essay he also provides an alternative term, 'central thought', and this is perhaps key here, the author's consideration that an architectural work should coalesce around a conceptual,

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[1] Although there is a chance there may have been further drawings for the project, the care Lethaby's colleagues took in preserving his drawings, together with, as I shall explore, important changes in his thinking and resulting working methodologies, suggest this was most likely the total information through which the project was designed and built.
[2] This transitional period was spent in part designing a studio extension for a friend, in part producing designs for Morris & Company for Stanmore Hall in Middlesex and, most significantly, during this time he started his prolific writing career in earnest, researching at the nearby British Museum.
[3] W. R. Lethaby, "*Of the 'Motive' in Architectural Design," AA Notes* 4, no. 31 (1889): 24.
[4] As described in: Trevor Garnham, "*William Lethaby and Late 19th Century Architecture,"* unpublished M.Phil, Essex University, 1980.

organising principle, an idea. Significantly he goes on to counterpoint the 'Motive' in architectural design with the problematic process of building, referring to, '…*the compromise between the thought and its realisation,'*[5] a theme that was further developed two years later in his first published book.

Architecture, Mysticism and Myth looks at a broad range of historical and geographical cultures, in search of common underlying principles that might inform a universal foundation for architectural understanding: the mythical origins of architecture (fig. 1). Lethaby uncovers similarities across centuries and continents, suggesting that their universality lies in a shared language of symbolism.[6]

The book was praised by many of his contemporaries eager to establish a renewed basis for decoration in symbolism, and as such it can be seen to sit within a broader interest in late-Victorian England in Orientalism, alchemy and spiritualism, although this was clearly not Lethaby's intention.[7]

While the book is full of intriguing examples, Lethaby himself recognized and commented upon the weaknesses of the book, later describing it as: 'the most ignorant book ever published.' The text was finally re-worked and republished in 1928 under the new title, *Architecture, Nature and Magic*.[8] Despite the book's failings, Lethaby's efforts to establish an authentic basis of both form and ornament, and his search for the origins of architecture are noteworthy. Of particular significance is his identification of these in the 'ideal'. In the introduction Lethaby follows Ruskin's distinction, made just five years beforehand, between architecture and building, equating the two to the 'soul' and the 'body'.[9]

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[5] Lethaby, "Of the 'Motive*' in Architectural Design,"* 24.
[6] W.R.Lethaby, *Architecture, Mysticism and Myth* (London: London Architectural Press, 1891)
[7] The text certainly relates less to normative architectural history than to the contemporary interest in anthropology, being written soon after James Frazer's *The Golden Bough: A Study in Comparative* Religion (1890) and Andrew Lang's *Myth, Ritual and Religion* (1887) from which Lethaby acknowledged his title had been derived.
[8] 'My little book was very insufficient and, in many ways, feeble; second rate and second-hand authorities were mixed up with true sources, and the whole was uncritical and inexpert…My little volume went out of print, and I was pleased that it should be unobtainable.' W. R. Lethaby, *Architecture, Nature & Magic* (London: Duckworth, 1956), 15.
[9] In Chapter 1, The Lamp of Sacrifice, Ruskin states the necessity of distinguishing between Architecture and Building, suggesting: '…Architecture concerns itself only with those characters of an edifice which are above and beyond its common use.' John Ruskin, *The Seven Lamps of Architecture* (New York: Wiley, 1886), 9.

As such, the *idea* of architecture, rather than building, is very much the focus of his book, and his explanation for seeking origins - and indeed universal truths - in myth is justified later in the book when he writes: ‘It is only in story that we can find ideal architecture - the pure thought unrelated to cost and utility.’[10]

Lethaby suggests that the ‘utilitarian origins’ of building distinguish it from architecture, and states, ‘As the pigments are but vehicles of painting, so is building but the vehicle of architecture.’[11] The disparaging implication of the word ‘but’ is not irrelevant here, for in general the tone of the text makes clear that his aspiration to define architecture as ‘idea’ apart from the practicalities of building is based on a sense of ‘building’ as compromise.[12] It is worth noting that in the previous 10 to 12 years the author had been immersed in assisting with the design and construction of numerous buildings at Shaw’s office, yet the suggestion of these texts is that at the end of this period Lethaby was seeking a greater significance to his activities beyond the immediate facts of building.[13]

Avon Tyrell, Hampshire

Written in the years after leaving Shaw’s full-time employment, the development and publication of *Architecture, Mysticism and Myth* coincided closely with commencement of work on Avon Tyrell. Lethaby was appointed to this project on the recommendation of Shaw who had originally been approached for the job by the client, Lord Manners.[14] The house is located on the edge of the New Forest and is approached from a long drive that eventually passes through a stretch of woodland, past a stables block (also by Lethaby) and arrives at an entrance forecourt to the north of the property (fig. 2).

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[10] Lethaby, *Architecture, Mysticism and Myth*, 202.
[11] Lethaby, *Architecture, Mysticism and Myth*, 1.
[12] This position, and its later reversal, is examined at length in, Trevor Garnham, “William Lethaby and the Two Ways of Building,” *AA Files*, no. 10 (1985), 33.
[13] In his re-working, Lethaby adjusts his earlier position regarding motive and idea, to accommodate, rather than sit in opposition to, his later sense of practicality and service, writing: ‘Those ancient works were imitations of paradise, ours are exercises in commercial ‘grandeur’ and advertising vulgarity. Design must have some motivating idea in it; what idea can we modern people think except structure for reasonable service?’ Lethaby, *Architecture, Nature & Magic*, 39.
[14] Regarding Richard Norman Shaw’s recommendation, Lethaby later wrote: ‘He usually managed to pass over a “setting-up” commission to anyone who had been a long time with him, and I was started on my mad career in this way.’ W. R. Lethaby, *Philip Webb and his Work* (Oxford, Oxford University Press, 1935), 75.

Figure 2. Avon Tyrell, Hampshire, Entrance façade seen through gateway.
(Photo: Hugh Strange, 2019)

To the far side of the building, the south-facing garden façade overlooks a sloping site with far-reaching views towards the Solent in the distance. There is much evidence of Lethaby's time at Shaw's office in the architecture, and in the plan in particular. From a small entrance space, a large hall extends through the full depth of the plan from the entrance façade to the garden side and the views beyond, a timber screen wall partially dividing the front section off.[15]

In his influential record of key English architects and buildings of the period 1860-1900, *The English House,*[16] Hermann Muthesius documents in detail the key architectural features of the English country house, charting the relationship between the plan form and the social life of the occupants.[17] The book draws attention to the

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[15] Godfrey Rubens has previously identified in letters between the architect and Lord Manners (Lethaby to Manners, 26 August 1890, RIBA Library) during the design development that it was the client's initial idea to have the hall full depth of the plan. 'In the ground plan of the house, availing myself of your suggestion to take the Hall through from front to back I have planned a long and somewhat narrow hall, the part where you enter being cut off from the rest by a screen like an old hall.' Godfrey Rubens, *William Richard Lethaby: His Life and Work 1857-1931* (London: The Architectural Press, 1986)

[16] Hermann Muthesius, *The English House* (London: Granada, 1979). First published as *Das Englische Haus*, 1904 by Wasmuth.

[17] Julius Posener emphasises the influence of Lethaby on Muthesius, suggesting a direct influence from the Arts and Crafts, through Lethaby and Muthesius, to the Deutsche Werkbund, and through this, towards the formation of the Modern Movement in architecture. Julius Posener, "Muthesius in England," in *From Schinkel to the Bauhaus: Five Lectures on the Growth of Modern German*

organisational significance of the central hall of the typical country house which functioned as both occupied room and connecting space. That of Avon Tyrell, derived through Norman Shaw, is very much part of this tradition.[18] Around this space, and connected through it, are located the primary rooms - the Library, Drawing room and Dining room - and adjacent to it, running West to East, is a corridor that separates the remaining family rooms from the staff areas, a single storey kitchen courtyard terminating this circulation route (fig. 3). Above, on the first floor are family bedrooms, and on the second floor servant quarters.

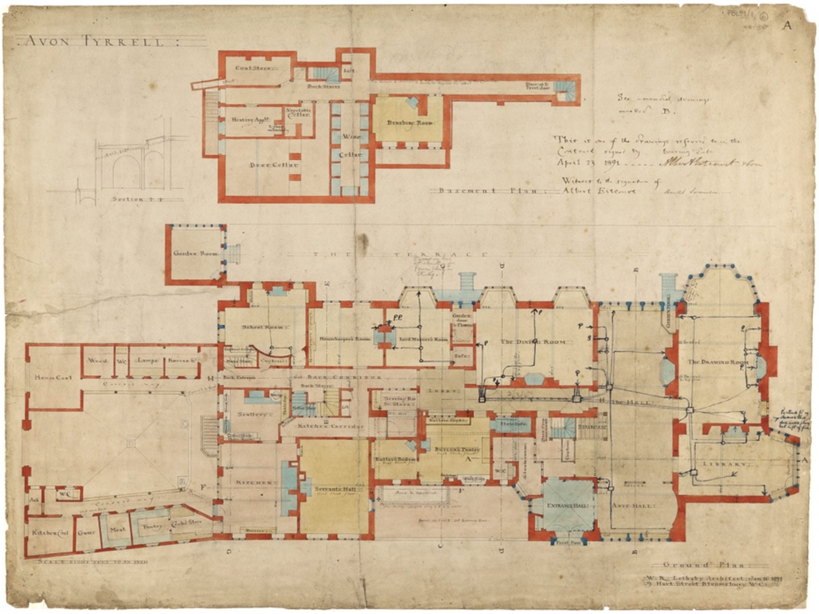

Figure 3. Avon Tyrell, Hampshire, W.R.Lethaby's Ground floor and cellar plan, Contract drawings, RIBA Drawings Collection, Victoria and Albert Museum

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Architecture (London: Lund Humphries, 1972) Similarly, Reyner Banham singles Lethaby out as the significant end point of the Arts and Crafts movement, and the link, through Muthesius, to further European developments. 'He (Lethaby) and his connection were not systematic thinkers, but men of feeling, who carried the moralistic attitude of Ruskin and Morris forward into the new century and made a present of it to the German movement. But Lethaby himself, at least, marries this morality to a Rationalist interest in construction and engineering.'
Reyner Banham, *Theory and Design in the First Machine Age* (London: The Architectural Press,1960), 46.

[18] Muthesius was a great admirer of Lethaby's architecture, documenting Avon Tyrell at length, 'He (Lethaby) brings a delicate, distinctive atmosphere to the sombre grandeur of the English house…The number of his houses is not large, but all appear to be masterpieces. His aims are perhaps embodied in their purest form in the country seat Avon Tyrell built for Lord Manners and fully illustrated here. Though the entrance front appears earnest and stern, the garden front with its terraces and three white bay windows projecting from the dark brickwork is lively and inviting. Lethaby's sole aim for the interior has been restfulness and comfort.' Hermann Muthesius, *The English House,* 39.

The house is constructed in red brick with stone trims and tiled roof, and while the hierarchy of the rooms is legible in the elevations throughout, with large and small windows sitting in close juxtaposition, the composition of the two primary façades differs markedly. That of the main entrance presents a highly elaborate compositional play of symmetries and asymmetries.

The plan here indicates a recessed central area, with equal wings to either side. Yet the left-hand wing is lower and entirely discrete in character, while the right-hand wing is three-storey high, includes the main entrance at ground level and has a grandeur to its fenestration, as well as its own internal compositional play of alignments and misalignments. In contrast, the garden side of the house presents a single, long façade formed of a rhythmic sequence of bays, gables, and chimneys, although these too are held in a series of complex interrelationships (fig. 4).

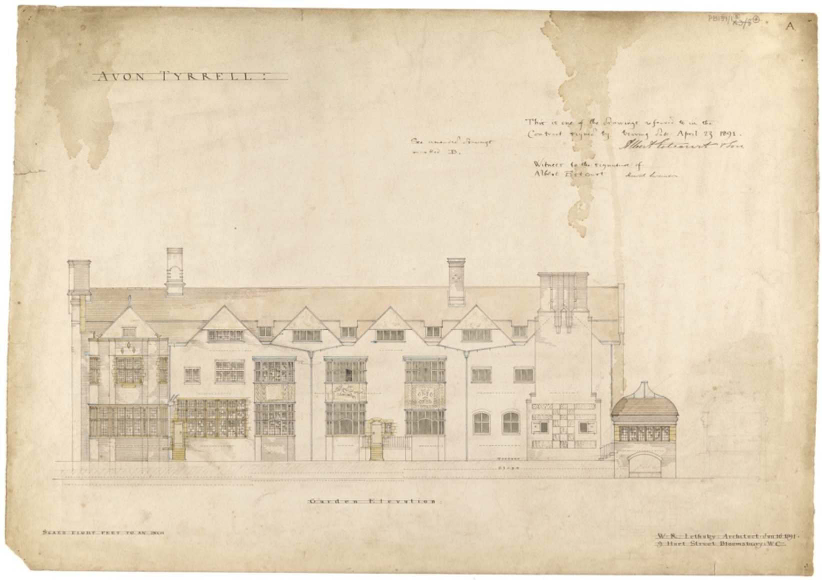

Figure 4. Avon Tyrell, Hampshire, W.R.Lethaby’s Garden elevation drawing, Contract drawings, RIBA Drawings Collection, Victoria and Albert Museum

Of note internally are the marble fireplaces to the primary rooms, each distinct in design and marble type, and carved by the highly regarded Victorian firm, Farmer & Brindley. Particularly impressive is the grand chimneypiece to the hall. Here a decorative grid of black and grey Derbyshire marble has a smooth surface free from profiles, which highlights the material's distinctive veining and produces an effect quite remarkable given the year of construction. As well as Shaw's influence, the house also bears witness to the preoccupations of *Architecture, Mysticism and Myth,* and several decorative and symbolic motifs can be seen throughout. Perhaps most notable is the stone bellcote to the elevational recess on the entrance façade: a small square structure with stepped roof, that derives from Lethaby's interest in universal temple forms.[19]

The year that construction started on Avon Tyrell, 1891, was to prove pivotal for Lethaby. Progress was well under way with both *Architecture, Mysticism and Myth,* and the design of the house, when he became close with the architect Philip Webb. Their friendship and high mutual regard developed initially in February of that year, when Lethaby moved his office and living accommodation to Gray's Inn Square, where Philip Webb was based, and then later in the year when he joined the Society for the Protection of Ancient Buildings, on the proposal of Ernest Gimson and William Morris, where Webb was a pivotal member.

The older architect's influence was to prove fundamental to a transformation in Lethaby's thinking, and its effect appears to have been immediate. While the similarities between the series of garden-facing gables at Avon Tyrell and those at Webb's Standen (also in design development during 1891) attest an aesthetic impact, it was in his consideration of what was important in architecture and how one might go about realising it, that the effect was most fundamental.

Lethaby appears to reverse his position - only recently stated - that building entails an unfortunate compromise for architecture.[20] In place of his earlier emphasis on the necessity of an overriding conceptual

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[19] The square temple is described as a universal type identifiable throughout the world's various architectural cultures in Chapter Three: 'The perfect temple should stand at the centre of the world, a microcosm of the universe fabric, its walls built four square with the walls of heaven. And thus, they stand the world over, be they Egyptian, Buddhist, Mexican, Greek, or Christian, with the greatest uniformity and exactitude.' Lethaby, *Architecture, Mysticism and Myth*, 53.
[20] This reversal is explored at length in: Garnham, "William Lethaby and the Two Ways of Building," 33.

idea that would order formal designs, he wholeheartedly adopted Webb's preoccupation with building, and building well. This view, that a measured and careful focus on construction might provide a modest architecture of integrity, struck a chord with Lethaby,

> The happy chance of close intimacy with Philip Webb at last satisfied my mind about that mysterious something that we call architecture. From him I learnt that what I was going to mean by architecture was not designs, forms and grandeurs, but buildings, honest and human, with hearts in them.[21]

But Lethaby also took from Webb a certain methodology as to how this concern with construction might be enacted. Webb worked up each drawing by himself, and each was later traced by his assistants before being delivered to site. His drawing sets were exhaustive; every area of construction was covered, and every detail drawn, including otherwise mundane areas of the building. Thorough in all respects, they fully defined the scope of works to be executed on site, leaving no space for confusion or interpretation on the part of the builder. To avoid any misunderstandings during site works, hand-written notes to the builders were added to the drawings to clarify the architect's intentions.[22]

Accordingly, Lethaby's 229 drawings for Avon Tyrell fastidiously documented every aspect of the building: virtually nothing was left to chance, or indeed, variation.[23] The plans and elevations are finely drawn in pen, dated January 1891, and signed as contract drawings on April 23, 1891. Several of the drawings have colour washes denoting material distinctions, many incorporate text descriptions

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[21] A.R.N. Roberts, "The life and Work of W.R.Lethaby," *Journal of the Royal Society of Arts* 105, no. 5000 (1957), 358.

[22] Philip Webb's drawing practice is described in detail by Margaret Richardson who writes: 'During construction, working drawings for every part and detail of the building, numbering several hundred for large buildings, were produced as necessary at scales of one sixteenth of an inch, half an inch, and one inch to one foot. Believing that few workmen could use materials with the simplicity and directness of their medieval counterparts, Webb indicated the size and position of every stone and, in all but the most straightforward walling, every brick.' Margaret Richardson, *Architects of the Arts and Crafts Movement* (London: Trefoil Books, 1983), 15; Mark Swenarton, *Artists and Architects: The Ruskinian Tradition in Architectural Thought* (London: Macmillan, 1989), 41; Sheila Kirk, *Philip Webb* (Chichester: Wiley Academy, 2005), 279.

[23] Margaret Richardson recounts R. Weir Schultz's response in 1932 on having reviewed Lethaby's drawings for Avon Tyrell: 'I will say that no practising architect could have gone more thoroughly into the working details for the building of that house than he did.' Richardson, *Architects of the Arts and Crafts Movement,* 31.

clarifying Lethaby's design intentions, and the level of construction detail throughout is both exacting and exhaustive.

All 229 drawings are understood to have been produced by Lethaby himself. In terms of the building's compositional elements, they are extremely precise, and notably define with great care the formal relationships between gables, chimneys, bays windows and apertures on the elevations, together with the exact lines of gutters and downpipes that punctuate the larger play of volumes. While little seemed to change between the original drawings and the completed building, text notes adjacent to the contractual signatures indicate, '*See amended drawings marked B*,' and so, as minor revisions were made to the design, the drawings were clearly updated in parallel.

Alongside the general arrangement drawings, numerous detailed drawings evidence the architect working through the practicalities of construction (fig. 5). An extensive series produced in relation to the rainwater drainage is noteworthy here; works that were later completed on site in leadwork. These range from detailed drawings that give a clear indication of construction and dimension, through to outline drawings suggesting falls and the spacing of fixings. The sketching of adjacent roofs indicates both the source of water flow and a compositional awareness of the placement of the downpipes and gutters. Many of these drawings were produced in a combination of pen and pencil, with only small areas of colouring; the focus towards technical resolution rather than attractive draughting is clearly apparent throughout (figs. 6 & 7).

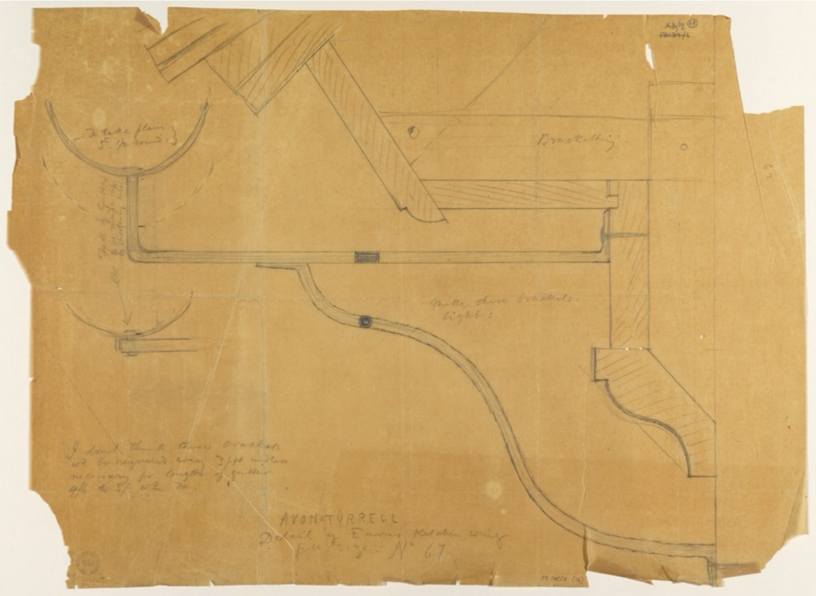

Figure 5. Avon Tyrell, Hampshire, W.R.Lethaby's detailed drawing of gutter.
RIBA Drawings Collection, Victoria and Albert Museum

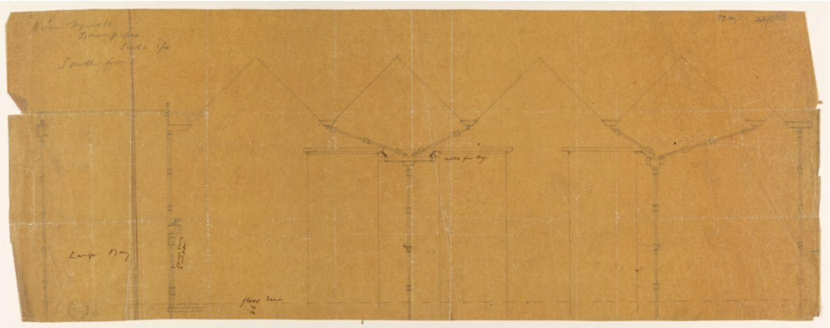

Figure 6. Avon Tyrell, Hampshire, W.R.Lethaby's study drawing for drainage to the garden elevation.
RIBA Drawings Collection, Victoria and Albert Museum

Figure 7. Avon Tyrell, Hampshire, the garden elevation’s play of gables, bays and drainage (Photo: Hugh Strange, 2019)

Two peacocks, carved in stone and derived from the Manners' crest, stand facing each other atop the north-facing entrance gable, divided by an emphatic brick chimney breast. A sketch for these is particularly significant as an indication of Lethaby's relationship at this stage in his career with the craftsmen working on site (figs. 8 & 9). The drawing was produced at one quarter scale in pencil and coloured pencil and shows the peacocks in both plan and elevation. While the drawing itself suggests the desired form, the accompanying notes indicate the required process, instructing how it was to be made, the upper note suggesting: 'Note First cut out square the form shown by red line then take off chamfers shown by black.' Additional notes also explain how Lethaby should be involved, requesting: 'Please make a model <u>this</u> size in wood and send up to me' and another, 'Follow the form carefully & send drawing back with model.'

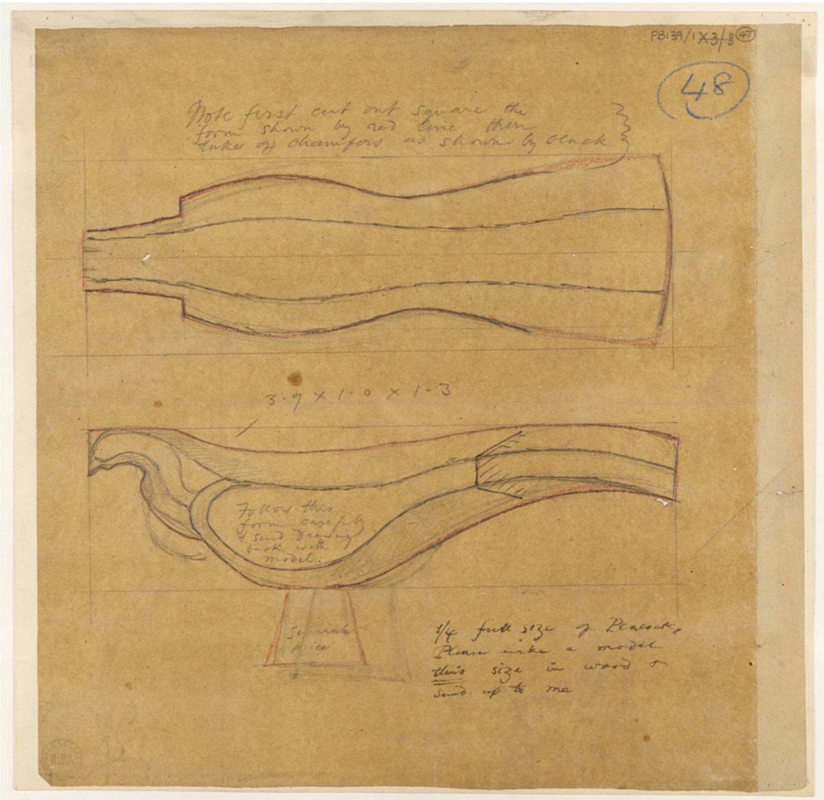

Figure 8. Avon Tyrell, Hampshire, W.R.Lethaby's sketch drawing, incorporating instructions to the craftsman, for one of the sculpted peacocks that stand above the entrance facade.
RIBA Drawings Collection, Victoria and Albert Museum

Figure 9. Avon Tyrell, Hampshire, Entrance façade with sculpted peacocks above
(Photo: Hugh Strange, 2019)

As with his mentor, Webb, it is evident here that Lethaby, though inexperienced in handling stonework himself, took on the role of instructing and directing the craftsmen, through his drawings, in how best to go about their work, and retained an approving role. Clearly there was a degree of distrust at play not only with the mason's ability to satisfactorily sculpt as the envisioned designs, but also with the drawing as a wholly adequate tool of instruction.[24]

Having completed his exhaustive production of drawings, Lethaby approached the construction of Avon Tyrell in a manner recognisable to contemporary practice. In a letter to his client, Lord Manners in 1891, Lethaby notes that following completion of the drawings: 'The next step, preparatory to getting estimates, is to put them in the hands of a Quantity Surveyor who prepares an accurate schedule of all the quantities of materials required.'[25]

The contract was eventually given to the Gloucester firm of Albert Escourt & Sons, who had worked with Philip Webb several times and notably constructed his project of Clouds House in Wiltshire for the Wyndhams in the 1880's. It appears the contract for Avon Tyrell was diligently overseen, and the building completed on budget and to the client's full satisfaction. The sole exception to Lethaby's prescriptive methodology at Avon Tyrell was with the plasterwork, which was completed by his colleague, Ernest Gimson. During his time working for Norman Shaw, Lethaby had met Gimson, as well as Detmar Blow, who were both working at John Sedding's practice at the same time. The three men became close, and in 1890 discussed a shared project to design and make both own furniture and other handicrafts.

In the event, Blow withdrew and the remaining two were joined in October of that year in establishing Kenton & Co. by a select group of colleagues including Sidney Barnsley, Mervyn Macartney and Reginald Blomfield. Though established almost thirty years after Morris, Marshall, Faulkner & Co. (by that stage, Morris & Co.), the new firm sought in a similar manner to design, manufacture and

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[24] Adrian Forty and Sophie Read explore this point in relation to Philip Webb's drawing of carved decorative woodwork for Clouds House in Wiltshire. Here, despite a beautiful and intricate drawing, Webb resorts to an accompanying text, above the pen and wash, to describe the feel of the workmanship required. Adrian Forty and Sophie Read, "The Limits of Drawing," in Desley Luscombe, Helen Thomas and Niall Hobhouse (eds), *Architecture through Drawing* (London: Lund Humphries, 2019), 204.

[25] Letter No. 6. W.R.Lethaby to Lord Manners, January 1st, 1891. RIBA Drawings Archive. Rubens, *Lethaby,* 120.

supply handcrafted furniture. Each piece would be designed by a single partner who would also oversee its production. Importantly, Kenton & Co.'s printed circular of 1891 emphasises both the proximity of the processes of design and manufacture, and the hierarchical separation between the two, stating:

> All members of the company will be designers, and will personally superintend the execution of their work by their own workmen…It is also hoped that such an association of designers working on common lines and personally controlling their workmen, may succeed in again establishing a school of furniture such as existed in England down to the end of the eighteenth century.[26]

The company did not last long and disbanded in 1892. During that short time, however, it brought Lethaby into direct contact with the four or five craftsmen that the firm employed on their premises, which awakened in him a greater awareness of the issues associated with the separation of roles of designer and maker in the production of the furniture pieces. In addition, the endeavour brought Lethaby and Gimson closer still, at a time when the latter, who had originally trained as an architect, was exploring an expanded role in working first-hand in the production of various handicrafts. He had, in 1890, taken up an apprenticeship with the London-based plastering firm of Whitcombe and Priestley, where Gimson appears to have become proficient at the craft.[27]

The following year saw the exhibition of several test friezes, as well as the publication of a text on the history of the craft, but the invitation from Lethaby to work at Avon Tyrell was to be Gimson's first significant paid commission. The work there related to the hand-moulded ceiling reliefs and associated friezes in the primary rooms, as well as external panels for the gabled bays on the garden elevation. These were originally completed in decorative pargetting, but have unfortunately since been replaced by hung tiles, although one panel, depicting a stag, has been retained and relocated. In contrast to the involvement of other trades on the project, there seem to have been few drawings for the plasterwork, leading one to assume

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[26] Annette Carruthers, Mary Greensted and Barley Roscoe, *Ernest Gimson: Arts & Crafts Designer and Architect* (New Haven CT and London: Yale University Press, 2019), 46.
[27] Ernest Gimson's role in Kenton & Co. is discussed in: Carruthers, Greensted, and Roscoe, *Ernest Gimson*, 53.

that instead the two men collaborated on the designs on site. It is unclear what the contractual relationship between Gimson and Albert Escourt & Sons, the main contractor, might have been; whether he was independently employed by the client, or employed as a nominated sub-contractor by the contractor. Gimson had rented a cottage nearby for the duration of the works though, and Lethaby's later reports that the two men spent their afternoons playing cricket might suggest the former scenario more likely.

For Lethaby, the construction works at Avon Tyrell signalled not only the beginning of a new career in private practice, but also, in some respects, a turning point. After Avon Tyrell the influence of Shaw on Lethaby's architectural designs waned and, as with his unease with his first book, one imagines the project, though accomplished in many respects, might not have been entirely to his satisfaction. Although the construction of the house coincided with the start of his life-long devotion to Philip Webb and the reversal of his earlier prioritising of idea over building, it also appears to have raised considerable doubts in his mind about the separation of the roles of designer and maker that seemed inherent within the drawing approach he had adopted from his mentor.

The completeness implied by Webb's rigour seemingly precluded the craftsmen's creative input and emphasised the distance between his draughting table and the workmen on site. These concerns were surely highlighted by Lethaby's concurrent experiences working closely with furniture makers at Kenton & Co., but more pertinently, in the exception to his methodology, in having his colleague Gimson working directly on site having learned a handcraft. Lethaby must, one assumes, have been querying the roles of all those invested in realising the house, including his own, perhaps redolent of his conversation with Webb years later regarding William Morris's early life as an architect: 'I asked Webb why Morris gave up architecture. "Because he found he could not get into close contact with it; it had to be done at second hand."'[28]

[28] Lethaby, *Philip Webb and his Work*, 122.

Developmental Texts

Between his first and last buildings, Lethaby oversaw the construction of four further designs. After Avon Tyrell, Lethaby constructed another house, The Hurst, in 1893, followed by a series of projects associated with the extension and transformation of Melsetter House on Hoy in the Orkney Islands from 1898, then another residential project, High Coxlease, was completed in 1900, as was the Eagle Insurance building, in Birmingham, Lethaby's only commercial project. In these intervening years, prior to the construction of All Saints' Church in Brockhampton and in parallel with these various construction projects, he also wrote extensively.

The texts published during this period demonstrate both a coherence quite apart from the rambling style of *Architecture, Mysticism and Myth,* and a developing sense of political engagement through which he appears to have been positioning himself in relation to the questions raised by the Avon Tyrell project. The first of these texts, titled *Leadwork: Old and Ornamental and for the Most Part English,* provides a historical study of the use of lead in building works, including fabrication methods and applications, and is accompanied with numerous drawings produced by the author.[29]

The main body of the book comprises detailed examples of leadwork, largely from England, and examines the 'high art' of leadwork, such as statues, coffins, and fonts, as well as gutters and pipes. As such, it provides perhaps the first indication of Lethaby's conviction that beauty could be found in modest yet well-crafted works of necessity; in prosaic items such as rainwater goods. Not just a paean to leadwork, though, it is also a book about lead-working, and Lethaby directs the text towards a call for architects to become directly involved in learning a trade.[30]

[29] W. R. Lethaby, *Leadwork Old and Ornamental and for the Most Part English* (London: Macmillan & Co, 1893)

[30] In a similar manner to Gimson's training in plasterwork, Lethaby later encouraged his colleague, the architect F.W.Troup, to study lead-working. Neil Jackson writes of Troup's outlook and skill, 'He recognized the importance of the crafts, for he saw architecture as a craft process. Learn one craft or trade, he would tell a student, and you will understand the others. Leadwork was Frank Troup's trade, and he could wipe a joint better than many plumbers.' Neil Jackson, *F W Troup: Architect, 1859-1941* (London: The Building Centre Trust, 1985), 9.

> The only way in which the crafts can again be made harmonious by beauty is for men with a sense of architectural fitness and a feeling for design to take up the actual workmanship and practice it themselves as they would painting or sculpture, seeking the delight of being good artists not the reputation of being successful merchants or clever professional men. To any such, lead-working may be recommended. [31]

Crucially, a key purpose of taking up a trade, Lethaby suggests in the text, is to express oneself as an 'original worker', apart from another's designs, or the instruction of an 'architect's drawings.'[32]

The limited scope and focus of the *Leadwork* book contrast starkly with the broad ambitions of Lethaby's next short text: *The Builder's Art and the Craftsman*, published in *Architecture, a Profession or an Art*, in 1892.[33] In his contribution to this collection of essays, Lethaby focuses on the centrality of craftsmen to architecture and identifies the division of labour as the fundamental problem of architecture.[34] The text incorporates an extended passage from William Morris's lecture, *The Influence of Building Materials Upon Architecture*, given just a year earlier and published in January 1892, and Lethaby is clearly indebted both to this particular source as well as to Morris's broader influence at the time. In his lecture, Morris had discussed in detail the qualitative aspects of the various building materials of the time, making the case for greater care over the choice and use of materials, and going so far as to suggest, '…perhaps one would not go very far wrong if one defined architecture as the art of building suitably with suitable material.'[35]

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[31] Lethaby, *Leadwork*, 4.

[32] 'Pipe heads and other objects of a somewhat ornamental kind have recently been made again, but we must remember that ornament is not art, and these have only been carefully, painfully, "executed" to the architect's drawings. The plumber's art, as it was, for instance, when the Guild of Plumbers was formed, a craft to be graced by the free fancy of the worker, is a field untilled. That someone may again take up this fine old craft of lead-working as an artist and original worker, refusing to follow "designs" compiled by another from imperfectly understood old examples, but expressing only himself – this has been my chief hope in preparing the little book NOW CONCLUDED.' Lethaby, *Leadwork*, 148.

[33] W.R. Lethaby, "The Builder's Art and the Craftsman," in *Architecture, a Profession or an Art: Thirteen short essays on the qualifications and training of architects,* ed. by R. Norman Shaw and T.G. Jackson (London: John Murray, 1892), 149-172.

[34] On the division of labour in architecture and construction see also: Linda Clarke, *Building Capitalism: Historical Change and the Labour Process in the Production of the Built Environment* (London: Routledge, 1991)

[35] 'I suppose that the draughtsmanship of the architects of the thirteenth century for their grander buildings was not particularly splendid or complete; I am perfectly certain that a vast number of very beautiful buildings that are built all over the country never had an architect at all, but the roughest

Morris then argues that if materials are central, then the role of those who work them, those most closely acquainted with them, is key. Lethaby develops Morris' assertion further, suggesting that architecture is too often practiced as a scholarly discipline in the re-working of earlier architectures, in the drawing and re-drawing of architectural features. His target is the 'paper-architect': the practitioner whose separation from the actual handling of material leaves only 'abstract exercise.'

He advocates instead a basis for practice in construction, for 'work done rightly', and argues that this be carried out with both feeling and a direct contact with materials. All great architectures of the past, he suggests, were the result of this approach. To best achieve this he suggests, the architect's role should be focussed on co-ordinating, rather than instructing, craftsmen on site, which would allow them the freedom to be independently expressive in their use of material:

> The art of architecture is thus the co-ordination of the several crafts in the achievement of right or beautiful building; and this not only in the outer form and adornment, but in the very structure and anatomy. Architecture is the easy and expressive handling of materials in masterly experimental building – it is the craftsmen's Drama.[36]

John Ruskin is also quoted in the text, and although written 39 years after *The Stones of Venice,* Lethaby's exploration of the split between those who think and those who make can be seen as sitting clearly in the Ruskinian tradition of thought.[37]

When discussing the separation of roles of thinking and producing in *The Nature of Gothic*, Ruskin's perspective - simultaneously the fruit of his Christian theology and his background in aesthetics - was towards the work resultant from the liberty of the worker, and as such

possible draught was made out for those buildings, and that they actually grew up simply without any intermediary between the mind and the hands of the people who actually built them.' William Morris, "The Influence of Building Materials Upon Architecture," from a lecture given by William Morris to the Art Workers' Guild on 20th November 1891, in *Architecture Industry and Wealth: Collected Papers* (London: Longmans Green & Co., 1902), 264.

36 Lethaby, "*The Builder's Art and the* Craftsman," 151.

37 This line of thinking, from Ruskin's 'The Nature of Gothic', through Philip Webb and William Morris, to W.R. Lethaby is explored thoroughly in: Swenarton, *Artists and Architects.*

presented a critique of both industrial production and the 'Renaissance Schools' of architecture.[38]

The outcomes of both are deemed to result in work characterised by mindless repetition, as opposed to the 'Changefullness' of 'Gothicness' that he championed. The separation of design and realisation, he suggested, resulted in debased labour and, as a result, a debased architecture of lesser artistic merit. While Lethaby had clearly read Ruskin well, he was also by this time a close personal colleague of William Morris, who had both continued Ruskin's line of thought and had imbued it with a political character borne from his enthusiasm for the writings of Karl Marx. For Morris, Ruskin's moral underpinning of, and antipathy towards, factory production was replaced by a broader critique of capitalism that saw the demise of the crafts and the detrimental effects of the division of labour on architecture within a larger political framework.[39]

Lethaby's experience in practice, alongside his detailed technical and historical scholarship, allowed him to invest in Ruskin and Morris's ideas a specificity regarding architectural practice and construction. As such, *The Builder's Art and the Craftsman* provides a detailed analysis of the building industry at the time, and a critique of the separation of intellectual and manual work:

> …design progresses and changes through the suggestions gained from direct observation of special aptitudes and limitations in material, and the instant ability to seize on a fortunate accident, and to know when the work is properly finished. The separation of the two necessarily makes design doctrinaire,- a hot-pressed-paper-craft,- and workmanship servile; degrading even in the ordinary necessities of building; destructive to ornamentation; a mere insult and pretence of art at which sculptors and painters do well to make a mock.[40]

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[38] John Ruskin, *The Nature of Gothic: A Chapter of the Stones of Venice* (London: Pallas Athene, 2011) First published 1892 by Kelmscott Press.

[39] Morris charts the historical cycles of craftmanship in relation to the development of feudalism and capitalism here: William Morris, "Architecture and History," in *The Collected Works of William Morris Volume XXII* (1884), 296-397.

[40] Lethaby, "*The Builder's Art and the* Craftsman," 161. Lethaby also writes earlier in the piece, 'The crafts of the mason, the carpenter, the plasterer are even now being finally destroyed by a system in which the designer has no hands to execute and the worker no head to think.' Lethaby, "*The Builder's Art and the* Craftsman," 153.

Perhaps most surprisingly, given his approach to the construction of Avon Tyrell completed earlier in the same year as the publication of this essay, and given the 229 sheets he himself produced for the project, is his antipathy here towards architects' drawings. These he now sees as both a distraction of the architect from his real vocation, that is attaining as direct involvement in construction as possible, and as an active instrument in the broader de-skilling of the building site and the subsequent deterioration of craftsmanship,

> If you ask an "architectural carver" or "architectural metal-worker" or "decorator" if he seriously likes his work, if he considers "that" beautiful, he is surprised and injured; that is not his business, he works to the order of "the architect" and "one likes one way, and another likes another", or he shows you those fatal drawings which throughout are the bane of our modern method: for it is on these we lavish our care; it is these that have to be made pretty enough to catch the uninstructed eye and be "approved", it is these which have already sapped our enthusiasm; and before the work is actually begun the architect is engaged on the next, and the next.[41]

Although Lethaby's writings to this date had been primarily focussed on the architect's perspective and role, in 1893 he visited Constantinople with Harold Swainson, who had counter-signed the Avon Tyrell contract drawings - the following year, the two men published a detailed study of the Byzantine Church of Hagia Sophia there, the preface of which boldly opens with the statement: 'Sancta Sophia is the most interesting building on the world's surface.'

They then go on set the book's broader agenda within the context of Lethaby's concurrent reorientation towards building as 'finding the root of architecture once again in sound common-sense building and pleasurable craftsmanship.'[42]

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[41] Lethaby, "*The Builder's Art and the* Craftsman," 162.
[42] Lethaby and Swainson, colleagues from their time working together at Shaw's office, produced their book at a time of renewed interest in Byzantine architecture, and by accounts, it played a significant part in the developing scene. For instance, Bentley's Westminster Cathedral (1895-1902), London primary example of this tendency, was designed in the Byzantine style almost immediately after the publication. W. R. Lethaby, and Harold Swainson, *The Church of Sancta Sophia, Constantinople: A Study of Byzantine Building* (London: Macmillan & Co, 1894)

But the authors also look to position the architecture of the Hagia Sophia within a broader social context and associate its success with a visionary client who held architecture in high esteem and the model of building practice that the project employed. Anthemius and Isodorus, the master-builders responsible for its completion, are described as both leading design decisions and working directly on site during the construction works. Lethaby and Swainson also identify the wider culture of building trades that was operational at the time as distinct from contemporary contracting and as a potential historical precedent for an alternative to the division of labour in architecture that preoccupied Lethaby.[43]

Crucially, they saw this organisational structure, onto which they projected the Western medieval guild system, as successful from both a social and artistic perspective:

> All workers in the East seem to have been thus associated into guilds, and municipal life was organized on the guilds…The existence of the guilds is the most significant fact of the middle ages. In such craft organization of labour, free of the financial middlemen who now rightly call themselves "Contractors," we see the only hope that building for service, and ornamenting for delight, can again be made possible.[44]

Lethaby was keen to draw contemporary lessons from historical precedents of labour relations.[45] In a series of two lectures titled

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[43] Lethaby wrote extensively, a short time later, on the role of the guilds in the development of Gothic architecture in France, noting: 'The transition in architecture coincides with great changes in the constitution of town communities and the status of the workman. Romanesque architecture, outside Italy at least, was monastic and feudal, and the builders were attached to the soil. Gothic on the other hand, is the architecture of towns, guilds, and masters who were free to pass from place to place….When towns of Northern France became communes, the guilds became regular schools of craftsmanship. A medieval town was a sort of craft university, and Gothic art is the art of the mason's guild.' W. R. Lethaby and David Talbot Rice, *Medieval Art from the Peace of the Church to the Eve of the Renaissance, 312-1350*, (London: Thomas Nelson, 1904), 109.

