

Primary Substation, 2012 Olympics London

DESIGN RESEARCH

November 2013

Northern Office for Research & Design

GENERAL DESCRIPTION

1.0

The Primary Substation for the 2012 Olympics is a vital piece of infrastructure, helping to supply the new Olympic Park with electricity. The building will continue to provide this function beyond the life of the Olympic Games.

Given its critical role it was the first completed building at the park. It is situated close to rail lines in the Kings Yard area of the site. The building itself houses three large transformers within a secure compound, not accessible to the general public but has a significant visual presence on the site given its size; it is 70 metres long with a tower at each end, one rising 9 metres and the other to 16 metres. Its monolithic presence brings together 130,000 ebony coloured engineering bricks, variously arranged to provide protection and ventilation to the plant housed inside.

As an unoccupied building and as a large substation the requirements placed upon the design do not mirror those of most built projects, perhaps exemplified by the lack of any requirement for windows but the necessity to provide blast protection.

The development of the Olympic Park is a large and relatively new undertaking. It is also predominantly a 'blank canvas' for which a large swathe of land in East London has been procured for this sole purpose. As such it represents a relatively unique situation in a contemporary Western metropolis whereby so little existing built context exists and so much and so varied an urban fabric will be created in a very short space of time. Additionally, as an Olympic Park the site will assume two very different guises over the course of barely a decade; firstly for the event itself and then in the so-called Legacy mode.

STATEMENT OF SIGNIFICANCE

2.0

The Primary Substation was the first completed building as part of the London Olympic Park (2012). The primary substation was to serve both the Olympic Park and its neighbouring Stratford City development. The substation was located in the west of the Olympic Park at Kings Yard. The Primary Electrical Substation will supply electricity to the Olympic Park during the Games and for future legacy developments. Sixty-six MVA transformers within the substation 'step-down' the power from an upstream network of 132 000 volts to 11 000 volts for distribution to venues and housing across the park.

Providing the foundations for a sustainable legacy to be realised, this building will help to provide huge environmental and infrastructure benefits, both for the local and London regional areas, in the form of improved infrastructure.

NORD were selected from an Invited group of 10 world-class architects who were asked to compete for the project. EDF Energy (now UK Power Networks) and The Olympic Development Authority (ODA) were joint commissioners of the project with EDF Energy eventually taking on the direct role of client. EDF Energy is one of the UK's largest energy companies, producing around one-fifth of the nation's electricity from its nuclear, coal and gas power stations, as well as combined heat and power plants and wind farms. The company provides power to a quarter of the UK's population via its electricity distribution networks and supplies gas and electricity to more than 5.5 million business and residential customers.

EDF Energy would not normally use an architect for their projects and instead an in-house team of engineers would typically design their utility infrastructure. This was a significant opportunity for NORD as architects to influence a company who were building infrastructure across the globe. The design of the substation set a benchmark for other projects in the park as it was the first building to go through the unique planning process set up for the duration of the Olympic games. The design review process led by ODA was also unique to the Olympic games process and meant that the design of the substation was exposed to a rigorous and extensive audience of design professionals, engineering experts, planners, journalists, critics, and community representatives. NORD were one of only six Scottish Companies involved in the Park and the only Scottish based Architects commissioned to design a building for the 2012 games.

The building has been featured in over 30 lectures given by Alan Pert and ODA since 2010. These include lectures in the UK, Europe, America and the Asia Pacific. The build-

ing has been exhibited at the Building Centre, the Royal Scottish Academy, and as part of the European Brick Awards exhibition in Vienna in 2011. The building has been featured as part of the RIBA Education Roadshow, RIBA Awards, Scottish Design Awards as well as major Civil Engineering Awards (ICE). The building formed part of the RIBA 'We Made London 2012' film and documentary and is included in a diverse range of publications associated with the London 2012 games as well as a range of architecture and design based journals and magazines.

The Architects Journal and Building Design Magazine have both published detailed technical reviews of the building.

The design solution combines aesthetic and material considerations with significant engineering, security and health & safety considerations. These structures are typically engineered and 'open to the elements' for maximum ventilation requirements. NORD had to consider the security issues associated with the games, the legacy requirements of residential development on adjacent sites, the aspirations for a highly designed environment around the Olympic park and the context of a 21st century park-land setting with an evolving heritage. The solution mediates all of these conflicting and opposing issues and its unique success is represented by the combination of architectural and engineering awards associated with the project. NORD have also been awarded their second Substation to design in recent months, which demonstrates the satisfaction of the EDF Energy. When we consider that there are 2000 primary substations in the London area and more proposed across the UK it is obvious how significant the design of these are in the future.

The project has been a huge success in terms of design but just as significant is the exemplar working relationships across a variety of disciplines. The project has introduced design in its broadest sense to an introverted engineering process and the role of the architect has helped to bring a critical voice and creative endeavour to the typical engineered approach. As architect Alan Pert rigorously challenged and tested the site constraints with the engineering constraints and a number of prototypes were put forward which, eventually led to an arrangement and design which has never been used prior the games. The output was original and the building was one third smaller than anticipated

or typically engineered for this capacity of power. This created efficiencies in a range of ways but critically it allowed the siting of the building to work more comfortably within the visual constraints of the Olympic park. The material simplicity of the building masks a highly technical and structural range of problems. The choice of material has allowed for a series of specific details to be constructed, which can be replicated on future projects. The building has as such been designed as a prototype for future substations as well as being designed to allow for major technological changes to happen inside. The façade and structure can allow for future adaption through a series of carefully detailed access walls, which allow for transformers to be removed and replaced.

This is a design, which has been shaped by a set of specific problems rather than intuition. As an architect Alan Pert has had to fully understand the engineering implication of every decision as well as consider the legacy of the site and park beyond the games. The design is responding to a specific context while at the same time it is the context. The building acknowledges the Victorian tradition of high quality infrastructure buildings and sets a theme solidity and permanence for a new family of infrastructure in the Olympic Park as well as being inherently low maintenance.

