RETRACING THE STRANDS
Reflections on post-PhD life

Dr. Henrik Schoenefeldt

Kent
School of Architecture
Centre for Architecture & Sustainable Environment (CASE)
The Centre for Architecture and Sustainable Environment

The Centre for Architecture and Sustainable Environment (CASE) aims to promote research in the field of sustainable design regionally, nationally and internationally.

Its research focus encompasses different aspects and scales of the sustainable built environment from the individual building to the urban block, promoting the wider environmental agenda and keeping the school at the forefront of research and development in the field. CASE also pursues research into the historical and cultural dimension of environmental design to foster links between the sciences, arts and humanities. There is a strong interest in understanding the environmental behaviour of historic buildings and the strategies originally deployed to manage the internal environment.

The Centre has already been involved with three EPSRC-funded projects on climate change weather data for a sustainable built environment, sustainability of airport terminal buildings and design interventions in the public realm for affecting human behaviour.

CASE has developed its laboratory infrastructure for environmental monitoring in the built environment. Its capabilities include undertaking thermal imaging surveys, monitoring of microclimatic conditions and other weather data, along with lighting studies.

Our team’s research interests in the field of sustainable design include:

- thermal comfort in complex environments
- occupant perception and use of space
- sustainable building design
- natural ventilation in complex spaces
- urban microclimate
- future weather data for building performance simulation
- history of environmental design and technology
- environmental behaviour of historic structures

Our PhD students are currently working on the following topics:

- Environmental diversity in the urban environment
- Comfort conditions in airport terminals
- Low carbon prefabricated homes
- Ventilation strategies for healthcare buildings in Nigeria
- Fault lines on the road to more sustainable buildings

For more information about CASE please contact Prof Marialena Nikolopoulou.
The Titanic, Collage, Stanley Tigerman, 1978
‘This father figure [Mies van der Rohe] could not be killed, but had been set adrift in the endless ocean of the architectural subconscious of Stanley’s generation of (post)-modern Chicago architects—

the Titanic, alias Mies, could not simply sink, but instead had to stay suspended on the ocean surface as the paragon of a modern belief system, whose framework has irretrievably been corroded’

Emmanuel Petit, in Designing Bridges to Burn, 2011
1833
1850/51
1851 Great Exhibition Building, Hyde Park
1852-54
Crystal Palace, Sydenham

Prototypes
1st Experiment
Diagnosis
2nd Experiment

Ridge-and-furrow greenhouse, 1834
Conservatory Wall, 1840
Victoria Regia House, 1850
1850/51

1851 Great Exhibition Building, Hyde Park

1850/51

Crystal Palace, Sydenham
1852-54

1855

Sanatorium, Victoria Park

‘The Great Victorian Way’

1st Experiment

Diagnosis

2nd Experiment

Public urban winter winter gardens

Winter Park, Hyde Park
1851 Great Exhibition Building, Hyde Park

Crystal Palace, Sydenham (1852-54)
Cross-Section of Crystal Palace, showing ventilation and heating systems. [Author]
Late July, 90 sashes were replaced with operable canvas screens.

[First Report, 1852, p. 68]
Timeline of Events

1. May: Opening of Great Exhibition by Queen Victoria

15. October: Official Closing of the Great Exhibition by Queen Victoria

17. July: Part of the vertical glazing units at the gallery was removed

19. July: Vertical glazing restored

26. July: Large parts of vertical glazing at both transept ends removed

11. October: End of Monitoring Process
(According to First Report)

Graph: Daily range of temperatures, May-October 1851

Key:
- Yellow: average indoor temperature
- Red: maximum indoor temperature
- Black: minimum indoor temperature
- Orange: peak outdoor temperature
- Blue: average outdoor temperature
- Green: minimum outdoor temperature

May June July August September October
Adapting Glasshouses for Human Use: Environmental Experimentation in Paxton’s Designs for the 1851 Great Exhibition Building and the Crystal Palace, Sydenham