[44] Lethaby and Swainson, *The Church of Sancta Sophia*, 208.

[45] Soon after, in a lecture given in Birmingham, and published in text form as *Art & the Function of Guilds* in 1896, Lethaby develops his interest in the Guilds as a historic precedent for contemporary labour relations in construction, suggesting that unions might take on the traditional roles of the guilds, maintaining quality of production as well as training. 'Quality in workmanship has been very largely destroyed in the name of science and wealth. I can see no hope of labour being de-brutalized by the isolated works of the self-regarding art genius or by the efforts of the ignorant political expert; organized labour can alone accomplish it…The unions, in a word, must become craft guilds, and, as such, be responsible to society in their several mysteries: they must discuss materials and methods and build up a new tradition of workmanship.' W. R. Lethaby, "Art & the Function of Guilds," in *Form in Civilization: Collected Papers on Art and Labour* (Oxford: Oxford University Press, 1922), 164.

'Modern Building Design', that he gave at the Architectural Association in November 1895, he further extended his critique of the division of labour in construction.

The subject of these lectures was the general improvement of contemporary building quality in its broadest sense. Rather than focusing just on architecture, he examined the state of the profession and the construction industry, bemoaning the development of the general contracting firm and railing against the effects of the profit motive on building works.[46]

This was evidenced, he suggested, in the tendering of construction projects, such that great effort was needlessly wasted, with a consequential loss in the quality of the resulting buildings. Lethaby further suggested that the profit motive resulted in a separation of roles, an extension of the division of labour, that produced needless strata and saw traditional builders transformed from craftsmen into general contracting firms, into financial agents:

> First came the employer, who provided the capital; then the architect, who usually employed several journeymen architects; then the surveyor; then the contractor, a middleman employing sub-contractors. The clerk of works followed, and then sixth came the builder's foreman, generally a very skilful man, who had gained his place by natural selection; here at last we had a man who could build, but he was too busy with the time-sheets; then came the workmen. The money interest displaced every other duty, stratum after stratum, till the chief function of the builder's foreman was to look after the contractor's margin of profits.[47]

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[46] The development of the General Contractor in Britain in the 19th Century is described in: Howard Davis, *The Culture of Building* (Oxford: Oxford University Press, 1999), 112-114.
[47] W. R. Lethaby, "Modern Building Design," *The Builder* 69, no 1753 (1895): 334.

All Saints' Church, Brockhampton

Following his series of increasingly politicised texts, and ten years after his Avon Tyrell project, Lethaby started work on what proved to be his final commission: All Saints' Church, Brockhampton in Herefordshire. Although an Anglican parish church, the building works were funded by Alice Foster, an American heiress who had married and settled in the village. Set in the centre of its gently sloping site, one approaches the building through a thatched lychgate, arriving at the porch beneath the belfry, to the south of the main east to west axis of the church (fig. 10).

To the rear the north side is clearly the building's back, with a projecting service stair providing access to the vestry below and the tower roof above. The church is constructed in local sandstone, the rough surfaces of plain walling broken only by angled buttresses and roofed in thatch. The only exception to this is the upper level of the porch tower, which is constructed in timber boarding and has a shingled roof (fig. 11).

Figure 10. All Saints', Brockhampton, exterior view as approached from the South.
(Photo: Hugh Strange, 2019)

Figure 11. All Saints', Brockhampton, exterior view of the West end with porch tower behind (Photo: Hugh Strange, 2019)

A stone font is located to the left of the entrance, with the nave leading on the right towards the transept, beneath a crossing tower, and on to the chancel at the far eastern end. Either side of the altar here are Morris & Co. tapestries designed by Edward Burne-Jones. The side walls of the building are low, and from these spring a series of distinctive stone arches, each both steeply sloping and gently curved, with chamfered edges softening their effect on the interior space. These arches support vaulting of exposed unreinforced concrete, cast on rough timber shuttering and coated in a limewash finish.

Earlier design iterations included a timber roof structure, supporting tiling above, but it would appear that a combination of his successful use of concrete for the roof of the chapel at Melsetter, completed the year before, together with an ambition to combine new constructive elements with traditional ones, led to the switch.[48]

[48] Trevor Garnham writes in detail on Lethaby's use of concrete as an example of his belief in architecture as a 'living, progressive structural art.' Garnham also identified in his earlier AA Files

Accordingly, two years after completion of the project, Lethaby wrote disparagingly of the smaller early-Byzantine churches in his historical account, *Medieval Art from the Peace of the Church to the Eve of the Renaissance, 312-1350:*

> The majority of these, however, are not of very great importance in the evolution of Christian architecture, for they have roofs supported on timber, and no new problems are tackled in their construction. [49]

Elements of the interior at times appear rustic and primitive in the manner of small-scale, early Medieval or Romanesque works, as with the font or the simple exposed timber structure to the crossing tower. But at times, most notably with the concrete vaulting, the building feels unexpectedly modern. The windows, all completed in stonework with lead tracery, draw on a remarkable range of references, while all the time appearing cohesive. In the chancel, their double quatrefoil form suggests a residual gothic language, and there is a geometric abstraction in the stone tracery to the north transept window, seemingly devoid of historical reference, while the windows to the nave, low, horizontal, and plainly detailed, appear proto modernist in character.[50]

The construction process for the church varied greatly from that of Avon Tyrell. Instead of tendering to a series of contractors and appointing a single main contractor to oversee the works, Lethaby configured the project such that the trades were all separately and directly employed by the client and paid on a 'day work' basis.[51]

These trades then worked independently and were overseen by an on-site architect, acting as clerk of works, together with a foreman employed by the client. The intention was that this project structure, together with substantially limiting the scope of drawings that needed to be produced and issued to site, would allow, and encourage a

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text that on May 1900 Shaw wrote to Lethaby: 'but times are so different. Reinforced concrete ought to do a lot for us. What do you say we have a turn on those lines?'
Trevor Garnham, "Architecture and the Eclipse of Reason," *Scroope*, no 12 (2000), 84-89.

[49] Lethaby, and Rice, *Medieval Art*, 22.

[50] In his entry to the buildings of Herefordshire, Pevsner described the building as 'one of the most convincing and impressive churches of its date in any country', and later suggests the interior was, 'Expressionist in the sense in which Central Europe designed churches about 1920.' Nikolaus Pevsner, *The Buildings of England: Herefordshire* (Harmondsworth: Penguin Books, 1963), 90-91.

[51] *Specification of works by W.R.Lethaby for building a Memorial Church at Brockhampton, Hereford & Worcester, April 1901*, RIBA Collections, Victoria and Albert Museum, LeW/2/12, 1.

greater involvement from the various craftsmen in the design development as it progressed. Freed from the constraining framework of contractually tied full documentation, the trades on site were able to contribute to the fullest of their skills, rather than within the limits of the architect's expectations. In addition, the set-up prompted a radically different approach to the role of the architect. Instead of wholly defining the project beforehand and then overseeing the construction such that the design was correctly enacted, Lethaby's practice loosely defined the project through drawing, and then co-ordinated the independent craftsmen who completed it. The information provided can therefore be considered as deliberately incomplete: intentionally requiring resolution on site and collaboration between designers and makers to ensure that the building was completed satisfactorily.

Of the eleven drawings in the archive, two contain plans, sections and elevations, scaled at one eighth of an inch to one foot (1:96), completed in pencil and coloured washes, stamped by the Ecclesiastical Commissioners for England as 'Approved Conditionally', and dated 25th April 1901 (fig. 12).

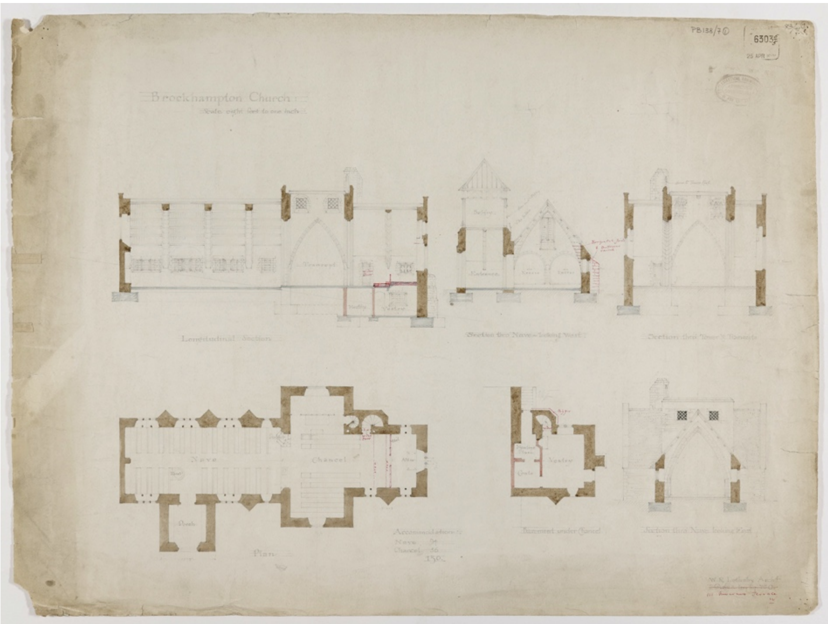


Figure 12. All Saints', Brockhampton, W.R.Lethaby's plans and section drawing.
RIBA Drawings Collection, Victoria and Albert Museum

An additional plan at the same scale explains the heating system and two sectional drawings explore the construction, while a loose pencil sketch depicts the bell tower. A further five drawings describe the various windows in some detail, and one can assume that this additional level of resolution was produced because the windows were the sole area of works fabricated off-site, presumably in a nearby mason’s yard, and therefore not overseen by the site architect.

On some documents, design changes during the period leading up to site works are partially charted. Interestingly, the general arrangement drawings show the roof in the earlier design form, unrevised, as tiled with a timber structure, while a looser drawing of two sections shows the nave with a timber structure and thatched roof, and the transepts as structured in concrete with thatch over. The title to the transept sketch has the text, ‘an alternative’, crossed out - perhaps at the moment this option was adopted - although the nave version remains unamended.

In other areas, works carried out on site clearly varied from the drawings. To the north side of the building the drawings show the lower stair to the vestry with a low flat roof, but this was clearly found not to work with the internal clearance heights and a steeply sloping roof was constructed instead. The resulting roof form, combined with the chamfered wall below, provide this element as constructed with a satisfyingly sculptural quality of its own. Though not apparent from the drawings, it is wholly attuned to the overall feel of the church and attests the potential benefits of the improvisational strategy at play.

While the drawings provide only a broad outline of the design, they were, however, accompanied by a written specification ‘of materials to be used and works to be done,’ that was also stamped with the Ecclesiastical Commissioner’s conditional approval. This document is supplementary to the drawings, explaining certain omissions without altogether eliminating the opportunity for improvisation on site (figs.13 & 14).

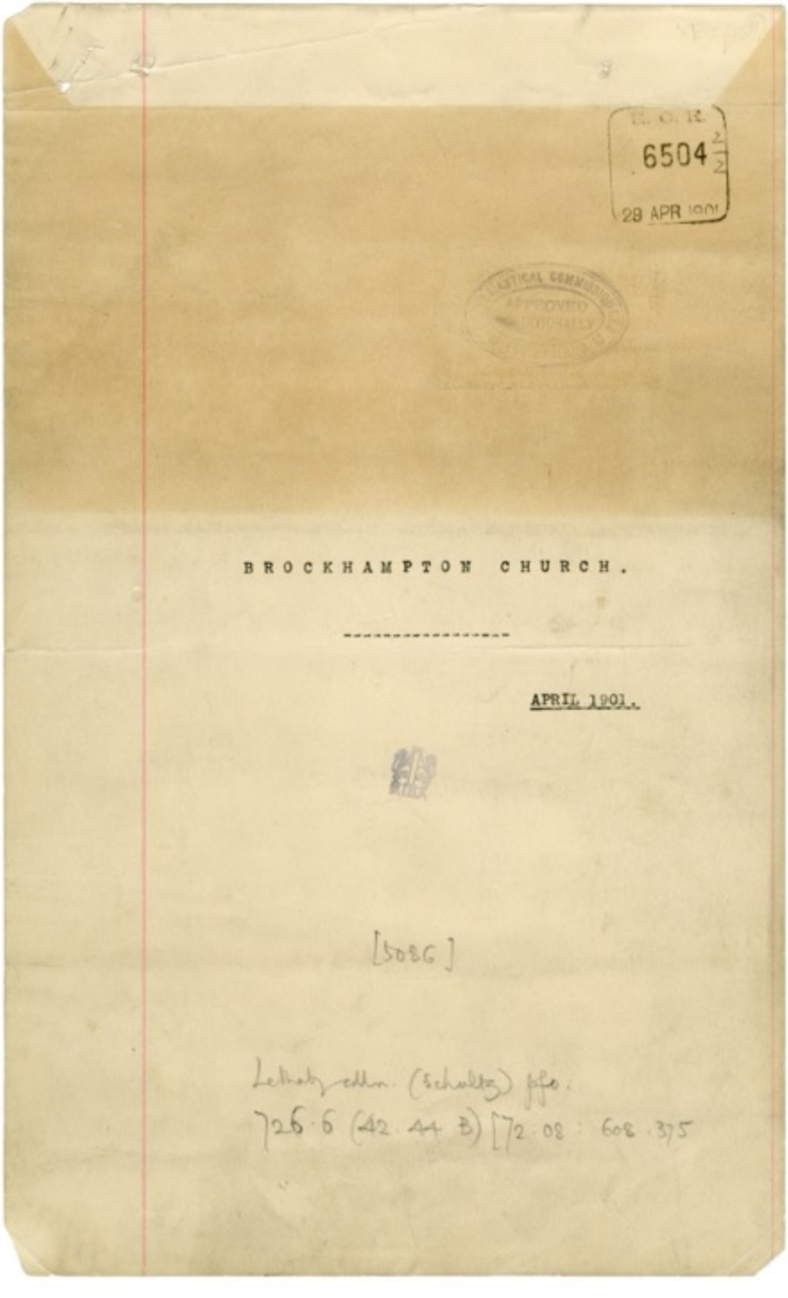
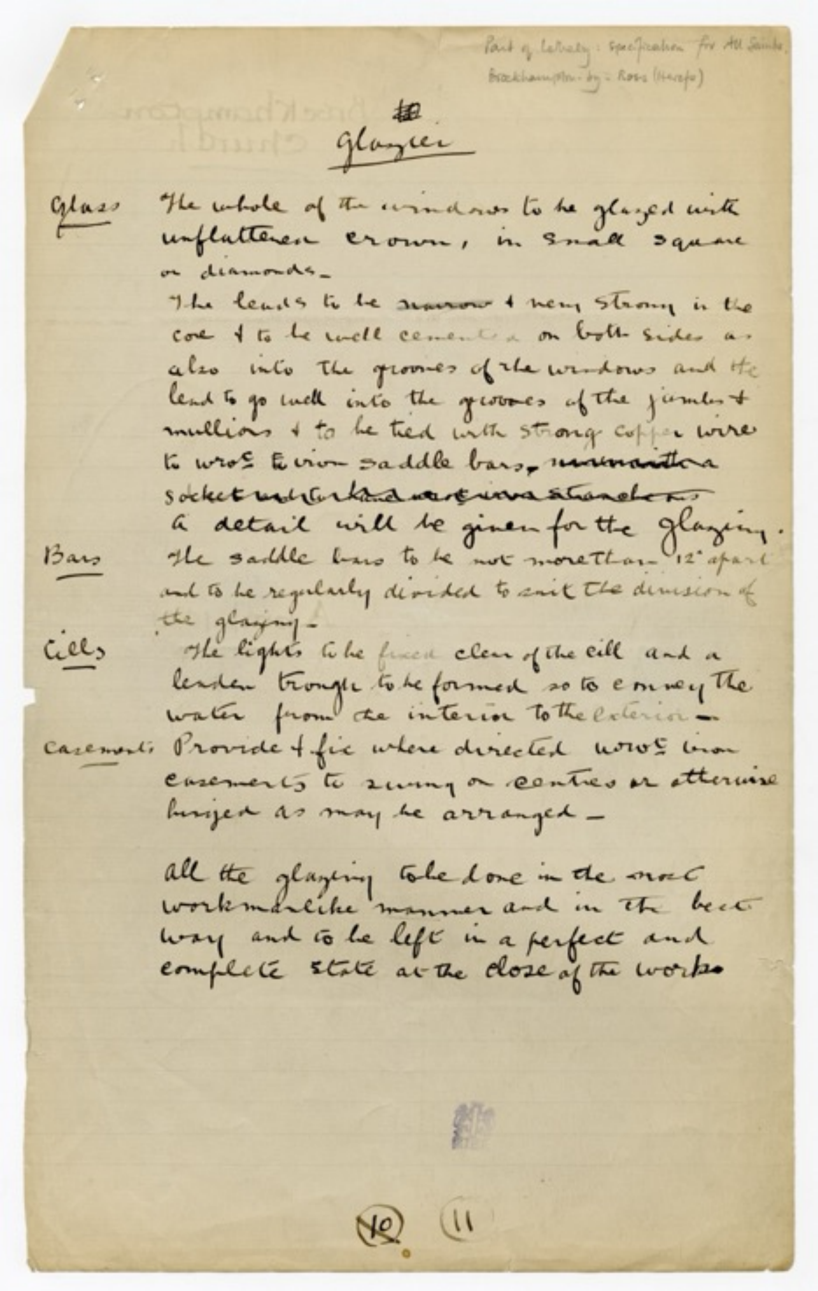


Figure 13. All Saints', Brockhampton, specification cover.
RIBA Drawings Collection, Victoria and Albert Museum



Part of Lethaby : specification for All Saints, Brockhampton-by-Ross (Herefs)

Glazier

Glass The whole of the windows to be glazed with unflattened crown, in small squares or diamonds –

The leads to be ~~narrow~~ & very strong in the core & to be well cemented on both sides as also into the grooves of the windows and the lead to go well into the grooves of the jambs & mullions & to be tied with strong copper wire to wrot iron saddle bars, ~~[illegible]~~ socket ~~[illegible]~~

A detail will be given for the glazing.

Bars The saddle bars to be not more than 12" apart and to be regularly divided to suit the division of the glazing –

Cills The lights to be fixed clear of the cill and a leaden trough to be formed so to convey the water from the interior to the exterior –

Casements Provide & fix where directed wrot iron casements to swing on centres or otherwise hinged as may be arranged –

All the glazing to be done in the most workmanlike manner and in the best way and to be left in a perfect and complete state at the close of the works

10 11

Figure 14. All Saints', Brockhampton, specification page for the glazier.
RIBA Drawings Collection, Victoria and Albert Museum

In some areas, the specification delineates a coordinating process. For example, there is no location plan drawing or any evidence of one having been produced, but the notes allow for the determination on site of the building's specific positioning, stating in relation to the setting out of walls: 'The form and position of the several walls are to be carefully marked out subject to the particular directions of the Architect.'[52]

In some places, where drawings do exist, the text document is complementary, so that while the windows are the only precisely drawn elements, it is the specification that notes in relation to their masonry, 'All to be left from the chisel'. The result is a distinctive, textured surface to the stonework that recalls Ruskin's quality of Gothic 'savageness' - the vitality he recognised in Medieval carving which stemmed from the freedom granted to stone masons (fig. 15).

But the specification is also precise in many areas of trade work where the drawings are vague or altogether lacking, providing detailed information missing in the drawings that is nevertheless formally unspecific and therefore still permits interpretation on site. Three areas of the works are particularly noteworthy as elements of architectural significance that are seemingly not covered by Lethaby's drawings at all.

The joinery elements are evident only in outline form on the general arrangement plan, and the relevant section within the specification pertains primarily to carpentry-work. Yet, they have a strong impact on the character of the interior: timber pews, pulpit, and choir stalls, all completed in oak, creating together a warm counterpoint to the building's masonry shell. The latter two elements were both skilfully made by Philip Webb's former assistant, the architect and wood carver, George Jack. The wooden pulpit depicts Christ preaching in low relief, while local wildflowers are carved into the panelling of the choir stalls.[53]

[52] *Specification of works by W.R.Lethaby for building a Memorial Church at Brockhampton,* RIBA Collections, 1.
[53] Amy Clark, "George Jack, Master Woodcarver of the Arts & Crafts Movement," *Journal of the Decorative Arts Society 1850 to the Present*, no 28 (2004), 82-107.

Figure 15. All Saints', Brockhampton, worked stonework, chancel window with quatrefoil stone tracery, behind the altar are hung Morris and Co tapestries designed by Edward Burne-Jones (Photo: Hugh Strange, 2019)

Similarly, the main door within the porch provides a noteworthy entrance to the church but is hardly visible in plan. The door and its ironmongery are however particularly well-defined in the specification notes:

> Doors
> The doors are to be 1 ½” closely framed oak, covered with 1” grooved and tongued oak boarding, straight joint on face, the inside of framing to be wrought and chamfered.
>
> Hinges
> The doors to be hung with purpose made wrot iron hinges with back and front straps welded together and with eyes for hooks carefully drilled out. The doors to have 18” wood stock locks fastened on with screws and nuts, long drop latches and closing rings and ornamented escutcheons and square bolts.[54]

And yet, these descriptions give little indication of the simple, robust, and characterful ironwork produced by the blacksmith, which adorns the door leaf as built.

Perhaps most striking, given the enthusiasm for leadwork in Lethaby’s book, is that the rainwater goods are only briefly covered by the specification and - in remarkable contrast to the lengths at which these elements are described in the thorough sequence of drainage drawings produced for Avon Tyrell - are not shown on any of the project drawings for All Saints’. Yet the leadwork guttering, downpipes and flashings for the completed building are characterful and expressive and are clearly worked on site in a responsive manner (figs.16 & 17).

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[54] *Specification of works by W.R.Lethaby for building a Memorial Church at Brockhampton,* RIBA Collections, 8.

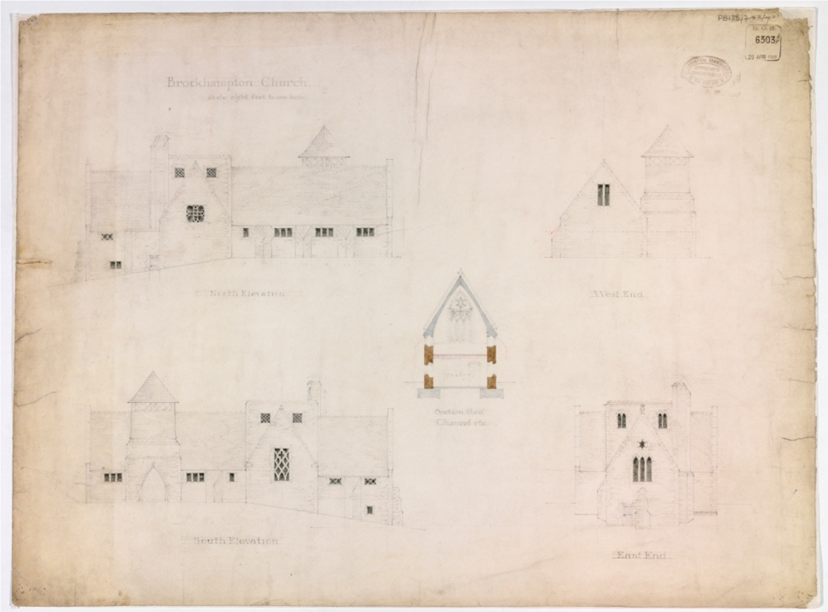

Figure 16. All Saints’, Brockhampton, W.R.Lethaby’s Elevations and section drawing
RIBA Drawings Collection, Victoria and Albert Museum

Figure 17. All Saints’, Brockhampton, Expressive drainage detailed, undrawn.
(Photo: Hugh Strange, 2019)

All these areas relate to trades - the joiner, the ironworker, and the lead-worker - whose works are completely undirected by the drawings. However, this is not to suggest they were unimportant to Lethaby, for if there is an overriding impression one might take from the architecture of the church, it is of crafts having been carefully undertaken alongside each other; of the building design as a vehicle for good craftsmanship (fig. 18). In this respect, perhaps Lethaby had succeeded in fulfilling his aspiration set out in his text *The Builder's Art and the Craftsman* for a practice directed towards 'the co-ordination of the several crafts in the achievement of right or beautiful building.'[55] That by substituting drawings with words as the primary means of communication - in the dual form of the specification and site conversations - he was able to co-ordinate, rather than instruct; able to create 'the Craftsmen's Drama.'

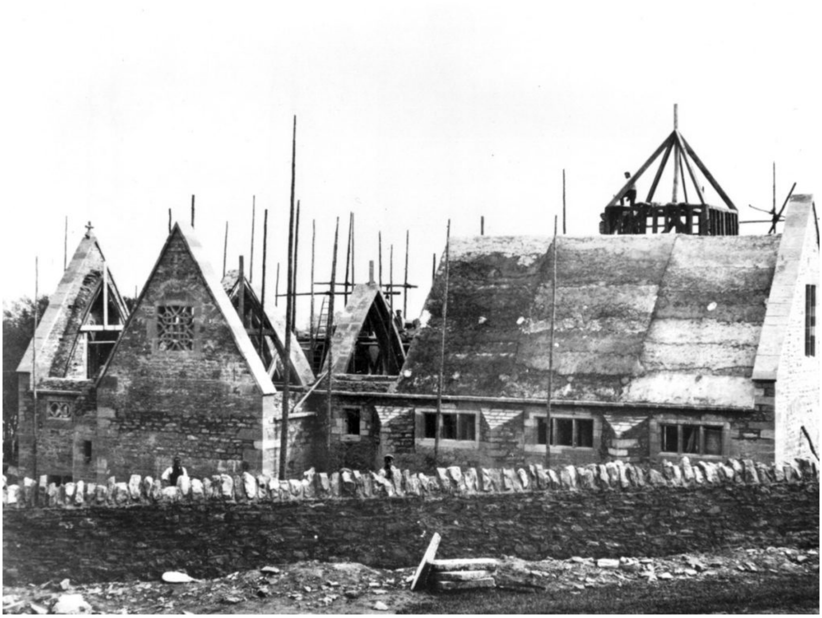

Figure 18. All Saints', Brockhampton, Construction Photograph.

[55] Lethaby, "*The Builder's Art and the* Craftsman," 151.

Postscript

Lethaby was not alone in seeking to increase craftsmen's involvement in the design and construction of buildings through reconfigured site relations, and a number of colleagues were undertaking similar experiments around the same time.[56] In particular, his friends Detmar Blow and Ernest Gimson had during the late 1890's collaborated on a number of cottages in Leicestershire, Blow was directly involved in the projects' construction, and in 1900 - the year before work commenced at Brockhampton - had built Happisburgh Manor, a large butterfly-plan house in Norfolk, in a similar manner. To achieve this level of involvement on site, while also juggling his numerous other commitments at the time, Lethaby had his assistant, Randall Wells, live nearby during construction to directly oversee the works. Wells went on to fulfil the same role for E.S. Prior at St. Andrew's Church in Roker five years later and established his own architectural practice.

At the time of the construction of All Saints' Church, though, Wells was only twenty-four years old, and the combination of his youth and the experimental project structure proved problematic. Several incidents occurred on site that might be considered independently from Lethaby's aspirations for the project, but not, one suspects, entirely independent from Wells' involvement. When an arch collapsed, Lethaby was informed by the disgruntled client rather than his assistant, who then claimed that the failure was the result of an unsuccessful experiment in mortar. More significantly, the height of the crossing tower was increased by ten feet without Lethaby knowing.[57]

The shortness of the tower, which rises just above the ridge line of the main roof, is clearly a key element of the original design drawings - the longitudinal section indicates the undemonstrative humility that was intended; the un-tower like impression that Lethaby sought. The additional stonework that resulted from this variation is now apparent on the exterior of the building in the decorative banding at the top of the wall (not present in the design drawings) and the built relationship between the stone crossing tower and the timber clad entrance tower is perhaps not quite as successful as drawn. Perhaps in both

[56] Michael Drury, *Wandering Architects: In Pursuit of an Arts and Crafts Ideal* (Donington: Shaun Tyas, 2000), 1-3.
[57] Rubens, *Lethaby,* 156-9.

instances one might excuse Wells, considering he was working within the spirit of experimentation and site-directed design development that Lethaby himself had established and encouraged. While he was based on site, however, Wells was approached, independently from his employer, to design and build a church in the nearby village of Kempley.[58]

The design he completed for the Church of St. Edward the Confessor there shares several features with Brockhampton, and is similarly constructed in local sandstone, although the tower is significantly more emphatic. As at All Saints' Church, Wells oversaw the design personally on site, and contracted the job on a direct labour basis. While All Saints' Church was consecrated in 1902, the church at Kempley was dedicated in 1903, and perhaps even completed as early as 1902.[59] It can only be surmised from the closeness of the dates that the youthful Randall Wells was clearly not wholly focused on the successful delivery of the Brockhampton church through this period. Of the various problems that befell the construction of Lethaby's building, perhaps the most noteworthy was the appearance of cracks in one of the walls. Concerns were raised over the adequacy of the foundations, and following advice, concrete was cast underground, below the East end of the church, to shore it up. The issues on site coincided with rising project costs, and the client, not entirely supportive of the architect's methods, grew dissatisfied. Lethaby was remorseful and, feeling responsible for the complications, both paid for the remedial works, and refused his fee. He was, by all accounts, left debilitated by the experience. Although he entered the competition for Liverpool Cathedral in the same year as the church's consecration, together with a group of close colleagues, this was to be the end of his private practice, and he dedicated the remainder of his working life primarily to writing and teaching (figs.19 & 20).[60]

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[58] Drury, *Wandering Architects*, 171.

[59] Nikolaus Pevsner and Enid Radcliffe, "Randall Wells," *Architectural Review* (November 1964): 366.

[60] By this time Lethaby was also significantly involved in teaching, having been appointed in 1894 as art inspector to the newly established Technical Education Board of the London County Council, and soon after, in 1896, when the Central School of Arts and Crafts in Holborn was set up, as one of its founding co-heads, and sole principal from 1902. During this period, he was also appointed Professor of Ornament and Design at the Royal College of Art, in 1901, and later still, when The School of Building in Brixton opened in 1904, Lethaby was appointed head, acting in the role until 1911. Here he was able to continue his pedagogic mission; located in a former swimming baths, the large central hall allowed students to work together, constructing full-size elements of buildings within the space. A detailed description of Lethaby's involvement in education can be found in: Swenarton, *Artists and Architects*, 107-125.

Figure 19. Model, Liverpool Cathedral Competition, 1902.

Figure 20. Building construction, School of Building, Brixton, 1911.
London Metropolitan Archives, City of London.

Although the shift in Lethaby's career that followed the completion of the All Saints' Church project cannot be entirely separated from the problems that occurred on site, it would be wrong to consider them altogether responsible for it or draw a direct correlation between these issues and the project's experimental methodology. Given the considerable architectural merits of the building as constructed - that are not unrelated to the quality of craft evident at every turn - his methodology, which involved the craftsmen in giving final form and texture to material, should be considered independently.

The contrast between Lethaby's approach to his first and last buildings could not be more striking. At Avon Tyrell, his desire was to fix the project, prior to construction, in a fully conceived, definitive design of his sole authorship, from which as few variations as possible were to be made once handed over to a contractor. The works on site were thus to be rendered as closely as possible to the prescriptive design drawings; the project, independently conceived, was to be unmediated by the process of building. In comparison, All Saints' Church witnesses a willingness to loosely define the project initially, and only later, on site, and with the assistance of others, to resolve matters fully. As such, the sense of a comprehensive, 'original' design, perfectly captured through drawings, is replaced by a strategy that enables the project to evolve through the process of construction. Rather than a routine act of realisation, of 'mere' building, construction might offer instead a richer fulfilment of the project's potential. The transferal of decision-making from the distant drawing board to the site might be said to have provided the church with a greater degree of site specificity. More pertinently, however, through the collaborative construction process, the human endeavour of making is manifested, indeed, celebrated, in the built work. One of Lethaby's great triumphs at All Saints' is that these qualities are gained without any sense of a loss of coherence.

The seemingly inverse relation expressed in the two projects, between the degree of resolution through drawings prior to construction, and the liberty granted the craftsmen building the work on site, might be read through the growing sense of political engagement apparent in Lethaby's writings that were published in the years that separated them. Certainly, these texts suggest that the apparent difference in approach was highly considered, rather than contingent, based in part on a Ruskinian sense that the methodology of the latter would produce an architectural outcome that was better, more alive, and that the traces of labour would contribute to the artistic merit of the building. Significantly, and here influenced by William Morris, they were also based on a desire to impart craftsmen with agency within the production processes that occurred on site to counter the alienation that he saw as inherent in the separation of design and construction.

The last of Lethaby's published books, his biography of Philip Webb, was written ten years after Webb's death in 1915. Webb was a generation older and Lethaby's great hero; the life and work of whom he considered the ideal model for an architect. Evident throughout the text is that Webb was a brilliant draughtsman and designer, and yet he nevertheless considered the building site, not the drafting table, to be the true location for the production of architecture:

> He (Webb) was, before everything, a born craftsman, and might have been a great master builder or sculptor, but he found himself imprisoned in an "office" with no other use for his hands, with their unappreciated cunning and skill, than to make heart-breaking attempts to convey his ideas of design and execution through the irritating medium of a lead pencil.[61]

Perhaps this paradox might be viewed as symptomatic of the Arts and Crafts movement as a whole; of the struggle to come to terms with the division of labour, borne of an earlier theoretical separation between project and building, but exacerbated by the industrial revolution through which the two men lived.

In this regard, the methodology adopted by Lethaby with his church at Brockhampton, inspired by Medieval precedent, aesthetic aspiration, and social conscience, suggests not a rejection of drawing, but rather an attempt to shorten the distance between architect and building site - a challenge to the gap between thinking and making. The project posits that prior to the act of building, designs might be left unfinished; that one might undertake an architecture of incomplete intention.

[61] Lethaby, *Philip Webb*, 232.

Chapter 3

The Emancipatory Building Site

Walter Segal and the Rigorous Simplification of Building Process

Figure 1. Highgate House, Frame from the film, The Dilapidated Dwelling
Patrick Keiller, 2000

> I built 30 houses in London before 1962 but it was becoming really warfare…I found it harder and harder and I longed to get out.[1]

In 1962 the architect Walter Segal was faced with a dual dilemma. Having been born in Germany, and grown up in Switzerland, since the 1930's Segal had lived and practised in Britain but felt he had been engaged in what he described as his '30-year war' with the traditional processes of getting buildings built.[2] This war involved clashes with the state-sponsored bureaucracies of planning and building control that Segal considered set unnecessarily constrictive rules on design, it involved struggles with the established system of contracting, that he felt separated the architect from direct contact with those who constructed his designs, and it involved frustrations with traditional masonry construction that relied on numerous trades and was inherently slow.[3]

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[1] Pawley, Martin, "Walter Segal's House," *The Architects' Journal* (20 June 1984): 36.
[2] Segal was born in Berlin in 1907, spent his childhood in Switzerland, and moved to London in 1936. His early life and education are well recounted in: John McKean, "Becoming an Architect in Europe between the Wars," *Architectural History,* vol.39 (1996), 124-146.
[3] Walter Segal, "Low-Cost Housing and User Participation," in *Architecture and social sciences: selected papers*, ed. by P G Raman (Edinburgh, University of Edinburgh, 1973), 122.

But Segal also faced an immediate problem. He was building a new home for his family in Highgate, in North London, and this required the demolition of the existing house on the site; he needed to provide accommodation for his family during the building works. Segal did this by constructing a temporary structure to the rear of the plot, later known as, 'the little house in the garden'.

While the main house was to be built in brick, as was much of the architecture of his previous '30-year war', this interim dwelling was of timber construction, notably using a simple structural frame, dimensioned to accommodate off-the-shelf standardised products. Segal established with this house a particular approach to building that he was eventually able to apply in a series of self-build houses on council owned land within the London Borough of Lewisham for which he is best known; the radical simplicity of his approach allowing unskilled residents to construct their own houses with their own hands. In doing so, he proposed new roles and relationships between architects, builders, and clients.

Challenging the separation of design and construction, Segal proposed an approach to design wholly aligned with construction and, perhaps most importantly, re-oriented towards the building site. But this achievement was only possible through the series of private house commissions completed in the decade between his own temporary house and the Lewisham projects, where these principles were developed and refined, always with a view towards a rigorous simplification of building process that made construction accessible to all.[4]

Eventually, the client for one of these projects, the Hollands, suggested that they could construct their house themselves, and the potential of Segal's approach became evident.

[4] This phrase, and later sub-title, is derived from a section of text in Broome and Richardson's book, 'The Segal method is an approach that suggests how to build rather than a system of building. It is an attitude of mind based on a rigorous simplification of the whole building process, including design and documentation as well as the actual processes on site.' Jon Broome, and Brian Richardson, *The Self-Build Book* (Dartington: Green Books, 1991), 187.

The little house in the garden

> I slithered into the discovery, shamefully late, that a market of mass-produced materials does exist, that, by and large, there are many materials that are dimensionally co-ordinated which you only have to buy and assemble.[5]

Although conceived as a secondary structure to facilitate the new brick house, the timber building within the garden in Highgate proved pivotal in Walter Segal's career (fig. 1). The ideas tested within this project certainly developed out of previous work, yet they also formed a distinct new trajectory in his oeuvre. A temporary planning permission had been given for the structure, and the funds for it were to come from the budget of the main house. Segal therefore sought to design as cheap a building as possible, one that was both quick to construct and demountable. Significantly, by preserving building elements in their original condition he hoped to recoup as much of the material costs as possible through re-sale of the disassembled parts once the building had served its purpose.[6]

While the proposed brick building was to be set towards the street, the temporary house was located at the far end of the sloping rear garden and, for just under two years, provided accommodation for Segal, his wife, and their children.[7]

The house was almost square in plan and very compact, measuring just 715ft^2 and with an internal height of only 7 feet. Distributed around the three sides of a central living room, such that minimal space was required for circulation, the master bedroom, three children's bedrooms, a study, hall, W.C., bathroom, and kitchen, were all extremely small, with built-in storage units reducing the need for additional furniture. The tightness of the rooms was compensated in part by the generosity of the central space onto which they all opened (fig. 2).

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[5] Walter Segal, "Low-Cost Housing and User Participation," 115.
[6] "Four Bedrooms - £800," *Architects' Journal*, 26 January 1966, 252.
[7] The house remained on site until 2016, when it was dismantled by the then owners.

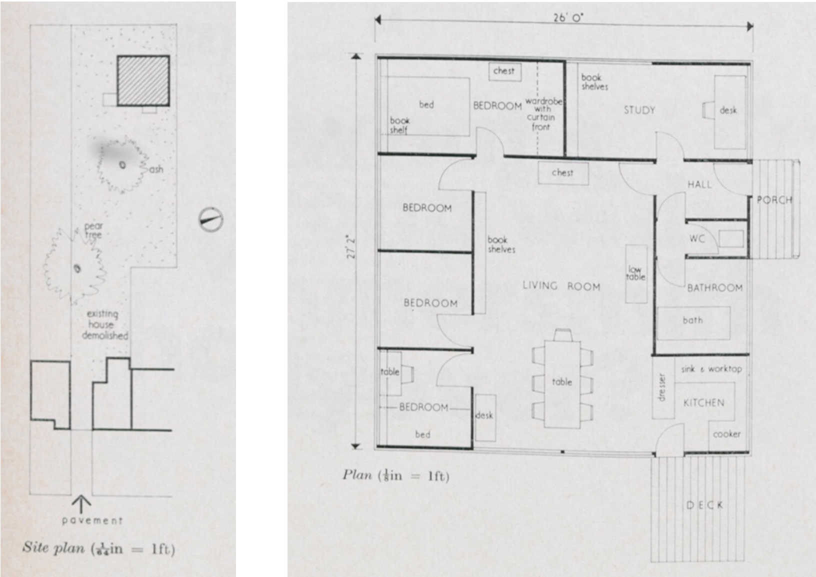

Figure 2. Site Plan & Ground Floor Plan
Highgate temporary house, Images courtesy of the *Architects' Journal.*

Arranged on a single floor, the house was raised above the surrounding ground on twenty supporting posts, cut to accommodate the varying slope of the back garden. Remarkably, each post sat unfixed on a 2' square concrete paving slab, which was simply laid into the ground on sand, with no foundations below; Segal's careful calculations had proven that the building weighed enough to remain static, without any fixing to its site, but not enough to require any more than the most minimal of footings.

The house was built with a lightweight timber frame, with slender 4"x2" posts supporting 6"x2" rafters and joists. With the joists sitting on top of the beams, and the roof structure lapping to the sides of the posts, the relationship of members within the structural system was very legible (Fig.3). There was minimal cross-bracing, and although some rigidity was provided at the connections, the structure reportedly had a fair bit of give.[8]

[8] Florian Beigel describes the house's 'Wobbly structure', in: "Pragmatic Approach," an interview with Florian Beigel, ed. by Peter Carolin, *The Architects' Journal*, May 4, 1988, 64.