Sustainability was also at the heart of the design and the building was also helping to ensure that London 2012 was a truly sustainable Games. The power transformers are low loss (< 3%), the majority of the lighting is low energy and the building uses free cooling wherever possible, for example on the ventilated towers. EDF Energy & NORD undertook simulation of the occupied (2.31 kg CO₂/m²/year) and unoccupied (1.68 kg CO₂/m²/year) footprint energy consumptions, equivalent to the highest level under the Code for Sustainable Homes.

RESEARCH QUESTIONS

3.0

1. How can a building accommodate a contextual approach to its design when so much of the surrounding context is yet to be built and when its context will change so markedly over a short space of time?

2. How can such a building design best respond to the specific and varied technical requirements imposed upon it?

3. Can brick as a material be made to respond to the needs raised in the above questions?

AIMS & OBJECTIVES

4.0

I. To design a building which responds to the varying historical, current, short-term and long-term contexts of the site.

As the first building on the site the substation will influence others. As such it is given a coherent, legible and assertive, though relatively understated, presence from which others can take their cue. The utility structures have been developed to consider a common palette of reference materials where these relate to their use and location. The choice of this palette of materials then becomes pivotal in grounding the building in its historical context as well as over the longer term.

NORD's approach to materials extends a desire to be sympathetic to the traditions of utility buildings and the industrial context of Waterdene Road. The existing Edwardian industrial buildings with their dominant use of brick characterise much of the City's material heritage and NORD were keen to reference this with the use of brick as the primary material for the electricity substation. The choice of brick gives a formal and urban character to the building similar to the existing buildings adjoining the site. When thinking of a landscape character for this site it is important to consider the history of the area and the references to both the industrial heritage of the area and that of greater London. Buildings of this nature are part of the everyday experience of our cities and we felt this was a key consideration when progressing with design ideas. The materials make strong reference to the local post-industrial environment.

Around the coolers NORD make reference to the use of Victorian airbricks and vented chimneys where the detailing of the brick changes as it responds to a functional requirement to allow air through and around the coolers. This 'perforated' brick envelope around the coolers at the West and East of the site then becomes an opportunity for lighting where the simple use of backlighting changes the appearance of the building dramatically at night; a further, perpetual condition of the context that must also be addressed.

The aim has been to create an enduring building and brick gives visual weight and density that brings a sense of permanency. The use of a single material also offers an inherent sculptural quality which can be harnessed. This is pertinent given that restricted access to

the building means connections to it are primarily visual and from distance. NORD therefore approached the building mass as a sculptural form, where the singular use of one material has been explored in relation to the functional form of the building and its context.

NORD have developed a strong contextual approach to the building as a whole where the use of brick has been chosen as a consistent building material to emphasise the character of the site. The challenge for NORD was the creation of a sculptural form, which celebrates the use of brick, responds to the functionality of the building and its technology and creates visual reference both during the day and at night. The brickwork is continuous, sculptural and monolithic in its presence, whilst subtlety in the building mass is addressed through the wrapping of the material on ground surface, walls and roof. Changes in the detailing of the brickwork where it is stretched across the façade forming an open pattern to allow for ventilation through and across the cooling towers breaks down the mass and offers the potential for illumination at night as mentioned. This consistency in the use of one material and the effect of wrapping the material over the roof is a conscious decision to attempt to create the sculpted brick landscape. The lower section of the building grows out of the brick ground plane and wraps over at 4.8m creating a sculptural plinth on which the cooling towers sit. At night these towers appear to float above the plinth like large brick 'baskets' and the 4.8m datum line, which ties in with the adjacent land bridge, becomes an additional and critical contextual reference.

NORD's approach to the appearance of the electricity substation has evolved from an understanding of the material qualities evidenced in London's rich industrial brick heritage and specifically in the British tradition of utilities building design. The appearance celebrates the honesty and functionality of the building where the sensitive but creative use of materials results in a landmark building rooted in its industrial heritage.

In conclusion the building has been designed to respond to the changing context in a number of ways. Its response to the historical context is bedded in the material choice and detailing. Britain's rich heritage of designed utility structures is referenced, though not imitated, again both in materials and in the overall rigour and simplicity of the sculpted form. The current and future context is managed through a clearly defined but relatively understated presence intended to provide potential references for future work, whilst the apparent mass and solidity allied to the sculpted ground plane are intended to hold the

space around it creating an assertive and grounded presence in the existing transient landscape. The sculpted form acknowledges both the adjacent datum of the land bridge and the viewing corridor across the site, pertinent to both present and future conditions.

2. To design a building which responds to the specific and varied technical requirements of this particular brief.

A further key consideration in the development of the design is that the electricity sub-station is a building containing complex plant and equipment with very specific technical requirements. This must be integrated with the already mentioned wider contextual needs to form a coherent whole. Such a whole can best be achieved through an efficiency of design moves whereby one device can meet a number of disparate challenges. The use of brick offered a number of opportunities for such efficiency.

As an established material brick requires little maintenance and its durability has been proven over the longer term. The selection of engineering brick further enhances this durability whilst also allowing a subtlety of detailing not possible with less robust alternatives. Further, it is a material of which contractors have an intimate knowledge, thereby offering additional flexibility in detailing and assurance in terms of budget and timescale.

Security requirements on buildings of this type are understandably paramount given the importance of consistency of supply. The brown roof created through the recycling of bricks taken from the site responds to three separate challenges; its weight adds structural integrity as part of the blast protection and security strategy, whilst it also responds to environmental objectives of biodiversity as well as the contextual aspirations mentioned above.

The brick is also made to perform in a number of ways, as landscape, structure, weather-tight skin and ventilating panel, answering the variety of needs required by the equipment housed inside. The form is largely defined by this equipment, though through dialogue and design team collaboration it has been possible to create a carefully modulated form which responds both to the technological needs of the brief and the sculptural and contextual requirements of the wider context already touched on. Anticipated future developments of the internal equipment have also been considered, ensuring as far as possible that the

objectives of longevity and sustainability considered in relation to other challenges within the brief are maintained here also.

The achievement of this aim is evidenced in the review and esteem indicators below.

3. To advance to the accepted parameters in the use of brick as a material to the end of responding to objectives 1 and 2.