By HENRIK SCHÖNEFELDT

The use of scientific experimentation in developing the glazing for the Palm House at Kew

Henrik Schönefeldt
Department of Architecture, University of Cambridge

Abstract:
This paper investigates the role of scientific experimentation in the design development of the Palm House at the Royal Botanic Gardens at Kew designed and constructed in 1844-48. It focuses on the cross-disciplinary design process underlying development of a special light-filtering glass that was adopted for protecting the tropical plants from the solar radiation transmitted by the highly transparent glass roof. To validate the performance of the glass, the design team was not only dependent on the study of the optical and chemical properties of glass, but also relied on scientific research into the effect of natural light on the physiology of plants. Kew commissioned the scientist Robert Hare to conduct a series of scientific experiments first to specify the right tint and to advise the glass manufacturer in producing a glass with the required properties. The final section discusses the performance history of the glazing as a solar control strategy.

Keywords
Glass, lighting, Palm House, botanic garden, internal environment, experimentation

Introduction

The Palm House at the Royal Botanic Gardens at Kew (fig. 1), designed and constructed by Joseph Paxton and Richard Turner between 1844 and 1848, represents an early example of a cross-disciplinary and collaborative design approach, adopted in order to achieve an artificial environment for the preservation of Kew’s valuable tropical plant collection, which could not be sustained in England’s temperate climate. The Palm House was the outcome of a distinctively horticultural approach to building design development, which was unique from the formal architectural doctrines of contemporary architecture. Eighteenth- and nineteenth-century horticultural literature indicates that the requirements of horticulture provided the impetus for the development of new design criteria, theories and working methods, which were adopted by horticulturists to meet the specific functional, largely environmental requirements of tropical plant cultivation. The emergence of the glasshouse as a distinct building type reveals a process of innovation that was driven by a conception of architecture as a design discipline primarily concerned with the cultivation and preservation of plants.

Paxton’s early ambitions for a unified system of environmental control involving mechanical and passive technologies were partially realised in the Crystal Palace of 1850.

The Crystal Palace, environmentally considered

Henrik Schönefeldt

In the nineteenth century, horticulturists such as John Lindley and William Lobb, among others, contributed to the development of a biological approach to the cultivation of tropical plants. The Crystal Palace was an early example of such an approach, which was designed to control the environmental conditions for plant growth. The Crystal Palace was constructed using a zinc-coated iron truss structure, which allowed for the ventilation of the building. The glasshouse was designed to be a microclimate, with the aim of simulating the conditions of the plants’ natural habitat. The Crystal Palace was considered a success, as it achieved the desired environmental conditions for plant growth. The Crystal Palace was also a significant contribution to the development of environmental control in architecture, as it was the first large-scale building to incorporate the principles of environmental design into its construction.
Creating the right internal climate for the Crystal Palace

Henrik Schønfeldt, MPNI (Cantab), PhD (Cantab)
Department of Sustainable Design in Architecture, University of Kent, Canterbury, Kent, UK

This paper explores Joseph Paxton’s experiments with climate control inside glasshouses between 1830 and 1850 and how he exploited this experience to achieve the right internal climate for the 1851 Crystal Palace in Hyde Park. The first part investigates various solutions for ventilation and the management of solar radiation, heat loss and humidity inside glass structures that Paxton had developed before his employment at Hyde Park. It also shows how these solutions were appropropriate for Hyde Park and discusses the various alternative ventilation, shading and cooling arrangements that Paxton introduced for the palace before adopting the final strategy. The final section is a brief analysis of the actual performance of the building and explores the steps taken to improve the ventilation. This post occupancy history suggests that Paxton’s previous experience was insufficient to be entirely successful for the Crystal Palace, but it provided Paxton with new insights that informed his design for the ventilation system deployed in the second Crystal Palace at Sydenham (1852–1854).