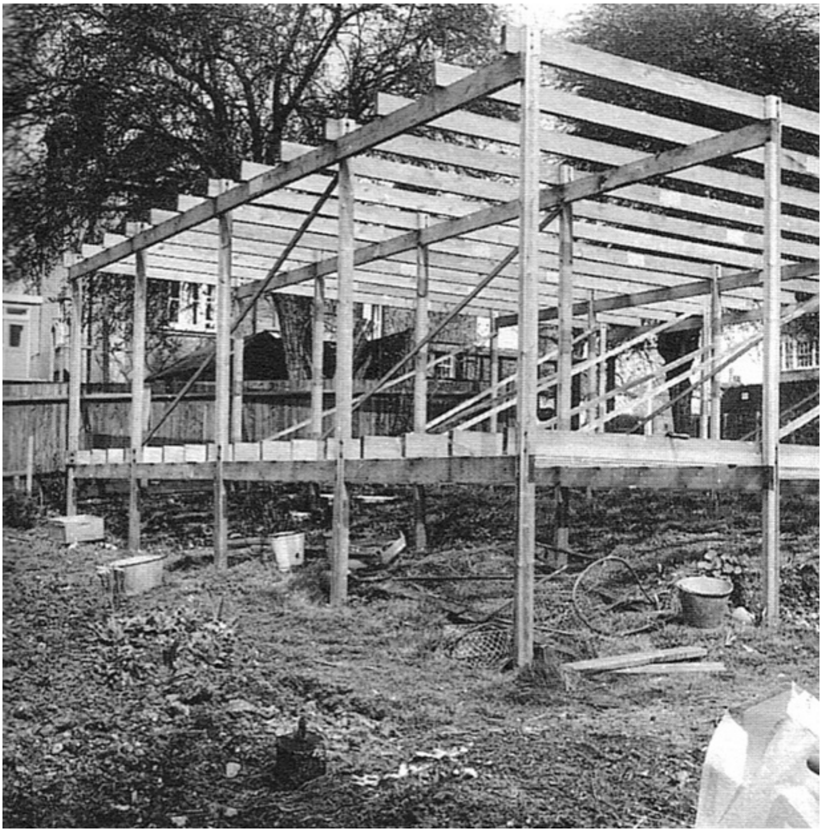

Figure 3. Highgate temporary house. First published coverage in the Architects' Journal.

Set within the frame, the external and internal walls, together with the roof, were all formed in woodwool slabs of 2' widths and 2" thicknesses, and arranged in three lengths: 6', 6'8" and 7'. In total 130 slabs were used in the house. These slabs were readily available from several suppliers at the time, with the ones used in the temporary house sourced from British Gypsum. They were factory-made using a mixture of cement and wood strands, and provided both strength and insulating properties, yet were light enough to be easily handled on site. On the roof, the woodwool was laid perpendicular to the rafters, in a grid of 4 x 13 slabs. An underlay of Sisalkraft building paper was loose-laid onto the slabs, with two layers of a bitumen-based roofing felt bonded to this. Unfixed to the substrate, these layers were simply weighed down by a constant one and a half inches of water that covered the roof, together with a series of loose laid bricks. During the hot summer months, to counter evaporation, Segal would top up the water with a hose when needed.

In general, the internal and external wall slabs ran vertically, a single woodwool slab equalling the building's height. Windows were made with unframed single glazing sliding within tracks formed by aluminium angles, and when these occurred the slabs were laid horizontally beneath, with the heights of the apertures determined by the width of the slab. A slurry was applied to the external wall slabs, which were then clad on the outside with green mineral roofing felt. The inner face of these external walls was lined in hardboard, with the rough side of the boards facing into the room.

Also of 2" thick woodwool slabs, the internal walls were loosely lined with a wood chip paper that remained undecorated, and both these and the external panels were clamped in place with battens. These visible fixing battens to internal and external walls were to be a key and highly recognisable element of Segal's timber architecture of the following twenty-five years, exemplifying the logic of his approach. The timber battens clamped the woodwool slabs, together with any linings, and were bolted tight; the fixity of the junction relying on pressure rather than nailing or screwing. While Segal recognised that nails would have been cheaper, this bolted detail, which resulted in no holes to the planar materials, was preferred as it allowed for the demounting and resale of materials.

Segal managed the construction works on site without a general contractor, co-ordinating work directly with the trades involved. Key amongst these was the timber work, and here Segal employed Fred Wade for both carpentry and joinery. Wade became a near constant in the domestic projects that followed, the understanding that developed between the two men clearly a factor in the gradual technical refinement that occurred through these houses. In addition to Wade, a drainlayer, roofer, electrician, plumber, and glazier were all employed directly by Segal at Highgate. Access to the site was less than ideal, with materials having to be carried by hand through the basement of the existing main house and down the garden. This awkwardness revealed another benefit of the lightness of the timber frame, with the use of heavy masonry materials very limited, and the small house was quickly constructed in just ten weeks.

The construction cost was remarkably low, including materials and labour, totalling just £854. As an indication of relative price, this was about 1/10 the cost per square foot of the brick build that followed.[9] This was of course a primary aim of the building; to retain as much as possible of the overall budget for the construction of the main house. And it was achievable because Segal had a very keen sense of where the costs resided in a project, and from this, how an economy of means might best be considered and deployed.

His first strategy to this effect was by not employing a main contractor. This omitted the costs of administration and contractor profit from the project budget, but it also meant there was no intermediary between architect and labour, which suited Segal's aspiration for a closer, more direct involvement in construction. In relation to material costs, the savings were twofold. A number of low-cost materials were utilised in place of standard solutions, with atypical internal finishes particularly noteworthy; the use of wood chip paper in lieu of wallpaper as an internal wall finish is an example of this. But the material costs were also reduced through a reduction in the quantities used: the slenderness of the frame required less timber than might otherwise be expected, but also created a building that was so light that traditional foundations could be dispensed with. Perhaps most significant in reducing costs, the simplicity of the construction greatly reduced the work involved on site, with the construction of the temporary house requiring in Segal's calculations a combined labour input of just 13 working weeks.

Segal's reductive approach to construction was neither didactic, nor aesthetically oriented. It entailed a reduction in the number of trades involved, a reduction in the number of operations involved by each trade, and finally, a reduction in the complexity of operation by each trade. Critically, Segal recognised that a historical shift had occurred in the balance between material and labour costs. Using cheaper, and less material helped, but the most consequential savings were achieved through re-thinking the operation of labour within the building process. The Highgate temporary house shared several ideas with earlier projects. Segal had throughout his career been preoccupied with the subject of dwelling, carefully surveying, photographing, and studying house forms from Ibiza, Mallorca, and

[9] A detailed cost breakdown is provided by Walter Segal in the first full coverage of the building: "House at Highgate," *Architects' Journal* (23 March 1966): 769.

Egypt first hand, and, in his extensive study of 1948, *Home & Environment*, had produced a detailed analysis of low-rise housing typologies.[10] Although his buildings prior to the temporary Highgate house were almost entirely masonry, there were notable exceptions. As an architectural student in Switzerland, he had studied under Hans Poelzig, and had been greatly influenced by the publication in 1930 of a small book on timber construction, *Holzhausbau*, by Konrad Wachsmann.[11]

Soon after finishing his studies, in 1932, he designed a summer house with a timber frame structure, La Casa Piccola, and in 1957, also in Switzerland, he built himself a timber ski house.[12] Parallels between these projects and the later houses make clear his ready knowledge of timber construction. There were also precedents for his later understanding of standardisation. In the 1950s he designed a factory and warehouse in Hackney, London, for Premier Pickle, that was constructed in brick and concrete; the plan layout incorporated an administration block to the front, behind which open factory spaces allowed for the pickling and bottling. In a precursor to the later timber houses, the whole site plan was set out on a grid determined by the dimensions of standard woodwool slabs.[13]

Segal had also experimented with alternative contractual arrangements, notably in the small terrace of houses at Tasker Road in North London. This project, which was built around the same time as the temporary house as a speculative development, involved Segal acting as main contractor, and his wife, Moran Scott, as client.[14] However, in the Highgate temporary house, these earlier ideas joined those of low-cost and demountability in a wholly coherent manner, establishing a set of principles that were developed and refined in the subsequent private commissions. From this point on, process fully aligned with product; the 'how' of building seemingly equally important to Segal as the 'what'.

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[10] Walter Segal, *Home & Environment* (London: Leonard Hill, 1948), 64.
[11] Wachsmann was one of Poelzig's former students. His book was published in 1928, and after many years out of print, was in 1995 published in English for the first time. Konrad Wachsmann, *Building the Wooden House: Technique and Design,* ed. by Michael Grüning, Christian Sumi and Christa Grüning (Basel: Birkhäuser, 1995)
[12] The Casa Piccola (1932) and Ski house (1957) are described in: Philip Christou, "Unassertive, optimal, typical: The work of Walter Segal," in, *BAU* (May 1999): 48-59.
[13] "Factory, for the manufacture of preserves, and warehouse. Ramsgate Street, London; Architects: Walter Segal," *Architects' Journal* (2 October 1958): 493-500.
[14] Walter Segal, "Case study of three houses in Use," *Architects' Journal* (26 January 1972): 209–15.

The Private Houses

Figure 4. Highgate temporary house.

Although completed in 1963, the temporary house in Highgate was not published until three years later when the project was extensively featured by the *Architect's Journal*, where Segal was a regular contributor, and was much admired by the magazine's editor, Colin Boyne (fig. 4). In the same year several articles within the mainstream press brought the house to a wider public, all focussing on the project's remarkably low cost.[15]

The coverage quickly led to a demand for comparable homes from private clients, and over the next few years, and in particular from 1968-71, Segal completed a number of private houses in timber frame construction, all for extremely low budgets and completed within very short programmes.[16]

[15] The Financial Times noting: 'A four-bedroom home at a cost, in labour and materials, of £854 8s 5d (a precise enough figure), erected in 10 weeks, is a phenomenon worth noticing.' *The Financial Times*, 23 March, 1966, 10.
[16] Wilhelm Kainrath, "Walter Segal's Houses," *Architects' Journal* 152, no. 39 (30 September 1970): 769-780.

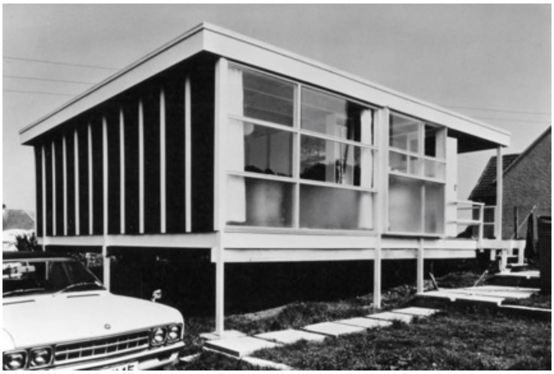

Figure 5. Donohue House, Ballygarrett. 1968.
Image courtesy of the RIBA Collections.

First of these was the Donohue House, of 1968, located in Ballygarrett, Ireland (fig. 5). The project had much in common with Segal's own house: it was single-storey and was very tightly planned. At just 630ft^2, yet accommodating three bedrooms, it was also very small. Costing only a little more than the temporary Highgate house, the project was constructed in a three-week period over the summer holidays by the owner working alongside a carpenter.

The basis of the construction was very similar: a lightweight timber frame, raised above the ground, with the frame infilled with uncut woodwool slabs, and the external walls clad in the same green felt. However, several other details and finishes differed, notably the addition of plasterboard to the internal walls in lieu of hardboard and building paper, although, in the same spirit, the plasterboard was left unpainted. And, while the horizontal roof plane was unbroken in the Highgate project, here, clerestory glazing was introduced above, to light the centrally located bathroom.

Figure 6. The Tree House, Halstead. 1969.

The following year, a house at Halstead in Essex was built for the Colliers, named The Tree House by the client as the sloping site lay close to an orchard (fig. 6). Once again, the Highgate template of a single storey lightweight timber frame with wood wool slab infill was utilised, but again with further variations. Like the house at Ballygarrett, internal walls and ceilings were finished in unpainted plasterboard, but by this stage alternatives to water were found to hold the loose laid roofing down, and, to satisfy building regulations, concrete foundations were cast below the paving slabs on which the frame sat. Differing from both the Highgate and Donohue houses, green felt used for the external wall cladding was replaced with enamelled asbestos sheets, in white and red.

Planned and built with three bedrooms in a simple rectangular plan form, at 1025ft^2 the house was larger than the previous two buildings. Immediately following completion of building works, the client added a wing of 345ft^2, containing an additional bedroom and study, and configured in a stepped arrangement that now wrapped around an existing tree, and allowed access to the roof. The ease with which the original house design was reconfigured and expanded demonstrated to Segal both the flexibility and extendibility of his approach.

Figure 7. Vesey Holt Extension, ‘Phantom Ranch’, 1970.
Image courtesy of the RIBA Collections

Several projects were completed in 1970, each suggesting slight technical adjustment and incremental development. In North Chailey, East Sussex, a substantial extension was added to an existing single storey house, Phantom Ranch for the Vesey Holts (fig. 7). The addition was almost self-contained, providing bedrooms, bathroom, study and living space, although no kitchen, and was built in 19 weeks, with the husband and wife occasionally helping with construction.[17]

Like the project at Halstead, it was externally clad in the enamel asbestos panels that became a standard component of the projects that followed. But a key new development was here added to the architectural vocabulary, with the flat roof projecting beyond the walls, where previously it was flush, now providing both shading to the large areas of glazing, and some protection from rain to the opening windows.

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[17] As recounted to the author on 21st January 2021 by the architect Duncan Roberts who was involved in dismantling several of Segal’s houses, the site was later divided and the extension separated from the original house and successfully moved apart intact, to form two independent houses.

Figure 8. The Wembley Playroom. 1970.
Image courtesy of the RIBA Collections.

Also completed in 1970, the Wembley Playroom in North-West London, at just 324ft^2, was the smallest of the Segal timber projects to date, a single space within a free-standing building supported on four posts (fig. 8). Constructed by Fred Wade in just 3 weeks, the building utilised the Glasal asbestos panels both externally, in white, and, for the first time, as an internal finish, in red.

Figure 9. Leigh House, Yelling.1970.
Image courtesy of the RIBA Collections.

To this point, the building layouts were notable for their tight spatial planning, with the economic ratio of external wall to internal floor space very much in evidence, but with the Leigh House in Yelling, Cambridgeshire, completed in 1970, Segal started working with looser plan configurations (fig. 9).

The house shared the construction methodology and appearance of the previous buildings but differed significantly in layout. Acoustic transmission was an issue in the earlier houses, a consequence of the detailed design of the internal partitions that was exacerbated by the compactness of the house plans. At Yelling, to provide acoustic separation, the house was planned as two separate wings for bedrooms and living spaces. These wings were separated by an open, sheltered terrace, with a connecting hall and adjacent bathrooms providing access and an additional buffer to sound transmission.

At $1204ft^2$ it was the largest house to date, and the loose layout, combined with the relative generosity in size, suggested a new level of spatial complexity.

Figure 10. Cook House, Warrenorth,1971.

A similar approach of providing acoustic separation through an extended plan layout was developed the following year at the Cook House, in North Common, East Sussex (fig. 10). The client here had seven children and wanted a larger house of around 1700ft^2. While the main living accommodation was compactly planned, noise reduction was achieved by laying the four bedrooms in a wing that extended away from the living spaces, resulting in a generous 76ft long building. In earlier projects the finish of the interiors resulted directly from the exposed construction, and had very much been to Segal’s designs, but here the clients intervened, and the children chose various wallpapers to their bedrooms that were then fitted between battens.

Figure 11. Lomask House, Co. Cork, Ireland.1971
Image courtesy of Nicolas Cunningham.

While the Leigh and Cook houses experimented with how Segal's method of construction might produce more complex plan arrangements, the Lomask House, in Ballycummisk, Ireland, constructed in 1971, explored sectional variation (fig. 11). Located on a sloping site overlooking the nearby bay, the project was still fundamentally single storey, but here, stepped levels differentiated three internal areas. Two level changes, at six steps each, allowed views from the master bedroom, at the top of the site, over the living space at the bottom, with the middle section slipped in plan to form a private terrace at the centre of the house.[18]

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[18] Further private houses designed by Segal after 1971 that also contributed to the process of design refinement:
- Children's Home, Singleton, West Sussex. Completed in 1972. This project had cantilevering rooms beyond the frame. The building provided accommodation for children and staff in a T-shaped plan, and the site sloped, with the entrance placed at the higher end, and the living spaces at the lower, opening onto a large terrace raised high above the ground, and enjoying views towards the South Downs. The four bedrooms and living room that were arranged along the long elevation all extended over four feet beyond the last line of posts. As the cantilever beams were continuous from the adjacent structural bay, their extension limited bending in the timbers, allowing greater material efficiency.
- Godfrey house and surgery/studio, Clifford, West Yorkshire. Completed in 1972. The bracing was brought into the house and incorporated between floor to ceiling within one of the internal walls, rather than beneath the floor beams. This change brought greater stability, but also altered the way the frames operated in plan. With the bracing beneath the floor level, the open frame offered unlimited flexibility for internal planning and a high degree of future adaptability. With the bracing now above, the design phase fixed a single internal wall encompassing the cross-bracing within the open frame of posts, and this wall became a permanent fixture within the layout, around which future alterations could be made. - Birch House, Barnet, London. Completed in 1977. This was a two-storey house with a pitched roof. - Green House, Bedfordshire. Completed in 1979-80. This was a two-storey house. - Romilly, Herefordshire. Completed in 1980. The clients here were Brian & Maureen Richardson, Brian having been deeply involved in the Lewisham self-build projects in his role at the council.

The Rigorous Simplification of Building Process

Looking at this series of private commissions dating from 1968 to 1971 in relation to the Highgate house, Segal can be seen to have established the key construction principles in his own project, while the specific details were developed and further refined in the subsequent houses.

To an extent, this refinement related to the transferral of ideas from a temporary structure to permanent structures, and the recognition of the necessary changes that came from this shift, in both client expectations and regulatory context. The addition of small concrete footings as foundations, necessary to satisfy building regulations for a permanent building, is a key example of this. Some changes in detailing represented incremental improvements: lessons learned through each project, such as the change in wall cladding from green felt to enamel finished asbestos, the introduction of pebbles to the roofs in lieu of water and bricks, and the overhanging roof, rather than flush edge profile. But the projects also reveal Segal exploring the spatial opportunities nascent within the logic of his own house, such as his experiments with looser plan configurations and more complex sections.

Despite all the refinements and developments, a certain strategic logic of building was nevertheless established in the Highgate temporary house that guided all the later projects. The rationale of this house was centred on the use of readily available, mass-produced, and dimensionally coordinated materials.

These elements were employed with minimal on-site alteration and fitted with dry jointing into a timber post and beam structure that was dimensioned according to standard woodwool slabs and plywood sheets. With the omission of wet trades, and the reduction in secondary alteration, the nature of on-site work was transformed towards a process of assembly.

Figure 12. Wood wool building slabs advertisement

Key to the constructional logic of these buildings was the use of off-the-shelf materials that, although obtained from different sources, could be easily combined (fig. 12). In part Segal was benefitting from a level of dimensional coordination that already existed in industry, but he was also acting with precision in selecting specific materials for their dimensional compatibility.

These materials were fitted into the timber post and beam structure with minimal on-site alteration, little change to their finish or appearance, and only using dry jointing. With limited modification, the structural frame was able to be dimensioned according to standard available materials, with the sizing of the wood wool slabs of particular significance.

Here, Segal was not designing a system, or attempting to invent or standardise a production process. Nor was he designing components or joints to be manufactured. Indeed, Segal's approach suggested a critique of closed systems of prefabrication and standardisation.

The idea of a fully considered integration of industrialisation within construction activity held a strong appeal to architects of the Modern Movement, such as Walter Gropius and Konrad Wachsmann.[19]

With an emphasis on the connection of components, jointing became key to these architects, and the design of joints often fetishized. Adherents divided into those promoting a closed system, one fully integrated yet unable to connect with other systems, and those, like Segal, who pursued an open system able to accommodate components and materials from a variety of sources. The former type was also popular with the rival construction companies that dominated post-war building in Britain, each firm keen to exclude their competitors through the technical exclusivity of their system.[20]

Segal, amongst others, recognised the limits of standardisation within closed systems, and his timber details allowed greater freedoms of choice. His strategy involved observing the coordination that already existed in industrial production and seeking to best utilise and combine these ready-made building products within an accommodating framework.[21]

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[19] Gilbert Herbert, *The Dream of the Factory-Made House: Walter Gropius and Konrad Wachsmann* (Cambridge, Mass: MIT Press, 1984), 7.

[20] Finnimore's study of System Building identifies the way research and development architects during this period could only initiate development where manufacturers stood to profit, yet for reasons of competitive advantage these commercial sponsor's 'instinct was to design systems in which only their components could be used.' Brian Finnimore, *Houses from the Factory: System Building and the Welfare State 1942-74* (London: Rivers Oram Press, 1989), 148.

[21] Christine Wall makes clear that this degree of modular co-ordination in part resulted from both concerted industry effort and government policy. In particular, she highlights the role played by the post-war school building programme, and notes that, 'from 1963 onwards, a series of design guides on dimensional co-ordination for industrialised house building had been published by the MHLG (Ministry of Housing and Local Government).' Christine Wall, *An Architecture of Parts: Architects, Building Workers and Industrialisation in Britain 1940-1970* (London: Routledge, 2013), 147.

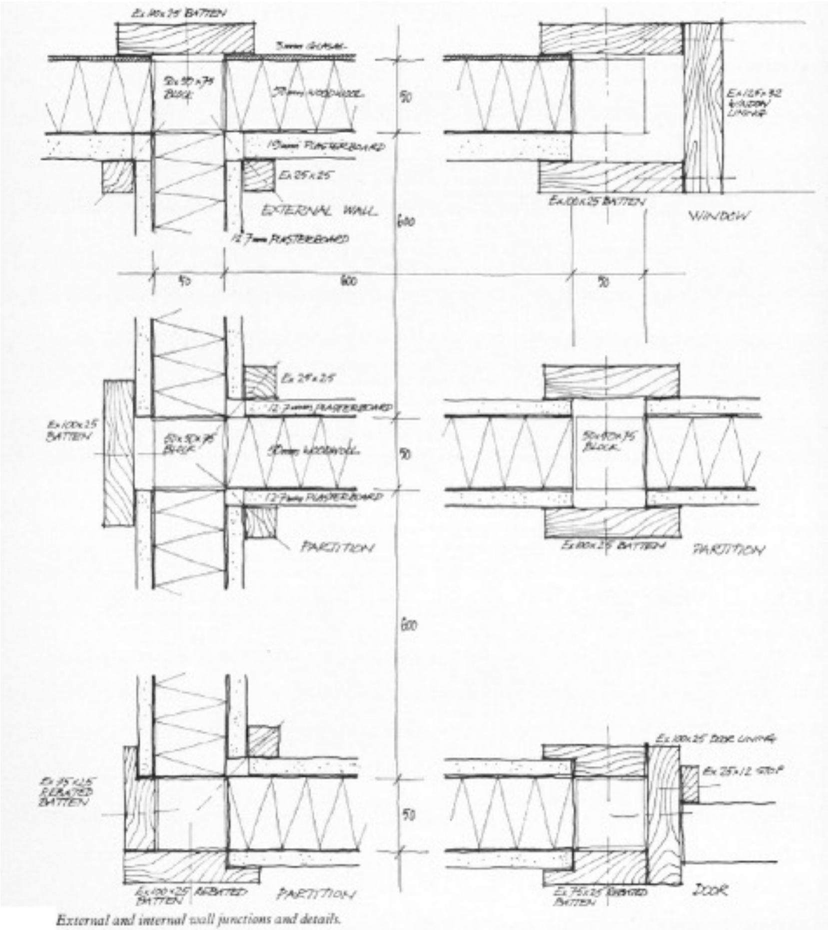

Figure 13. Typical wall detail. (Drawing Jon Broome)

The panel-to-panel wall detail makes clear the overall constructional logic of Segal's method: the wood wool came in 2' by 2" slabs, so the internal and external walls are sized accordingly, and the panels are spaced 2" apart to allow cross walls. After linings are applied to either side, also minimally altered, timber battens are bolted tight, so the wall is held together without glue or screws, relying instead on pressure and friction (fig. 13).

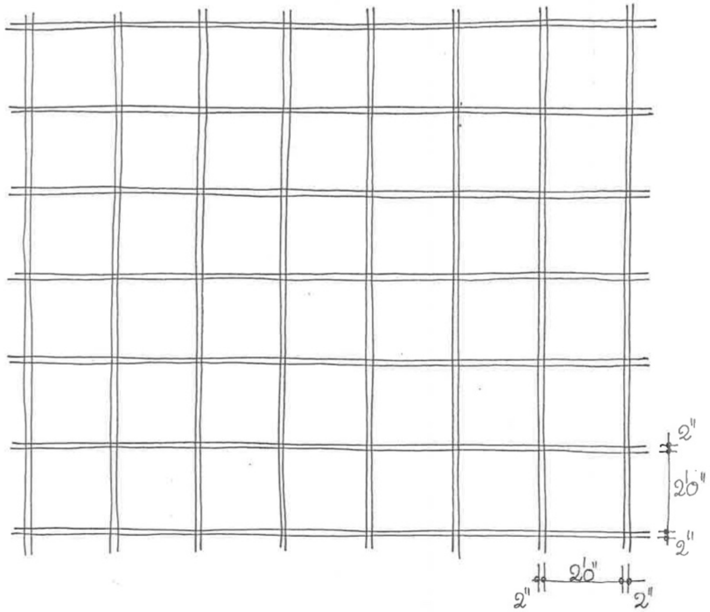

Figure 14. Segal's tartan grid. (Drawing by Jon Broome)

The detail thus suggests a dimensional arrangement, an elimination of unnecessary alterations, and a manner of connection that is both flexible and adaptable. And the detail also leads to a basic tartan grid (Fig.14), with 2' and 2" spacing, later 600mm and 50mm, on which all the house plans were based.[22]

This grid and constructional logic, in turn, lead to house plans where the walls are drawn as a series of 2' 2" slabs, and other elements, such as windows, doors or stairs are similarly co-ordinated. The logic continues through all the details; for instance, the doors largely fit into the grid, as 2' single or 4' double units, though the framing reduced these further, with 1'9" wide door blanks (535mm) used generally.

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[22] Around this time, Great Britain switched from imperial to metric measurements. Metrication in construction lasted from around 1969-75, and Building Regulations were amended to accommodate the change in 1972. Segal's drawings over this period can be seen to switch accordingly.

And, pursuing the logic of dry-fit, the roofing felt edge is clamped tight at the perimeter, but the membrane itself is neither bonded to the substrate or screw-fixed or bonded at the edges, allowing free thermal movement.

In parallel with the simplification of construction processes, Segal's own working method undertook a process of simplification. In these private commissions, he again managed the projects without a main contractor, working closely with a carpenter, often Wade, who did most of the works, and with electricians, plumbers and roofers contributing when needed. Apart from periods at the beginning and end of his career, he worked without architectural assistants. Reinforcing his independence, he also worked without structural engineers or quantity surveyors, doing all his own structural calculations and schedules of materials.

By this time Segal had simplified the drawn and written information from which the architecture was constructed. Each house had a set of project-specific information. A4 freehand drawings showing the general arrangement of plan, section and elevation were produced for developing the layout with the client, and for the planning submission, while structural layouts, together with calculations, were produced for Building Regulations sign-off. A project-specific schedule of materials, with inset drawings clarifying information where necessary, set out everything required for the job, and was organised in the order of the sequence of purchasing.

But Segal had also developed a generic set of details applicable to all the projects of this period. This comprised a twenty page 'Catalogue of Elements', that presented standard details common to all projects, although as we have seen, this was in a continual state of development and improvement. An accompanying nine-page written document, 'Sequence of Erection & Assembly', described the various procedures involved in the construction step-by-step in as clear and simple a manner as possible (fig. 15). The specific and generic information combined to describe not only the configuration of the completed building, as is usual in architectural drawings, but also how one should go about its construction.

SEQUANCE OF ERECTION AND ASSEMBLY.

Foundations

Construct piers of dimensions as shown on the drawings and of a minimum depth of 3ft in 1:2:4 concrete and bed on top, before the concrete is fully cured, best quality concrete paving slabs 2ft by 2ft by 2in thickness well levelled and projecting 2in above the level of the site using a 1:1;2 concrete bed.

Perimeter paving

Bed in clean sand 2ft by 2ft by 2in best quality paving slabs as before, to enclose perimeter of building as shown on the drawing. Start with bedding the slabs in front of the slabs of the foundation peers and fill in the spaces between them with evenly spaced slabs likewise bedded.

Strip off topsoil.

Upon completion of the perimeter paving strip off the existing top soil and depose where directed all to a depth of 4in. Fill back with loosely laid well distributed clean gravel ($\frac{3}{4}$ in minimum) without any admixture of sand up to the level of the underside of the paving slabs. 147 OVERSITE SLABS

Framing

Carefully mark on the paving slabs of the posts all centres as shown and check their accuracy of position. Note in particular the relationship of posts and infilling walls and consult for this purpose also the catalogue of element (no.II). Place under each post a 2in by 6in sheet of 5-6lb lead.

All posts and beams to be pre-drilled before erection; whereever possible drill holes to be staggered. Bolts to be galvanised or sheradised $\frac{3}{8}$in min.dia; for longer spans $\frac{1}{2}$in dia.bolts to be used. Stand up and plumb frames using temporary bracing; likewise pin some floor joists prior to final fixing to the beams (CE nos.IV,V). Follow carefully the building plans and note which beams do not project to the front faces of the posts.

Fix the roof beams to the posts as shown (CE nos IV,V) observing carefully which beams are to be bolted to the posts and which are to be checked out to provide seating on top of the posts; this applies chiefly to the end frames and where roof beams project to provide overhangs. Note carefully all instances where secondary posts are to be used which are to be attached at floor level either to beams or joists by bolting and which serve to reduce spans of roofing beams or as supports for these; the latter case occurs with cantilever constructions. Consult the building plans for this purpose; particularly projecting parts of the building where such cantilever structures are employed. Fix to the roofing beams joist battens (CE no V) which are to receive the roofing joists which must be checked out as shown (CE no.V) and fix some of these joists temporarily by pinning to stiffen the structure prior to final plumbing.

Select all members of the frame from the timber store on site in strict accordance with the List of Materials with particular attention to columns 2-5. (All lengths are listed in the lengths in which they will be required e.g. to the nearest ft and failure to observe the description col.2 will result in loss of structural members for the framework).

Figure 15. Sequence of Erection and Assembly

Novem

> We started in our summer holidays. And then we moved in at the beginning of December, so it was pretty good going. Just weekends and evenings as well because we were working during the week. We used to finish work and go back to the site. We worked every hour under the sun, really.[23]
>
> Muriel Holland

> We gained in the rapid construction. We gained a house of our own choosing, or our own design in many respects – and this at a price we could afford. We lost a lot of sleep. It was often very tiring.[24]
>
> Michael Holland

Eventually, and perhaps inevitably, one of Segal's clients told him that they wanted to take on their project's construction themselves. The clients were a pair of young teachers in their twenties, Muriel and Michael Holland, who had seen a Segal house published in the mainstream press.[25]

Observing the remarkable simplicity of the building process evident in the earlier houses, they were confident they could construct themselves, significantly saving on their costs. The house that they went on to build in the small village of Bromeswell, Suffolk, was both typical of the Segal-designed houses of this period and a culmination of the design refinement to this date. Being the ninth timber frame building that Segal had completed since, and including, his own Highgate temporary house, the Hollands named the house in Latin, Novem.

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[23] Muriel Holland, in conversation with the author, 30th August 2023.
[24] Michael Holland, as recounted in, John McKean, "A certain basic satisfaction in building a shelter for oneself," *Architects' Journal* (3 September 1975): 458.
[25] "Putting the family out of the house," *The Daily Telegraph Magazine*, 28 March, 1969, 46-50.

Together with friends, Ricky and Erna Asker, they bought, and divided a plot that had been granted outline planning permission in 1969 for two single storey houses. The layout set the building back from the road, at the upper level of its sloping site, giving far views over the surrounding East Anglian countryside. A garage was constructed at the lower level, with an adjacent external stair leading up to the house's front door.

Seeking to minimise circulation, the main living accommodation was compactly planned by Segal, with the hall, kitchen, dining room and living room all directly connected in a looped arrangement. To one side, two bedrooms formed a staggered L-shape, acoustically separated by the bathroom block, and with the master bedroom and living space both opening onto a South-West facing external terrace (figs. 16 & 17). As with his previous clients, Segal involved the Hollands closely in the design process and encouraged their decision-making, including the layout, cladding colours, and ironmongery.

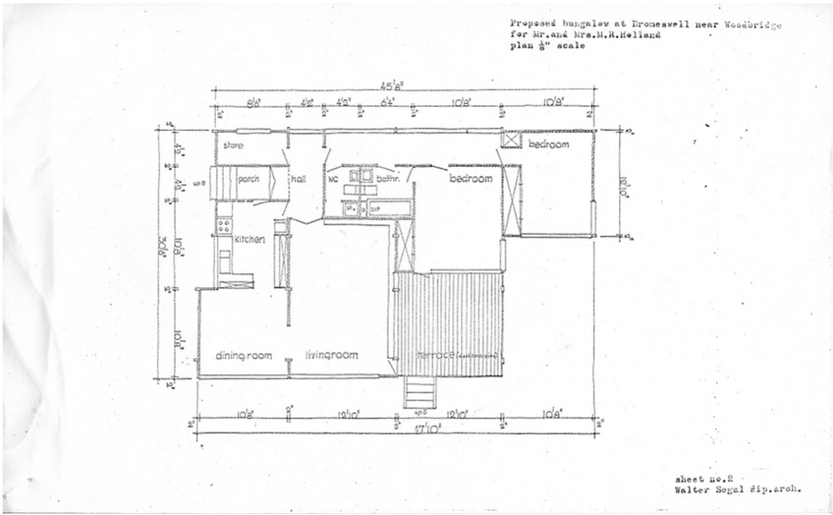

Figure 16. Ground Floor Plan, Novem, 1971.

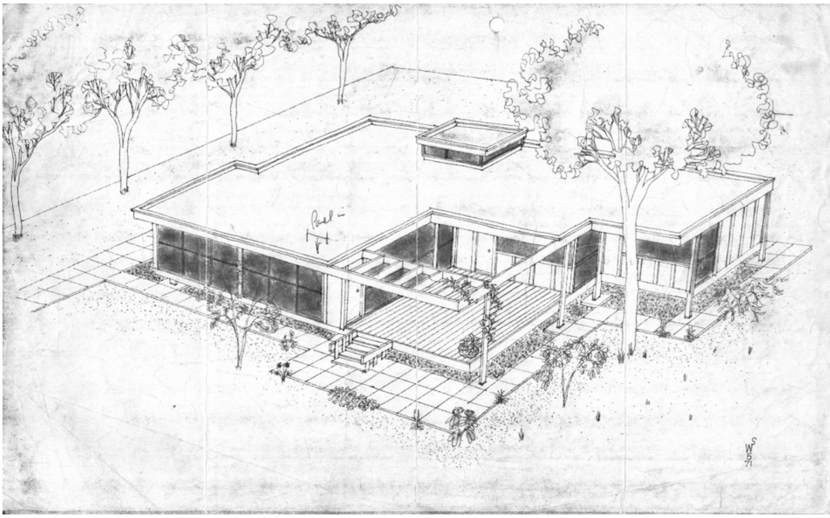

Figure 17. Perspective, Novem, 1971.

Figure 18. Muriel Holland on site, Novem, 1971.
(Photo: Michael Holland)

The Hollands had bought the site in early 1971, and Segal worked during March and April of that year on the design, sending twelve different plan arrangements for their consideration, all within the same tartan grid. As well as involvement in the design, however, the Hollands were also keen to be involved in the construction work. Michael, 26 years old, had already renovated a house in nearby Woodbridge, learning various building skills as he went, and now, he and Muriel, just 22 years old, took on the job of constructing their own house from scratch (fig. 18).

They employed various trades during the works: a bricklayer who built the septic tank at the bottom of the garden, two carpenters who, with Michael's assistance, constructed the frame in two days, the roofers who laid the membrane and the pebbles that held it down, and a jobbing carpenter, Maxi, who undertook miscellaneous works to speed progress. They also had help from friends and colleagues as they progressed.

Nevertheless, the Hollands undertook most of the construction work on site, in their free time, during the summer holidays, in evenings and weekends, and all the while still teaching in the local school. In this endeavour they were encouraged by Segal, who assured them that once they had worked their way through the drawings, calculations, and schedules, they would find, 'it is really very simple.' Segal later remarked on their endeavour: 'with their enthusiasm and motivation there was no trouble and no difficulty, and it succeeded quite astonishingly.'[26]

Their house was planned to Segal's standard 2' 2" tartan grid, with 3' deep concrete pad foundations that the Hollands dug and poured together, with the architect insisting on demanding tolerances for the setting out, such that the frame above was absolutely central to each pad. The posts and beams of the slender timber frame were set on paving slabs capping the foundations, the end grain of the posts protected from moisture by a separating strip of lead, and these slabs continued around the perimeter of the building, providing a dry work surface.

[26] Learning from The Self-Builders / Walter Segal, produced by Monica Pidgeon, Dec 1983 (London: Pidgeon Audio Visual Library)

The structural frame extended in part around the boarded terrace, giving a sense of enclosure and reinforcing a reading of this external space as an integral part of the house. While the roof profile is generally flush, to the west-facing elevations it projects forward to provide shading. This detail, combined with a small cantilever to the frame, gives a distinctive forward-leaning section to the front façade of the house.

Working in the dry summer weather, two carpenters recommended by Segal spent two days working with Michael Holland erecting the structural timber frame.[27]

This was of pine and remained unpainted, but the battens that rhythmically enclosed the house, securing in place the woodwool slabs and external and internal cladding, were, together with the fascia boards, all painted white by Muriel Holland. Working in parallel with the frame assembly, and later wall construction, she prepared the fascia and battens prior to assembly. Supplied in 4’ x 8’ sizes by the manufacturer Eternit, standardised, and mass-produced Glasal panels clad the external walls, as well as those of the bathroom. These were chosen in a grey-green colour that, together with the painted battens and unpainted frame, gave a highly articulated, and somewhat abstract reading to the external elevations.

The opening windows were formed as horizontally sliding sashes with ¾” aluminium angles, the elegant and simple solution designed by Segal for his own Highgate house. While good at providing ventilation, they were not effective at keeping draughts out, and were one of the factors that led to this, along with Segal’s other timber-framed houses, being particularly cold in the winter months. Three electric storage heaters provided warmth of a sort, but were used sparingly to save money, Muriel Holland noting that she later discovered her mother-in-law never visited between October and Easter, for fear of the house’s cold.[28]

[27] In Segal’s later telling, after observing the two carpenters work on the first day of the job, the client called Segal and said the men weren’t required and that they themselves would complete the works. However, this seems to have been something of an exaggeration on his part, and Muriel Holland recounted that the carpenters did in fact complete the frame. A TV programme was broadcast soon after completion, focussing on the house and included interviews with the Hollands. In this Michael Holland suggests that the carpenters completed the erection of the frame in the first two days. “Science Session,” BBC School, 1972.
[28] Muriel Holland, in conversation with the author, 30th August 2023.

Internally, the painted battens fixed plasterboard panels to the walls and ceilings, while timber floorboards were generally in softwood, but with oak boards used in the living room and hall. Sized to fit within the structural grid, the internal doors were generally the standard 1'9" width (535mm), with battens screwed either side to support them. The W.C. and bathroom backed onto each other and, as they were located centrally within the plan, were naturally lit via clerestory glazing above. The Hollands completed all the sanitaryware installation here, and as external grade Glasal panels, this time in Marine Blue, were used to line the bathroom, no tiling was installed; excluding foundations, the house altogether comprised of dry construction.

With the house lifted above the ground, the void below provided space for the frame's cross bracing, as well as ease of access to the plumbing and electricity which ran beneath the flooring. While facilitating ease of construction, this void certainly contributed to the house's internal environment's coldness but was appreciated by the Hollands as useful storage space.[29] The two spent Christmas 1971 in Novem, having bought the site in the Spring of that year; it had certainly been fast progress. Muriel's parents visited for the festive break, and the Hollands put up makeshift curtains to provide privacy to the bedroom's sizeable windows.

The following year, with their neighbours house also now completed, the sloped access route to the higher level was no longer required, and the two households built a pair of adjacent garages in its place, to serve the two houses. As their neighbour wished to build a garage of block construction they required a concrete raft foundation, while Segal had designed a timber frame garage for the Hollands, to match the house, with woodwool slabs to walls and roof. There was no sense in the two garages having differing foundations, and so this led to the slightly anachronistic solution of the Hollands constructing here a Segal-designed timber frame garage on a four-inch concrete slab.

[29] This void was unfortunately closed in by the subsequent owners of the house, with low brick walls entirely changing the character of the external appearance.

House and garage as originally designed were now complete. Novem had been built by the Hollands in 1971 in preparation for starting a family and in 1974, as their family grew (eventually the pair had three children between 1973 and 1977), they added an extension that housed an additional two bedrooms, in what could now be read in plan as a children's wing.[30]

Once more, Segal provided the drawings, calculations, and schedules for construction. This time, the Hollands were able to construct the frame without Segal's carpenters, and only brought in outside help for the roofing membrane, and some assistance again from Maxi. The adaptability of the construction methodology allowed the couple to simply dismount the end wall of the existing house and add the new structure and cladding in place; the extension appearing as if it had always been there. The Hollands continued living at the property until 1978 when Michael was offered a headship at a school in Hampshire, and the family left the house they had built with their own hands (fig. 19).

Figure 19. Muriel Holland, Novem, 1978.
(Photo: Michael Holland)

[30] Walter Segal, "Timber Framed Housing," *RIBA Journal* (July 1977): 284-295.

Clients had previously worked alongside skilled trades on Segal's projects, such as at the Donohue House, but here, for the first time, they undertook the larger part of the works, employing trades and labour only when absolutely required. The Highgate house had been designed with low-cost as the primary concern, and to achieve this Segal had simplified. Interestingly, the private houses that followed didn't work towards reducing the expense of construction any further, as this aspect of building had already been resolved to the architect's satisfaction, and all these projects were constructed at very low cost. Instead, these projects transferred the ideas explored in a temporary structure to suitability in a permanent form. In addition, and without losing the essential qualities of the earlier house, the details were continually refined.

The simplicity of process that these projects revealed allowed Segal's clients to become more involved in both designing and building their own homes. In this respect, the house built by Muriel and Michael Holland can be seen as the end point in this line of design enquiry, the culmination in a search for integration of design and realisation. Bringing the roles of architect, client and builder into a closer relationship thereby suggested a rejection of, and reaction against, the predominant culture that distances project phases and project roles.

Half a century after its construction, while several of Segal's other private houses of the era have since been demolished, the house still stands, and is in fact still in the same ownership following the Hollands' sale. But it has been substantially altered over the years, for reasons that must have seemed sensible to the owners at the time, and now bears little resemblance to the original structure (fig. 20).