In answering the above questions it has been necessary to expand our understanding of brick as a material and its potential as a building material. As an established material there is a vast body of evidence from which to draw conclusions. Close collaboration with other members of the design team as well as external sources (manufacturers, literature, existing built works etc) was collated as part of a research phase and the existing parameters clearly defined. Merging our knowledge of these limitations with the aspirations created through the evolution of the brief then allowed us to draw conclusions on how these challenges could be met. Again the achievement of this objective is better evidenced in the peer review and esteem referenced below than might be written here.

CONTEXT

5.0

The practice takes great inspiration from the UK's legacy of 'making things'. Within industrial Britain there was often a sense of collective pride and craftsmanship about what came out of factories and workshops. This interest and passion for materials, technological innovation, for detail, craftsmanship, texture and pattern is something, which underpins the work of NORD. NORD are often provoked and inspired by social and cultural issues inherent in the contemporary city and believe that this awareness also allows a response in form and materiality. Such an approach has led to the development of a series of buildings, places, products and objects, which respond to 21st century, needs but celebrate the British tradition of craftsmanship and love of materials. With a foundation in delivering award-winning architecture and commissioned research into the built environment, we are driven by an aspiration to create genuinely unique architectural solutions. NORD believe that if we are to rethink the present, we need to constantly recalibrate the relationship between tradition and innovation, knowledge and imagination.

As stated the context of the site itself is one of a varied mix of past, present and future use and as an Olympic Park it is also a politically charged and highly newsworthy one. Issues of project timescales and budget must bare exceptional scrutiny on a job of this nature and this has to be taken into account from early design stages. The client group is also large and multi-faceted with a complex relationship of owners and stakeholders, restrictions and guidelines. It is further acknowledged that this building is a facilitator for other events on the site and not, as stated above, and event in its own right. We believe that all of these factors, as a part of the process of design should be, and are, exposed in the completed building.

RESEARCH METHODS

6.0

NORD's response relies to an extent on semiotics and as such could easily betray a specific and personal interpretation of embodied history and meaning in any given design decision - perhaps most obviously in the choice of materials. It is therefore critical that a thorough understanding of the context and the myriad facets that this word encompasses is brought about through the most comprehensive analysis. Site analysis is the most obvious first recourse, involving research into the social, political, economic and geographical context.

The proposal for the electricity substation went through a number of design development propositions as more detail relating to context, legacy, security and technical requirements became available. The outcome is the result of a lengthy process of investigation into the architectural design approach for a utility building on the site, the relationship to neighbouring infrastructure, the legacy context, use of materials in relation to both building form and mass and issues of biodiversity.

This process is facilitated via a variety of media from hand sketching and model making to 3D visualisation and measured drawings, all of which are then used for personal or in-house assessment and can then be disseminated amongst the design team for comment and further development. More specific to the brick itself was the creation of a number of mock-ups on site with the contractors who would be responsible for the build. As part of the experimental phase in the development of details this allowed a variety of issues to come to the fore as well as providing 1:1 models for assessment. The practicality of building innovative brick bonds is easily reviewed by these methods and of course highlights related issues of cost and timescale which are assessed in parallel with issues of aesthetics, structural integrity etc.

DISSEMINATION - PUBLICATIONS

7.0

Stewart, Dan. 'Image: Power behind 2012 Olympics revealed', *Building*, 13th Feb 2008
(Critical review of Substation design in construction industry periodical)

Abrahams, Tim. 'The Aesthetics of Infrastructure', *Blueprint*, July 2009, pp28-52
(Critical review of Substation design in design industry periodical)

Woodman, Ellis. 'Nord's Olympic substation is first to the finishing line',
Bdonline, 9th Oct 2009
(Critical review of Substation design in architectural industry periodical)

Waite, Richard. 'NORD completes first building for 2012 Olympic site',
Architects journal online news, 9th Oct 2009
(Critical review of Substation design in architectural industry periodical)

'2012 London Olympics Construction Progress', *E-Architect*, 26th Oct 2009
(Critical review of Substation design on architecture industry website)

'London 2012 powers ahead as first Olympic Park building is complete. New substation switched on to supply electricity to Olympic Park and Stratford City development',
London 2012 news, 26th Oct 2009
(News item on official London 2012 website)

Spring, Martin. 'The Building Blocks of Quality', *Architect's Journal Specification*, Nov 2009, pp31-35
(Critical review of Substation construction detailing in architectural industry periodical)

'Electrical substation, Olympic park, London', *Dzine, Istock, Autumn 2010*, pp12-13
autumn 2010
(Review of Substation design in Brick Supplier quarterly magazine)

'Station to station: the new power generation', *The Independent*, 5th Aug 2010
(Critical review of Substation design in national daily broadsheet)

'First Person column', *Brick Bulletin*, 1st Jun 2010
(Critical review of Substation design within brick industry periodical)

translated to Danish by V. Krogh. 'Monumentalitet & Kontrast', *TEGL, 1, 2010*, pp12-17,
1st Mar 2010
(Critical review of Substation design within Danish brick industry periodical)

Star auf Zeit, Powerpunkt: Material Wirkt, *Deutsche Bauzeitung*, February 2010
(Critical review of Substation design within German construction industry periodical)

DISSEMINATION - PUBLICATIONS (CONT.)