1. Paxton’s role as an environmental designer

Past research into the design of the Crystal Palace (Figure 1), a temporary glass structure erected in Hyde Park, London, to house the ‘1851 Great Exhibition of the Works of Industry of all Nations’ has focused on the role of the engineers and contractors in the development of the iron frame and the methods of prefabrication and assembly (Addis, 2006; Hitchcock, 1953; McKean, 1996; Thorne, 1987). This paper, however, argues that the exhibition building was the outcome of a cross-disciplinary effort, in which the skills of glasshouse designers in creating the right internal climate were as critical as those of the structural engineers or architects. The contractors Fox and Henderson depended on the horticulturalist and glasshouse designer Joseph Paxton for his specialist knowledge and experience with the detailing of glass envelopes and with managing the environmental conditions inside glass structures. Although the climate inside glasshouses was not designed to meet the requirements of humans or animals, Paxton was very confident that his design experience allowed him to create large, well lit spaces and to manage the internal climate. The Magazine of Botany, Gardener’s Chronicle, Architect’s Journal and the Building Gazette report that Paxton developed numerous solutions for managing the humidity, sunlight and solar gains inside glasshouses. Accounts of how this experience influenced the exhibition building are recorded in various lectures, interviews and papers. These sources provide detailed insight into the specific design issues, working methods and objectives underlying Paxton’s experimentation in environmental design at Hyde Park and in horticulture (Schønfeldt, 2011a: chapters 4–8).

This paper argues that the exhibition building was strongly rooted in glasshouse design, which emerged as a specialist design profession in horticulture, yielding a new design approach and working methods that were distinct from both architecture and civil engineering. This new specialism was concerned with the design of artificial environments for plant cultivation. It specialized in the design and construction of glass envelopes and the control of climates inside fully glazed enclosures. Glasshouse designers also introduced scientific working methods into building design, but unlike their civil engineer contemporaries, they were concerned with the environmental rather than the structural dimension of buildings. The exhibition building represented the earliest attempt to adopt a glasshouse specifically for human occupation and the preservation and display of artefacts, rather than the horticultural purposes for which the building type was originally developed. Although numerous attempts had been made to adopt glasshouses as venues for social and cultural events, for example, in the Pantheon Banquet Conservatory and in the Winter Garden at Regent’s Park, these buildings were still designed as habitats for plants, with no special considerations for thermal comfort.

Previous articles by the author (Schønfeldt, 2008, 2011b) have shown that environmental considerations had been important in the development of the design and that a post occupancy evaluation was conducted to assess its actual performance. However, this paper explores to what extent Paxton’s experience in glasshouse design provided him with the necessary skills to realise the world’s first glass exhibition hall. Previous studies acknowledge the horticultural origins of the
Project I:
‘The Scientists of the Palace of Westminster: a study into environmental experimentation in mid-nineteenth century architecture’

Project II:
‘Inquiries into the historic ventilation system of the Palace of Westminster’
Outline of Experiments conducted inside the House of Commons between 1837 and the 1931 (Author’s own graph)

Key:
- Select Committees on ventilation
- Scientific experiments
- Key design stages, modifications

Principal scientific consultants:
- GG: Goldsworthy Gurney
- DBR: David Birtwell Reid
- NPL: National Physical Laboratory
- M: Meeson
- H: Professor Harris
- Comp: Teams of scientists:
  - P: Percy
  - W: W. J. Prinsep
  - T: T. J. Holdfast
  - W: W. J. Butterfield
  - T: T. E. Thorpe
  - G: Smith
  - Lemp()},

A: Temporary House of Commons and Lords
- Ventilation driven entirely by a central up-cast shaft

B: Reid’s ventilation master plan
1. Victoria tower/Clark tower on high level intake (driven by fan inside basement)
2. Central tower as the principal air discharge for the whole Palace.