Figure 20. The stair up to the house, Novem.
(Photo: Hugh Strange**,** 2023)

Lewisham Self-Builds

> We were constantly surprised, doing things we'd never dreamt of before. By now we were pretty much all working on our own houses, but the friendship and mutual support of the group had been invaluable.[31]

As his private clients took on ever greater personal responsibility for the construction work, culminating with the house the Hollands built for themselves, Segal saw the wider potential of his approach for self-build, and was keen to apply this to social housing schemes.[32] During the early 1970s he worked on a number of community self-build schemes, but to his great frustration, these failed to materialise.[33] Eventually however, in 1975, and through their mutual connection with Colin Ward, Segal met the Deputy Borough Architect at Lewisham Council, Brian Richardson. Keen to involve Segal in the Council's housing projects, Richardson introduced him to various councillors including Nicolas Taylor, the Chair of Lewisham Council Planning Committee at the time.[34]

Taylor involved Ron Pepper, then chairman of the Housing Committee, and encouraged Richardson to produce a report for this Committee, recommending Segal's approach. The councillors and housing officials were taken to visit one of Segal's completed private houses, where the client, having undertaken much of the construction work themselves, enthused about Segal's method.[35]

Based on the report and visit, the committee voted in March 1976 to proceed with the architect's appointment, as well as with the selection of sites and self-builders. The initial opportunity for the first phase of projects was advertised in the local council newspaper, *Outlook*, with

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[31] As narrated by a Phase 1 Lewisham self-builder for: *Open Door*, "The House that Mum and Dad Built (You can do it too!)," aired Apr 10, 1982, on BBC.
[32] Segal's friend, the writer and anarchist Colin Ward, and John F.C. Turner, the author of 'Freedom to Build', who was then leading meetings on Dweller Control at the Architectural Association, were both at this time suggesting greater user participation within housing provision as an alternative to top-down solutions. John F. C. Turner, and Robert Fichter, *Freedom to Build: Dweller Control of the Housing Process* (New York: Macmillan, 1972).
[33] John McKean, "The anarchy of planning," *Building Design,* no.387 (17 March 1978): 14-15; John McKean and Alice Grahame, *Walter Segal Self-Built Architect* (London: Lund Humphries, 2021), 129-130.
[34] Nicholas Taylor, *The Village in the City. Towards a New Society* (London: Temple Smith, 1973)
[35] I understand this to have been Novem but have not had this confirmed by either Muriel Holland or John McKean. John McKean, *Learning from Segal: Walter Segal's Life, Work and Influence* (Basel: Birkhauser Verlag AG, 1988), 168.

an invitation for people on the council's waiting list, and these self-builders were selected by random ballot following a public meeting in 1976, at which Segal presented his design approach. The project progressed on the basis that the council was to provide the land, central government the money for materials, and the self-builders the labour. On completion, the houses would be sold within a shared ownership arrangement, where the self-builders owned 50% through a council-backed mortgage, and 50% was to be paid as rent to the council.

Four sites were selected within the borough for fourteen houses; all the sites were deemed unsuitable for standard housing solutions. In Bromley a small site was carved from an existing villa's garden. This site allowed two houses, a single-storey, and a two-storey, that was the first of the self-builds to be completed, by Ken Atkins, who went on to provide much advice and support to later Lewisham self-builders. Two sites close together in Sydenham accommodated five houses, including a narrow, steeply sloping infill site with paired, two-storey houses. The largest site was in Forest Hill, in what was later to become Segal Close. Here, seven single-storey houses shared a communal parking area to the front of the site, allowing the houses to be accessed from a pedestrian lane.

Despite the rush of shared enthusiasm at the beginning of the project in 1976, it was not until March 1979 that construction of the first phase finally started. Delays in financial administration and building control resulted from an unfamiliarity, on the part of central government and the various council departments involved, with both the form of contract required for self-build, and the method of construction.[36] Securing planning permission took five months, in part delayed from the usual timeline by the planning department's requirement for drawings additional to those initially submitted by Segal.

Segal was joined for the Lewisham projects by Jon Broome, who became his assistant throughout the works, and who also took on one of the Phase 1 sites in Segal Close, as a self-builder.[37]

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[36] "Segal self-build hits bureaucratic chaos; Architect: Walter Segal," *Architects' Journal* vol.168, no.33, 16 August 1978, 288-289.

[37] Jon Broome went on to establish the architectural practice, Architype, and has written extensively on Walter Segal, including the following texts: "AJ Special Issue: The Segal Method," *Architects' Journal*, 5 November 1986, and Jon Broome and Brian Richardson, *The Self-Build Book: How to Enjoy Designing and Building Your Own Home* (Dartington: Green Books, 1991)

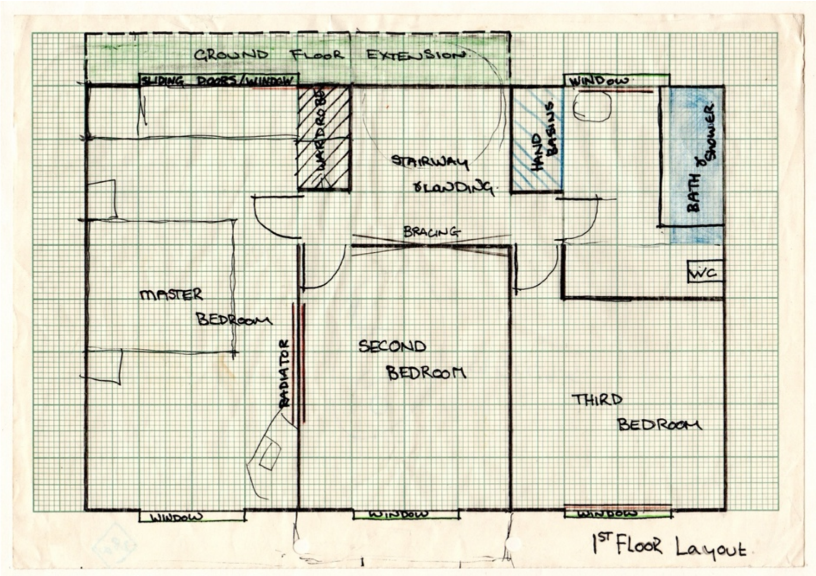

Figure 21. Walter's Way, Client layout drawing.
Image courtesy of Jon Broome.

Segal and Broome worked closely with the self-builders, suggesting multiple layout options, but also encouraging their involvement in the designs (fig. 21). It appears that while Segal was adamant that the builders could not change certain key details, or the fixed central core in the case of the phase 2 houses, he saw the broader configuration as very open.[38]

In both phases, every house was detached, allowing the self-builders to construct their homes at their own speeds, independent of their neighbours. The plans were typical of the previous private commissions and built on the many refinements developed through them: they were small and very efficiently planned, with staggered layouts on the single storey houses to allow separation of living and sleeping areas.

[38] Charlotte Ellis, "Walter's Way; Architects: Walter Segal," *Architectural Review* 181, no.1081 (March 1987): 81.

There was, however, much diversity of house types within the 14 units of this first phase, and when, following completion, a second phase for 13 two-storey houses was developed nearby in Honor Oak Park, in what was to become Walter's Way, a different approach was employed. In contrast to the variety of types in the first phase - 8 house types between 14 houses – here, the strategy was to have a standardised size, frame, and core, with a variety of layouts within the constraint of a two-storey, 80m^2 plan structure.[39]

The construction methodology of the Lewisham houses was close to that of their privately commissioned forerunners: the layout of timber frame and foundations determined by the tartan grid of 600mm and 50 mm, that in turn was determined by the regular layout of the dimensionally coordinated woodwool slabs. Elevations were generated by a combination of the grid dimensions of the frame, the batten cover detail, and the particular layout of rooms, the facades a seemingly self-evident result of the construction logic and plan configuration. As before, the cover batten detail determined the distinctive visual appearance of the houses, both inside and out.

Drawn and written information followed the pattern established with the private houses, and was very much oriented towards clear, sequential on-site instruction. Segal and Broome also gave classes for the self-builders at the local Adult Evening Institute, teaching basic skills and the use of the small power tools that would be needed. These were not general lessons in building skills, which, by necessity would have been much more involved, but were focussed on the essentials required for this fundamentally simple method of construction (fig. 22).

In addition, the self-builders met regularly at local pubs and community centres in the evenings, working independently on their own houses, but also collaborating for the many shared organisational requirements. During this process the group was formalised as the Lewisham Self-Build Housing Association.

[39] Plan variations in phase 2 are described in detail in: Ellis, "Walter's Way," 81.

LEWISHAM SELF BUILD II
PROVISIONAL PROGRAMME for EVENING CLASSES

WEEK No.	PROGRAMME		MATERIALS
1	INTRODUCTION SITE WORKS	How Walter invented the houses Setting out/Foundations/Oversite slabs	slides
2	FRAMING	Marking out/Measurement/Joints Squaring up/Templates/Drilling.	slides
3	TOOLS	Contents of Tool kit/Practice use of Power Saw/Drill/Jigsaw/Hand tools 110v tools for site use.	tools
4	MAKING JOINTS	Making templates/making bolted joints/making nailplate joints/ making housed joints	timber bolts nailplates slides
5	TAKING LEVELS	Use of level to get levels of foundations	level
	ERECTING FRAME	Stacking in order/temporary bracing	slides
6	COMPLETING FRAME	Bracing/Battens/Joints/Noggins	slides
7	ROOF FLOOR	Woodwool slabs/Fascia/Capping Underlining/Insulation	slides
8	WALLS	Slabs/plasterboard/External panels/ Blocks/Scaffolding	slides
9	ELECTRICS	Planning the position of fittings/ Circuit layouts	
10	ELECTRICS	Practice at wiring plug/Switch/ Ceiling rose/ Consumer unit/ Earthing	fittings wire etc
11	PLUMBING	Planning layouts of Hot& Cold water/Heating/Boiler position/ Waste pipework/Ducts/Tanks/ Rainwater	
12	PLUMBING	Practice making joints in PVC/ Copper	pipe fittings
13	PLUMBING	Drainage/Gullies/Manholes	
14	KITCHEN PLANNING		
15	BATHROOM PLANNING		
16	JOINERY	Windows/Doors/Stairs	door/ ironmongery
17	JOINERY	Practice fitting a lock/ Hanging door	
18	DOCUMENTATION	Bill of Quantities/Drawings	
19	ORGANISATION	Receiving material/Checking/Proceedures	

Figure 22. Lewisham Self-Build Evening Classes
Image courtesy of Jon Broome.

Figure 23. Walter’s Way, Site Works.
(Photo: Jon Broome)

Figure 24. Walter’s Way, Raising the frames.
(Photo: Jon Broome)

In contrast to many contemporary self-build programmes, which centred on male workers working together to produce houses sequentially, in Lewisham all members of families were encouraged to be involved, and each family constructed their own house in parallel (fig. 23). Communal works, such as the laying of drain runs and raising frames (fig. 24), comprised a smaller part of the works, and were undertaken on an ad hoc basis, in the spirit of unforced cooperation.[40]

With the exception of the roofing contractors, brought in at Segal's insistence to lay the roof felt, all works were undertaken by the self-builders. Combining construction with their working lives - building during evenings, weekends, and holidays - it was perhaps inevitable that they took very different lengths of time to complete their homes.

After the frames were erected, and stabilised with joists and beams, the roofs were constructed, providing the self-builders with a covered space for working and storage for the remainder of the build. Much of the material, such as the woodwool slabs and the Glasal external cladding sheets, was bulk bought together. Segal's approach was predicated on assembling materials in their market sizes, and, as such, had a certain vulnerability to changes in the market.

During the phase 2 construction, for instance, the building suppliers notified the self-builders that British Gypsum had changed the dimensions of its standard boards. With a construction methodology founded on the reduction of site alteration of materials, variations of this type were clearly problematic. However, by and large, there was tolerance provided within the construction logic that could accommodate some degree of variation; the key junction between woodwool slabs and the timber battens was indicative of this, allowing a degree of possible overlap and tolerance in the lining materials.

[40] Charlotte Ellis, "Do-it-yourself vernacular," *Architects' Journal* (17 December 1980): 1189.

Twenty-seven houses were constructed in total within the two phases. Many self-builders were able to obtain homes they would not otherwise have had access to, and, despite the delays, frustrations, and the hard, physical work, those involved seem to have found it a profoundly rewarding experience. In the years that followed, the adaptability of the construction allowed the inhabitants to alter the internal arrangements and make external additions, ensuring the houses remained well-suited to their changing lives.

Over thirty-five years after their completion, few of the houses in Lewisham are now inhabited by the original self-builders. As the council shares and freeholds were bought out, and self-builders moved on, the buildings have gradually entered the mainstream housing market of purchase and sale. The sense of dwellings distinguished by being both designed and built by their inhabitants has become residual. Yet the communities formed are very evidently vibrant and friendly, and their urban character remains distinctly atypical of London, reminiscent of a country lane in the case of Segal Close, and a steeply sited Alpine village at Walter's Way.

Photographs of the projects when the residents first moved in suggest a strong visual coherence, but as the alterations and additions have accumulated over the years, the buildings now look less and less alike. A few, such as the elegant house built by Jon Broome in Segal Close, are carefully preserved as architectural artefacts, but the majority have embraced an anarchic spirit of design freedom and are increasingly divergent in appearance (figs. 25 & 26).

Since their completion, the Lewisham projects have been much lauded within the architectural community as alternative housing models, regularly featured in news articles, and visited by students and practitioners. Yet, while Segal and his supporters in Lewisham Council never saw self-build as the sole solution to the nation's housing problems, there was undoubtedly hope that the projects might become models for a shift away from the dominance of market or council-led large-scale provision. Ever-increasing land values in the UK, together with changes in local government financing and the broader political climate, suggest any such shift seems less and less likely, and the houses remain an exception.

Figure 25. Jon Broome's House at Segal Close.
(Photo: Hugh Strange, 2020)

Figure 26. Walter’s Way.
(Photo: Hugh Strange, 2020)

Design of Construction

> The most impressive thing about Walter Segal was not his wonderfully simple and logical building system. It was the way that, step by step in the last 30 years of his practice, he moved to a position which blurs the distinction between architect, builder and client. They aren't at the three corners of a triangular relationship, but are all mixed up in the middle of the adventure of building.[41]

Segal's views on the use and role of drawings developed radically during his career. His early drawings, evidenced particularly in the illustrations of *Home & Environment* in the 1940s, reveal an accomplished draughtsman.[42] In the book, studies of plan typologies are accompanied throughout by precise line-drawn perspectives of both the interiors and exteriors of his proposals, and the drawings reveal the focus of the book: the nature of home as seen by the occupant. While the viewpoint is significant, so too is the careful composition and delicate line work by the author; they reveal a concern with the aesthetics of drawing.

As Segal's post-war career developed from design speculation towards production, the inevitable focus of his drawings became the communication of construction information. Throughout the period of masonry building, this communication tended towards large drawing sheets, where as much information could be placed on a single page as possible, often resulting in projects that were encapsulated in a single sheet. Whilst compact, the information was dense and the sheets unwieldy. With the shift to timber-framed construction, and the search for simpler models of practice, Segal's drawings reduced in size. Project information now comprised drawings as layout and detail, with illustrated schedules, all at A4 format. The aim was for the drawings to provide the most legible and effective communication to build from, and the reduced size allowed ease of use on site; carpenter, clients and self-builders could easily fit the paperwork in files to take to and from site.[43]

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[41] Colin Ward, "Walter Segal 1907-85," *Architects' Journal* 182, no.45 (6 November 1985): 30.
[42] Segal, *Home & Environment*, 37,111.
[43] Christine Wall charts a parallel search for drawn information focussed entirely on ease of communication through the post-war schools building programme: Wall, *An Architecture of Parts*, 140.

In earlier stages, before construction, Segal encouraged the clients of his timber-framed projects to be involved in design decisions as much as possible. Forever seeking to impart greater autonomy, Lewisham self-builders were encouraged to draw their house plans themselves: Segal and his assistant Jon Broome, having explained the opportunities and limitations of the structural system, would provide the self-builders with gridded paper to establish their own layouts. Segal's drawing style also became increasingly direct, communicating only that which was absolutely necessary, so as not to obfuscate, or confuse the process, and were now all produced free-hand over gridded underlays, allowing him to work faster.[44]

As the drawings became more and more oriented towards the act of building, the task of persuasion, sometimes necessary through architectural representation, became increasingly irrelevant to him. Notably, his drawings submitted to the Lewisham planning department for permissions, lacking a full set of drawn elevations, were deemed inadequate, and eventually had to be supplemented by a series of detailed elevations by Jon Broome, and perspectives produced by Brian Richardson.[45] Perhaps the inevitable end result of this practice of stripping away was that eventually the construction drawings were virtually dispensed with; while the first self-builders worked from Segal's information, later ones increasingly learned on site directly from their neighbours' experiences, through word of mouth.[46]

Despite his earlier accomplishment, in later life Segal claimed to dislike drawing, and in contrast to the polished quality of his earlier drawings, those of his later career appear starkly bare. [47] At this late stage of his career, he appears then to have developed an ambiguous relationship with drawing, but this also extended towards his attitude to authorship. Having produced the generic details and base tartan grids, the individual houses required less and less of their own drawings, specific to each building. Instead, these projects could almost rely on a combination of the clients' input on layout, through

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[44] "A man on his own: Walter Segal talks on the reason why he prefers to work alone," *Architect and Building News* (23 October 1968): 23.
[45] Charlotte Ellis, "Do-it-yourself vernacular," 1189.
[46] Walter Segal commented on the self-builders' contributions: 'This whole experience has taught me personally an awful lot about human beings. It has taught me an awful lot about the ability which, provided the methods of construction are not overbearing, can be brought to the fore, and where people can discover in themselves all kinds of talents which in their former lives, they had absolutely no opportunity to use.' Walter Segal, "Learning from The Self-Builders."
[47] Peter Blundell Jones, "The Path to Lewisham," *Architects' Journal* (4 May 1988): 46.

their sketch drawings, together with Segal's standard drawings, details, and schedules. Keen to give clients a sense of ownership of their projects, he was clearly unconcerned with his sole authorship of the buildings.

Yet he was by no means relinquishing design authorship. Instead, Segal can be seen as the author of a construction methodology, and a way of thinking that represented a particular approach to building, with each project an opportunity for refinement and development. And this overarching authorship allowed a generosity to the authorship of the individual buildings, each sitting as they did beneath a broad umbrella of his design thinking; rather than a designer of the specific buildings, he became a designer of the wider process. Segal's strategies of design and practice thereby suggest an alternative role for the architect.[48]

He saw the buildings as not of his own making. Largely working without assistants or consultants, his support for others and his precise design advice were his key contributions. The independence and freedom that Segal sought in his own working methodologies, were representative of the way he assisted others to control their own circumstances. In his model of practice, the architect might support and assist in both project design and building construction, the architect operating as enabler. And so, while Alberti famously suggested that 'the carpenter is but an instrument in the hands of an architect', cementing in theory the separation of design and execution, in Segal's model of enabling his clients to build their own timber houses, this might instead be turned on its head, and rather read, 'The architect is but an instrument in the hands of the carpenter.'[49]

Segal's journey from the Highgate temporary house, via the house for Muriel and Michael Holland, to the Lewisham housing projects resulted then in a template for future self-builders: a readily accessible construction methodology that allowed them a significantly greater degree of autonomy. This was evident in the broad sense of allowing self-builders to become producers rather than consumers, and in the sense of seeking the demystification of construction as a form of empowerment.

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[48] Segal's views on the architect as enabler were articulated in: Charlotte Ellis, "Segal's first half-century in practice," *Architects' Journal* 175 no.14 (7 April 1982): 36.
[49] Alberti, *On the Art of Building in Ten Books*, 3.

But it also addressed and challenged much broader issues associated with the production of architecture. Over the course of his career, construction had become increasingly central to Segal's designs, particularly to the later, timber-frame works. His architecture was not a representation of an external idea, and Segal believed there was no need for expressiveness in his work.[50]

Instead, his architecture represented an index of its construction, with the artefact fully aligning with the process. He delighted in a down-to-earth proximity of architecture to building, and, as such, the later works emerge out of both a hard-won understanding of the building site, and an engagement with the inherent dynamism of site works. Eventually, the building site, with its rewards and frustrations, became the focus of the projects.

But the projects were also essentially dependent on works off site. Segal's dramatic shift away from masonry building, following the construction of his own 'Little House in the Garden', represented a critique of traditional construction, a reaction to the slow and inherently cumbersome nature of the wet trades, and an embrace of a lighter way of working. And his achievement of extraordinarily low-cost building in his own house was predicated on an understanding of materials and labour costs: less labour and less skill were required in the construction of the house because of its construction logic and use of standardised, industrially produced materials and products.

Segal's ensuing prioritisation of ready-made materials and components, requiring little or no secondary adjustment, was, strictly speaking, distinct from prefabrication, but even so, suggested that while site works were central to his thinking, an understanding of off-site works was also integral. At this point, his designs might be considered as much assembled as built. Segal's was therefore an architecture of construction, closely identified with the practicalities of building, and encapsulating the logic of production. Yet his approach was not fully aligned with either works on site, or works off-site, with either craft or industrialisation. The use of hand power-tools on Segal building sites, used to fit purchased product to crafted carpentry, reveals this in-between condition perfectly.

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[50] Walter Segal, "Architecture: The Assertive and the Unobtrusive," The *Architect and Building News* (25 September 1969): 32.

Prior to the impact of industrialisation, traditional craft construction was predicated on plentiful skilled labour and the accumulated knowledge therein.[51] From the nineteenth century introduction of new materials and production processes, through to their ideological adoption within the twentieth century, the development of industrialisation was utterly transformative of this skill basis. Machine production within the factory system reduced the requirement for skilled labour, creating surplus labour and cheapening its value, but also reducing the subsequent development of skills. Resultant shifts in the construction industry, while never uniform in effect, were nevertheless fundamental, resulting primarily in a circular logic whereby the increasing prevalence of factory-produced elements resulted in decreasing use of traditional skills, which in turn resulted in skill shortages, and a presumption of the need for a further increase in utilisation of proprietary products produced in factory environments.[52]

While the shift clearly favoured the capitalist model of production, it was also heralded by the predominant modernist thinking. Architectural evangelists of machine production contemporary to Segal, such as Konrad Wachsmann, were thus able to declare,

> The principle of industrialization requires that production be transferred from the building site and the workbench to the factory [...] Building becomes assembly, a process which is essentially different from all previous methods of construction and is conditioned by industrialization alone.[53]

Generally associated with a process of de-skilling, and the ensuing alienation of builders, a cultural consequence of industrialisation was also the general invisibility of labour and the building site in histories of modern architecture. This invisibility is one with which writers such as Sérgio Ferro have suggested architects are, indeed, wholly

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[51] Harry Braverman commented: ‘From earliest times to the Industrial Revolution the craft or skilled trade was the basic unit, the elementary cell of the labor process. In each craft, the worker was presumed to be the master of a body of traditional knowledge, and methods and procedures were left to his or her discretion. In each such worker reposed the accumulated knowledge of materials and processes by which production was accomplished in the craft.’ Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century* (New York: Monthly Review Press, 1974), 75.

[52] David Leatherbarrow, *Uncommon Ground: Architecture, Technology, and Topography* (Cambridge, Mass: MIT Press, 2000), 124-125.

[53] Konrad Wachsmann, *The Turning Point of Building: Structure and Design* (New York: Reinhold,1961), 11.

complicit.[54] But these processes also pushed architects away from building sites and away from direct contact with labour.[55]

Segal's architecture recognised this historic shift away from craft construction and utilised the logic of standardisation. In particular, Segal's ideas on economy, or economy of means, took advantage of the changes in relative costs following industrialisation, as material costs decreased, and labour costs increased. But in his methodology, he seemingly challenges the alienation associated with the passage from craft to factory. He succeeds in utilising the standardisation resultant from industrialisation to create proximity to building site operations and to builders, in place of distance. As such, an understanding of skills is fundamental to his work: he accepted the broader, historic loss of craft skill as a given, yet within this context endeavoured to allow a wider uptake and development of building skills, democratising building construction as something available to everyone.

Segal's methodology combined simple site works with simple assembly of ready-made components, suggesting a new way of thinking about building processes. His simplification of process led in turn to a closer relationship between design and construction. The design, far from being an abstract precursor, detached in thinking and personnel from a later act of construction, became enmeshed with it, and in this way, Segal developed a design not for production, but of production.[56]

In turn, Segal's alternative model of a reconfigured construction process provided a critique of established roles within the production of buildings; a suggestion that there might be alternative ways for how architects, builders and clients might operate and relate to each other.

[54] The texts of Sérgio Ferro are significant in highlighting this omission. Kapp, Lloyd Thomas and Almeida Lopes writing in their introduction to his text, Concrete as Weapon: 'For Ferro, the lack of attention given to architecture's production is not just an oversight; theory has been complicit in rendering these questions invisible and apparently irrelevant for the field.' Silke Kapp, Katie Lloyd Thomas, and João Marcos de Almeida Lopes, "How to Look at Architecture from 'Below'," In *Harvard Design Magazine* No. 46, F/W (2018), v.
[55] Andrew Saint, *Towards a Social Architecture: The Role of School Building in Post-War England* (New Haven: Yale University Press, 1987), 250-1.
[56] Sérgio Ferro distinguishes between these two terms, suggesting design of production might rather be limited to the techniques of production, and be defined by its immediate producers. Sérgio Ferro, *O Canteiro e o Desenho* (São Paulo: Projeto, 1979)

Here then, the division of labour was directly challenged, the separation of design confronted. Designer and builder were no longer seen to be on opposing sides of conception and realisation. And so, while Segal's buildings, and the Lewisham projects in particular, are heralded for pioneering a form of self-build, perhaps their broader relevance is in the way through them Segal challenged the separation between conception and execution. Present in embryonic form in his own temporary house, and fully realised years later in the Lewisham projects, this provocation hinged on the moment that Muriel and Michael Holland suggested to Walter Segal that they might take on the construction work of their new house in 1971.

Chapter 4

Our House

Novem Site Photos and Narration

(Photos by Michael Holland 1971& 1974 / Interview with Muriel Holland 30th August 2023)

Figure 1.

We started in our summer holidays. And then we moved in at the beginning of December, so it was pretty good going. Just weekends and evenings as well because we were working during the week. We used to finish work and go back to the site. We worked every hour under the sun, really.

We just used to have meat pies and stuff for lunch. You know, ate all the wrong things, but we were able to keep going with a bit of carbohydrate. We were young. I mean, I was 22. Mike was 26. I was a PE teacher, so I was pretty fit.

We still lived in our house in Woodbridge. I think we took a bridging loan before we sold our house.

You used the access for the two houses. One was Ricky's and one was ours. To get the equipment up.

And the bricks at the top of the hill are all for the septic tank. Yes, two piles. I think most of the money went into the septic tank, I remember. Cost a fortune.

Figure 2.

That's the soakaway for the septic tank. So that's down the lower bit of the garden.

Figure 3.

We had a brickie build the septic tank. I think there were 2000 bricks in the septic tank, because it was a double brick.

Figure 4.

Putting the slabs on top of the foundations.

It's 18 by 18 by 3 feet. And that nearly caused the end of our marriage, digging those out.

Mike did the top two feet, and I did the bottom foot. But after I was lying on my stomach with my arm down the hole, trying to get the bottom foot out, and when it got to the top, there was nothing on it. So, after me jumping around and screaming and things, we did it together. It was awful. The foundations, or even the laying out, the planning of where the legs had to go, it took us two days. And it was so stressful because Segal had said it had to be accurate to about a quarter of an inch, so that the weight of the pillars was exactly over the centre of the footings.

So, we would have a tape, because there were no electric lasers or anything, so we'd have a tape measure and Mike would have one end and I'd have the other end, and then we'd be rechecking the diagonals and doing it all. And then, of course, you can imagine he would say, well, let's just redo that. And of course, I'd go to the wrong one. Yeah, we fell out a lot. I mean, I think we probably fell out more here than we did in the rest of our marriage, almost.

Figure 5.

That's two of the foundations. That's the soakaway, that's the pipes going down to the septic tank.

We hired a man and a digger, which we were pleased about as they broke down three times. We were really pleased it wasn't us who was hiring it.

Figure 6.

This is the septic tank that's been buried.

I remember all the work and the effort and the money that went and then we just covered it all up.

Figure 7.

That's all the wood that I painted.

Figure 8.

That's the two guys who came to put up the frame, who Segal recommended.

They came for two days and put up the entire frame. That's obviously Mike on the right. And that was the first one they put up, the far bedroom end.

So, they did all the verticals, they did all the floor joists, and they did all the roof joists.

It was all simple. There's no dovetailing or anything, so it was pretty quick. It was two days.

Figure 9.

That's some of the first ones going in. There's only three of the main timbers in there.

Figure 10.

That's Mike and that's a friend of ours who came and helped, I think he was a fellow teacher at Mike's school.

I think he came and helped put the paving slabs all around the edge. So, then you can walk all around it on the dry and the level.

He was a bit too pernickety for us, he was really fussy about the levels and so on, and we were just … let's just get it done.

Figure 11.

So, they've got the floor joists on, haven't they.

Figure 12.

I think they're butting up the cross beam onto the vertical.

Figure 13.

That's the overhang bit for the steps. Up at the front. This is the extension bit for the front door.

I think they put the fascia on as well, on the top, before they went, and all the fascia was all painted.

There's my pile of wood at the back, look, my painting pile.

You can see the path that goes around, and then we'd gravelled, as you can see, inside, so that was all sort of neat and tight and dry.

Figure 14.

Yeah, that's coming on.

Figure 15.

That's the drains. I put all of them in. I spent hours fixing the wretched things together and then wheelbarrowing the gravel in.

Figure 16.

That’s me. Half a hundred years ago.

So that's the front door bit, isn't it.

It was quite a mess. I don't remember it being quite such a mess. But of course, the mess really was from the septic tank, wasn't it.

Figure 17.

You can see the joining steels, kind of little steel plaques, they had loads and loads of zinc screws in them, each of them to hold the joint.

And the fascia was Parana pine. Again, that was a Segal thing, it had to be Parana. He did a lot of wood research in Egypt, on Egyptian thrones and Egyptian chairs. And that was why he got really interested in wood and the longevity of wood.

That's the woodwool. (Under the plastic sheeting) Because that was the middle fabric of the walls, and it was on the roof. It wasn't on the floor.

Figure 18.

So, the fascia's gone on, so some of my painting has gone on now. I tried to stay ahead of what was needed.

Figure 19.

Terrace bit, which is open plan.

Figure 20.

And that's the first panels, the first wall panels going on.

The frame was never painted. The verticals were painted.

Figure 21.

I was there day after day after day.

We worked as much as we possibly could.

Figure 22.

And we had a carpenter called Maxie who came and helped us.

That's the back of Maxi, so Maxi's obviously putting up the wall panels. You can see the woodwool, one on. He was a carpenter, but he worked for a local building firm. He'd helped us a lot with the first house in Woodbridge and the renovation there. So, he was quite interested in coming back.

I think we used to slide in the external panel after we'd fixed the woodwool. Because the wood wall was quite heavy. So, I think we used to fix that, but then the painted panel was quite thin, so you could sort of just slide it in, before you actually tightened.

Figure 23.

Suffolk was pretty good weather. It's very dry in Suffolk.

Yeah, we had six weeks summer. The roof's on, isn't it? So, yeah, it's probably still September time. But the top facia is done, and the bottom facia is done, all the verticals are done. I'm still painting away.

Figure 24.

The terrace living room.

In reality it (The panels) was greener because you could see it as you drove out of Woodbridge and crossed over. There's a bridge just before you turn into Bromswell, so you used to be able to see the house from that bridge. It used to stand up, so we tried to make it blend in reasonably. I mean it's behind a big high hedge anyway so you can't see it from the village but from further away you could see it. We tried to make it blend in as much as we could rather than having an orange one or whatever.

Figure 25.

So, we've virtually enclosed it with the poly at the windows and so on.

Figure 26.

And there's the little clerestory.

Figure 27.

These are the roofers who came, carrying those pebbles up.

And the wood wool pile, because the woodwool went on the roof as well. And because it had to be really, really dry before the roofers arrived, Mike and I went, before we went to school, and put all the woodwool slabs, stacked up on the roof, but covered up. And then we lifted them all out and put them all out flat so that when the roofers came it was all bone dry.

And then they felted, and that shows the over lip, and then it was held in place by the wood.

There was gravel on the roof, to weight it down. So, these roofing guys just carried it up a ladder, and then they scattered it. Segal used to water his roof; we never watered it.

And then - and that's one of my most embarrassing things - I went and bought eight urinal traps. Brass urinal from the builders' merchants. And they said, what do you want these for? Well actually it's my roof.

And then of course they slotted into the downpipe.

Figure 28.

We've just moved in. I was an only child and my parents lived in Edinburgh and they came this Christmas, we had just moved in. That is our bedroom in there and those are the sheets I've obviously put up for my mum and dad. So, they had some privacy at night, because obviously with those big windows you, you know people can see you undressing and things, can't they?

Figure 29.

That's obviously the same Christmas. You can see that we've sort of levelled the top lawn as we used to call it. Then we had the Christmas trees all down below where the septic tank was.

And it was covered in little Christmas trees when we bought it. The land was a Christmas tree plantation. So, we kept a lot of the Christmas trees and for a few years we used to dig up our own tree.

Figure 30.

Mike and I moved in the beginning of December, I think.

And I remember it was really cold, there was lots of frost. When we used to come back from school, we used to get the hair dryers out and lie under the house and thaw out the pipes. Because there was no insulation or anything on the pipes under the house and they used to freeze, so it was pretty rough.

Figure 31.

Half that fascia's not been painted has it. Because we put a fill-in bit for plants to grow up on the front of the terrace. But you see the capping's on the roof. So, the roof's all fixed.

Figure 32.

That's looking out through the terrace. You see the ceilings are the wood’s quite light isn't it. And the ceiling boards are all white.

Figure 33.

That's the living room, again there's no curtains up there. But you see you're very much a part of the garden aren't you, with the nice big windows even if they were freezing.

We had, what are they called, those electric storage heater things. Which weren't very efficient. And sunny days the house was fine, but like November, you know grey November days it was a very cold house. In fact, my mother-in-law wouldn't come between October and Easter to it because it was too cold. But she didn't tell me that until much later.

Figure 34.

That divides still there you see isn't it. All the panels are covered with pictures, I have magazines and things on the kitchen wall.

Figure 35.

This was a Segal designed table. So, it was just like a trestle. And then the tabletop was a door. Which just set into the frame, if you like. The legs were extended so that they retained the side of the table. See, this is a polished wood surface - this is a posh surface. So, if we were entertaining, or whatever, we'd have it on the wood side. But you could flip it and we had Formica on the other side for the kids. That was a Segal idea, which we took up. Mike built it. And we also had a bed Segal designed - again, just the frame with the mattress slotting into the it. I mean, we didn't have any money, as you can probably gather. So, things like making the table seemed to be a good idea.

Figure 36.

The garage hasn't come in because it's still the slope up.

We had to wait for Ricky to finish because we did it combined. Because we dug out simultaneously for his and ours. It was slightly funny because we did the Segal garage and Ricky did a brick garage.

That's Ricky's camper van and our Renault. Obviously just as they're starting to dig it out. Ricky had traditional footings, so we must have had traditional footings for the garage. And then just used the Segal idea to go on the top of it.

Figure 37.

(In 1974 when the bedroom extension was added)

Segal came to see us and to support us - I think it was just a very hot day and he just sort of stripped off. I can't remember how many times he did come - I think he liked us - because we were self-builders. He used to sort of come and support us and he had quite a few meals with us.

He knew when we were starting the frame, so he obviously came. He was mostly just the expertise really.

And that's our friend Colin, who was a woodwork teacher - we've obviously got him to come and help and be another prop - on the legs, probably by the looks of it.

Figure 38.

There's Colin and Segal again, and me sitting on the grass with Nicky.

You can see we've obviously laid the paving slabs down - they're obviously not as level as maybe the original ones were - but we've done the same sort of policy of putting the slabs all around it and then putting the gravel in. So, you do all that first before you actually then start to build on the site.

You can see all the trussing can't you - that is necessary to keep it level to start off with.

And the fascia's all ready to go up. It's already been painted and ready to go.

Figure 39.

Well, I'm child, I'm childminding, aren't I? I'm screwing the floorboards in place. And she's obviously trying to do some work as well.

Can you see the clamps? They're all clamped to be tightly put in, so I'm doing a proper job.

It does show a little bit of insulation, which we must have had. I mean, I can't think we had very much, but we have obviously got some insulation.

That shows the woodwool and how we fixed it before we put in the vertical batten and the internal plasterboard. Pieces of wood. Well, the vertical support will be on the outside, holding the external fixing and the woodwool. But then internally, there is no vertical bit still, but by just putting a crossing on, you could hold it all together. And there's a little filler piece just to the left of Nikki's head. In the hole, there was a little spacer block, because I think that just sort of held them all in place.

Figure 40.

The felt's obviously gone on the roof, so the roofers must have been.

You can see I haven't painted it, have I? (The battens before they went on) That's what having a child does for you. They were painted in situ. It looks a bit short - they look a bit ragged, don't they? They obviously haven't been finalised to their neat finish.

Figure 41.

I think it's (the extension) sort of balanced the house better almost.

Conclusion

Lessons from the Building Site

A project starts on site with a degree of exhilaration; months, often years, of project planning and design preparation will have led to this moment. The thrill that all the work up to this point has not been wasted, that this building will actually happen, blends with a peculiar type of awkwardness as one group of people who has worked hard together to get to here shifts in formation to accommodate new players: the builders.[1] Acts of clearance in readiness for construction commence, perhaps demolishing a structure, or stripping back an existing building of unwanted layers. These activities prepare the literal ground of a site, but also acquaint and familiarise those involved.

What follows is key. This preparation leads to the anticipatory thrill of setting out the design on site. X marks the spot. Strings and spikes, lasers and spray paints demarcate the position, extent, and orientation of the building, together with the calculated intersections of gridlines. Perhaps the builder, architect and client will stop together for a chat and observe this moment. The design, as developed so far, has prepared for this. It is an intensely projective moment: the moment building identifies with design. Here, the abstract geometries of the plan are revealed on the material reality of the ground. The strange combination of string lines precisely laid onto the rough surfaces of rubble and mud highlight the awkward conjunction of design and realisation at play.

Months, perhaps years later, it is a very different feel as the project nears completion, when a strange atmosphere often envelopes the building site. Whether the works have gone smoothly or not, a group of people, often with a core contingent throughout, and others joining, leaving, or dipping in and out, have been through an intense and revealing experience together. A weariness from the endeavour, of frustrations, disappointments, resentments, memories of disagreements and perhaps confrontations, blend with a sense of achievement of what has been produced together through graft and determination.

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[1] Jan De Vylder, foreword to *AgwA: Chantier / Construction Site*. (Ghent: MER. Borgerhoff & Lamberigts, 2019), 6.

The works are seen at this point through jarringly different lenses: a forensically detailed process of snagging, of scheduling and correcting problems, combines with an opportunity to step back and see the works at last in their entirety. For the designer and builder, it is an ending of sorts, but for the client, despite all they have already been through, also a beginning.

The conclusion to this thesis presents a similarly difficult moment. I have tried to make sense of the complex dynamics of a series of building sites. While I have approached the research as distinct from, and external to, my own work as an active practitioner, the concerns within it nevertheless clearly indicate those of the practice, and the conclusion ought somehow to form a bridge between the two. Similarly, while the thesis content is historical, its concerns are contemporary, and after assessing the composite meaning of the research, the conclusion must pivot to the present and the future.

Alienation at the Construction Site

My research started with William Lethaby and his approach to the construction of All Saints' Church. I was interested in architects whose careers revealed major shifts, yet while these were commonly associated with architectural language or technologies, here a practitioner had radically altered his way of working. I first interpreted this episode in musical terms: that Lethaby appeared to be exchanging the role of composer for the role of conductor. This analogy makes clear that he was not solely concerned with his own role; his consideration was also relational.

Yet the church at Brockhampton is ambiguous in its testimony to the venture. The project successfully coordinated various crafts to meaningful ends, the completed architecture is evidence that limiting the documentation can be seen to have improved the design. But the fact that Lethaby was overwhelmed by the experience, that he gave his fee back to the client, and turned his back on private practice, suggests - though it does not confirm - that the strategy was also flawed.

As the studies of Joseph Paxton and Walter Segal followed, various commonalities and differences became apparent, many of incidental and biographical interest. Both Paxton and Lethaby grew up in working class environments, in Bedfordshire and Barnstaple respectively, while Segal's bohemian childhood was spent amongst internationally famous artists in Switzerland. Lethaby and Segal both operated small practices that appeared to allow a more direct contact with clients and builders, generally only employing one assistant at a time.[2] Both also worked with clients who were prepared to support irregular contractual configurations, and often worked with builders of their own choosing. And the buildings of Paxton and Segal's that are featured are predominantly constructed in timber.

Importantly, the studies span from 1830 to 1980, describing an era of industrialisation in England, that has allowed an examination of the impact of industrial capitalism on architecture, and describes responses of resistance. As such, the study of the construction of the Great Stove at Chatsworth establishes the intellectual and political problems presented by these new circumstances, revealing Joseph Paxton as a facilitator of the distancing of the designer from the site of production, and the distancing of the site workers from the design. The adoption of labour-saving technical innovations suggested associated forms of deskilling and precarity to those involved, and in turn, led to the commodification of labour. Yet the study also presents Paxton in the lead-up to this project as an exemplar of integrated mental and manual labour, designing and building in a hands-on manner; the role of gardener here almost considered as a model of practice.

Walter Segal's involvement appears redemptive in character, presenting the successful union of design and construction, and demonstrating the extraordinary reconfiguration of clients as both designers and builders. Segal also represents a position of re-engagement: his involvement of clients in the design and construction of their own houses suggesting a radically different understanding of roles, played out at the site. Here, designer, builder and client were not distinct and distanced entities, but were significantly more fluid in their operation. Yet one cannot altogether avoid the problematic that in this model the traditional builder is made redundant; skilled labour now become superfluous.

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[2] Walter Segal, "A Man on His Own," *The Architect and Building News* (23 October 1968): 20-27.