London Olympic Park, *Casa Brutus*, Takefumi Ishiwatari, Issue No. 149, pp139, March 2012
(Critical review of Substation design within Japanese Design Magazine)

Experimente Gewurdigt, Wienerberger Brick Award 2012, *Bauwelt 21.12*, Bauerverlag BV GmbH, pp16, May 2012
(German publication with project description, released in tandem with awards ceremony)

Skin Care, *Azure*, AZURE Publishing Inc, pp39, June 2012
(Critical review of Substation design within North American Design and Architecture Magazine)

Pragmatik und Poesi, *Bau Meister 08 2012*, Callwey GmbH & Co Kg, pp60-63, August 2012
(Critical review of Substation design within German design periodical)

London Power Play, *AIArchitect*, American Institute of Architects, August 2012, <http://www.aia.org/practicing/AIAB095533>
(Critical review of Substation design on US industry website)

Eastside Story, Volume 2: Olympic Park, AJ Publication, pp96,97, September 2012
(Critical review of Substation construction detailing in architectural industry periodical)

Brick '12 - Award Winning International Brick Architecture, Callwey GmbH & CO. KG, pp 10, 22-25, 2012
(German publication with project description, released in tandem with awards ceremony)

Lucy Bullivant, *New Arcadians - Emerging UK Architects*, Merrell Publishers Limited, 2012, pp156-169
(Critical review of Substation and other NORD work for independent publication)

Architecture & Urbanism - No. 506 March 2013
(Critical review of Substation design within Japanese Design and Architecture Magazine)

Alberto Ferlenga, Marco Biraghi, Benno Albrecht, *L'Architettura del Mondo. Infrastrutture, Mobilita, Nuovi Paesaggi*. Editrice Compositori, pp139, 2013
(Citation of Substation in independent Italian publication)

DISSEMINATION - EXHIBITIONS

Royal Scottish Academy, Edinburgh, Architecture Open 2012,
(Exhibition of selected work -including substation model - at the RSA)

RIBA San Francisco Chapter, San Francisco, May 2012
(Exhibition of selected works - including description, photographs and drawings of substation in San Francisco)

Eidgenössische Technische Hochschule (ETH) Zurich, 2012
(Exhibition of selected works - including description, photographs and drawings of substation at the ETH, Zurich)

We Made 2012, The Building Centre, London, July 2013
(Exhibition of selected works - including model, description, photographs and drawings of substation in London)

ESTEEM INDICATORS

8.0

RIBA award 2010 and subsequent Stirling Prize Longlisting (on list of 19)
(Architect's professional body annual awards, judged by a selected jury and assessed through submission of materials and site visit)

Brick Development Association, Brick Design Awards 2010
Award for Best Public Building
Supreme Winner Award
(Brick Development Association annual awards, judged by a selected jury and assessed through submission of materials and site visit)

Scottish Design Awards - Winner in Regeneration Category
(Annual awards, judged by a selected jury and assessed through submission of materials)

Wienerberger International Brick Awards 2012, Best Non Residential Building (Winner)
(Manufacturer sponsored annual awards, judged by a selected jury and assessed through submission of materials and site visit)



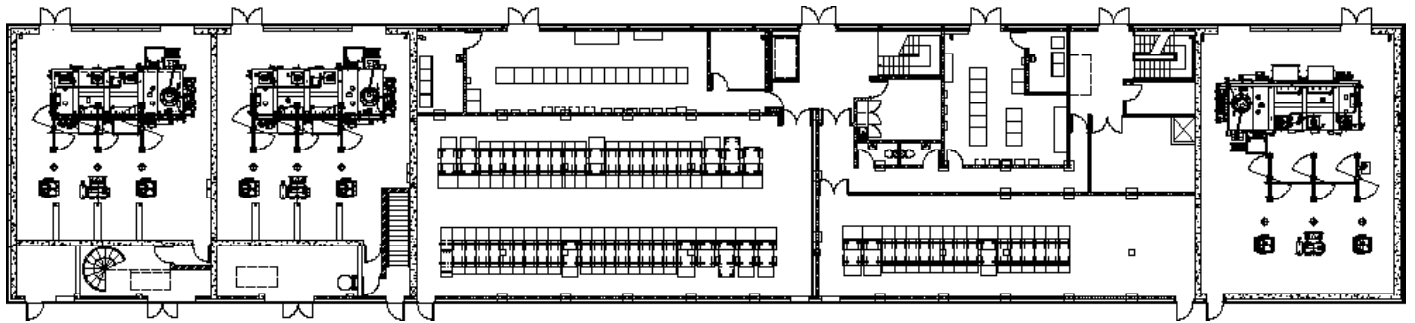
Battersea Power Station - Part of a rich history of British utility structures on which NORD drew influence, both materially (extensive use of brick) and formally (the buildings are not purely Modernist in style; whilst form and function are obviously alligned (as in all Modernist buildings) there are additional aesthetic flourishes and material choices which demonstrate an intent to imbue each with a sense of craft)



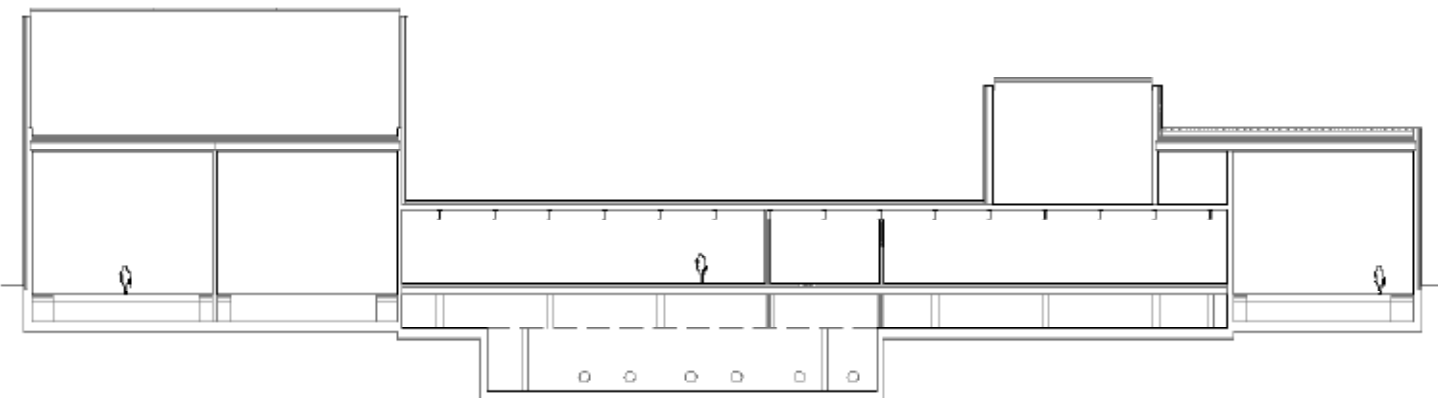
The designs for the Olympic Park Masterplan served as evidence of the future context to which any design would need to relate