C: System of local discharge shafts introduced to replace Reid’s centralized scheme

D: Meeson, Faraday and Barry adopt new system in the House of Lords

E: Reid continuous with House of Commons, but introduces a new turret to replace central tower as the discharge shaft. Low level inlets inside Commons and Star chamber courts.

F: Clock tower and Victoria Tower converted into discharge shafts, low level inlets

G: Two discharge towers fitted on the river front to ventilate committee rooms. Victoria tower not effective

H: Air inlet for House of Commons moved to River Front Terrace, fan introduced to increase air supply

I: Improved input fan for River front supply

J: Coke fires abandoned, electric fans fixed above HoC ceiling to boost the discharge current

*Focus on problems with sewer gas
+ Dr. Gordon’s Report
= Meeson’s reports
Diagram showing the process from Design development to Design modifications.

**Design development**
- Working methods
- Objectives
- Ideas
- Issues
- Context

**Anatomy**
- Construction details
  - Materials
  - Geometry
  - Environmental design strategy: e.g. passive features, mechanical services

**Design Evaluation**
- Monitoring
  - Empirical observations
  - Scientific studies

**Design modifications**
- Change of control regime
- Retrofitting/ modification of systems

**Resources**

- **Working methods**
  - Letters, sketches, consultant’s reports, scientific papers, journal articles

- **Anatomy**
  - Drawings, journal articles, lectures, papers

- **Design Evaluation**
  - Eyewitness accounts, newspaper reports, Historical data, scientific reports

- **Design modifications**
  - Newspaper reports, correspondence, technical reports
The Temporary House of Commons.

Ventilation and Warming, by D. R. Reid, M.D.

- a branch of the shaft communicating with a.
- b. ash pit door. The doors of the shafts to be close shut when it is in action.
- e. warm water chamber. f. floor pipes. g. return pipes.
- The chart shows the direction of the current of air.
Sample of data (22 May 1837) collected inside the Temporary House Commons during sittings between 1837 and 1844.

(Author’s own graph, based on data published in Reid, 1844)
Data collected inside the Temporary House Commons during sittings between 12 June and 11 July 1839.

(Author’s own graph, data published in the *Report of the Select Committee, 1839*)
<table>
<thead>
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<th>Date</th>
<th>Temperature of House in °C</th>
<th>Conditions</th>
<th>EXTRACTORS MEASURED</th>
<th>Heaters</th>
<th>EXTERNAL</th>
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<td>19.0</td>
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Standard Log-sheet used from 1843 till 1928
(Parliamentary Archives)
<table>
<thead>
<tr>
<th>DATE AND HOUR</th>
<th>TEMPERATURE OF AIR CHAMBERS</th>
<th>TEMPERATURE OF BODY OF HOUSE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FLOOR</td>
<td>GALLERIES</td>
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<td>1st April 1854</td>
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<tr>
<td>12</td>
<td></td>
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<tr>
<td>21</td>
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</tbody>
</table>

Data of 6 April 1854
(Parliamentary Archives)
Comments on 7 April 1854

[Handwritten text]

Comments on 6 April 1854

[Handwritten text]

Comments on 12 April 1853

[Handwritten text]

Comments on 22 April 1853

[Handwritten text]
Technical
(including managerial)

Behaviour of stacks
Control regime
Design features

Environmental

Air purity
Temperature
Humidity
Air currents

Physiological

Thermal comfort
health concentration
Is it time we had a truly modern Parliament building?

Following recent news that the Houses of Parliament might be unfit for use, Jo...

"Unwelcoming: a noisy, polluted, inaccessible place, seething with traffic and pedestrians and pockmarked by fortress-like security".

In short, says the Hansard Society, Westminster is a national disgrace rather than a place of national pride. As if that’s not enough, Big Ben’s clock tower is tilting and there are signs of cracks in the building. Admittedly, not enough to warrant immediate evacuation, but sufficient for MPs to consider renovation and even the remote possibility of selling the Palace of Westminster. After all, it’s a piece of prime real estate and the proceeds from any sale would more than cover the costs of a brand-new, purpose-built Parliament.