Architecture is Building

Significantly, Joseph Paxton viewed architecture and building as distinct realms, and in this he was typical of his time, and accepting of the received division. The architectural establishment of Britain was deeply guarded of their professional territory, and despite the accolades later granted him in relation to the construction of both the Great Stove and the Crystal Palace, these glass structures were not regarded as architecture at the time, but as utility buildings, or at best engineering, and the untrained Paxton was not accepted by his peers as an architect.[3] Indeed Paxton's obituary in *The Builder* ungraciously suggested that while he 'had great knowledge of, or aptitude in, matters of construction,' he could not be regarded as achieving 'the professional ideal of the true artist-architect.'[4]

Lethaby's texts, teaching and completed buildings all made apparent an esteem for knowledge of materials and techniques, and the skills of building, that was far from the consideration of the realisation of design as either 'mere building,' or of a form distinct from architecture. Rather, for Lethaby, architecture and building might be considered one and the same.

His conception of architecture was also able to contain both the aesthetic and the politic. In assessing his approach to the construction of All Saints' Church, one might question whether Lethaby was more concerned with politic and process, that is, with countering the lack of agency of the workforce involved, or with the sense of vitality their re-engaged craft would bring to the architecture of the church. While this is clearly an important question, the idea of either/or in relation to his, and also Segal's, work seems to be missing the point, as their appreciation of broader issues is entirely integrated within an aesthetic and tectonic vision.[5]

Walter Segal's houses, acclaimed for their rationalisation of construction, and for embracing the logic of standardisation, at first appear a world apart from Lethaby's example, perhaps more aligned

[3] "The Design of the Crystal Palace," Ecclesiologist XLI (1851): 269, quoted in Chadwick, *The Works of Sir Joseph Paxton,* 122-3.
[4] *The Builder* 23, (1865) 421, quoted in Chadwick, *The Works of Sir Joseph Paxton,* 254.
[5] In parallel to this point Raymond Williams documents a largely English literary tradition where communal concern, as expressed through political conviction, is wholly allied with the artistry of the individual. Raymond Williams, *Culture and Society 1780-1950* (London: Vintage, 2017), 7.

with the prefabrication of Paxton's glasshouses. Yet critical to Segal's logic of building was the marriage of two forms of assembly: the market-available products were accommodated within a timber structural frame that was made on site by hand. Here Segal appears to confront the alienation associated with industrial standardisation, giving it human scale and accommodating it within a process under the builders' control.

In Philip Webb's quiet dedication to construction there is an idea, or a tradition, of 'sound building' that is noteworthy when considering this relationship between architecture and building.[6] In his 'relentless concentration on the means of building,' Webb sought in the mastery of materials and techniques just such an idea of the culture of architecture.[7] Webb's focus on 'sound building' - *simplicity and economy, respect for client and user, knowledge of techniques and materials* - clearly resonates here with Lethaby, but also with Walter Segal's approach.

Building Process

Importantly, the modernist reverence for Paxton's glass constructions was in large part associated with the way the Crystal Palace, and the Great Stove before it, were understood to be results of their production methods; the way they conceptualised process.[8]

John Ruskin was critical of the material form of the Hyde Park structure, yet the greater focus of his critique, most coherently articulated with *The Nature of Gothic*, was articulated in relation to the means of production involved.[9] Where the modernists interpreted the utilisation of serial production as a symbol of the new epoch, Ruskin saw the banality of the mechanical, and the alienating effects of industrialisation.[10]

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[6] Andrew Saint, *The Image of the Architect* (New Haven: Yale University Press, 1983): 164-165.
[7] Andrew Saint, "I had to refrain," Review of *Philip Webb: Pioneer of Arts & Crafts Architecture* by Sheila Kirk. *LRB* 27, no. 23 (1 December 2005).
[8] Konrad Wachsmann, *The Turning Point of Building: Structure and Design* (New York: Reinhold, 1961): 12.
[9] Ruskin suggests on the re-location of the Crystal Palace to Sydenham: 'But mechanical ingenuity is *not* the essence either of painting or architecture: and largeness of dimension dos not necessarily involve nobleness of design.' John Ruskin, *the opening of the Crystal Palace considered in some of its relations to the prospects of art* (London: Smith, Elder, and Co., 1854), 6.
[10] Sigfried Giedion, *Space, Time and Architecture: The Growth of a New Tradition* 5th ed. (Cambridge, Mass: Harvard University Press, 1967), 249-255.

Against these, he identified the quality of ‘savageness’ - understood to characterise the nobility of imperfection - as one that offered an opportunity for labour to exercise agency on site. Savageness also offered an opportunity for material vitality; a sense that marked by the human hand, the trace of meaningful work might speak greater truth to human experience, providing aesthetic evidence of agency, and the subversion of industrial sterility.

For Lethaby, building process meant an awareness of skills and interplay of the craftsmen on site, an appreciation of the live activity of artisanal crafting in which his practice was rooted. The adjectives used by Lethaby and others of the Arts & Crafts to describe better or worse architecture – ‘vital’ or ‘dead-handed’ – reveal an understanding of the criticality of the kinetic.

Walter Segal was also acutely aware of building processes, appreciating the relationship of skilled and unskilled work, of sequencing and economies. In the simplification of building operations first revealed in his own temporary house, and later utilised in the self-build projects, Segal saw that a mastery of construction activities offered further potential for architecture.

What appears so distinctive in both Lethaby and Segal’s approaches to architecture is a knowledge of production practices that enriches and informs the built architecture - while avoiding a fetishization of craft, detail, tectonic - through an understanding that construction is a process, carried out over a duration of time, by people. By orienting architecture towards this, their work indicates an integration of designing and building, and the resulting architecture reveals both a greater sensitivity to materials and people, and a greater truthfulness of artefact to process.

An Unfolding Dynamic of Design

Central to all three studies have been forms of documentation other than drawings. The worksheet schedules for the Great Stove at Chatsworth gave names, and thereby human form to the abstraction of economic effect, the contract specifications at All Saints' Brockhampton identified areas of work described and undescribed, and the programme for the building skills evening class that Segal and Broome led in Lewisham revealed the practical character of the empowerment enacted. There have also been key drawings, particularly details: the window/wall detail in my own house, the sash-bar machine detailed drawing from Chatsworth, Lethaby's detailed sketch for Avon Tyrell of the peacock for the carver, and finally, Segal's wall junction detail. In each case, perhaps unsurprisingly given the inherently relational character of details, these were revealed to be not just technical responses, but embodied stories of complex personal, cultural, and socio-economic form.

Edwin Lutyens famously wrote that: '…a working drawing is merely a letter to a builder telling him precisely what is required of him…'[11] Paxton's sash-bar and patent drawings both operate in a similar, yet more extreme manner to Lutyens' hypothetical letter: as precise instructions that exclude the possibility of either response or further consideration. These drawings suggested no further development was required: they were the 'last word' on the design and, in effect, operated to foreclose further drawing. In this respect the Great Conservatory project, and specifically, Paxton's design for a sash-bar machine, can be viewed as paradigmatic: the machine reduced labour on site through its remarkable efficiency, but also effectively sought to kill the design process on site through fully defining it beforehand.[12]

Lethaby and Segal saw time on site as valuable time, full of design possibility. One might go so far as to suggest that for each, this time was perhaps more significant than that spent beforehand in design preparation: it was here on site that Lethaby's *Craftsmen's Drama*[13] was played out, and here that Segal assisted his clients in finding

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[11] Edwin Lutyens to Lady Emily Lytton, February 5, 1897, in *The Letters of Edwin Lutyens to his wife Lady Emily,* eds. Clayre Percy and Jane Ridley (London: Collins, 1985) 23.
[12] The famous early sketch on blotting paper of the Crystal Palace remains as the only drawing in existence that can be fully attributed to Paxton. Mark Girouard, "Genius of Sir Joseph Paxton," *Country Life* 138, Part 2 (December 9, 1965): 1607.
[13] Hugh Strange, "The Craftsmen's Drama," *AA files*, no. 77 (2020): 152-68.

fulfillment in creative manual and mental labour. Lethaby came to understand the tendency for drawings to distance the designer from the building site, and his gesture of restraint, in contrast to Paxton's machine, did not close the opportunity for further ideation: it might better be understood as postponing and re-locating design to the site. Similarly, Segal's gradual abstention from both perspectival and hardline drawing represented an exacting efficiency within his own working methods. With an economy of means he achieved as much as possible with as little drawing as possible.[14] Increasingly, Segal's drawings revealed a regard for the value of directness over that of virtuosity. In contrast to the finiteness represented by Paxton's sash-bar drawing, the openness apparent in Lethaby and Segal's drawings suggests then a conversational rather than a lecturing tone; they speak of a desire and willingness for collaboration, they ask what might be achieved with less, and question how producing less might then re-frame the dynamic of the design.

The Adventure of Building

At the beginning of this thesis, I refer to building practices documented in Marvin Trachtenberg's text, *Building-in-Time*, and to his warning that architecture in modernity stands in opposition to time: for time-of-construction to be eliminated as much as possible.[15] Trachtenberg suggests this was initially driven by an impulse to protect architectural authorship from dilution, and this has been seen to have been compounded by the later division of labour, central to the development of industrial capitalism, and now made evident throughout our contemporary building culture, in the precarity of both construction and design labour, and with increasingly remote architectural practice. Given the wider socio-economic structures within which we now operate, it may feel unrealistic to imagine design and construction fully re-integrated - with the various contemporary manifestations of the separation described in the introduction now seemingly wholly embedded.[16]

[14] Segal notes: 'To write legibly does not entail the use of calligraphy.' Walter Segal, "A Man on His Own," *The Architect and Building News* (23 October 1968): 23.
[15] Marvin Trachtenberg, *Building-in-Time*, 14.
[16] Pier Vittorio Aureli, "So What? Leon Battista Alberti and the 'Invention' of the Architectural Project," *AA files*, no. 79 (2023):58.

The thesis has nevertheless argued against the Albertian notion of an 'original' design, whereby realisation, and any resulting variation, inherently entails compromise, entwined as this is with the idea of 'mere building'. The ambition for an alternative model of practice encompasses then a re-valuing of building, and an assumption of a fundamental and intimate relationship between architecture and construction. Rather than distinct, separate and timeless, architecture might best be considered as building, or perhaps, as building well.

An appreciation of building as active process follows. Here, the conjunction of the creative, social and political relations of the extraction and transformation of materials, the activities involved in the making, through craft, assembly of industrial systems, or toil, and finally these activities occurring over time, are inherently involved. The design, no longer considered as fixed, develops through iteration and evolution over an extended design period that also encompasses the construction period. This suggests an unfolding of design that is inherently responsive to, and dependent on, the temporality of construction. Significantly then, the relationship between design and construction is one that recognises a dynamic on both sides of this association.

Those involved in the construction, the builders, are central then to the architecture that subsequently emerges. Buildings produced in this way are an endeavour of communality, and the reciprocity between the dynamic processes of construction and architecture suggests both a collective imagination and the re-consideration of those involved in a shared experience of design and construction as co-producers. This is surely the function of the vernacular: construction as socially owned knowledge of building-making, architecture as a 'common tradition of honest building,' as Philip Webb phrased it,[17] and goes some way to explaining the sense that cathedrals, like Wells, embodied the life of a community, the *communitas*, as their construction became a narrative of the common identity of the population that built them.[18] Or, as Colin Ward remarked in relation to Walter Segal's practice, the architect, builder and client might, in this manner, be, 'all mixed up in the middle of the adventure of building.'[19]

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[17] Lethaby, *Philip Webb and his Work*, 119.
[18] Scott, *The Gothic Enterprise*, 233-236.
[19] Ward, "Walter Segal 1907-85," 30.

Design Anticipates Construction

The architect therefore belongs on site, close to, and receptive to these operations, and in collaborative relation with those actively constructing. This role for the architect requires engagement with an organic process, characterised by technical know-how and design strategisation, together with improvisational and contingent thinking. It is rewarded by a sense of immediacy, a direct contact with those constructing and that which is constructed.

Importantly, there is also design before the building site that should be considered as it relates to, yet precedes, construction. In the simplest manner, design at this stage must prepare for construction through practical considerations, these generally associated with a term widely used in the contemporary construction industry – *Buildability* - that is not altogether unrelated to an earlier term, previously used in relation to Philip Webb: *Sound Building*. Importantly, one must regard this with the clear-headedness of the realist, and not as Sérgio Ferro notes, utilise the building works 'to be the image of a construction fiction that lies about its true formation process.'[20]

In seeking to bring the two acts of production closer, designing and building, one can also strategize to allow and encourage this process.[21] The design can anticipate the construction. Or rather, designing can anticipate constructing.

Acknowledging that architecture realises its potential in the constructed does not devalue design, or indeed make design before construction unnecessary. But it does suggest certain approaches over others. If architectural design can be considered as open, as invitingly porous in its conceptual configuration, if it can seek and express an empathy with the construction process, then the building site can again be viewed as a space of opportunity.

[20] Ferro, "Dessin/Chantier: An Introduction," 95.
[21] John Berger, "The Production of the World," in *Steps Towards a Small Theory of the Visible* (London: Penguin Books, 2020), 74.

In my own practice several strategies operate to develop the design prior to construction whilst not closing out the potential for significant development and enrichment through iteration and collaboration on site:

- A degree of formal simplicity that suggests the design might be accommodating enough to accumulate meaning through development, rather than inhibiting it.

- An appreciation of the commonality of typology that suggests forms with a robustness that can retain legibility through iterations.

- A continuing research and engagement with simple forms of building, including the monolithic, that might replace the technologically oriented, and technically distancing, multiple layerings that typify modern wall and roof build-ups.

- An acceptance and embrace of the interplay between modes of production (handmade / bespoke factory-made / off-the-shelf) that recognises the varied reality of contemporary building skills.

These are not presented as specific recommendations, for there are undoubtedly numerous other design strategies one might adopt, William Lethaby and Walter Segal each suggesting distinctive, perhaps idiosyncratic, ways of designing. Instead, rather than defining a specific route, the task of this research has been to indicate a better destination. This thesis then, looks to recover the relationship between architecture and the building site.

It makes the case for an architecture that emerges through the process of construction.

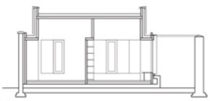
Appendix 1

The Strange House: DETAIL Magazine

House in London

Architects:
Hugh Strange Architects, London
Structural engineer:
Price & Myers, London
Others involved in the project: see page 220

The two-bedroom house is located in Deptford, South-East London, on a small site in an old pub yard, largely concealed from the street outside by an existing brick perimeter wall. The new building stands apart from these walls and thereby produces a series of narrow spaces. The enfilade rooms, high ceilings, and a framed view to a distant church make the home appear to be larger than it is. The surrounding brick walls screen the city beyond to create a private domain. The building frame of solid-timber panels was fabricated from spruce in a Swiss factory, driven to site in a container and erected in a week. The constructional logic of the building's detailing marries an engineered European product and Central American joinery. Fibre-cement panels envelope the building exterior; their lightness and verticality both relate to and contrast with the weight and horizontality of the rough in-situ concrete base situated atop the existing slab. The horizontality of the new building's concrete plinth is an expressesion of the original slab. It is still visible in the residual space cum garden, and even in the previous building's sliding door track was retained. Inside, the polished concrete floor represents the new slab. It also extends outdoors to form a terrace.
Each room has the same palette of materials: washed timber walls and ceilings, concrete floors and bespoke joinery comprising hardwood windows, doors, and furniture. Glass is sandwiched between the exposed structural timber and the hardwood frame to form the fixed windows; the top and bottom frames are not visible, emphasising the vertical mullions. The internal hardwood doors and frames are face-fixed to structural softwood openings, reducing site work, accommodating site tolerances and visually expressing the relationship between primary structural timber and secondary fit-out timber. The bespoke furniture is set within recesses in the structural frame. The bed, chairs and a dining table, made from a single piece of solid hardwood, are all provided by the same carpenter; these elements unifiy the timber interior. The building's energy requirements are low thanks to the high standard of air-tightness and insulation, the timber panels' thermal mass, minimal glazing to the north, and plentiful daylight.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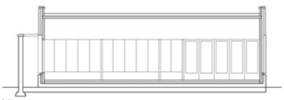
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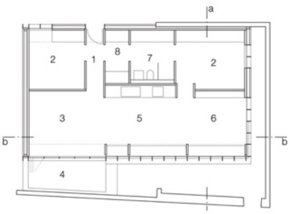
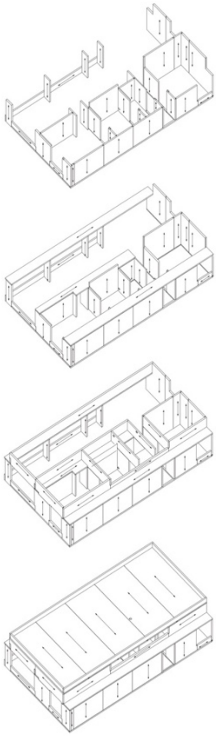


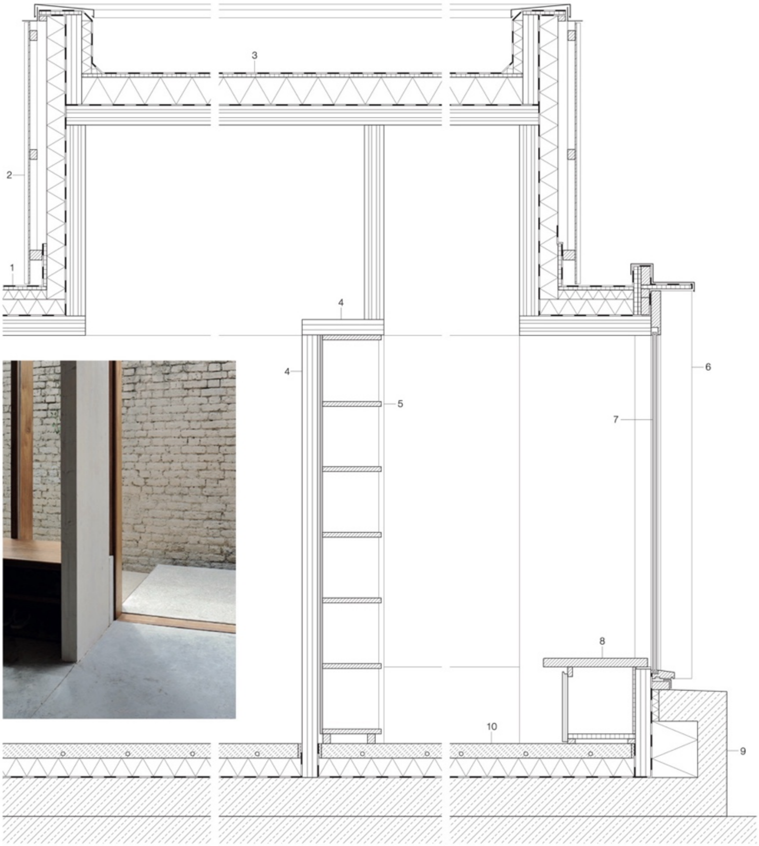
APPENDIX 1

Floor plan • Sections
scale 1:200

1 Hall
2 Bedroom
3 Living
4 Terrace
5 Kitchen
6 Dining
7 Bathroom
8 Utility room

Site plan
scale 1:1500
Axonometric drawing
Framing sequence





1 felt roofing
18 mm exterior-grade plywood
100–150 mm insulation to falls
vapour barrier
100 mm laminated cross-boarded timber
white woodwax oil
2 6 mm profiled fibre-cement cladding
38/50 mm timber battens
38/50 mm timber counterbattens
100 mm glass-wool insulation, low density
breather membrane
100 mm laminated cross-boarded timber
3 felt roofing
WBP Plywood 18 mm
130–210 mm insulation to falls
vapour barrier
100 mm laminated cross-boarded timber
white woodwax oil
4 80 mm lam. cross-boarded timber
5 25 mm hardwood
6 45 mm hardwood mullion
finished in Danish oil
7 24 mm double glazing
8 45 mm hardwood
9 150 mm concrete plinth
240 mm insulation
waterproof membrane
80 mm laminated cross-boarded timber
10 75 mm concrete floor, polished
underfloor heating, 100 mm insulation
waterproof membrane
200 mm concrete slab (new)
50 mm concrete slab (existing)

APPENDIX 1

Appendix 2

Building Sites of Hugh Strange Architects

Strange House

Building to my own very tight budget led me to consider the construction process and contractual relationships in a strategic manner, focussing on these with attention equal to that given to spatial and formal concerns. With a keen eye on an economy of means, I aligned the design as much as possible with the construction methodology.

APPENDIX 2

Figure 1. Building Site, Strange House, London, Hugh Strange Architects. 2010.
(Photo: Hugh Strange)

Drawing Matter

Having worked successfully with the cross-laminated timber supplier on the Strange House, we continued collaborating on the design for an archive and studio space to house the architectural drawing collection of Drawing Matter. Eager to push the material further than we had in the earlier project we used the CLT as monolithic wall and roof construction, without insulation or linings, where the mass of the timber provided adequate insulation itself, while also moderating the internal temperature and moisture for the storage of delicate archival material. Once again, the CLT was prefabricated in central Europe before delivery to site and assembled by a highly skilled workforce.

In contrast to the factory-made CLT, that had to be fixed in design prior to fabrication, several of the follow-on works utilised traditional hand skills, and much of the design for these elements was worked out on site once the main timber elements had been assembled. Thus, the floors in the two main rooms came from timber sourced from the surrounding woods, and worked by a local joiner, with the details of which timbers to use and how to detail them developed together. Wall-mounted display panels were also designed at this stage in collaboration with a specialist joiner and an upholsterer, who together made the panels in their London studios. Keen not to fetishize the crafted elements, much of the building is also formed of ready-made building components, bought off-the-shelf and fixed on site. Much of the architectural interest of the project comes from the coexistence of the factory-made structural frame with ready-made components and handmade elements.

Figure 2. Building Site, Drawing Matter, Somerset, Hugh Strange Architects. 2014.
(Photo: David Grandorge)

Clapton House

Budgetary pressure in this domestic project led us to cost-effective solutions throughout, and we looked to install the cheapest roof structure possible. At first, and perhaps out of professional pride, the main contractor suggested he could make the trusses up to a similar price as any that could be sourced. This did not transpire though, and instead we used standard, off-the-shelf trusses, together with low grade plywood above, at a significantly cheaper cost. These trusses, a little ragged in places, are left finished as supplied. This specification saved enough money for the joinery beneath to be made bespoke on site by a skilled joiner, using a better grade of timber, and this lower level of the room was fully lined in built-in storage and window seating. An important aspect of the completed architecture is the stratification of the two different timbers and the character that arises from their different grades and production processes.

The old plaster surface to the right of the joiner in the photograph reveals a site drawing, with notes and dimensions included, that I recall to be one of the builder’s own drawings.

Figure 3. Building Site, Clapton House, London, Hugh Strange Architects. 2015.
(Photo: Hugh Strange)

Avon Wildlife Trust Cabin

The brief for this seasonal shelter, located in a new wildlife reserve on the outskirts of Bristol, required a temporary structure to be delivered on an extremely small budget and within a very short programme. Inspired by recent experiences with ready-made building components, we took the idea further, and bought a small barn with a standard design from an agricultural supplier and adjusted it and added to it.

Bespoke adjustment works were made in timber to this off-the-shelf barn, including an external canopy and internal kitchen and storage units. Both the erection of the shed by the agricultural barn company, and the adjustments and additions by the builders took two weeks, the whole project lasting a month on site. To avoid delays we had to ensure we foresaw as many buildability issues as possible and designed with the construction process at the front of our minds. The external canopy for instance was designed as a series of goal posts, resulting in paired columns, so that the two men could build these on the ground and erect them without scaffold or additional labour, one section at a time.

Figure 4. Building Site, Avon Wildlife Trust Cabin, Bristol, Hugh Strange Architects. 2015.
(Photo: Hugh Strange)

Harewood Studio

This project transformed a small derelict outbuilding into a top-lit studio space. After tendering the project, we ended up working with a father and son team, who were based in nearby villages. Originally both joiners, the father now worked mainly with masonry, while the son had his own joinery company. The two worked separately but also collaborated on projects.

Knowing their trades, we adjusted the project, simplifying various aspects and aligning the design with their skills, such that the great majority of the work could be done by just the two of them, mainly in parallel but sometimes working together. The father did the masonry works – the wet trades – and the son did the carpentry and joinery work – the dry trades. The two men worked on the central concrete column together; concrete being a wet trade defined by a dry trade: timber shuttering. The prioritisation of these two trades is evident in the resultant architecture.

Figure 5. Building Site, Harewood Studio, North Yorkshire, Hugh Strange Architects. 2016.
(Photo: Hugh Strange)

Photographer's House

A new steel frame supports an existing house above, and extends beyond it, forming a regular grid within which a series of joinery elements allow and encourage domestic use.

Having worked with the same firm of joiners on several projects we had established a degree of trust that allowed us to draw much of the project only to a scale of 1:20, with the joiners producing additional drawings for the details that we then discussed together. The process utilised their skills and avoided doubling up on drawing production. In addition to the manufacturing cost, the firm charged the client a design fee, specifically tied to the time of their design input. The client however was aware of their design input, while the trust developed over many collaborative projects suggested to us a better way of working.

Figure 6. Building Site, Photographer’s House, London, Hugh Strange Architects. 2018.
(Photo: Simon Jones)

Garden Room

This project for a domestic, garden outbuilding commenced on a standard contractual basis, with a main contractor working within a priced contract, and with a project architect within my office overseeing the works on a day-to-day basis. Three-quarters of the way through the building works the contractor went into liquidation: it appeared the firm had under-priced several jobs to secure works and were unable to deliver to the contracted sums. At about the same time my staff member overseeing the project left my practice.

To complete the works the client directly employed the site manager who had worked for the contractor, and I undertook the necessary practice work myself. Fortunately, the building site was close to our studio. So, I largely stopped producing any further drawings or instructions from the office, and instead I would visit site daily and, together with the client and builder, would run through pressing matters and decisions required, perhaps providing a quick sketch on site as required. The resulting site dynamic had an immediacy and agility completely at odds with the original, planned method of progress.

Figure 7. Building Site, Garden Room, London, Hugh Strange Architects. Completed 2019. (Photo: Hugh Strange)

Hillside House, Hastings

Set on a steeply sloping site in the coastal town of Hastings, this project repaired the existing stepped concrete terraces that rose uphill from the rear of the client's house and added a series of lightweight timber pavilions constructed with LVL structures (Laminated Veneer Lumber). The client for the project was a small-scale developer who chose to employ various builders and sub-contractors directly, rather than use a main contractor. The engineered timber frame was provided by a specialist firm who were contracted to provide detailed design advice, fabrication of the elements off-site and erection on-site. However, once the timbers were cut and prepared, the sub-contractor did not have an available slot for installation for a few months. Rather than delay the project, the client chose to install the frame himself, together with two of his directly employed builders, saving both time and money.

The structure had been detailed by us and the engineers in a simple manner that facilitated this self-assembly, and the enterprise was largely successful. However, it became apparent that the client and builders were not able to achieve the same degree of accuracy in the setting out as the specialist sub-contractor worked to, and while this was not problematic with the frame itself, when the timber windows were subsequently installed the differences became apparent, with various gaps appearing that had to later be filled. Implicit within our detailed drawings were assumptions regarding the skill level of those involved in the construction.

Figure 8. Building Site, Hillside House, Hastings, Hugh Strange Architects. Completed 2023.
(Photo: Hugh Strange)

Farmworker's House, Cornwall

Recalling the enclosed moorland farmsteads of the West Country, this single storey courtyard house for a farm manager stands across a field from a recently constructed livestock shed. The protective wings of the house are formed by thick masonry walls, the depth of these a result of the specific construction system employed: monolithic clay blocks used without a cavity or insulation layer.

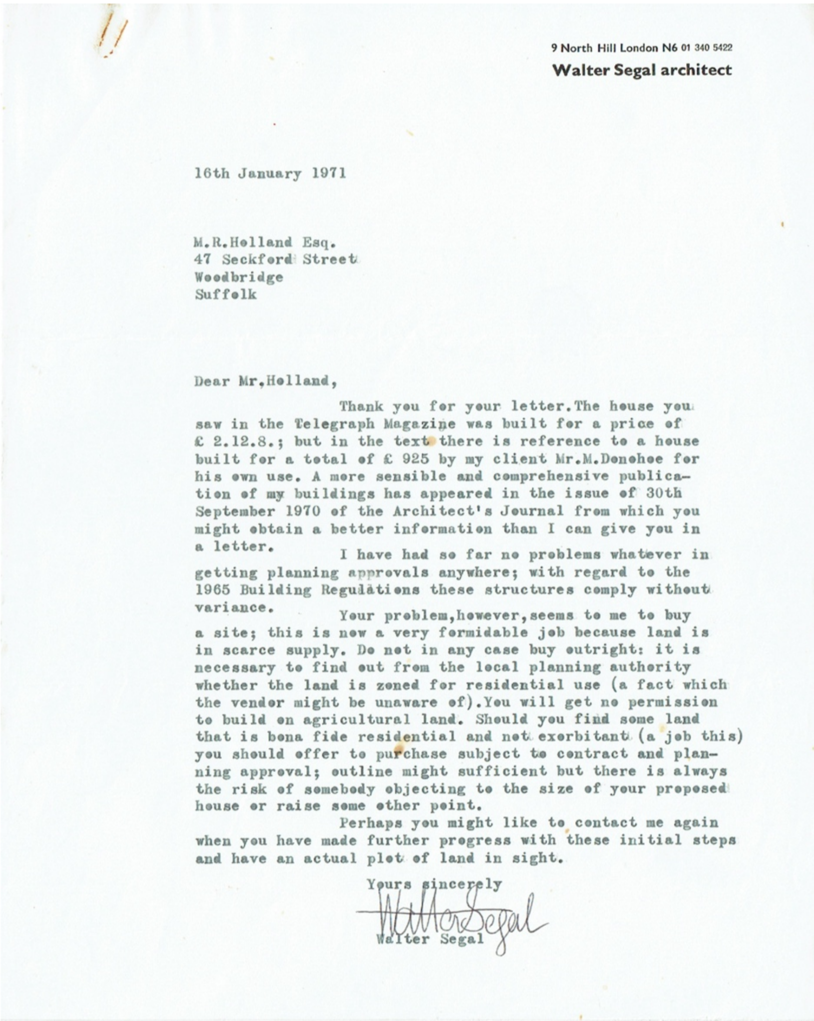
Construction commencement coincided with the onset of Coronavirus. While the locally based builders were able to continue work in the open, I was prevented from visiting the remote rural site for much of the early stages on site. An enforced physical distancing from site and direct contact with the builders – a condition of the global pandemic - determined project relations. Our drawings proved a poor substitute for immediate contact; rather than print them out, the contractor tried to view them on his mobile telephone while on site but struggled. Operating without a formal contract, they no longer functioned as either instruction or communication, and works tended to progress by him telephoning our office and asking for direct verbal instructions, which I would relay after checking the drawings.

Figure 9. Building Site, Farmworker’s House, Cornwall, Hugh Strange Architects. Completed 2022. (Photo: Hugh Strange)

Appendix 3

Novem Drawings & Documentation

(Largely previously unpublished)



9 North Hill London N6 01 340 5422
Walter Segal architect

16th January 1971

M.R.Holland Esq.
47 Seckford Street
Woodbridge
Suffolk

Dear Mr,Holland,

Thank you for your letter.The house you saw in the Telegraph Magazine was built for a price of £ 2.12.8.; but in the text there is reference to a house built for a total of £ 925 by my client Mr.M.Donohoe for his own use. A more sensible and comprehensive publication of my buildings has appeared in the issue of 30th September 1970 of the Architect's Journal from which you might obtain a better information than I can give you in a letter.

I have had so far no problems whatever in getting planning approvals anywhere; with regard to the 1965 Building Regulations these structures comply without variance.

Your problem,however,seems to me to buy a site; this is now a very formidable job because land is in scarce supply. Do not in any case buy outright: it is necessary to find out from the local planning authority whether the land is zoned for residential use (a fact which the vendor might be unaware of).You will get no permission to build on agricultural land. Should you find some land that is bona fide residential and not exorbitant (a job this) you should offer to purchase subject to contract and planning approval; outline might sufficient but there is always the risk of somebody objecting to the size of your proposed house or raise some other point.

Perhaps you might like to contact me again when you have made further progress with these initial steps and have an actual plot of land in sight.

Yours sincerely

Walter Segal

Walter Segal

Figure 1. Letter from Segal to client, Novem, 1971

9 North Hill London N6 01 340 5422
Walter Segal architect

24th March 1971

Mr.&Mrs.
M.R.& M.F. Holland
47 Seckford Street
Woodbridge
Suffolk

Dear Mr.and Mrs.Holland,

I am glad to hear that you will soon exchange contracts for the purchase of the site. I have started to make designs and have already some variations of the theme on paper. Others will no doubt follow and this will together with your own efforts show what scope there exists and permit us to make a final selection.

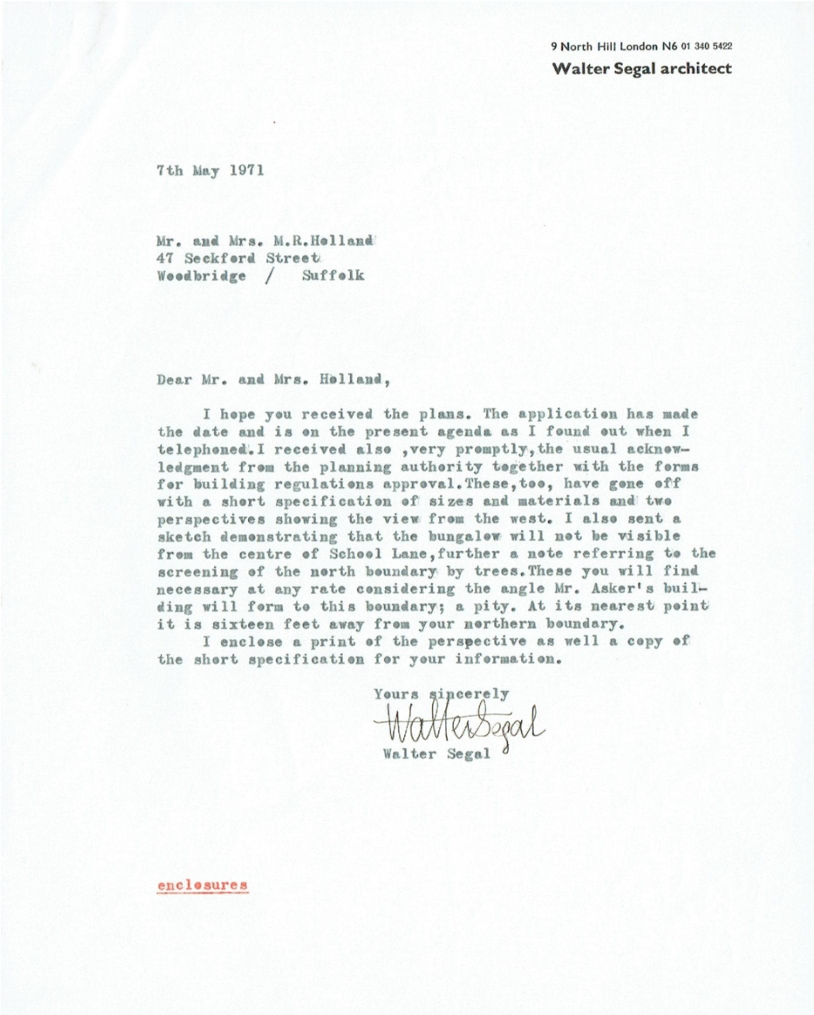
I am going to Co.Cork to start the house there and shall stay a few days returning on April 3rd. and I shall occupy myself there during the evenings with producing further designs for your house so that we should be able to meet after my return to decide. I shall send you these sketches a few days beforehand so that you may look at them at ease. We shall be able to get everything ready for April 29th to submit the plans etc. Thank you also for the data regarding the septic tank; this is much simpler than I thought.

As soon we shall have decided on the final design it will be a good plan to meet not only the local planner but to make contact with the County planner and his architects who have the whiphand in all these matters. The fact that they are sympathetic in principle is going to help us with the local committee; the other point in favour is, obviously, the high-lying position of the site. I think we shall be able to convince everybody when the project is nicely drawn up and presented and when they see what care has been taken in designing.

When we meet again we can discuss the best way for avoiding a shared water trench. Could you, please, obtain from the local RDC the forms for submission so to have them ready?

With kind regards
Yours sincerely
Walter Segal

Figure 2. Letter from Segal to client, Novem, 1971



9 North Hill London N6 01 340 5422
Walter Segal architect

7th May 1971

Mr. and Mrs. M.R.Holland
47 Seckford Street
Woodbridge / Suffolk

Dear Mr. and Mrs. Holland,

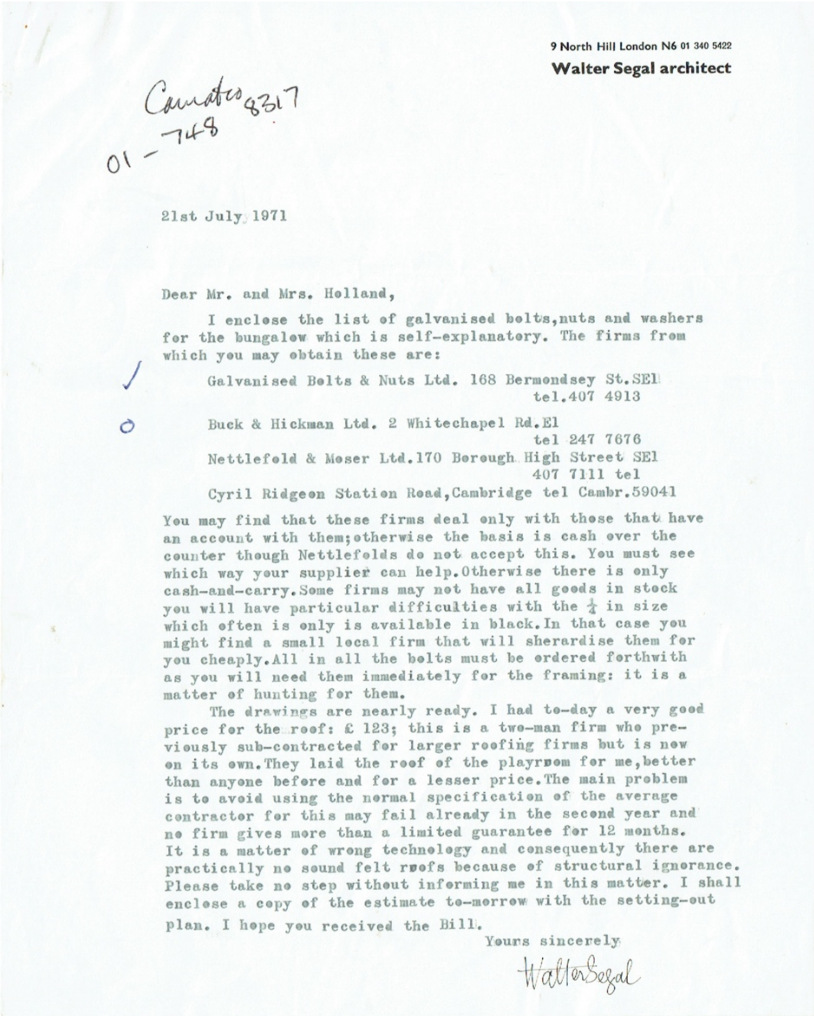
I hope you received the plans. The application has made the date and is on the present agenda as I found out when I telephoned.I received also ,very promptly,the usual acknowledgment from the planning authority together with the forms for building regulations approval.These,too, have gone off with a short specification of sizes and materials and two perspectives showing the view from the west. I also sent a sketch demonstrating that the bungalow will not be visible from the centre of School Lane,further a note referring to the screening of the north boundary by trees.These you will find necessary at any rate considering the angle Mr. Asker's building will form to this boundary; a pity. At its nearest point it is sixteen feet away from your northern boundary.

I enclose a print of the perspective as well a copy of the short specification for your information.

Yours sincerely
Walter Segal
Walter Segal

enclosures

Figure 3. Letter from Segal to client, Novem, 1971



9 North Hill London N6 01 340 5422
Walter Segal architect

Camates 8317
01 - 748

21st July 1971

Dear Mr. and Mrs. Holland,

I enclose the list of galvanised bolts,nuts and washers for the bungalow which is self-explanatory. The firms from which you may obtain these are:

Galvanised Bolts & Nuts Ltd. 168 Bermondsey St.SE1
tel.407 4913

Buck & Hickman Ltd. 2 Whitechapel Rd.E1
tel 247 7676

Nettlefold & Moser Ltd.170 Borough High Street SE1
407 7111 tel

Cyril Ridgeon Station Road,Cambridge tel Cambr.59041

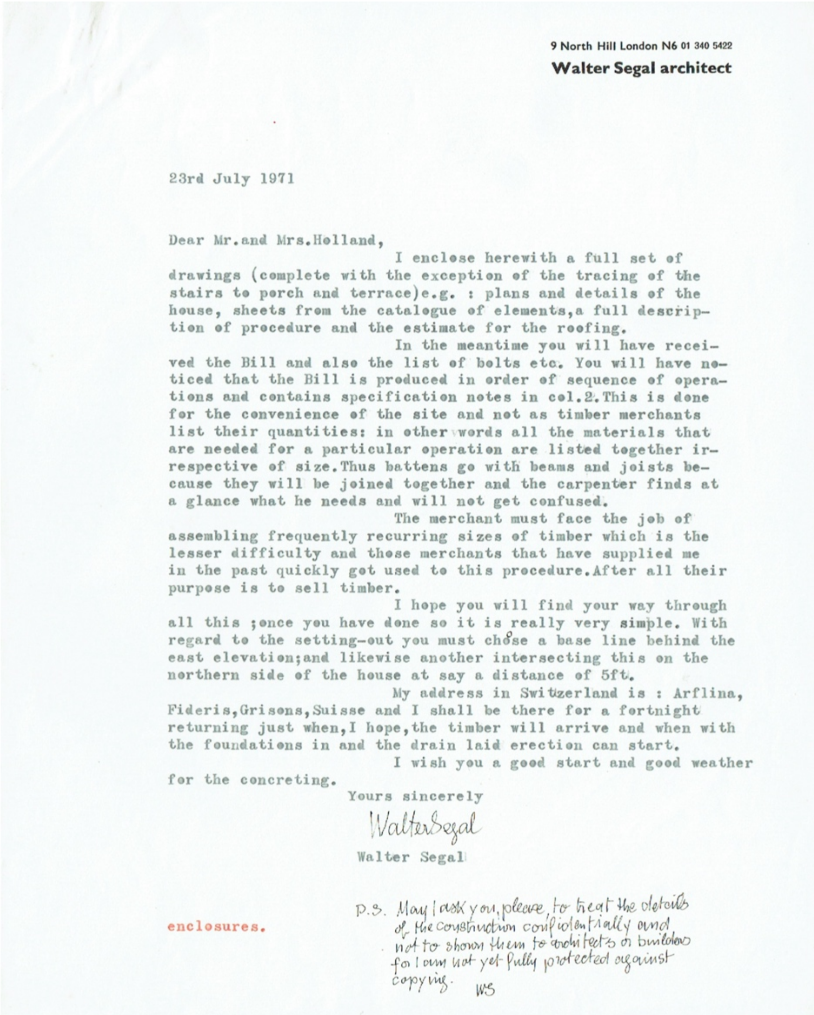
You may find that these firms deal only with those that have an account with them;otherwise the basis is cash over the counter though Nettlefolds do not accept this. You must see which way your supplier can help.Otherwise there is only cash-and-carry.Some firms may not have all goods in stock you will have particular difficulties with the ½ in size which often is only is available in black.In that case you might find a small local firm that will sherardise them for you cheaply.All in all the bolts must be ordered forthwith as you will need them immediately for the framing: it is a matter of hunting for them.