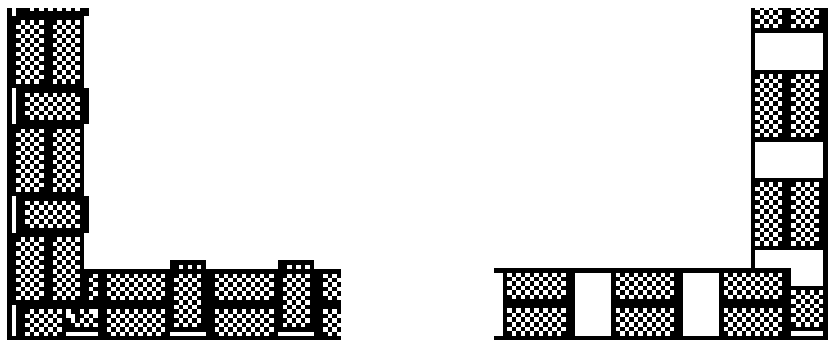
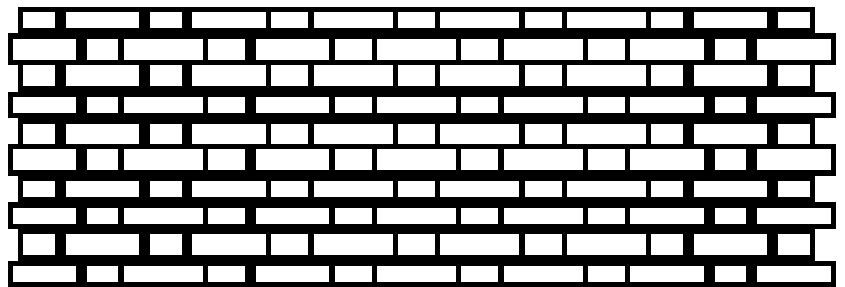
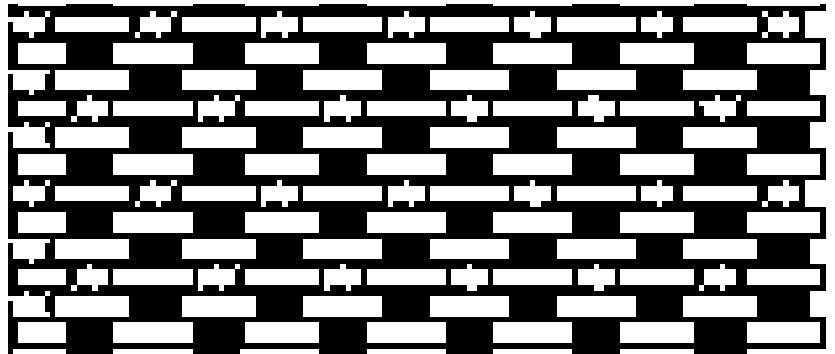
South Elevation - as built drawing