While that may be a secretly tempting but probably unthinkable outcome, it’s clear that the twin pressures of millions of visitors and national security are creating an unbearable strain on the buildings and their environment.

Paul Rynard of the architects Feilden & Mawson says, "Parliament is no longer fulfilling its fitness for purpose. We can’t chuck away the building, but we do have to recognise the wear and tear, cost of maintenance and huge pressure on it. Prisons and secure institutions are not the same as public buildings. It’s incredibly important to see real politics in action, but restricted views and access are changing that and it’s clear that Parliament is struggling to cope and is perhaps reaching the limits of usefulness."

His colleague Alan Robson agrees: "Portcullis House works because of minimum security... the secure and non-secure areas allow the public great visual access, while the atrium is a ‘marketplace’ for MPs and parliamentary staff. The biggest challenge is the impossible tension between security and access, but that’s the challenge of all politics."
PEDAGOGICAL RESEARCH
and Curriculum Development.
MSc in Architecture & Sustainable Environment

Programme staff:

Prof. Marialena Nikolopoulou - Programme Director
Keith Bothwell
Dr Henrik Schoenefeldt
Dr Richard Watkins

The MSc in Architecture and Sustainable Environment (MASE) is a taught course aimed at professionals and academics world-wide with an interest in sustainability in the built environment, including architects, engineers, geographers, surveyors, historians and urban designers.

The MSc is offered by Centre for Architecture and Sustainable Environment, a new research centre in the Kent School of Architecture that promotes a cross-disciplinary approach to research in the field of sustainability in the built environment, bridging the traditional boundaries between the arts and the sciences, research and practice. The course content ranges from the development of the design skills and the technical and scientific understanding required to develop sustainable solutions for new and existing buildings, the analysis of historic buildings and past environment technologies, to a critical exploration of the historical and cultural context of sustainability and environmental design.

The course, which can be studied full-time or part-time, offers an academically rigorous and intellectually challenging learning environment, which aims to enhance career development within the field for professionals and academics. The over-arching aim of the programme is to provide participants with a systematic understanding of core and advanced areas of sustainable design through a combination of taught courses, research assignments and project work. Students will be asked to conduct rigorous technical and historical research and to explore the practical application of their findings in the context of design and technology.

For more information contact:

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A Cross-Disciplinary Perspective on Sustainability in the Built Environment:

Reflecting the interdisciplinary outlook of the Centre for Architecture and Sustainable Environment, this course is designed specifically to cater for participants from a wide range of professional and academic disciplines. The objective is to facilitate collaborations between students with technical backgrounds, such as architects, engineers and building physicists, and those with a background in the history and philosophy of architecture, technology or science. The assignments offer participants from different disciplines the opportunity to collaborate or to adopt a cross-disciplinary approach, combining design with historic, scientific and technical research. The objective is to promote a critical understanding of the historical and cultural context of sustainability and to gain a better understanding of historic buildings from an environmental perspective. The latter is particularly important for historians as well as architects, surveyors and engineers involved in the conservation and adoption of historic buildings. While research in the history of environmental design is largely descriptive, rarely involving in-depth analyses, participants of this course will be asked to combine historical research with a thorough technical analysis in order to gain a deeper scientific and technical understanding of these past environmental solutions than the more conventional historical studies. The course aims to give historians the opportunity to establish the scientific and technical foundation required to understand historic buildings environmentally.

Course content:

- Module 1: Principles of Environmental Design (30 credits)
- Module 2: Rediscovery – Understanding Historic Buildings and past environmental technologies (30 credits)
- Module 3: Methods for Building Performance Evaluation (30 credits)
- Module 4: Environmental Design Project (30 credits)
- Dissertation (60 credits)
Inquiries into a new model for teaching environmental design in architecture

August 2012 - August 2013
Teaching environmental design...