The drawings are nearly ready. I had to-day a very good price for the roof: £ 123; this is a two-man firm who previously sub-contracted for larger roofing firms but is now on its own.They laid the roof of the playroom for me,better than anyone before and for a lesser price.The main problem is to avoid using the normal specification of the average contractor for this may fail already in the second year and no firm gives more than a limited guarantee for 12 months. It is a matter of wrong technology and consequently there are practically no sound felt roofs because of structural ignorance. Please take no step without informing me in this matter. I shall enclose a copy of the estimate to-morrow with the setting-out plan. I hope you received the Bill.

Yours sincerely

Walter Segal

Figure 4. Letter from Segal to client, Novem, 1971



9 North Hill London N6 01 340 5422
Walter Segal architect

23rd July 1971

Dear Mr.and Mrs.Holland,

I enclose herewith a full set of drawings (complete with the exception of the tracing of the stairs to porch and terrace)e.g. : plans and details of the house, sheets from the catalogue of elements,a full description of procedure and the estimate for the roofing.

In the meantime you will have received the Bill and also the list of bolts etc. You will have noticed that the Bill is produced in order of sequence of operations and contains specification notes in col.2.This is done for the convenience of the site and not as timber merchants list their quantities: in other words all the materials that are needed for a particular operation are listed together irrespective of size.Thus battens go with beams and joists because they will be joined together and the carpenter finds at a glance what he needs and will not get confused.

The merchant must face the job of assembling frequently recurring sizes of timber which is the lesser difficulty and those merchants that have supplied me in the past quickly got used to this procedure.After all their purpose is to sell timber.

I hope you will find your way through all this ;once you have done so it is really very simple. With regard to the setting-out you must chose a base line behind the east elevation;and likewise another intersecting this on the northern side of the house at say a distance of 5ft.

My address in Switzerland is : Arflina, Fideris,Grisons,Suisse and I shall be there for a fortnight returning just when,I hope,the timber will arrive and when with the foundations in and the drain laid erection can start.

I wish you a good start and good weather for the concreting.

Yours sincerely

Walter Segal

Walter Segal

enclosures.

P.S. May I ask you, please, to treat the details of the construction confidentially and not to shown them to architects or builders for I am not yet fully protected against copying. WS

Figure 5. Letter from Segal to client, Novem, 1971

9 North Hill London N6 01 340 5422
Walter Segal architect

14th February 1972

Mr.and Mrs.M.R.Holland
9 School Lane
Bromeswell
Suffolk

Dear Mr. and Mrs. Holland,

I am sorry to have sat so long on the garage plans. This was due partly to pressures of work and also because I felt that the garage design is only half the job and that access to the house would also have to be submitted apart from providing detailed information for your own use. Thus I played about, whenever I could, with various designs and came eventually to the conclusion that the one submitted will not only be the best looking but also the most economical to construct.

As you will note this is basically on the lines you accepted but I had to drop the idea of forming "panel"retaining walls because on calculation of the earth pressure they proved not strong enough. Thus I had to return to 9" brickwork with some reinforcement. As requested I reduced the space behind the garage and the arrangement still works well giving you not only a landing in between but also an easy construction for the upper flight. I hope you will like this including the honeycomb walls supporting the half-landing. I hope the details are clear and also that you will like them. These plans have now been submitted to the Planning Officer; I enclose a copy for Mr. Asker and his architect.

Yours sincerely

Walter Segal

Walter Segal

P.S. I enclose 2 prints of double window details

Figure 6. Letter from Segal to client, Novem, 1972

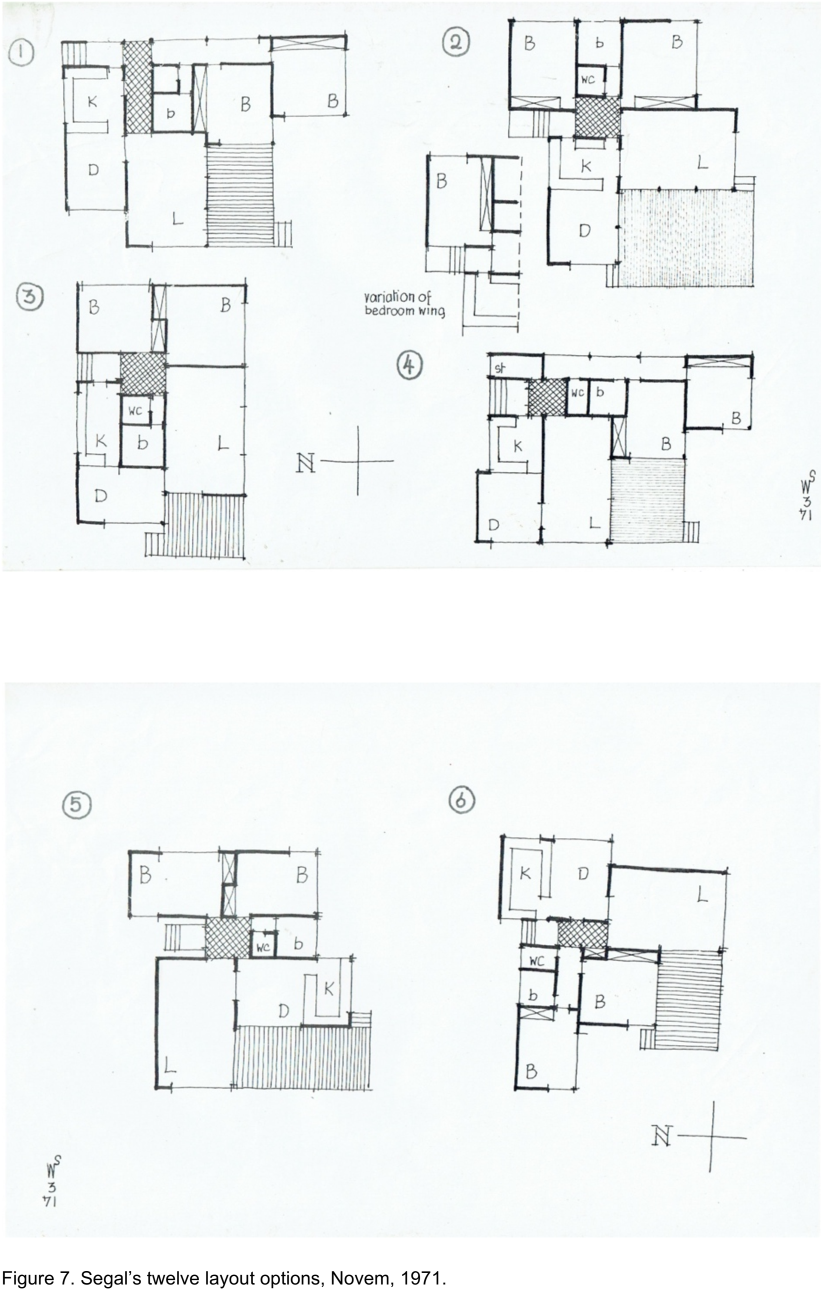
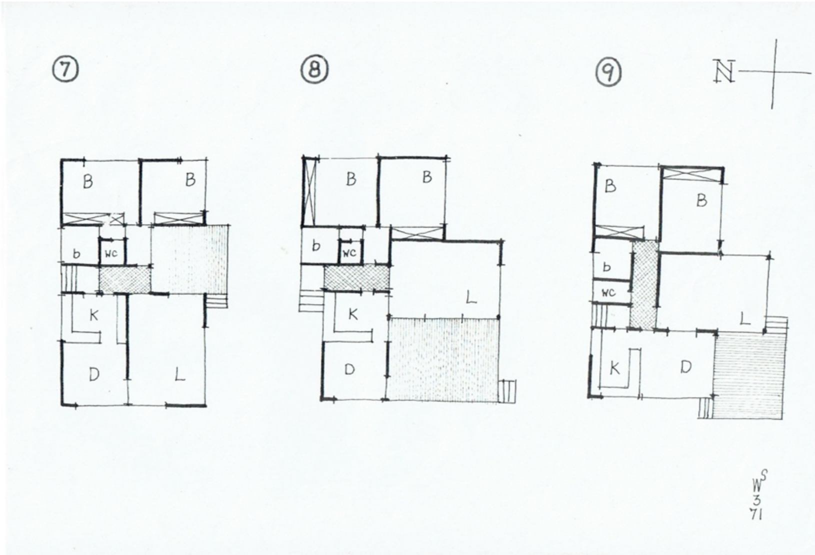


Figure 7. Segal's twelve layout options, Novem, 1971.



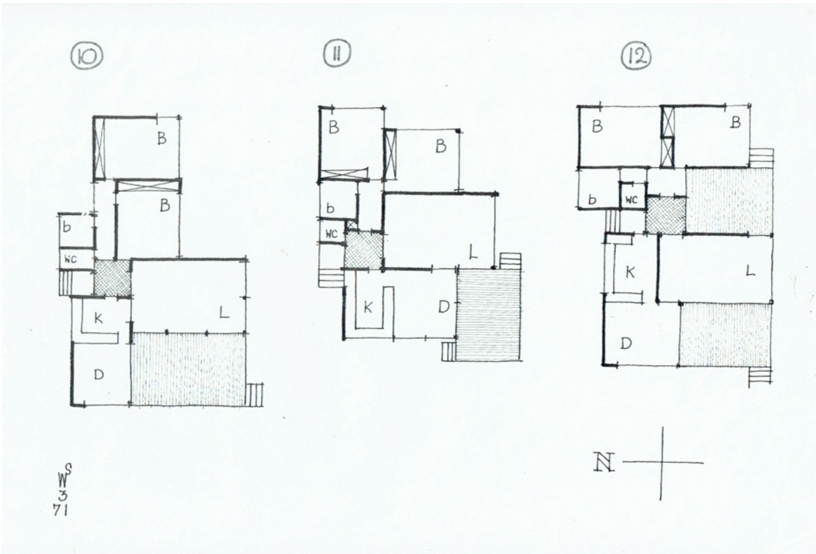


Figure 8. Segal's twelve layout options, Novem, 1971.

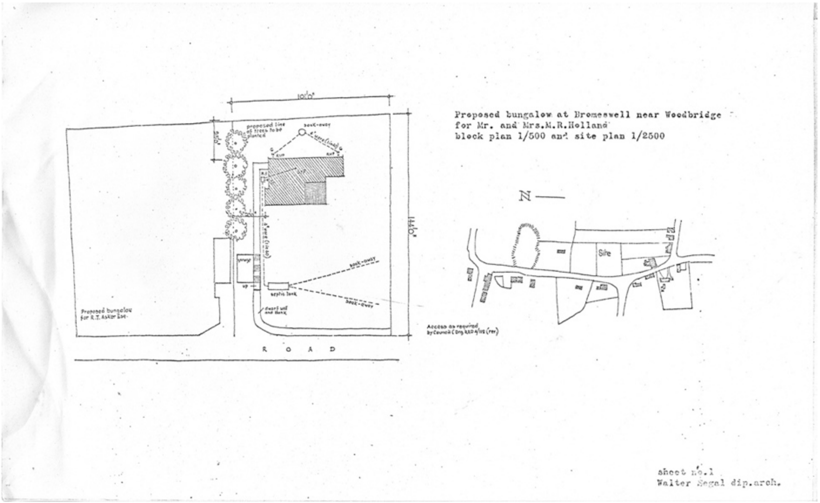


Figure 9. Site Plan, Novem, 1971.

APPENDIX 3

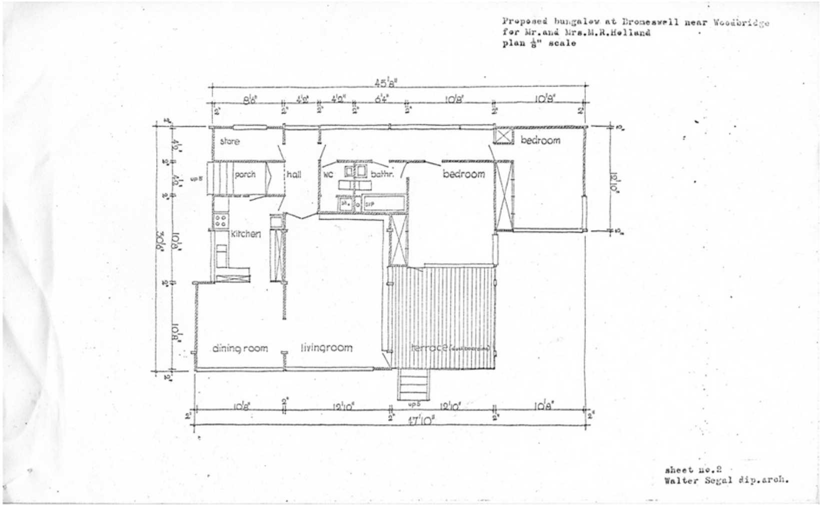


Figure 10. Ground Floor Plan, Novem, 1971.

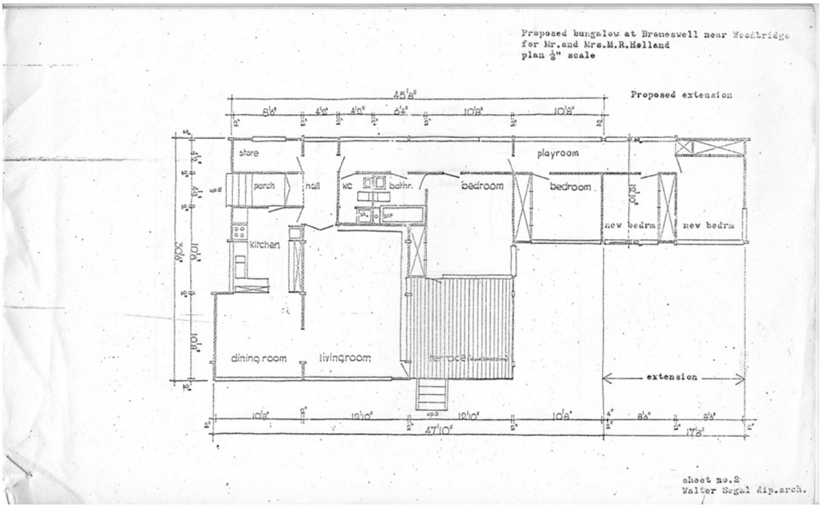


Figure 11. Ground Floor Plan Extension, Novem, 1974.

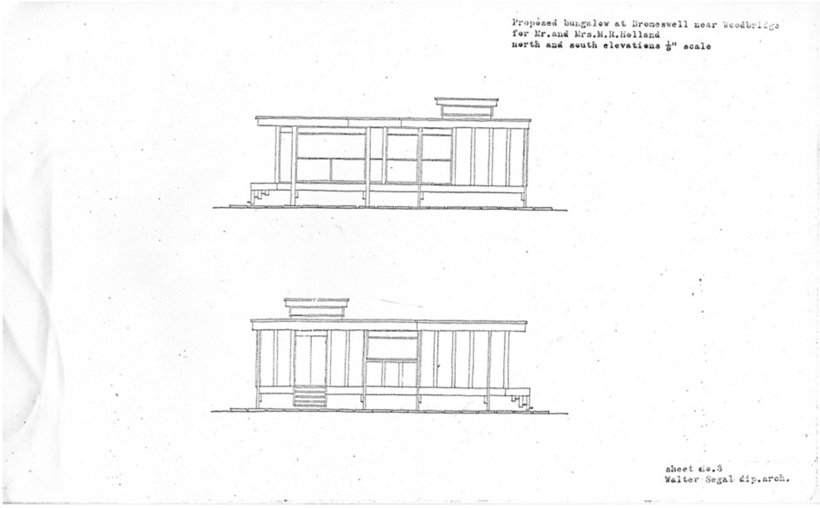


Figure 12. Elevations, Novem, 1971.

APPENDIX 3

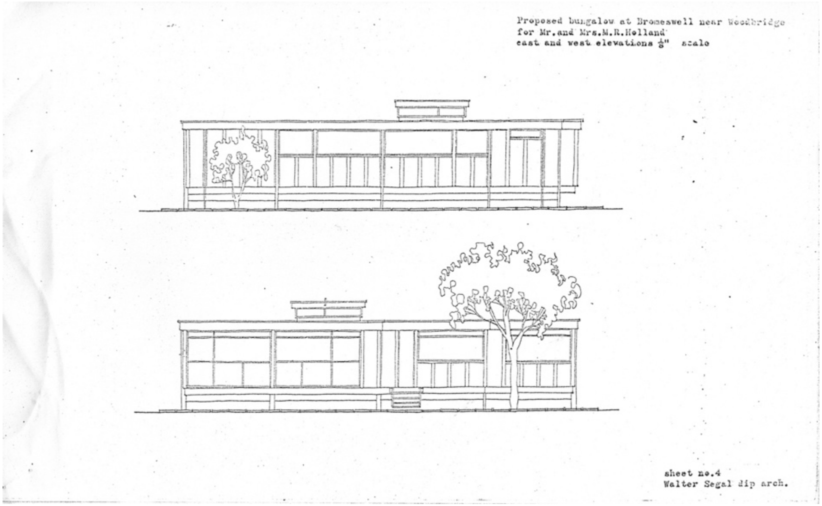


Figure 13. Elevations, Novem, 1971.

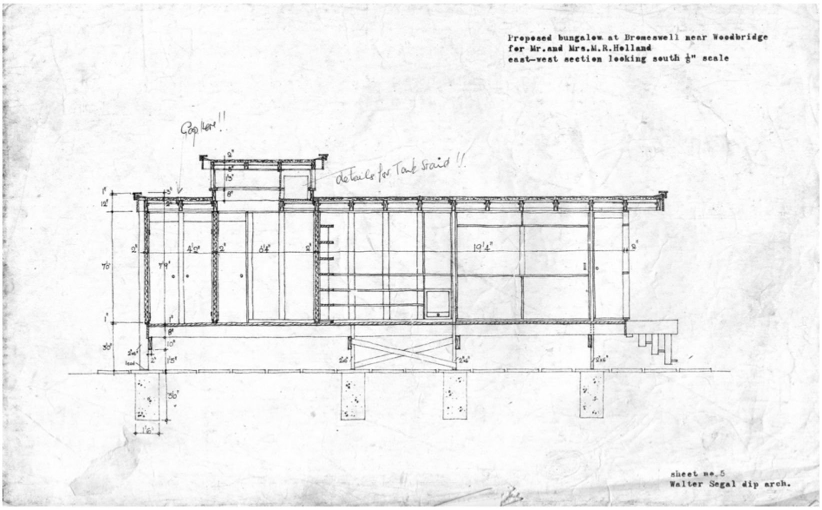


Figure 16. Sections, Novem, 1971.

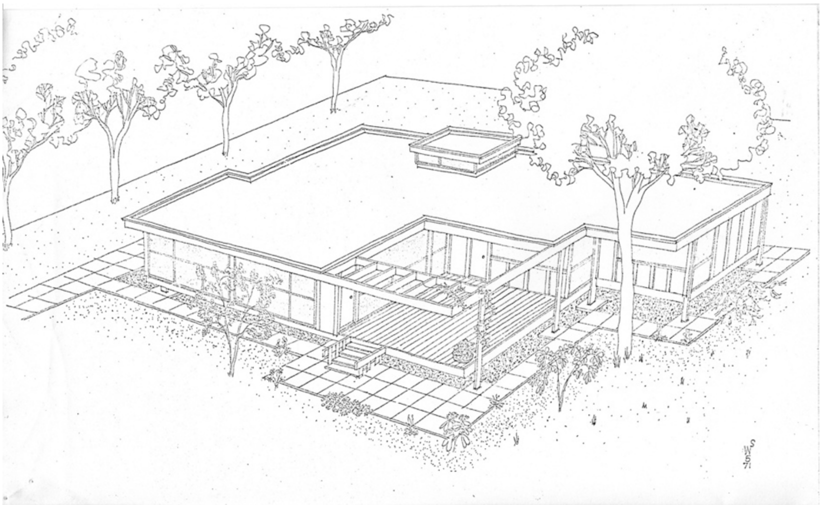


Figure 14. Perspective, Novem, 1971.

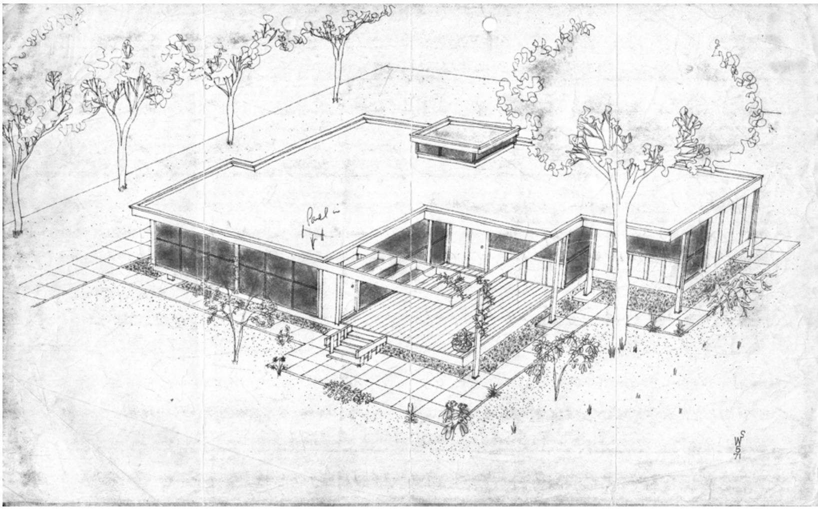


Figure 15. Perspective (coloured), Novem, 1971.

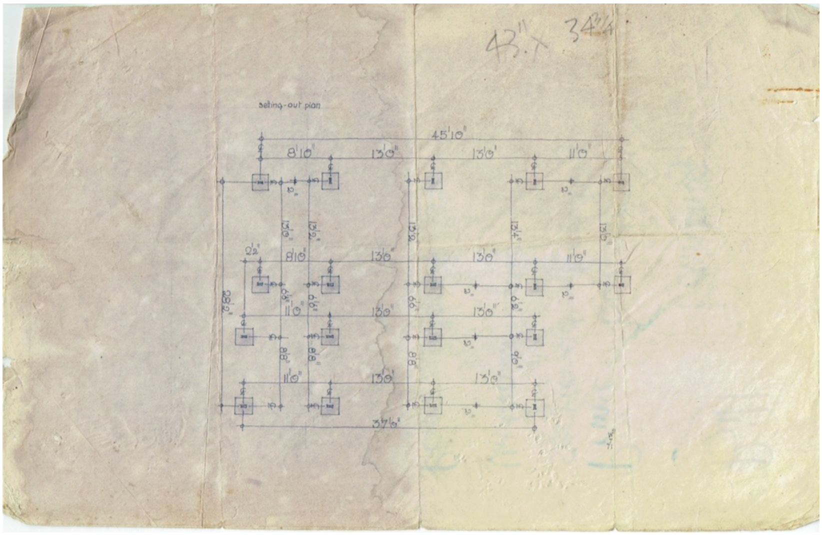


Figure 17. Foundations Plan, Novem, 1971.

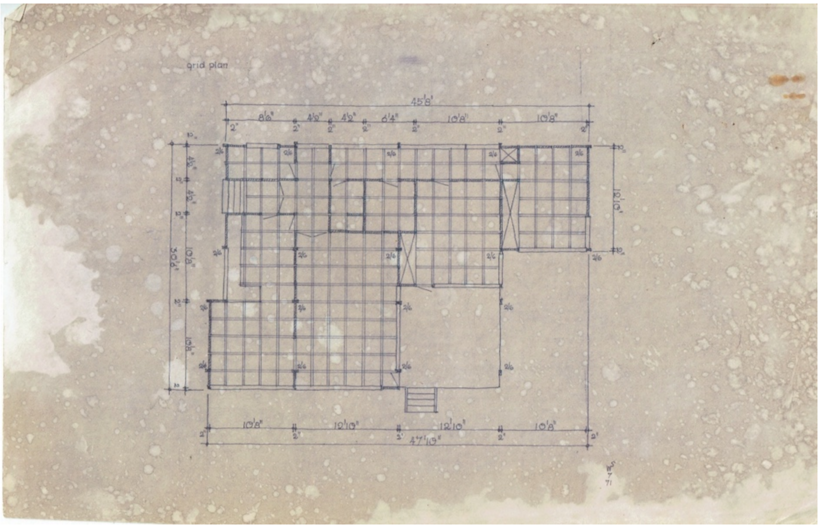


Figure 18. Floor Plan / Grid layout, Novem, 1971.

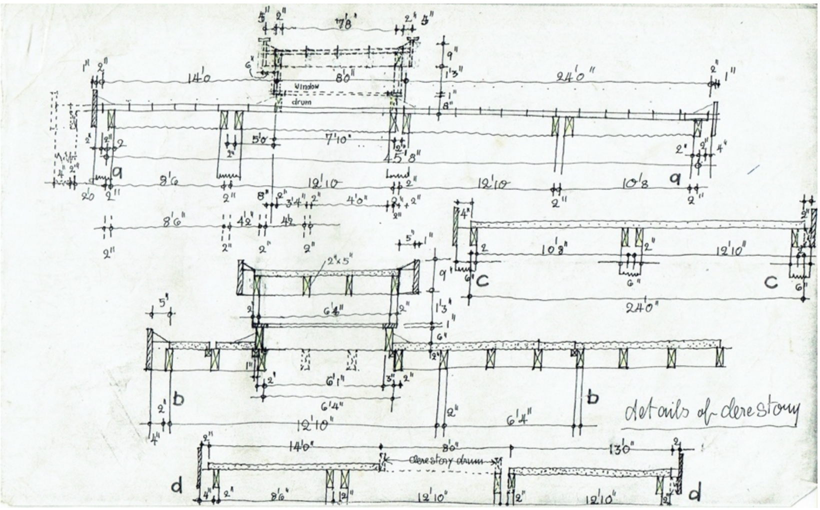


Figure 19. Details of Clerestory, Novem, 1971.

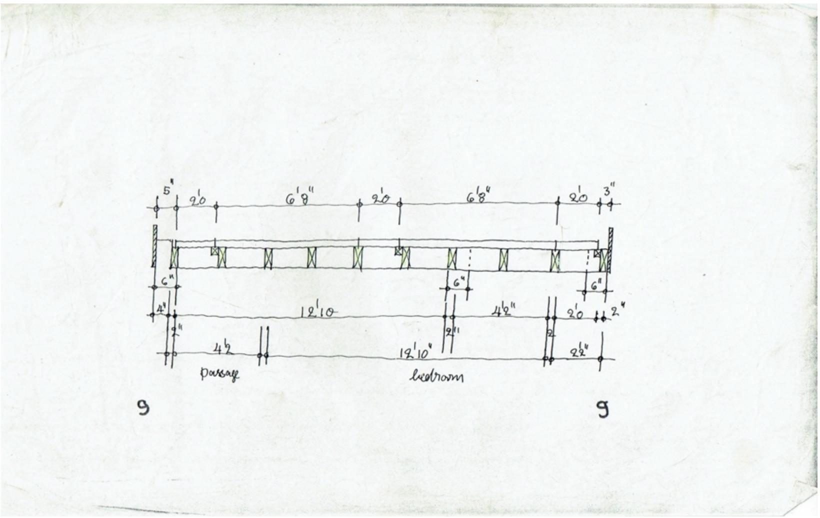


Figure 22. Detail of timber frame, Novem, 1971.

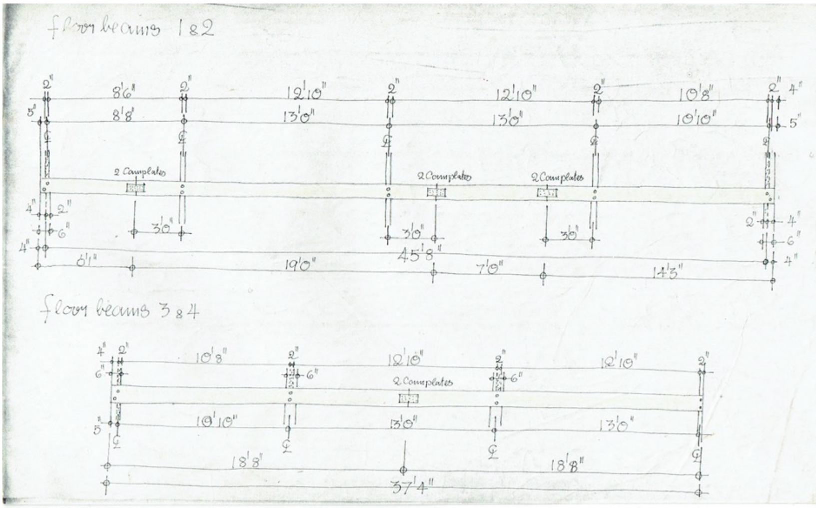


Figure 24. Details of Floor Beams, Novem, 1971.

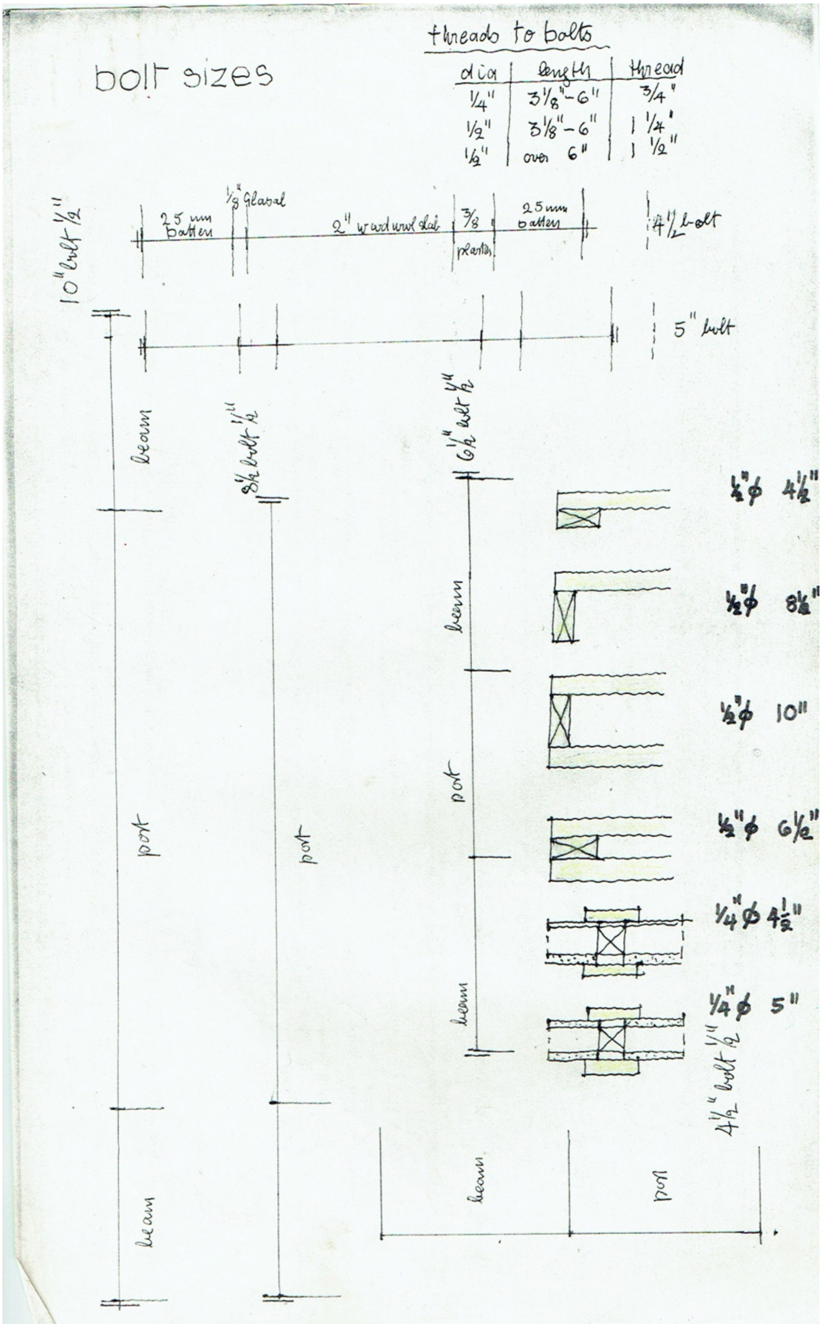


Figure 25. Details of Bolt Sizes, Novem, 1971.

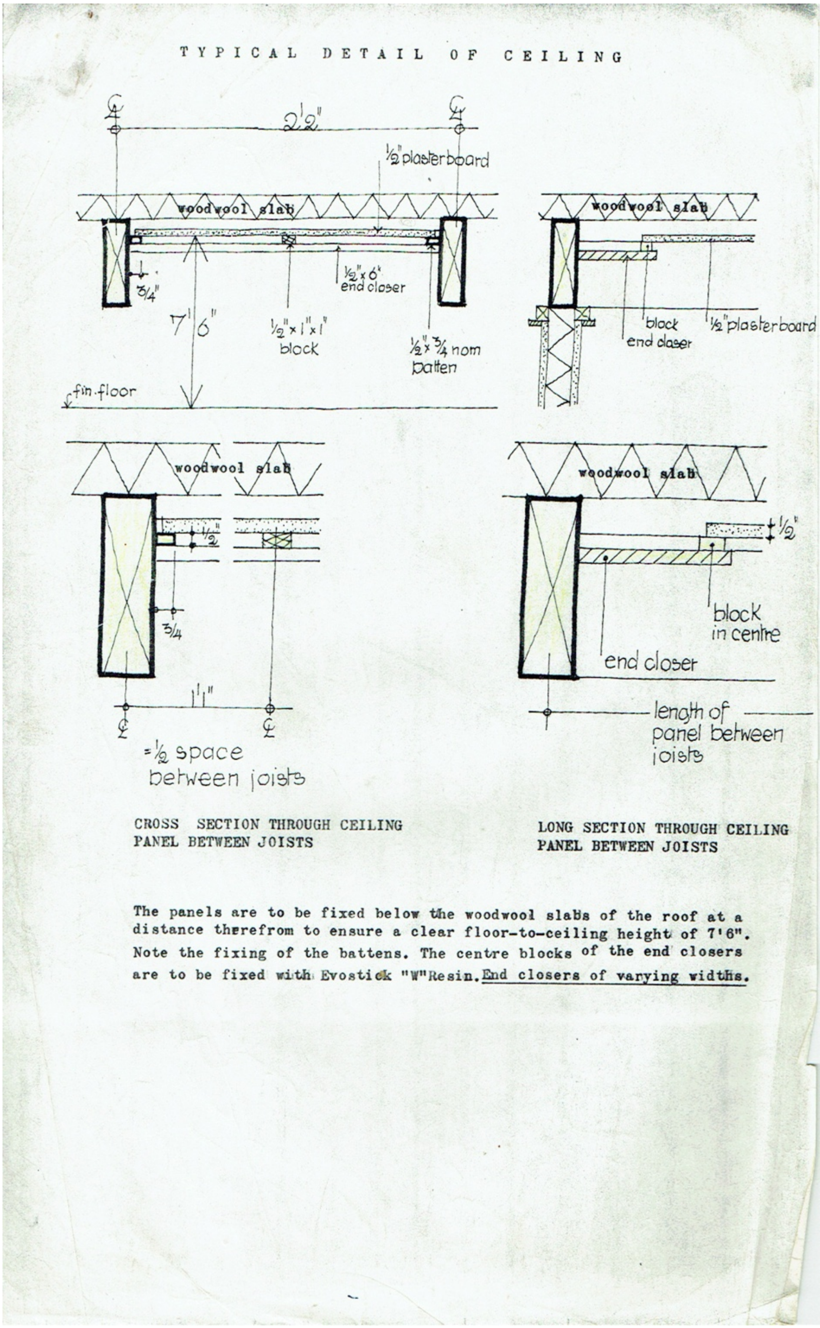


Figure 23. Details of Ceiling, Novem, 1971.

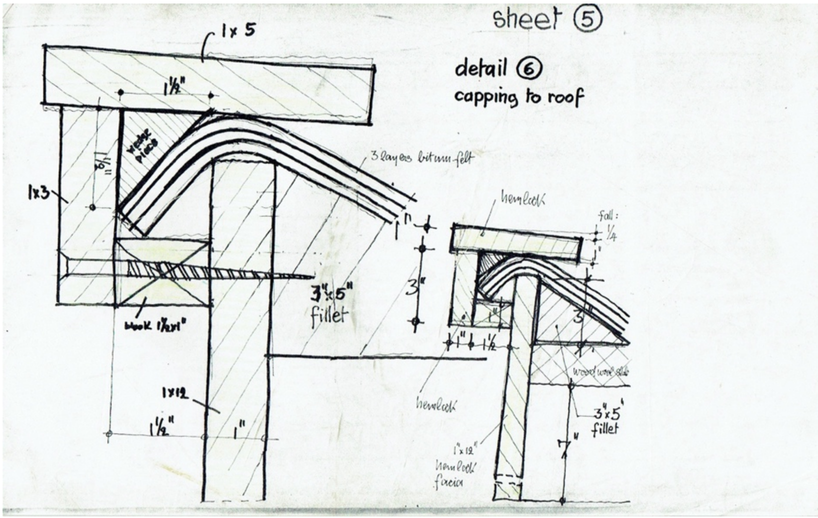


Figure 26. Detail of Roof Capping, Novem, 1971.

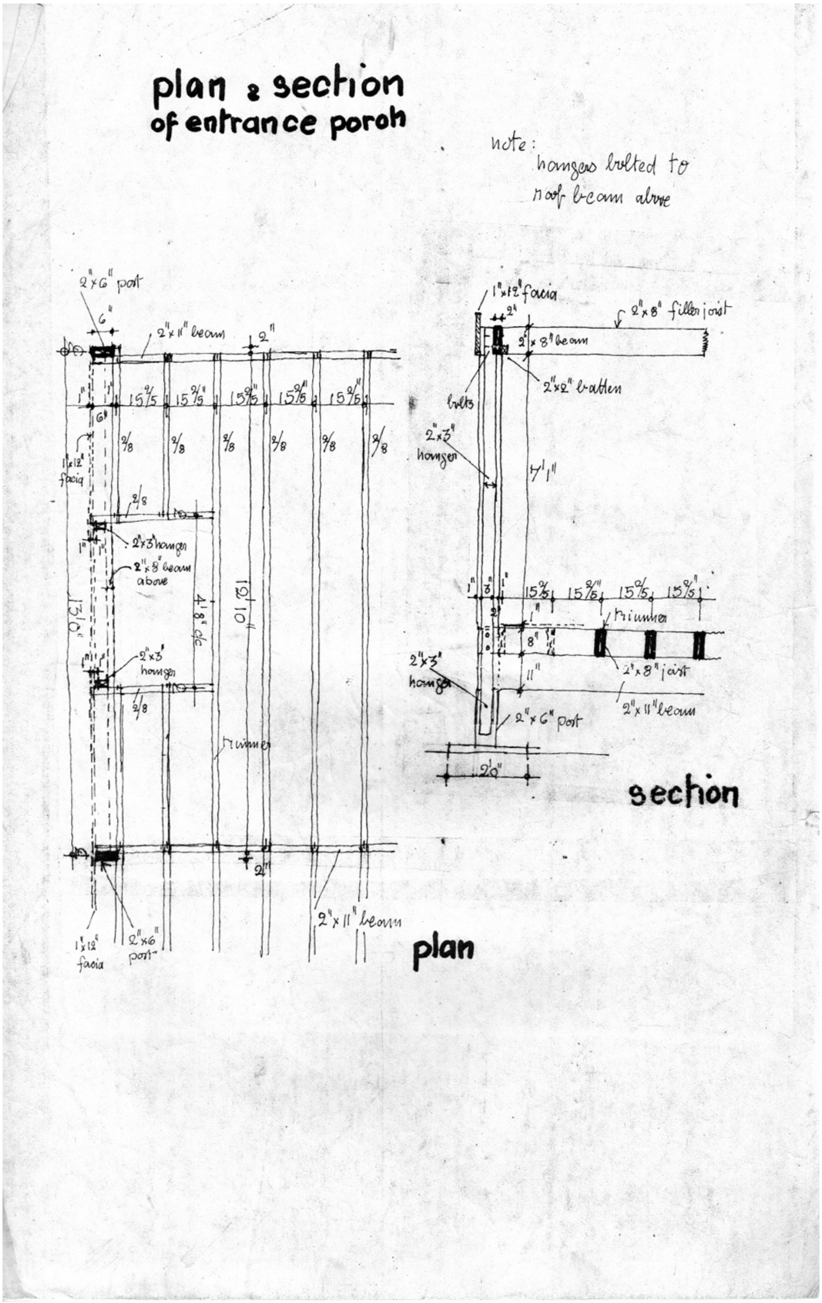


Figure 21. Details of Entrance Porch, Novem, 1971.