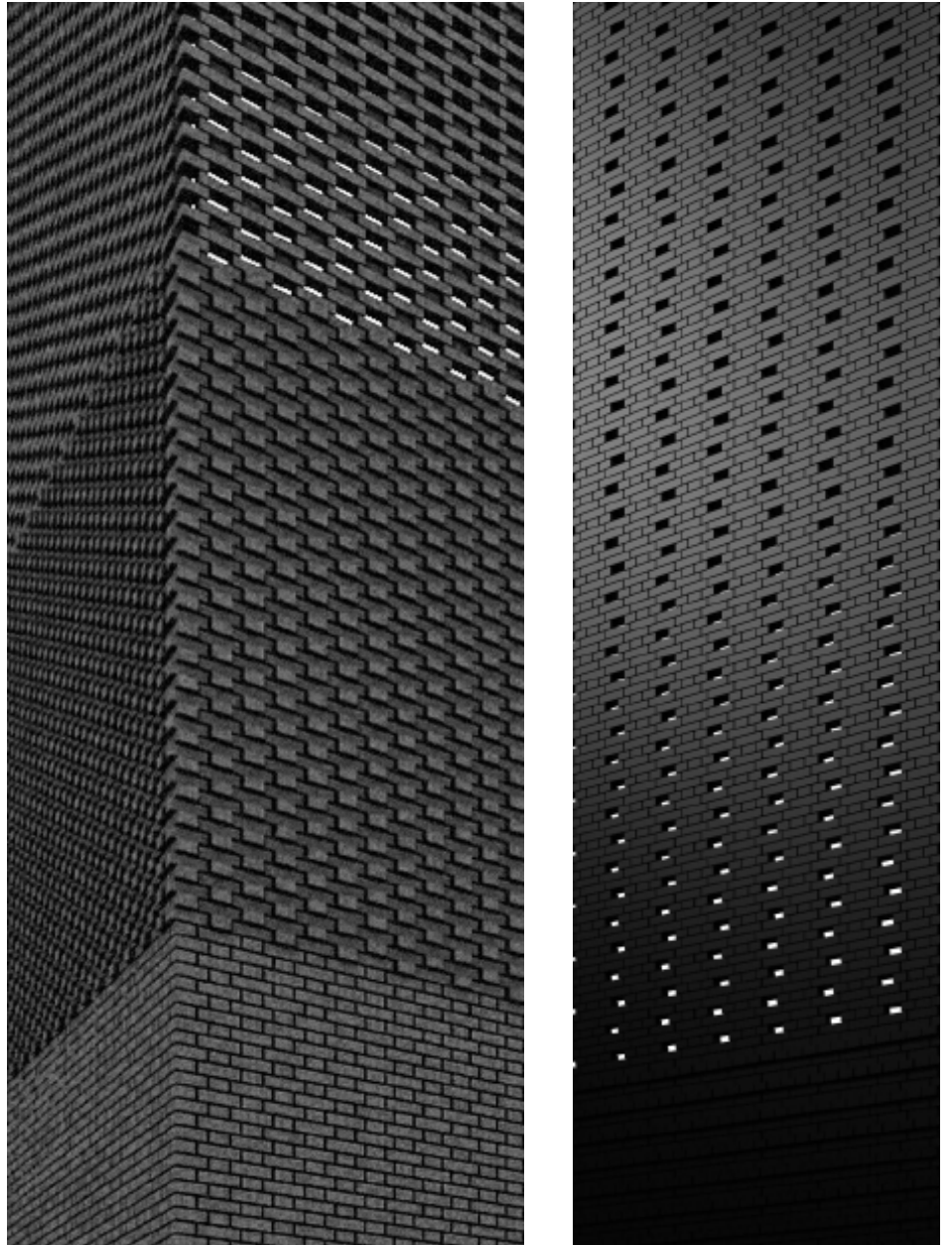
Ground Floor Plan - as built drawing



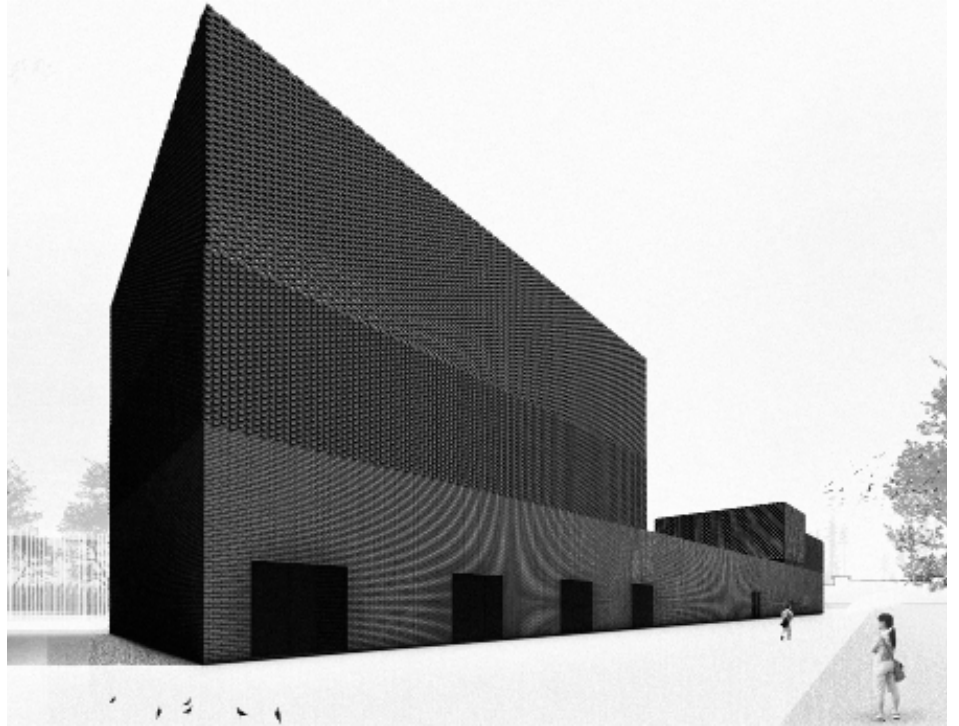
Long Section - as built drawing



Brick Detailing - as built drawing (evidence of attention to detailing and the result of research into the capabilities of the material and the embodiment of craft and an appropriate refined aesthetic)



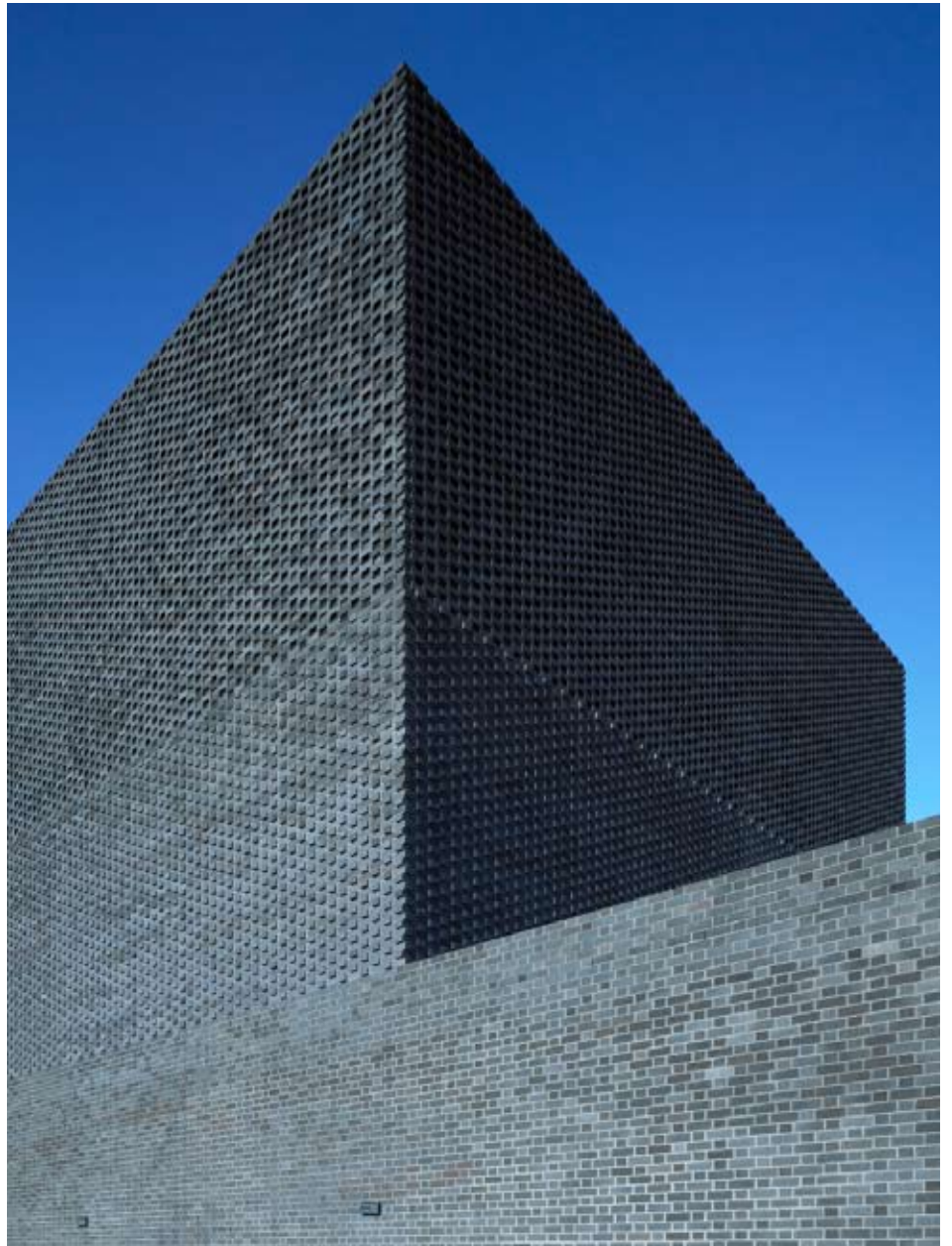
3D Modeling Studies - evidence of enquiry within the practice into appropriate detailing methods and of what would be achievable within the parameters of the material



3D Modeling Study - evidence of enquiry within the practice into appropriate massing and form and of what would be achievable within the parameters of the material



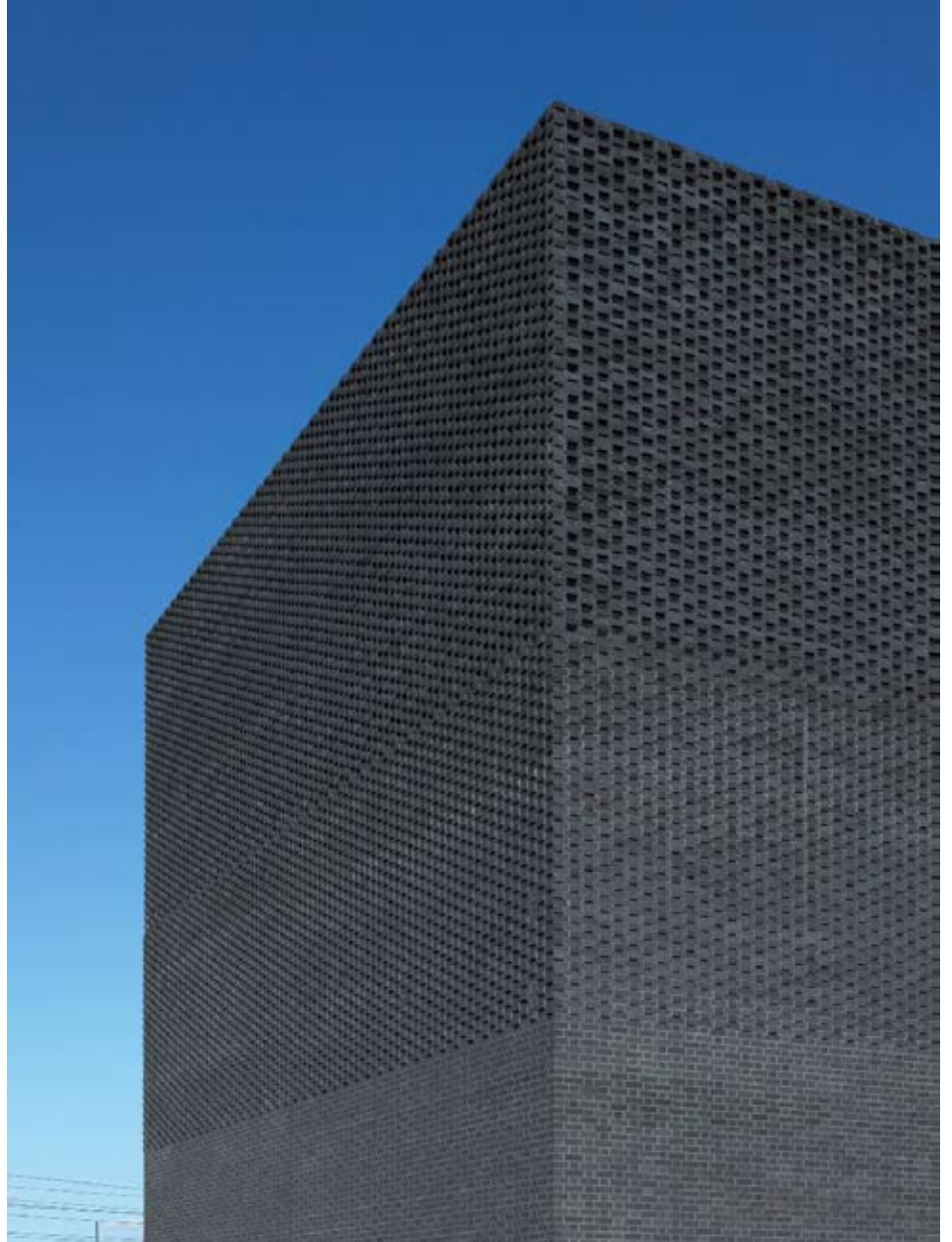
Brickwork Sample Panels - evidence of site enquiry into appropriate detailing methods and of what would be achievable within the parameters of the material and the abilities of the workforce