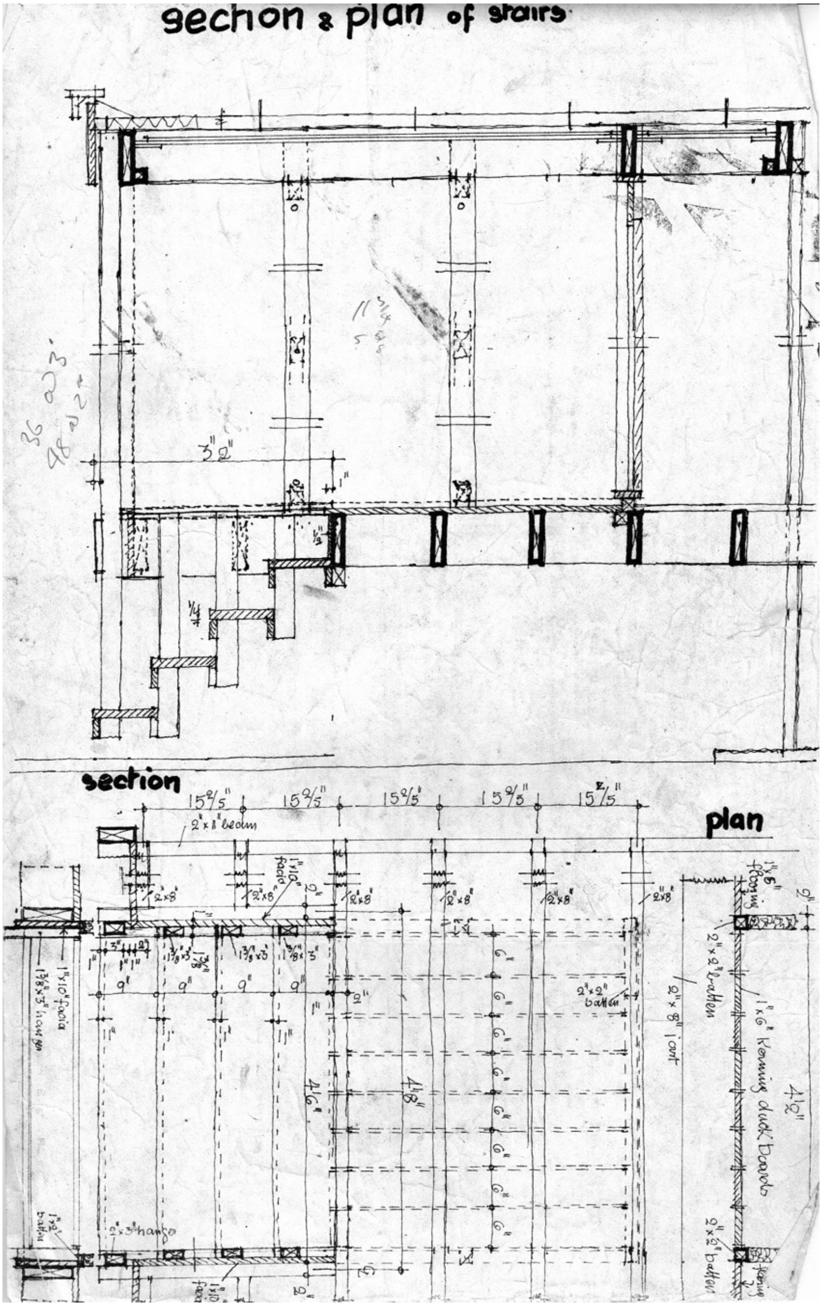


Figure 28. Details of External Stairs, Novem, 1971.

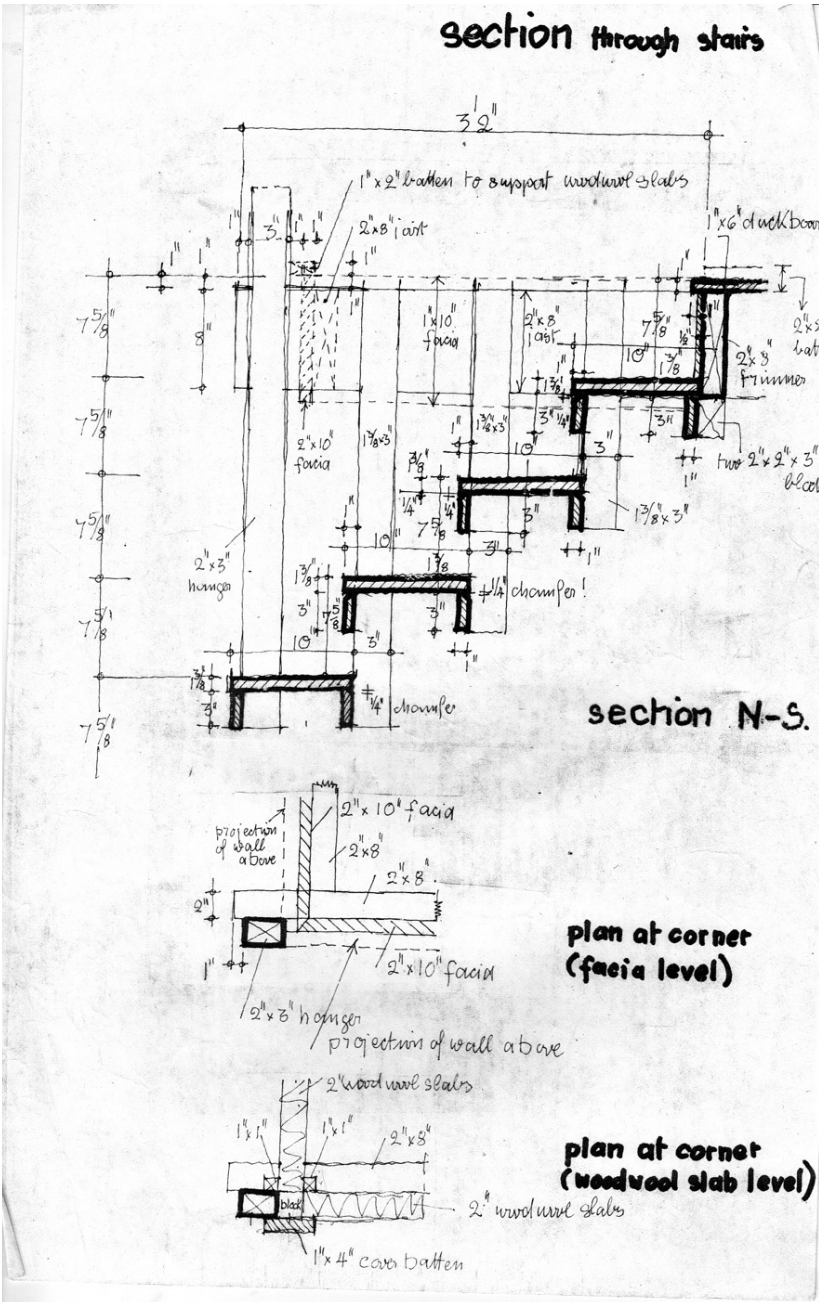


Figure 29. Details of External Stairs, Novem, 1971.

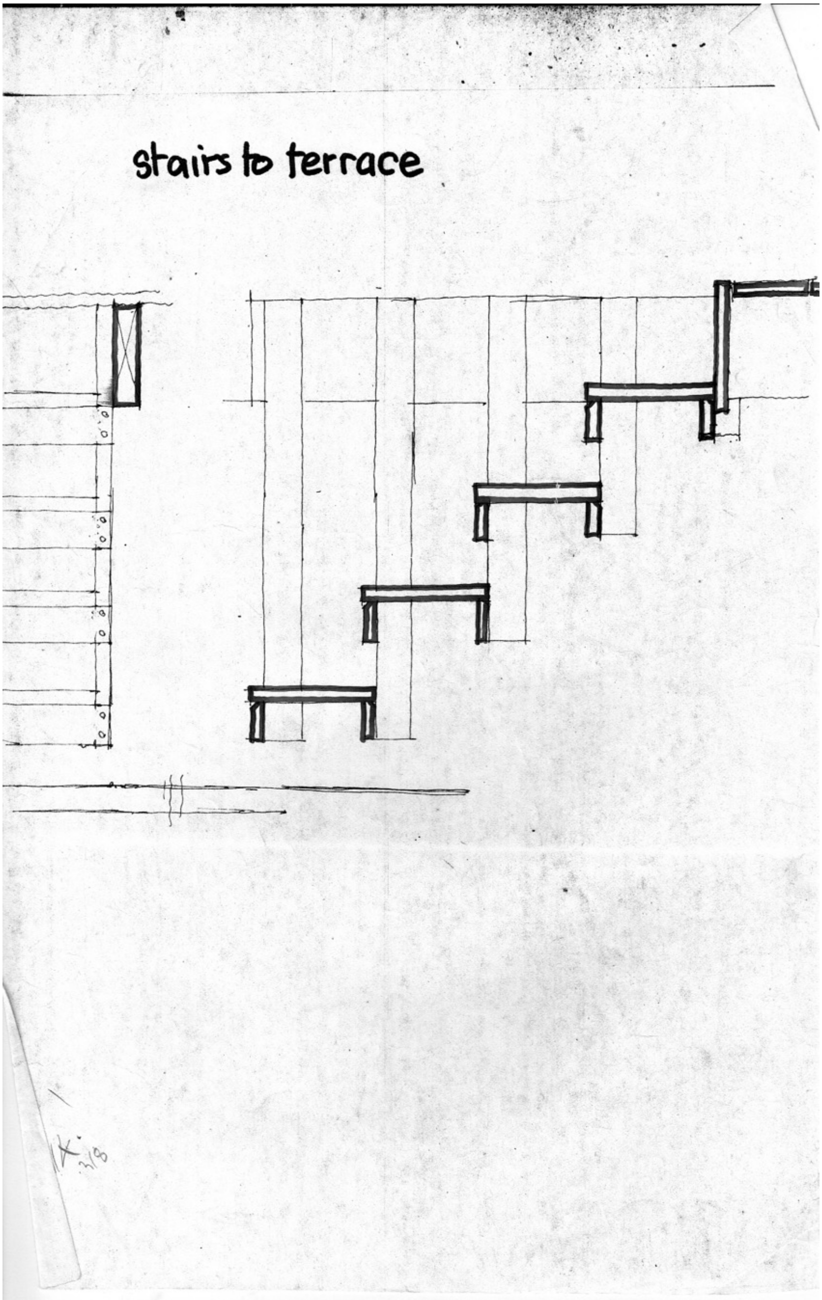


Figure 30. Details of External Stairs, Novem, 1971.

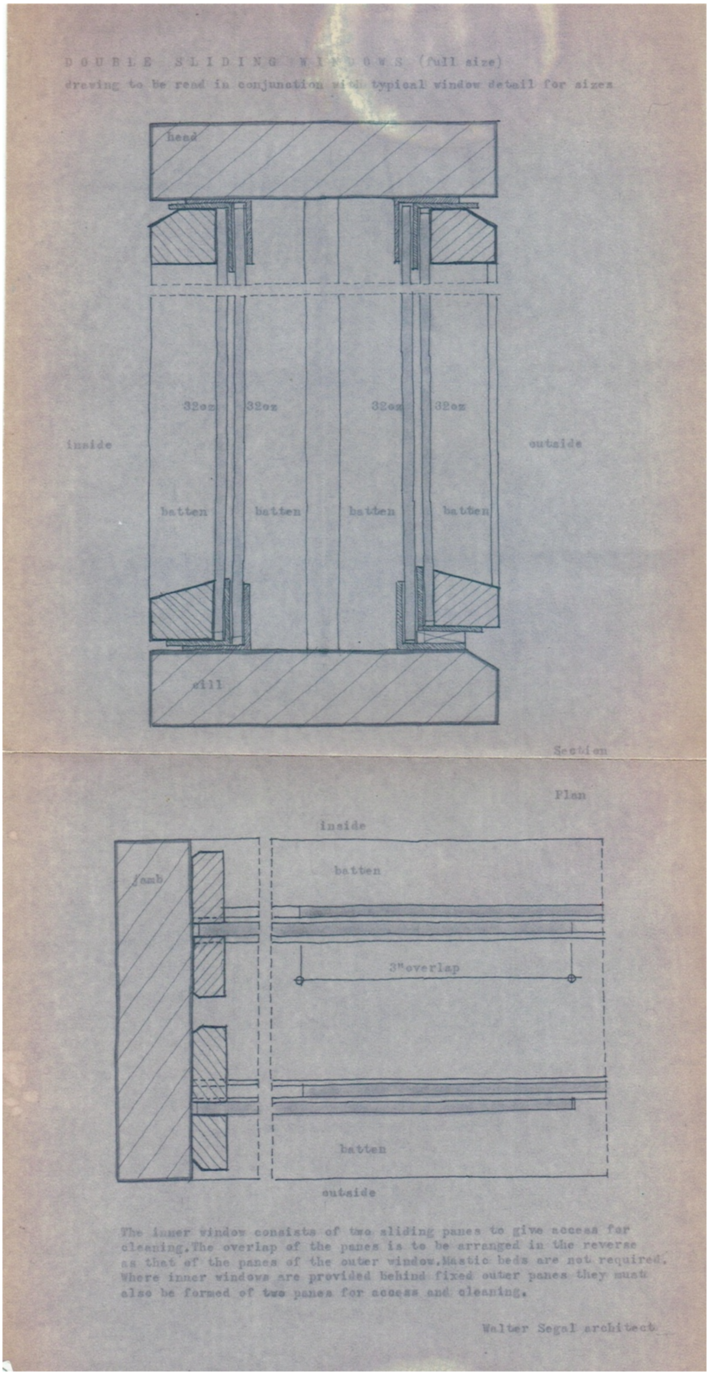


Figure 31. Glazing Details, Novem, 1971.

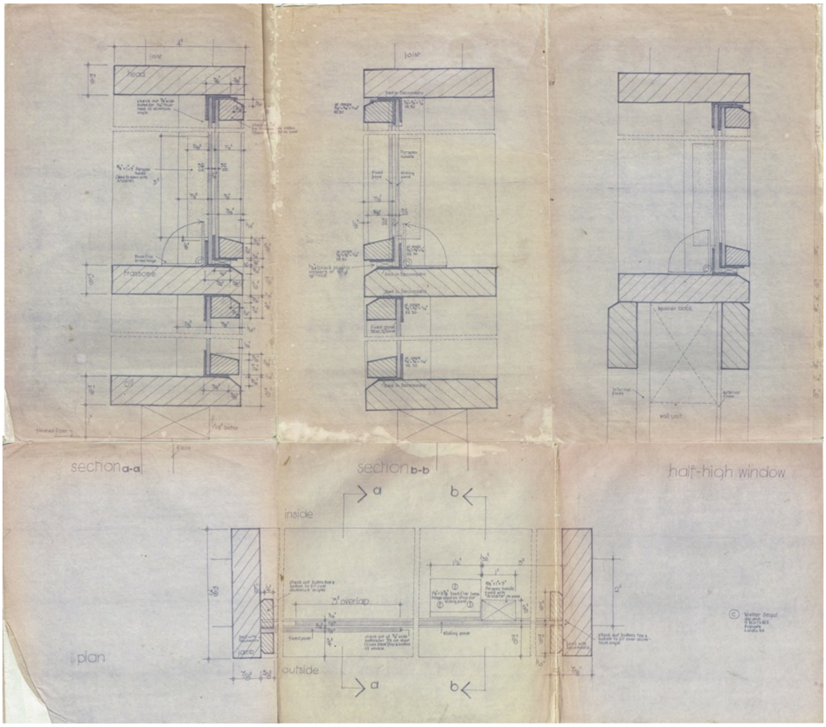


Figure 32. Glazing Details, Novem, 1971.

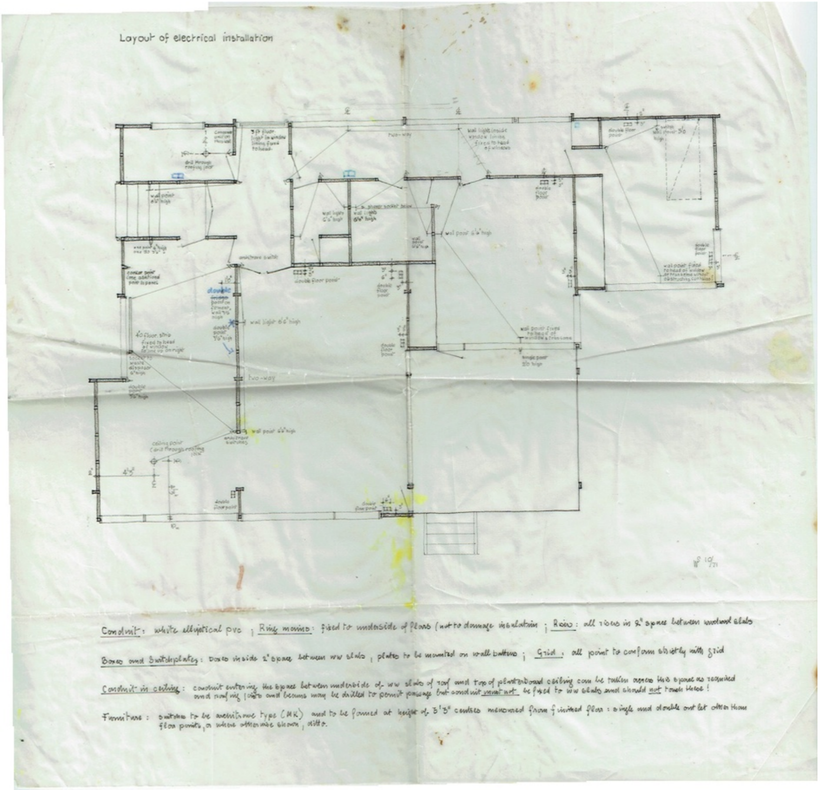


Figure 33. Electrical layout drawing, Novem, 1971.

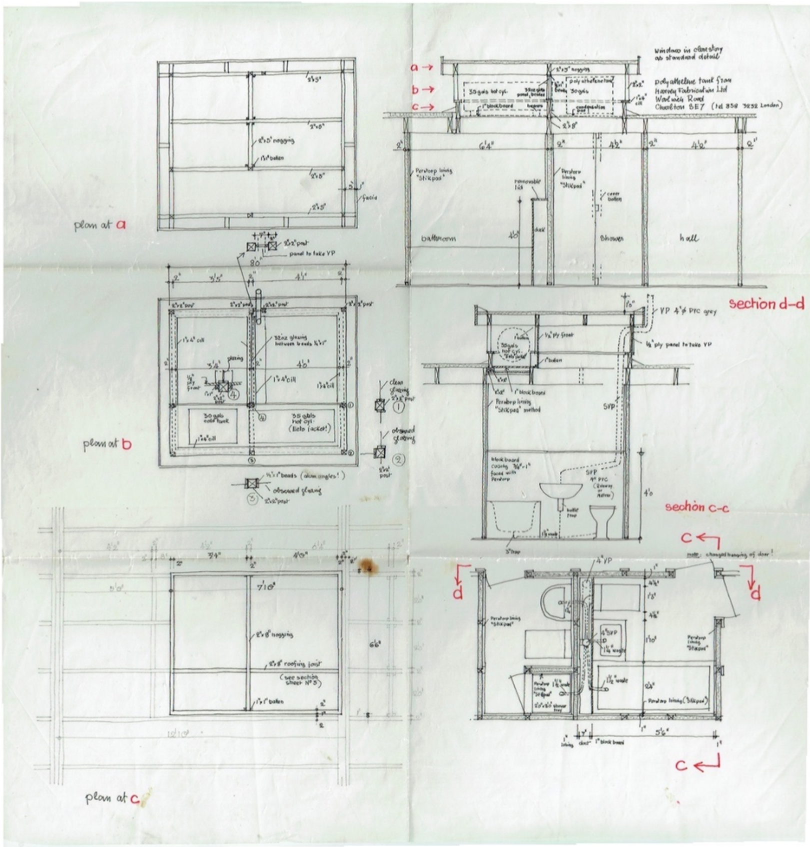


Figure 34. Bathroom core drawing, Novem, 1971.

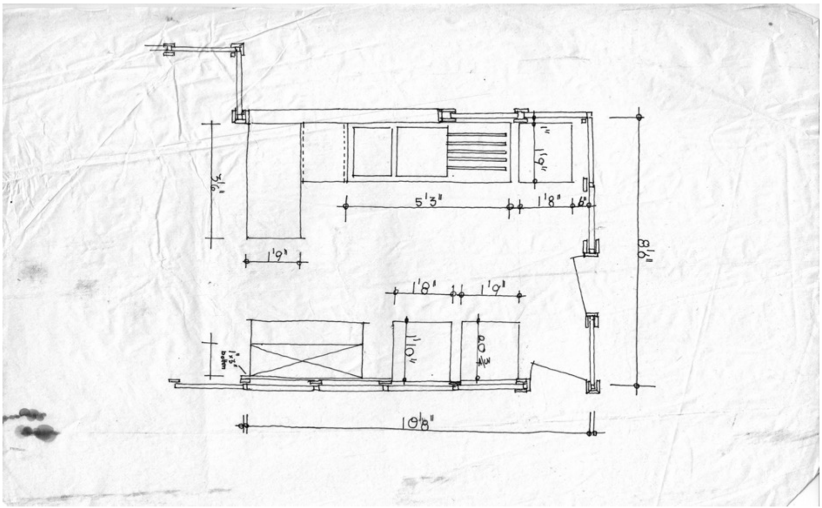


Figure 20. Detail of Kitchen Layout, Novem, 1971.

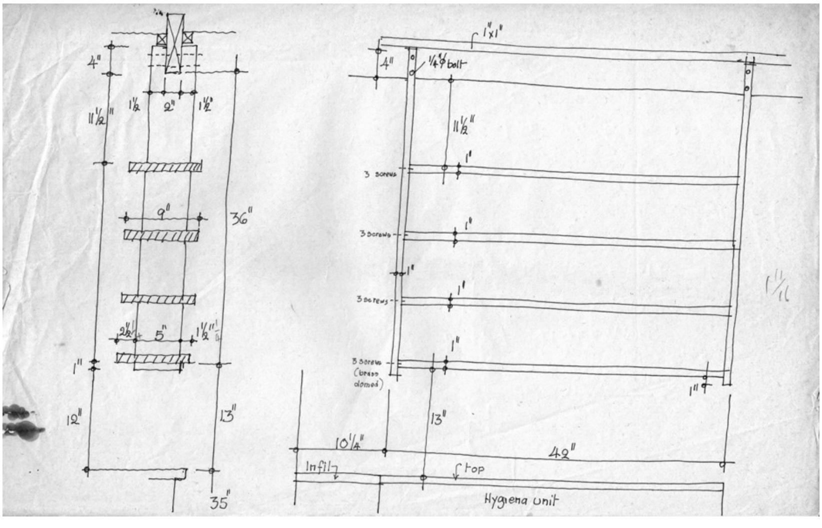
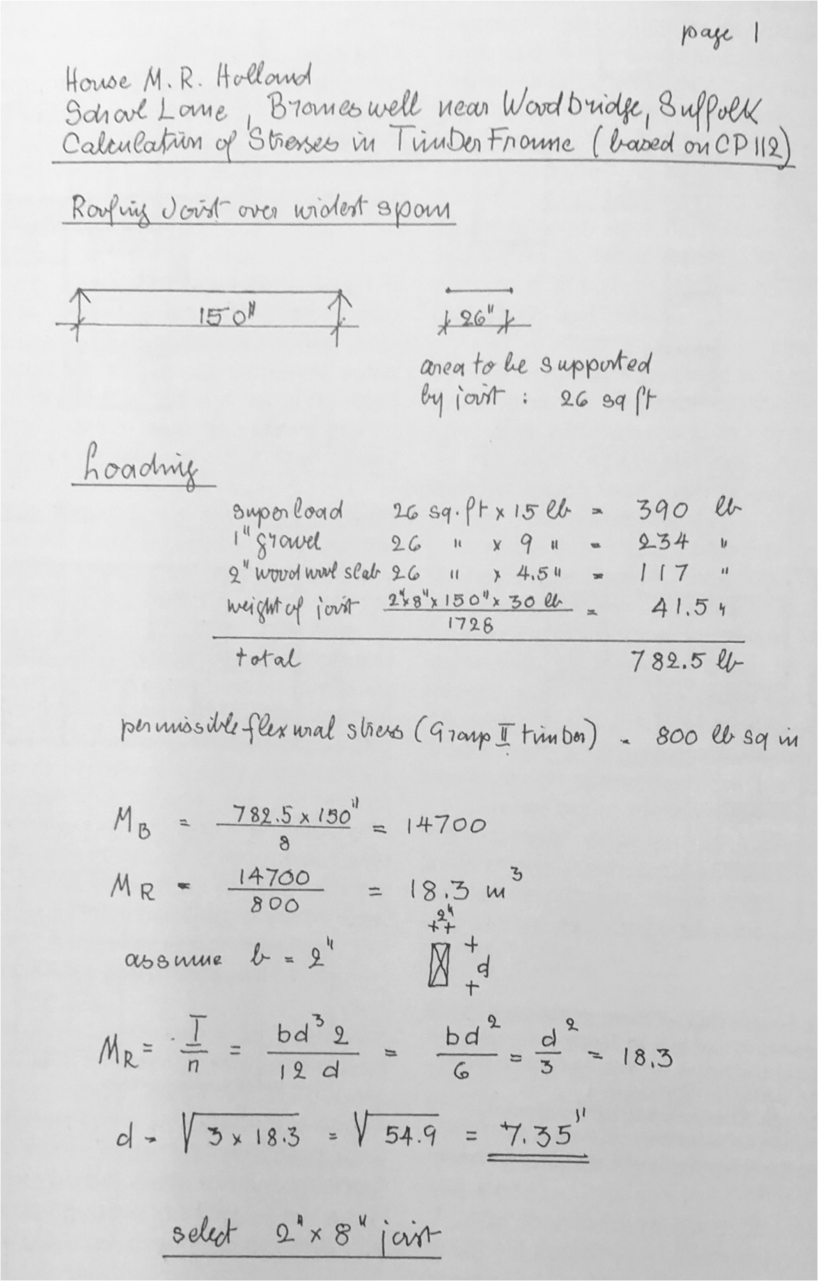


Figure 27. Details of Kitchen Shelving, Novem, 1971.



page 1

House M. R. Holland
School Lane, Bromeswell near Woodbridge, Suffolk
Calculation of Stresses in Timber Frame (based on CP 112)

Roofing Joist over widest span

15'0"

26"

area to be supported by joist : 26 sq ft

Loading

superload	26 sq. ft x 15 lb =	390 lb
1" gravel	26 " x 9 " =	234 "
2" wood wool slab	26 " x 4.5 " =	117 "
weight of joist	$\frac{2" \times 8" \times 150" \times 30 \text{ lb}}{1728}$ =	41.5 "
total		782.5 lb

permissible flexural stress (Group II timber) = 800 lb sq in

$$M_B = \frac{782.5 \times 150''}{8} = 14700$$

$$M_R = \frac{14700}{800} = 18.3 \text{ in}^3$$

assume $b = 2''$

2"

d

$$M_R = \frac{I}{n} = \frac{bd^3\,2}{12\,d} = \frac{bd^2}{6} = \frac{d^2}{3} = 18.3$$

$$d = \sqrt{3 \times 18.3} = \sqrt{54.9} = \underline{\underline{7.35''}}$$

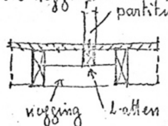
select 2" x 8" joist

Figure 35. Segal's calculations, Novem, 1971.

LIST and QUANTITY of MATERIALS for ASSEMBLY KIT

PROJECT / ADDRESS / CLIENT : bungalow/School Lane, Bramesswell, Suffolk, / Mr & Mrs A.R. Hollan

material	description & location	grade	section or unit size	length & quantity or total area	finish	price £
woodwool slabs	wall panels	heavy duty do	2" thick do	2/2'0"x6'0" imp 87/2'0"x7'0"	natural	
	do roof panels (including clerestorey)	normal quality	do	4/2'0"x6'0" do 70/2'0"x6'8" do 13/2'0"x7'0" do	do do do	
framing timber	main columns	1; BC pine	2"x6" imp	5/12'0" 9/13'0" 4/14'0" (no length shorter!)	prepared & protected	
	hangers to steps of entrance porch	2	50x75 met	2/3100	prepared	
	short columns to clere-storey	2.	50x50 met	1/1900	do	
	floor beams	2	50x275 met	2/4100 2/4500 6/5800	prepared & protected	
	floor joists (including trimming in porch)	2	50x200 met	28/2200 28/3400 33/4000	sawn & protected	
				2/4300 (Note: one of the 28 lengths of 2200 is to be prepared & protected)	prepared & protected	
	noggings fixed to 11th floor joist (counting south-north) to allow facia fixing 11 x 200	2	50x50 met	1/2200	sawn	
	battens in entrance porch to support wall slabs and end of duckboarding	2	50x50 met.	1/3000	do	
	battens under partition where flooring changes	2	50x75 met	1/3400 2/4600	do	
	do noggings between joists		50x125 met	1/3400 (between hall & store, hall & WC, liv.r. & kitchen, liv.r. & din.r.)	do	



	beam struts	2	50x125 met	3/4600	do	
	roof beams	1; BC pine	2"x8" imp.	1/14'0" 2/16'0" 1/20'0" 6/17'0" 1/21'0" (no length shorter!)	prepared	
	filler roofing joists	2	50x200 met.	9/2800 15/3400	do do	

Figure 36. Segal's: 'LIST and QUANTITY of MATERIALS for ASSEMBLY KIT', Novem, 1971.

LIST and QUANTITY of MATERIALS for ASSEMBLY KIT

PROJECT / ADDRESS / CLIENT bungalow/School Lane, Bramswell, Suffolk/Mr & Mrs M R Holland

material	description & location	grade	section or unit size	length & quantity or total area	finish	price £
framing timber	noggings between roofing joists	2	50 x 200 met.	2/3100 2/3700	prepared do	
	battens to fix noggings to joists; 4 battens per nogging	2	25 x 25 batten, nogging, joist	8/2000 1/1000	do	
	battens nailed to filler roofing joists to support woodwool slabs	2	50 x 50 met.	2/2800 1/3400 8/4000	do do do	
	battens nailed to roof beams to support filler roofing joists	2	50 x 50 met.	3/3100 1/3400 1/4900 6/5200	do do do do	
Plates	"CAMPLATES" 4¼" x 9" & 4¼" x 12" with nails (1¼ x 9 gauge) square twisted galv. nails to be obtained from CAMATCO Ltd, 31 Fulham Palace Road W6 (tel 748 8317) to be used for butt-jointing beams of floor and roof		4¼" x 9" for roof beams 4¼" x 12" for floor beams	8 plates 16 plates	including nails do	
framing timber	Clerestorey: drum	2	50 x 200 met.	1/2100 2/4500	prepared	
	roofing joists	2	50 x 125 "	3/2500 4/2800	do	
	columns listed on p.1		-			
	hor mullions	2	50 x 50 "	1/1000	do	
	noggings to facia	2	50 x 125 "	1/1000	do	
	cills to clerestorey	2	25 x 100 "	3/2500 2/2800	do	
	fillets to roof	2	63, 150	3/2500 2/2800	do do	
	do around drum	2	63 x 150	2/4500	do	
	facia to roof (mitred)	Parana pine	1" x 9" imp.	2/8'0" 2/9'0"	do	
	cappings to roof	2	25 x 125 met.	3/2500 2/2800	do	
	battens to secure cappings to facias	2	25 x 75 met.	3/2500 2/2800	do	
	wedges to battens to hold down felt	2	38, 38 met	1/1200	sawn	
	blocks to battens	2	25 x 38 met	1/1200	prepared	

Figure 37. Segal's: 'LIST and QUANTITY of MATERIALS for ASSEMBLY KIT', Novem, 1971.

LIST and QUANTITY of MATERIALS for ASSEMBLY KIT

PROJECT / ADDRESS / CLIENT : bungalow / School Lane, Bramcswell, Suffolk / Mr. & Mrs M.R. Holland

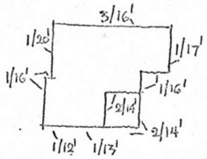
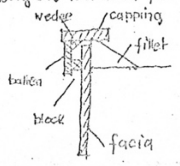
material	description & location	grade	section or unit size	length & quantity or total area	finish	price £
framing timber	battens between coupled roof beams  batten	2	50 x 50 one face only to be planed	4/4000 1/4300	planed on one side only	
	facias to perimeter of floor, porch and terrace	Parana pine	1"x10" imp.	4/7'0" 2/9'0" 5/11'0" 1/12'0" 5/13'0" no length shorter	prepared	
	facias to roof and terrace  3/16' 1/20' 1/17' 1/16' 1/16' 1/14 2/14' 1/12' 1/13'	do	1"x12" imp.	1/12'0" 1/13'0" 4/14'0" 5/16'0" 1/17'0" 1/20'0" no length shorter	do	
	noggings to facias of roof	2	50x100 met. 25x25	1/3200 1/1800	do	
	fillets to roof	2	63 / +150+ met	2/3100 1/3700 1/4000 2/4300 5/4900 1/5200	sawn do do do do do	
	cappings to roof	2	25x125 met	2/3100 1/3700 1/4000 2/4300 5/4900 1/5200	prepared	
	battens to secure cappings to facias	2	25x75 met.	2/3100 1/3700 1/4000 2/4300 5/4900 1/5200	do	
	blocks to battens as above	2	25 x 38	1/2400	do	
	wedges to hold down felt  wedge capping fillet batten block facia	2	38 / +38+	1/2400	sawn	

Figure 38. Segal's: 'LIST and QUANTITY of MATERIALS for ASSEMBLY KIT', Novem, 1971.

APPENDIX 3

LIST and QUANTITIES of MATERIALS for ASSEMBLY KIT

PROJECT / ADDRESS / CLIENT :

material	description & location	grade	section or unit size	length & quantity or total area	finish	price £
framing timber	blocks ("spacer blocks") for fixing wall panels	2	50x50x75 mt grain vertical!	270 blocks	sawn	
joinery timber	external battens to retain wall panels	j.t. do	25x25 mt 25x100 mt	14/2400 57/2400	prepared do	
	internal wall battens including jamb of doors and wardrobes	do	25x25 mt. 25x100 mt.	42/2200 140/2200	do do	
	sill boards to retain wall panels	2	25x50 mt.	10/2800	sawn	
	do			4/3400		
	do			4/4000		
	do	2	25 x 50 mt one 25 mm face planed!	4/3400	one 25mm face planed	
	battens at top of woodwool slab wall panels	j.t.	25x25 mt.	2/2800 20/3400 1/4000	prepared do do	
	cover battens to wall linings fixed to 25x25 battens (underside) at top of wood wool slab panels	do	12 x 25 mt.	3/2800 2/3400 17/4000	do do do	
	skirtings	do	12x50 mt.	16/3400 7/4000	do do	
	heads to doors	do	25x100 mt	4/3400 1/4000	do do	
	panels on top of doors	do	25x175 mt	4/3400 1/4000	do do	
	stops to doors of rooms and wardrobes	do	12x25 mt	49/2200	do	
	slim door jambs	do	19 x 100 mt	10/2200	do	
	grounds	do	12x 50 mt	10/2000	do	
Internal doors	various	standard	1 3/8" thick 6'6" high	11/1'9"x6'6" imp. 6/2'0x6'6"	hardboard faced do	
	wardrobe doors	do	do	4/1'6"x6'6" 1/1'9"x6'6" 4/2'0"x6'6"	do do do	
	battens screwed to 1'9" doors	Kerning	25x38 (1"x1 3/8")	13/7'0" no shorter length!	prepared	
external doors	various	standard	1 7/8 thick 6'6" high	2/1'9"x6'6"	exterior grade ply-faced	

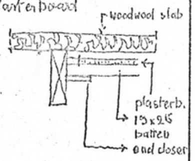
Figure 39. Segal's: 'LIST and QUANTITY of MATERIALS for ASSEMBLY KIT', Novem, 1971.

PROJECT / ADDRESS / CLIENT : bungalow/School Lane/Bromeswell, Suffolk/Mr. & Mrs. M.R. Holland

material	description & location	grade	section or unit size	length & quantity or total area	finish	price £
Windows	heads, cills, transomes	joinery timber	25 x 100 met.	1/2200 21/2800 10/5400	prepared	
	do jambs			14/2200 7/2800	do	
	do battens below cills of half-high windows	do	25 x 50 met	10/2800 2/3400	do	
	do hangers, head, transome, inside, outside	do	25x25	1/2500	do	
	beads to heads of windows	do	5/16", 3/16", 5/8", 7/8" imp.	4/2200 2/2500 12/2800 7/4000	do	
	do to cills	do	finished sizes 5/8", 7/16", 7/8"	4/2200 2/2500 12/2800 7/4000	do	
	do to jambs	do	3/8", 7/8"	31/2200 14/2800 4/3100	do	
Aluminium Angles	to be obtained from Messrs Rapp Metals Ltd PO Box 20 Dawley Road, Hayes	must be HE30	3/4" x 3/4" x 1/16" imp.	80 lengths		
External wall lining	"Glasal" sheet to be obtained from Messrs. G.R. Speaker & Co Ltd, Eternit House, Stevenage Road SW6 (01 385 9451	687	4'0" x 8'0" x 1/8"	23 sheets	687	
duck-boarding	porch and terrace	Keruing	25 x 150 met	4/2500 13/4000	prepared	
	batten to support half wall of bedroom adjoining terrace including cill to door (batten, wall, 50x200, joist, duckboards, floor)	2	50 x 50	1/4000	do	
flooring	soft wood flooring	joinery timber	25 x 150 met. t&g	68 m² as laid		
	Oak strip in living room and hall; no short lengths	long strips	25 x 75 m	25 m² as laid		
Insulation	under all flooring; stretched over joists	must be quilt	Fibreglass in stout bitumen paper either side	93 m² as laid (allow for laps!)		
Internal Wall Linings	plasterboard to be obtained from British Gypsum Ltd	standard sizes	3/8" x 2'0" x 7'6" high imp.	92 sheets (check sizes!)	natural pack with buff faces facing inward; two boards at a time	
ceiling	do	do	600 x 2286 x 12.7 600 x 3048 x 12.7 600 x 3700 x 12.7	9 boards 13 do 24 do		

Figure 40. Segal's: 'LIST and QUANTITY of MATERIALS for ASSEMBLY KIT', Novem, 1971.

PROJECT / ADDRESS / CLIENT : bungalow/School Lane/Brameswell, Suffolk/Mr. & Mrs M.R. Holland

material	description & location	grade	section or unit size	length & quantity or total area	finish	price £
ceilings	battens to support plasterboard	joinery timber	19 x 25 met	18/2800 26/3400 48/4000	prepared	
		do	12 x 100 met	6/2200 10/4000 2/4600	do	
Lining to walls of bathroom & WC.	"Glasal" sheet (see p 5)	522 631	4'0" x 8'0" x 1/8" do	6 sheets 5 sheets	522 631	
Flooring to store	"Pical" insulation board to be obtained from Messrs Speaker & Co Ltd (p. 5)	Standard	4'0" x 8'0" x 3/4"	1 board	natural grey	
Wall lining do	do	do	4'0" x 8'0" x 3/8"	6 boards	do	
Stairs	stairs to porch & terrace	Joinery				
	treads	do	38 x 250 met	4/2800	prepared	
	1/2 risers	do	25 x 75 "	8/2800	do	
	hangers	do	38 x 63 "	3/3100 1/1900	do do	
	Lining to top riser in stair to porch	do	12 x 175	1/1500	do	

Note lengths of timber are to be supplied closest to the metric lengths specified, but not shorter than these, and without any cross-cutting.

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as prepared by: Walter Segal Dip Arch 9 North London NG 01 340 5422

Figure 41. Segal's: 'LIST and QUANTITY of MATERIALS for ASSEMBLY KIT', Novem, 1971.

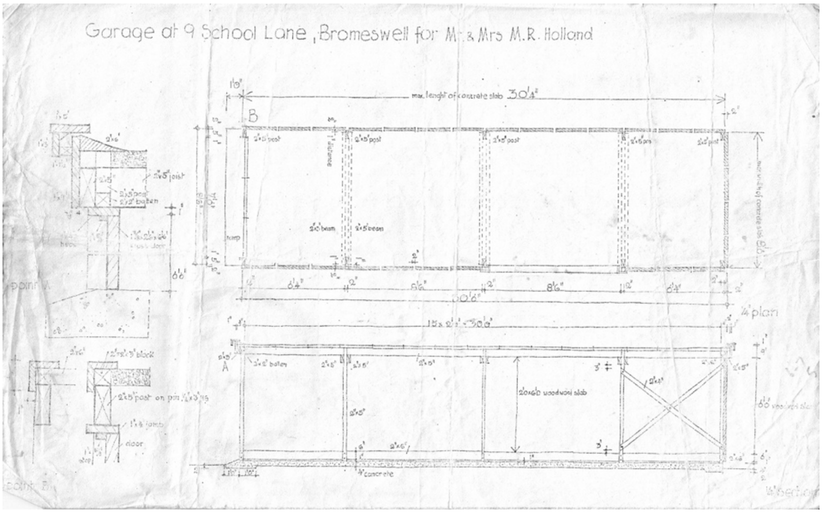

Figure 42. Garage Drawings, Novem, 1972.

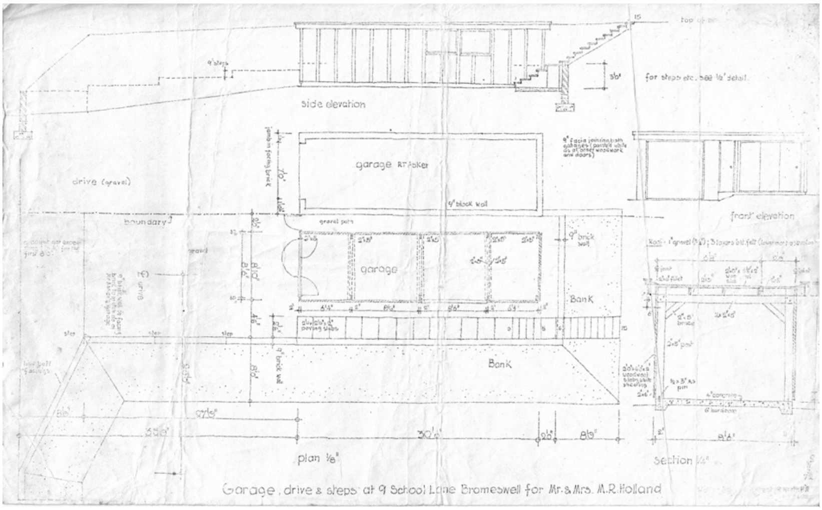

Figure 43. Garage Drawings, Novem, 1972.