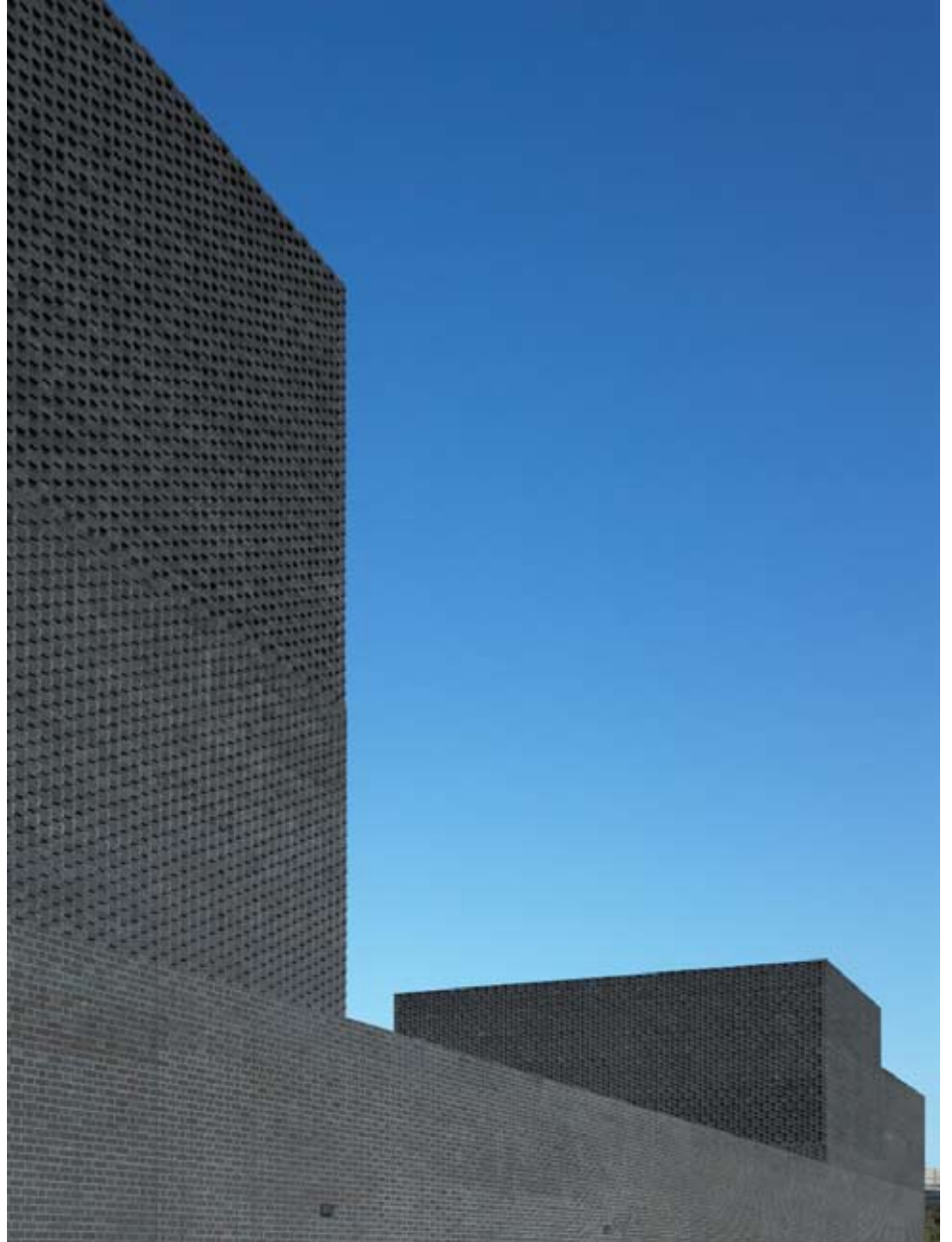
Completed Substation - photographic record of completed building



Completed Substation - photographic record of completed building



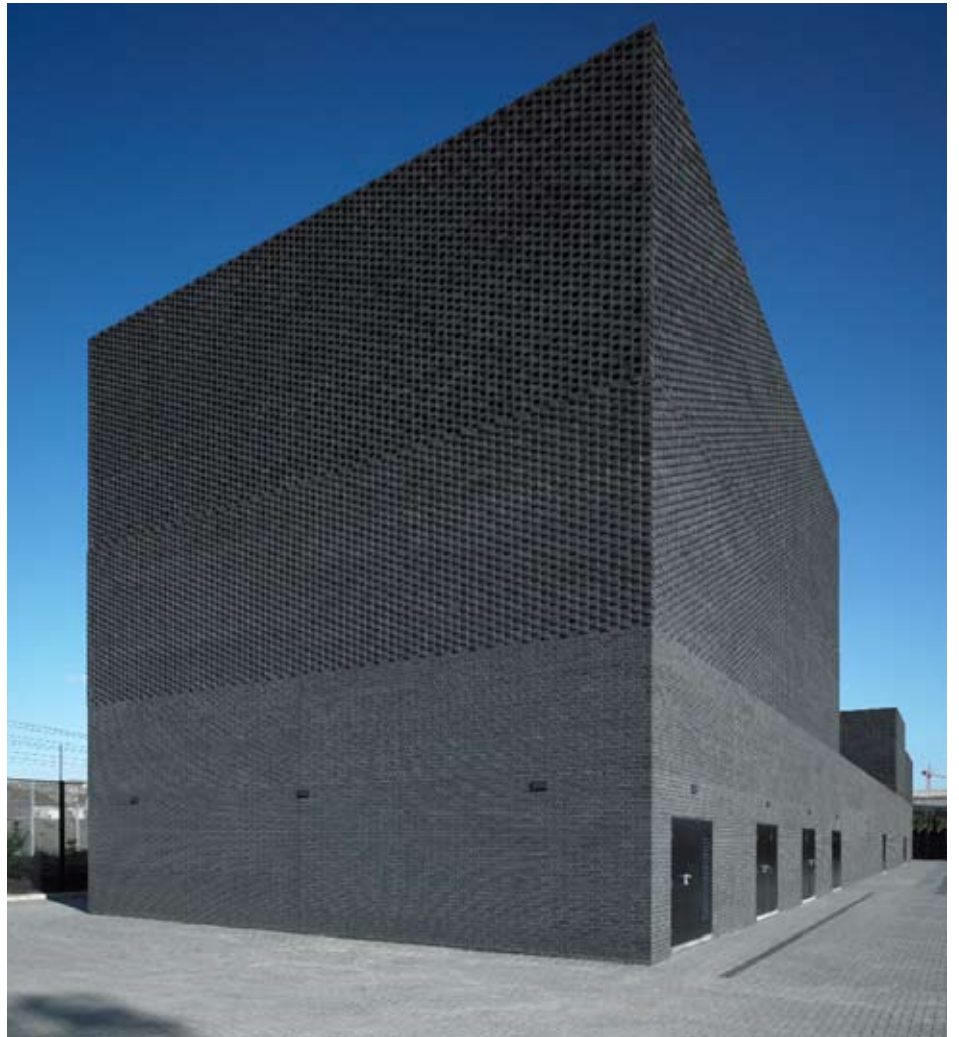
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