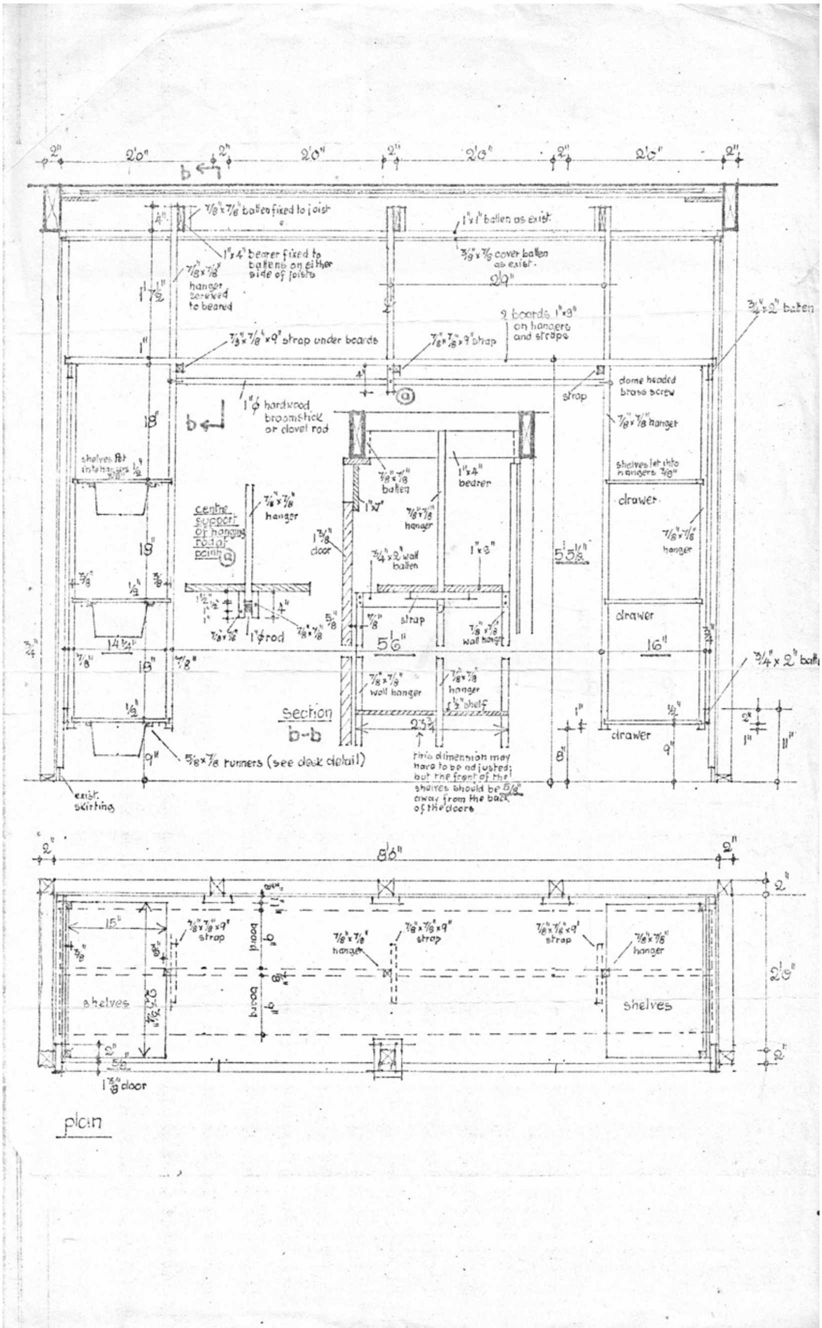

Figure 44. Garage Drawings, Novem, 1972.

page 1

LIST and QUANTITY of MATERIALS for ASSEMBLY KIT

PROJECT / ADDRESS / CLIENT : garage / Novem, Summer Lane, Bromeswell, Woodbridge, Mr & Mrs M.R. Hills

material	description & location	grade	section or unit size	length & quantity or total area	finish	price £
woodwool slabs	wall panels	heavy duty	2" thick	30 / 2'0" x 6'0" imp.	natural	
	do roof panels	normal quality	do	5 / 2'0" x 6'0" " 15 / 2'0 x 6'8" "	do do	
framing timber	main columns	1: BC pine	2" x 5"	5 / 15'0"	prepared & protected	
	perimeter beams (bottom) supporting woodwool slabs	2	50 x 150 mm	1 / 3000 2 / 4200 2 / 5400	do	
plates	"CAMPLATES" with nails (1¼ x 9 gauge) square twisted galv. from CAMATCO Ltd 31 Fulham Palace Rd W6 (tel. 748 8317) for butt-jointing perimeter beams at bottom of columns		4¼" x 9"	4 plates with nails	galv.	
	do. outside joists of roof		4¼" x 9"	4 plates with nails	galv.	
framing timber	roof beams	1: BC pine	2" x 5"	8 / 9'0" imp.	prepared	
	roofing joists	2	50 x 125 mm	2 / 4200] on outsides 2 / 5400] (CAMPLATES) 6 / 4800 in middle	do	
	beam struts	2	50 x 125	1 / 4800	do	
	cross bracing in end bay (halved over each other)	2	50 x 100	4 / 2700	do	
	battens nailed to gable end roofing beams to take roofing joists (check out)	2	50 x 50	2 / 3000	do	
	do battens nailed to roofing joists to support woodwool slabs	2	50 x 50	2 / 4800	do	
	fascias to roof (mitred)	joinery timber	25 x 225	1 / 3300 1 / 3600 front; to join up with adjoining garage fascia 4 / 4800	do	
	noggings to roof fascias	2	50 x 125	1 / 3000	sawn	
	do	2	50 x 50	1 / 900		
	fillets to roof	2	50 x 150	4 / 4800 2 / 3300	do	
	cappings	joinery timber	25 x 125	4 / 4800 2 / 3300	prepared	
	battens to secure cappings to fascias	do	25 x 75	4 / 4800 2 / 3300	do	
	blocks to battens as above	2	25 x 38	1 / 1500	sawn	

Figure 45. Garage Schedules, Novem, 1972.

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LIST and QUANTITY of MATERIALS for ASSEMBLY KIT

PROJECT / ADDRESS / CLIENT : garage/Novem, Summer Lane, Bramcowell, Woodbridge, Mr. and Mrs M.R. Hollow

material	description & location	grade	section or unit size	length & quantity or total area	finish	price £
framing timber	wedges to hold down felt (also as capping to top of door of passage between garages)	2	38 × 38	1/2100	sawn	
	"spacer" blocks between wood-wool slab panels	2	50×50×75 grain vertical !	97 blocks	do	
	external battens to retain wall panels	joinery timber	25 × 100	36/2100	prepared	
	internal battens do	do	25 × 100	22/2100	do	
	do	do	25 × 25	14/2100	do	
	three-leaf door: jambs		25 × 100	1/4200		
	head		25 × 100	1/2400		
	meeting rails and stops	do	15 × 25	4/2100 1/2400		
garage doors	three only	standard	2'6"×6'6"×1 3/8"	three doors	hardboard faced	
window	in south wall (fixed panes)	joinery timber				
	head & cill		25×100	2/2700	prepared	
	jambs		25×100	1/3900	do	
	battens below cill (inside and outside)		25× 50	2/2700	do	
	sections imp. lengths met. — beads to head		5/8" × 7/8" (5/16", 3/16")	1/2700	do	
	bead to cill		5/8" × 7/8" (7/16")	1/2700	do	
	beads to jambs		5/8" × 7/8"	4/2400	do	
Aluminium angles	to be obtained from Rapp Metals Ltd PO Box 20 Dawley Rd, Hayes	must be HE 30	3/4"×3/4"× 1/16" imp.	2 lengths @ 12'0"		
Mineralised felt	in rolls of 36'0" to be cut into sheets 5 per roll as external wall finish wedged behind external wall battens. Obtainable in variety of shades, white or near white was approved). Trimming of widths needed. Brad-headed pins for fixing of sheets to top joist only: sheet must be allowed to hang down, merely wedged in.		in rolls 3'0" wide 12yds long	6 rolls	white spar finish	
door to passage between garages	only one jamb required: the other is the external batten of the corner	joinery timber	25 × 100	1/2100	prepared	
	single door	standard	1'6"×6'0"×1 3/8"	one only	hardboard finish	
	capping on top of door: see under "wedges" p.2					

Figure 46. Garage Schedules, Novem, 1972.

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LIST and QUANTITY of MATERIALS for ASSEMBLY KIT

PROJECT / ADDRESS / CLIENT : garage / Novem, Summer Lane, Bramewell, Woodbridge, Mr & Mrs. M.R. Holland

material	description & location	grade	section or unit size	length & quantity or total area	finish	price £
Urinal waste	roof outlet : see 1/4" plan	chrome or brass	2"ϕ or 2½"ϕ	1 only		
RWP	rain water pipe	standard	3"ϕ Rymway	1/8'0"		
gully	to take RWP : see plan	standard ware	6"x6"	 outlet 1 only		
galvanised nuts & bolts	½ϕ for framing		½"ϕ	1/ 2½" long 4/ 4½" 18/ 6½" 24/ 7¼" 6/ 8½"		
	¼"ϕ for walling		¼"ϕ	58/ 4½"		
galvanised washers	to bolts		¾"ϕ ⅜"ϕ ¼"ϕ	106/ ¾" 58/ ⅜" 58/ ¼"		
roofing	3 layers bit. felt, lower mat asbestos based 1st layer only laid not stuck 2nd and 3rd stuck to first, no fixing of felt other than by wedging, 1¼" layer of ¾" coarse gravel of top		60 lb bit felt	34 yds as laid		

as prepared by :
Walter Segal architect
9 North Hill London N6

Figure 47. Garage Schedules, Novem, 1972.

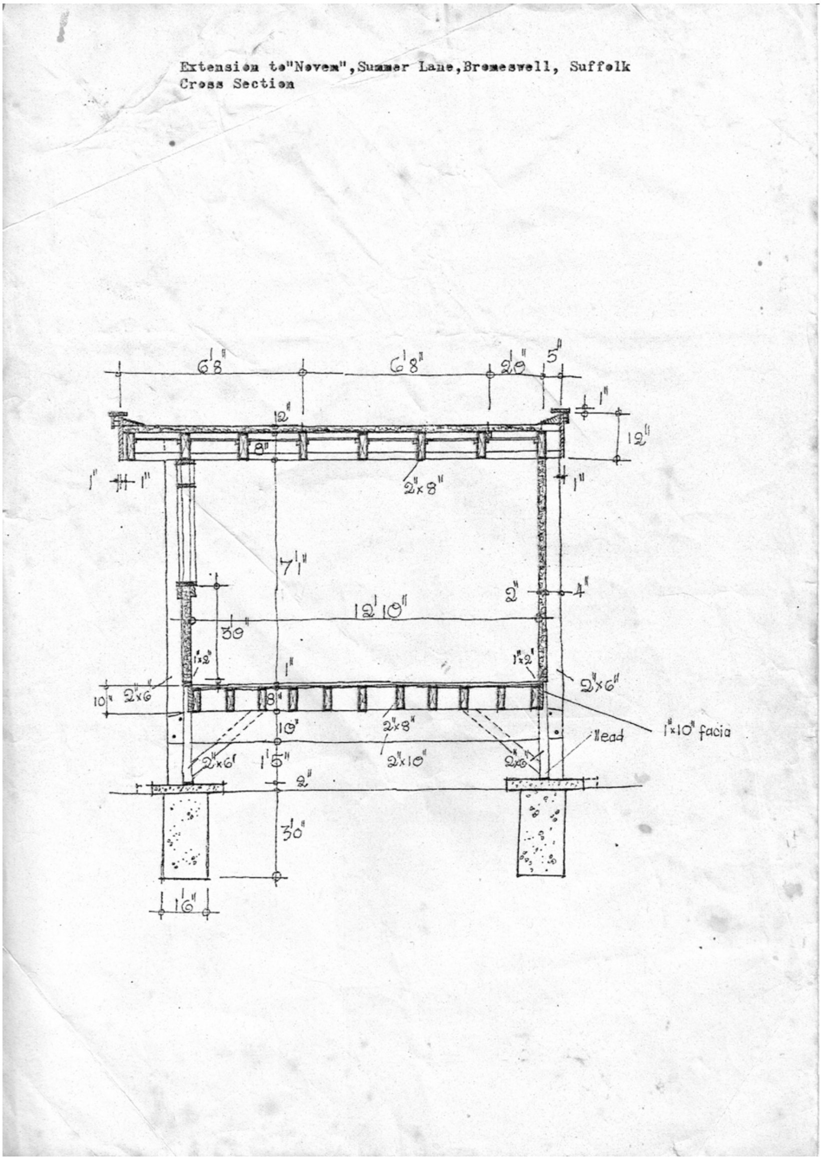


Figure 48. Bedroom extension drawings, Novem, 1974.

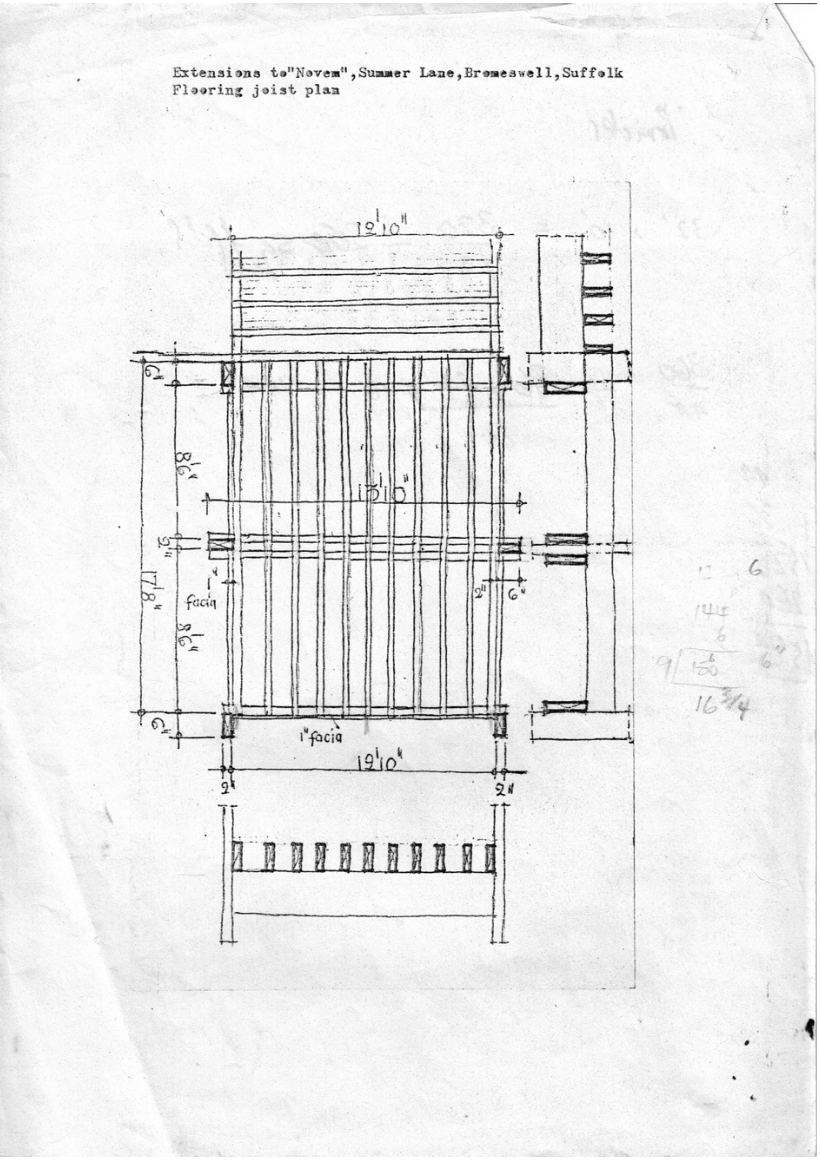


Figure 49. Bedroom extension drawings, Novem, 1974.

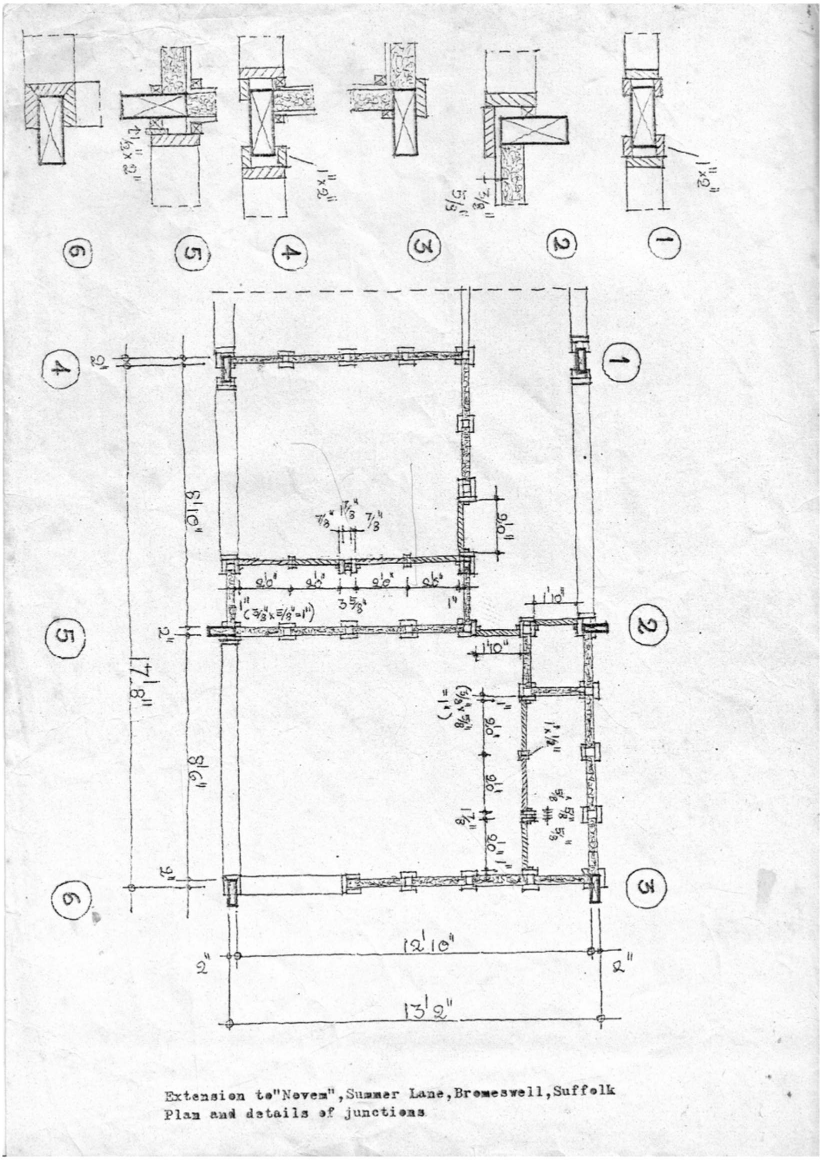


Figure 50. Bedroom extension drawings, Novem, 1974.

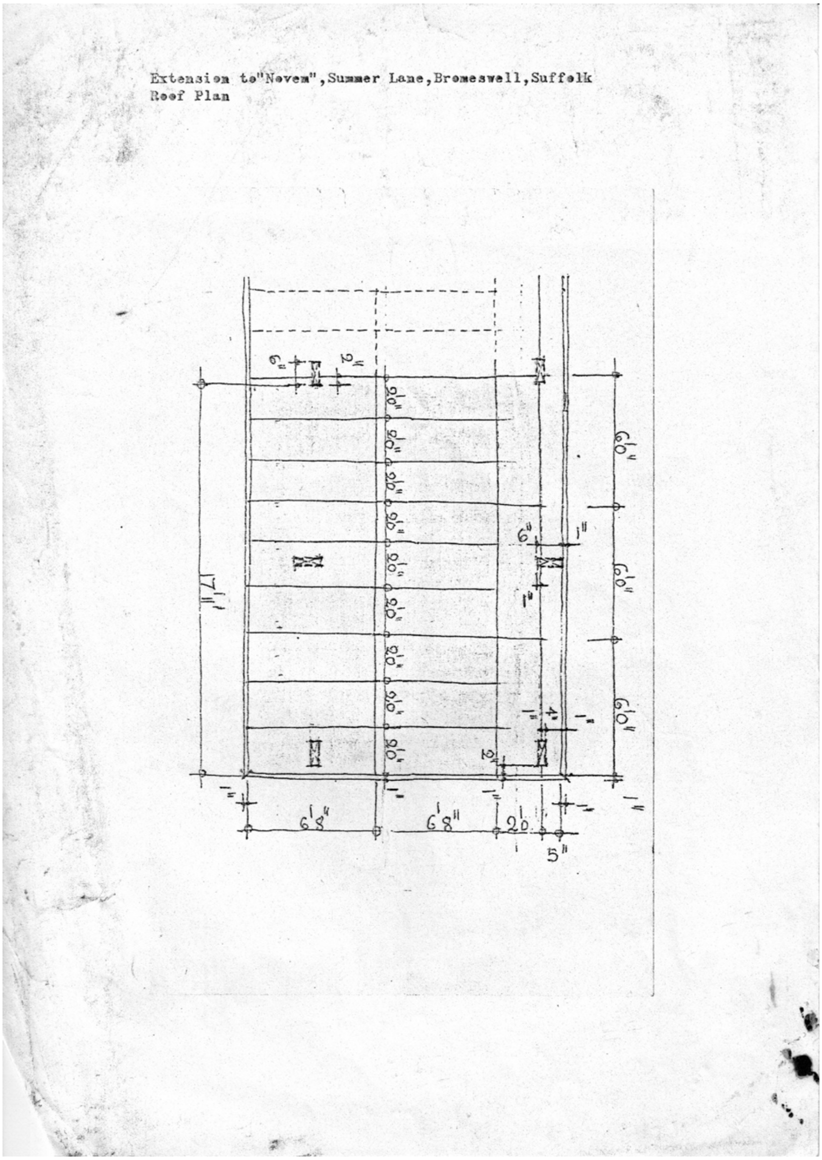


Figure 51. Bedroom extension drawings, Novem, 1974.

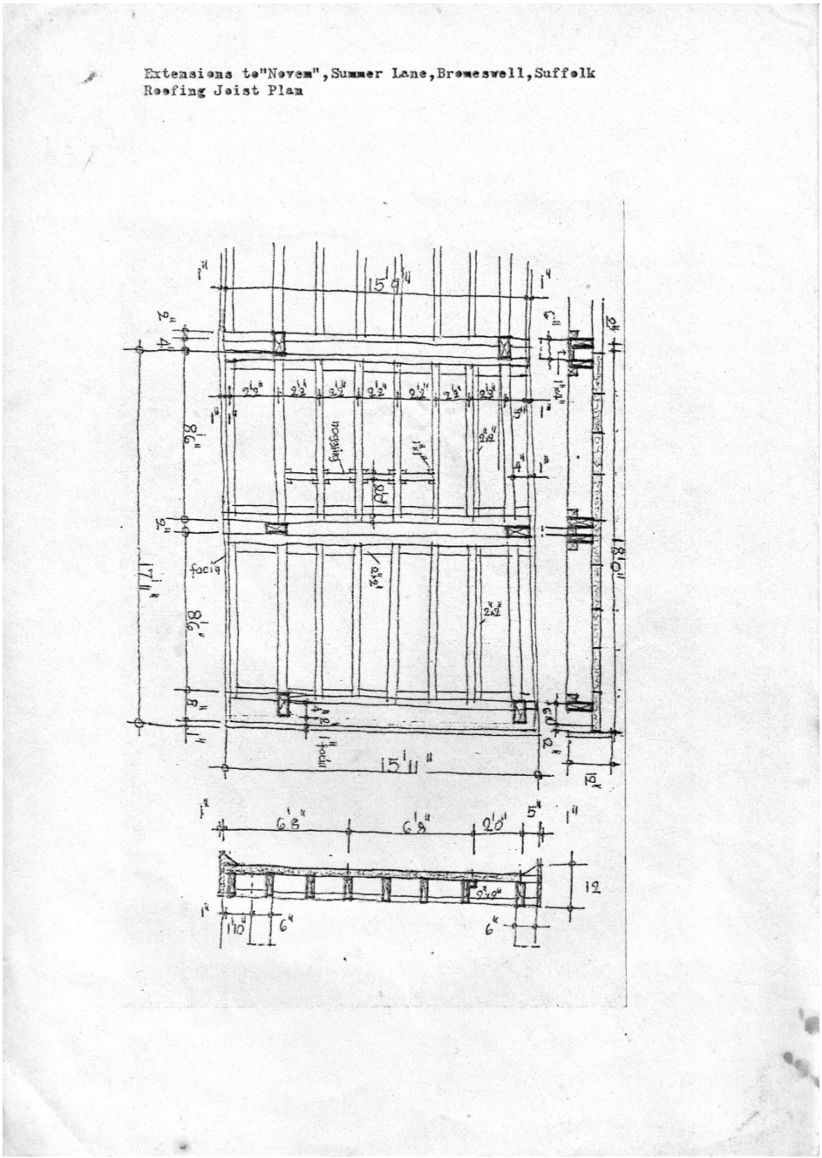


Figure 52. Bedroom extension drawings, Novem, 1974.

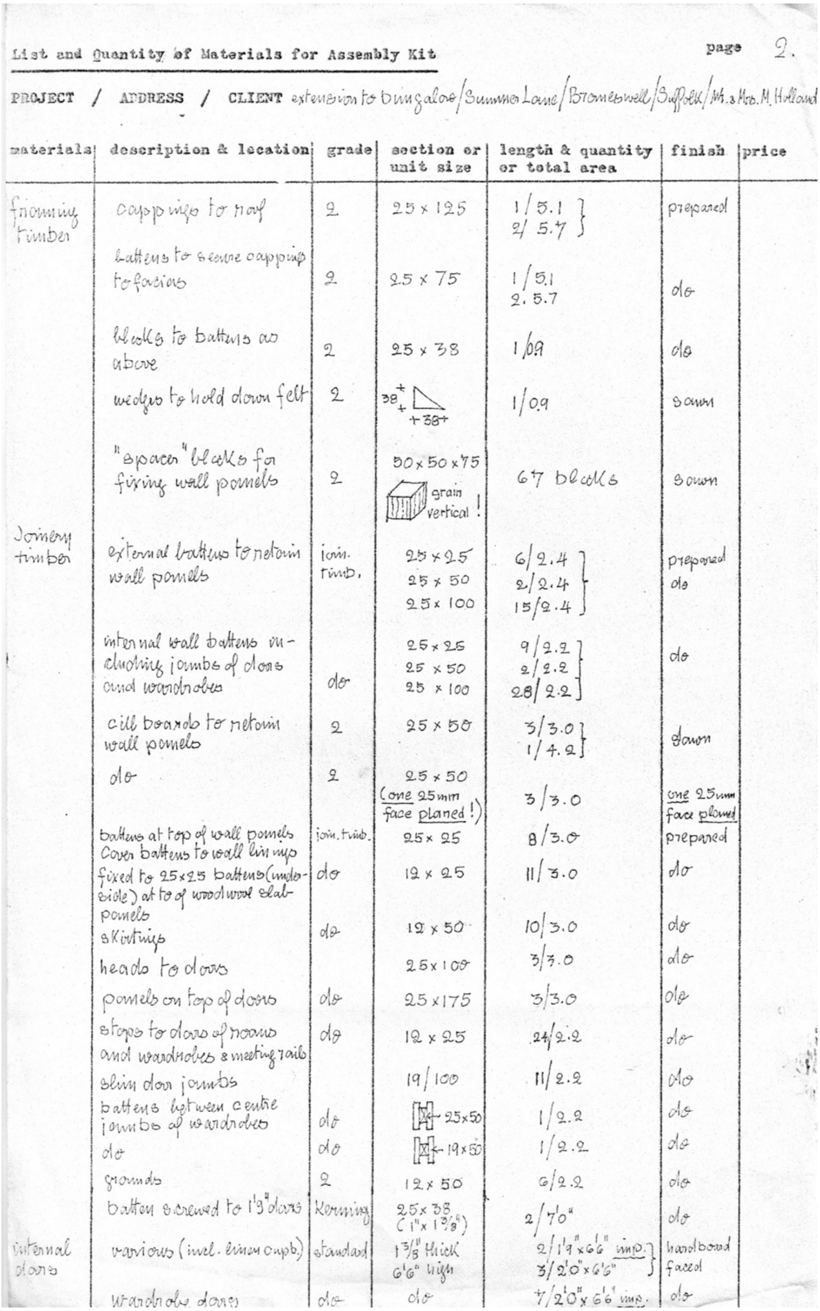
Type: A. non-load bearing.
: B load bearing. } page 1.

List and Quantity of Materials for Assembly Kit

PROJECT / ADDRESS / CLIENT extension to bungalow/Summer Lane/Bromeswell/Suffolk/Mr & Mrs M. Hollan

materials	description & location	grade	section or unit size	length & quantity or total area	finish	price
woodwool slabs	wall panels B	heavy duty	2" thick	2/2'0"x6'0" 22/2'0"x7'0" imp	natural	
	do roof panels A	normal quality	do	2/2'0x6'0 do 18/2'0x6'8" do	do do	
framing timber	main columns	1; BC pine	2"x6" imp	4/13'0" (no length shorter)	prepared & protected	
	floor beams	2	50x 275 met	2/4.5 2/4.8	do do	
	floor joists	2	50x200	11/5.7	sawn & protected	✓
	beam struts	2	50x125	1/3.3	prepared & protected	
	roof beams	1; BC pine	2"x8" imp	4/16'0" (no length shorter)	prepared	✓
	filler roofing joists	2	50x200 met	16/3.0	do	✓
	noggings between roofing joists	2	50x200	1/3.0	do	
	battens to fix noggings to joists; 4 battens per nogging	2	25x25	1/3.6	do	
	battens nailed to roof beams to support filler roofing joists	2	50x50	4/5.1	do	
	battens nailed to filler roofing joists to support woodwool slabs	2	50x50	2/3.0	do	
	batten between coupled roof beams batten	2	50 x 50 one side only to be planed	1/5.1	do	
	do	2	25 x 100	1/5.1	prepared	
	facias to perimeter of floor	Parana pine	1"x10" imp.	4/3.0 1/4.2 } no length shorter	do	
	facias to roof	do	1"x12" imp.	1/5.1 2/5.7 } no length shorter	do	
	noggings to roof facias	2	50x50 50x100 50x150	1/0.9 1/0.9 1/0.9	do	
	fillets to roof	2	63 150	1/5.1 2/5.7	sawn	

Figure 53. Bedroom extension schedule, Novem, 1974.



List and Quantity of Materials for Assembly Kit — page 2.

PROJECT / ADDRESS / CLIENT extension to bungalow / Summer Lane / Bromeswell / Suffolk / Mr. & Mrs. M. Holland

materials	description & location	grade	section or unit size	length & quantity or total area	finish	price
framing timber	cappings to roof	2	25 x 125	1/5.1 2/5.7	prepared	
	battens to secure capping to facias	2	25 x 75	1/5.1 2.5.7	do	
	blocks to battens as above	2	25 x 38	1/0.9	do	
	wedges to hold down felt	2	38 x 38	1/0.9	sawn	
	"spacer" blocks for fixing wall panels	2	50 x 50 x 75 grain vertical !	67 blocks	sawn	
Joinery timber	external battens to retain wall panels	join. timb.	25 x 25 25 x 50 25 x 100	6/2.4 2/2.4 15/2.4	prepared do	
	internal wall battens including jambs of doors and wardrobes	do	25 x 25 25 x 50 25 x 100	9/2.2 2/2.2 28/2.2	do	
	cill boards to retain wall panels	2	25 x 50	3/3.0 1/4.2	sawn	
	do	2	25 x 50 (one 25mm face planed !)	3/3.0	one 25mm face planed	
	battens at top of wall panels	join. timb.	25 x 25	8/3.0	prepared	
	Cover battens to wall linings fixed to 25x25 battens (underside) at top of woodwool slab panels	do	12 x 25	11/3.0	do	
	skirtings	do	12 x 50	10/3.0	do	
	heads to doors		25 x 100	3/3.0	do	
	panels on top of doors	do	25 x 175	3/3.0	do	
	stops to doors of rooms and wardrobes & meeting rails	do	12 x 25	24/2.2	do	
	slim door jambs		19/100	11/2.2	do	
	battens between centre jambs of wardrobes	do	25x50	1/2.2	do	
	do	do	19x50	1/2.2	do	
	grounds	2	12 x 50	6/2.2	do	
	batten screwed to 1'9" doors	Kerning	25 x 38 (1" x 1 3/8")	2/7'0"	do	
internal doors	various (incl. linen cupb.)	standard	1 3/8" thick 6'6" high	2/1'9" x 6'6" imp. 3/2'0" x 6'6"	hardboard faced	
	wardrobe doors	do	do	7/2'0" x 6'6" imp.	do	

Figure 54. Bedroom extension schedule, Novem, 1974.

List and Quantity of Materials for Assembly Kit page 3

PROJECT / ADDRESS / CLIENT extension to bungalow/Summer Lane/Bramesuell/Suffolk/Mr.&Mrs. M. Holland

materials	description & location	grade	section or unit size	length & quantity or total area	finish	price
Windows	heads, cills, transomes	joinery timber	25 x 100	3/2.1 2/2.7 6/3.0	prepared	
	do jambs	do	25 x 100	3/2.4 2/2.7	do	
	do battens below cills of half-high windows	do	25 x 50	2/2.1 4/3.0	do	
	do hangers to transomes	do	25 x 25	1/1.8	do	
	beads to heads of windows	do	finished size! +5/16" +3/8" 5/8" + +7/8"+ imp.	2/2.1 1/2.7 4/3.0	do	
	do to cills	do	finished size! imp 5/8" +7/16 +7/8"+	2/2.1 1/2.7 4/3.0	do	
	do to jambs	do	3/8"+ +7/8"+	4/2.4 6/2.7	do	
Aluminium Angles	to be obtained from Messrs Rapp Metals Ltd PO Box 20 Dawley Road, Hayes Middx	must be HE 30	3/4" x 3/4" x 1/16" imp	24 lengths @ 12'0"	standard	
External Wall Lining	"Glasal" sheet to be obtained from Messrs G.R. Speaker & Co Ltd, Eternit-House, Stevenage Road SW16 (01 385 9451)	N° 687	4'0" x 8'0" x 1/8"	6 sheets	N° 687	
Flooring	softwood flooring	joinery timber	25 x 150 t & g	22 m² as laid		
insulation	under all flooring; stretched over joists	must be quilt	Fibreglass quilt in stout bitumen paper on either side	22 m² as laid allow for laps!		
Internal Wall Linings	plasterboard to be obtained from British Gypsum Ltd	standard sizes	3/8" x 2'0" x 7'0" high	37 sheets (check sizes)	natural: pack with buff faces facing inward; two boards at a time	
Ceilings	do	do	600 x 2438 x 12.7	14 boards		
	battens to support plasterboard	join. timb.	19 x 25	28/2.7	prepared	
	end closers	do	12 x 100	4/5.1	do	
Bolts	framework		1/2"φ x 6½"	14	galvanised	
			1/2"φ x 8½"	14	do	
	bolts to external wall battens		1/4"φ x ~~5"~~ 4½"	40	do	
	do to internal wall battens		1/4"φ x 5"	40	do	
Washers			3/4φ	56	do	WS
			3/8φ	80	do	5 74
			~~1/4φ~~	~~80~~	do	

Figure 55. Bedroom extension schedule, Novem, 1974.

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Boulton & Watt Collection, Library of Birmingham
- Letters between Joseph Paxton and Boulton & Watt, Boulton & Watt order books, Boulton & Watt drawings.

Drawing Matter Collection, Shatwell Farm, Somerset
- Joseph Paxton, p*atent specification*, DMC 2694.2.7.

RIBA Drawings Collection, Victoria & Albert Museum
- W. R. Lethaby, Designs, working drawings & details of woodwork for Avon Tyrrell House, Hampshire.
- W. R. Lethaby, Designs, Church of All Saints', Brockhampton.
- Robert Smythson, Designs, Longleat House, Wollaton Hall, Hardwick Hall

Archive of Art & Design, Victoria & Albert Museum
- Philip Webb, drawings of repairs to East Knoyle Church tower, and associated correspondence with Detmar Blow.

The materials identified in relation to the works of Walter Segal have been sourced from a series of private collections:
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Statement of Errata

Name: Hugh Strange
Title: Architecture at the Building Site
Challenging the Separation between Design and Construction

The following typographical errors have been addressed:

p.1, line 1, comma after 'House' omitted.
p.1, line 3, comma after 'family' omitted.
p.7, para 3, line 1, 'attests' amended to 'attests to'.
p.7, para 3, line 2, commas added around 'with the building'.
p.20, para 4, line 1, Palace capitalised.
p.21, para 1, line 5, 'de-basing' amended to 'debasing'.
p.21, para 2, line 2, 'between man and man within society, and between man and nature' amended to 'between humans within society, and between humans and nature'.
p.31, penultimate line, '*De Re Aedifactoria'* amended to '*De Re Aedificatoria'*.
p.44, first quote, line 5, 'Shaw' amended to 'Shaw's'.
p.54, para 1, line 6, 'Country Life' amended to '*Country Life*'.
p.80, lines 2/3, 'had later been identified by' amended to 'was later identified by'.
p.86, para 2, line 3, 'fermented' amended to 'fomented'.
p.95, para 2, line 1, 'Illustrated London News' amended to '*Illustrated London News*'.
p.122, line 8, comma after 'only' omitted.
p.126, para 3, line 1, commas added around 'he suggested'.
p.143, para 2, penultimate line, 'draughting' amended to 'drafting'.
p.252, para 4, line 1, 'its'' amended to 'its'.

In addition, at the committee's request, an additional page has been added to better clarify the aims of the research, situate the text in the academic landscape and state the academic methods, while also outlining key research decisions taken that have shaped the direction of the research. To this effect, the single page 'Summary' that precedes the thesis has been amended to two pages.

This previously read as follows:

Summary

This thesis makes the case for an architecture that emerges through the process of construction.

The research investigates how, within the context of industrialised England from 1830 to 1980, the historic separation between designing and building in the production of architecture developed, and how it continues to define our contemporary building culture. It focusses on the impact of this development on labour and construction, and examines both the agency of those who construct, and the role of the architect, particularly as understood through drawings and related documentation. The research reviews critiques of this 'partitioning' and looks at ways in which it has been challenged through alternative models of architectural practice.

The research is structured around studies of three buildings sites. I have read the construction of the Great Stove at Chatsworth in the 1830s, to Joseph Paxton's design, as exemplar of the impact of the factory system and machinery on the production of architecture, with the resulting replacement on site of skilled craftsmen by unskilled labour. Following this, William Lethaby, working within the context of the Arts and Crafts in the 1890s and early 1900s, changed his working methodology, producing fewer drawing before construction, to integrate craftsmen into an ongoing design process at the building site. And from the 1960s onwards, Walter Segal, in developing a radically simplified construction methodology, sought to make designing and building accessible to all.

In arguing that architects (and architecture) should re-embrace construction, the temporal process and labour of building, and the creative space of the building site, the thesis proposes – despite all the obstacles - both a political project of renewed agency within the production of architecture, and a parallel revitalisation of the architectural artefact.

And nows reads:

Summary

This thesis addresses the relationship of construction to design in the production of architecture. To approach this, the research examines the distance that exists between the two, charting how this has developed and how it continues to define our contemporary building culture. The text focusses in turn on examples of resistance and challenge to this tendency and proceeds to argue more broadly for an architecture that emerges through, and from, the process of construction. Developing from themes within my own work, this research aims to position the ideas of the practice within a wider context. More broadly it aims to develop an argument that architects (and architecture) should re-embrace construction, the temporal process and labour of building, and the creative space of the building site.

The methodology is thus informed by my experience as a practitioner concerned with the processes and details of construction. My investigation of the issues surrounding how buildings come into being starts from precise readings of construction details developed through professional experience, rather than from theories, and leads on to broader conclusions. The chapters comprising this thesis are undertaken as close readings of construction. I cross-reference the critical interrogation of archive-based historical construction documentation with the examination of actual buildings and bibliographic research, varying to the extent that these are available in each case. A supplementary chapter takes a different approach, interviewing a key participant; excepts from this transcript combine with their own site images to form a photographic essay.

Situated between an earlier discourse relating to the culture of construction (tectonics), and a more recent 'turn to labour' and material discourse, the thesis seeks to simultaneously consider architectural artefact and architectural production. In this, the research is led by a sustained effort to situate each figure and study in their historical moment, yet each study may also be considered to operate allegorically. At the same time, the thesis follows a tradition of established practitioners who have written in parallel to their own design work, internationally and within a British context, from

Alison and Peter Smithson onwards, that has addressed construction within a cultural context. The thesis has also benefitted from the supervision of Pier Vittorio Aureli, whose consistent concern for the relationship between architectural history and political theory has informed the spirit of the whole.

When first contemplating the structure of the thesis I considered a series of architects preoccupied with the nature of 'building', some of whom I felt close to in my own practice – Sigurd Lewerentz, Sverre Fehn – but also some as counterpoints - Carlo Scarpa. While this might have related closely to my own practice, I wanted to address underlying themes, and proceeded to cases that represented more overt relationships between designing and making. These included Michelangelo's development from a sculptor handling material directly, to an architect instructing workmen at one remove, and of the Perret brothers, operating both a concrete construction company, and through Auguste, an architectural practice. This might have brought geographic breadth and allowed the thesis to develop apart from the British discourse led by John Ruskin and William Morris on the relationship of designing and making.

But, after completing a first text on William Lethaby in January 2020, and concerned with embarking on archival research outside my mother tongue, the pandemic forced my hand. Unable to leave my immediate neighbourhood to visit buildings or archives, and not knowing how long such restrictions might last, I chose to research Walter Segal, whose key buildings were close to where I lived. His former assistant Jon Broome also lived nearby and was happy to share archival documents across the distance of a park bench. This study, together with that of Lethaby's work, provided a geographical focus to the thesis. Seeking historical breadth, and aware that the time between these two was approximately the same as that between Segal and my own practice, I decided to look for an earlier case study, alighting on Joseph Paxton's first greenhouses at Chatsworth of the 1830s.

Thus, the choice of three historic building sites allows for comparative investigation of these themes within the context of industrialised England from 1830 to 1980. The focus is on labour and construction, and examines both the agency of those who construct, and the role of the architect.