...as a theoretical subject
declarative learning

...as a design activity
explorative learning styles

Environment lab

Lecture theatre
Exams

Studio

Procedural learning

‘Curricular split’
Integrated programme of Learning and Teaching activities

INTEGRATION

- Architectural project
- T&E Design project

- Case study research
  - (research/analytical skills)

- Design exercises
  - (methodologies and their application)

- Factual learning
  - (background knowledge)

- Lectures

- Exams

- Research assignment

- Tutorials & workshops

- T&E Cits and Report*
Closing the Feedback loop

- Literature review
  - Writing interview Guides
    - Guide for Student Interviews
    - Guide for Educator interviews
  - Pilot interviews (KSA)
    - Environment Lecturer
    - Group of 3rd year students
- Interviews in schools of architecture
  - 1-2 x Student groups
  - 2-3 x Educators
- Analysis of interview data
- Re-design of modules
  - Adapt and Extend
  - Technology in context
- Student consultations
  - Former 2nd years
  - Former 4th year students
- Staff consultations
  - Lecturers
  - Studio Tutors

Implementation

- Lecturers/Studio Tutors
- Students
  - Weekly briefings
  - Reflective diaries (blog)

Review in action

Final Evaluation (Review on action)

Staff perspective
- Review workshop with staff
- Review of staff diaries

Students' perspective
- Review of student diaries
- Survey questionnaire (whole year)
- Follow-up interviews (small groups)
Structure of the 2 plus 1 studio

(Diagram: Schoenefeldt, January 2013)
The Integrated curriculum

Diagram: Schoenefeldt, January 2013

Tech studio
(2 tutors x (3 x 15 students, 120 hours per group)

Arch studio
(2 tutors x 15 students, 90 hours per group)

WEEK 13
1. Survey

WEEK 14
2. Brief development

WEEK 15
3. Concepts

WEEK 16
4. Advancing the initial concepts

WEEK 17
5. Design Investigation No. I

WEEK 19
6. Design Investigation No. II

WEEK 20
7. In Detail No. I

WEEK 22
8. In Detail No. II

WEEK 24
Refinement and consolidation

WEEK 25
10. Finishing Presentation

T&E Lectures

Design Lecture

Alliances

Jointed review

Charette

T&E INTERCRIT

DESIGN INTERCRIT

T&E CRIT

FINAL CRIT
The Integrated curriculum, abstract

(Diagram: Schoenefeldt, January 2013)
Research and Design (Diagram: Schoenefeldt, January 2013)
Tutoring integrated environmental design in studio

**SEMINAR DETAILS**

This seminar is designed for practitioners in architecture, landscape or urban design who work as studio tutors in architecture schools, but are not experts in the area of environmental design.

The aim is to provide some of the knowledge and skills to supervise students in developing environmental design in the context of their studio projects.

The premise of this seminar is that studio tutors play a critical role in achieving a better pedagogical integration between teaching in studio and more specialized technical lectures, seminars and tutorials.

**LEARNING AIMS**

- Incorporating environmental methodologies into the design process
- Environmental consideration in strategic, architectural and detail design phases.
- Reappraising studio work from an environmental perspective
- Case studies, rules of thumb and environmental design tools

**COURSE STRUCTURE**

The day is divided into 5 sessions. Each session starts with a lecture, followed by an interactive studio workshop. During workshops participants engage in practical design exercises, designed to enable them to apply methods and theories. Each session finishes with a presentation and discussion of the workshop projects.

**CONVENOR**

Dr Henrik Schoenefeldt is strongly involved in teaching and curriculum development and an active researcher in the field of architectural education. His objective is to achieve better integration of sustainability considerations into the architectural design process.
Architectural training & practice

CAMBRIDGE

UniKENT

Chicago

New York

PhD handed in

corrections

Yr 1

Yr 2

Yr 3

Yr 4

May ball

MC seminar

PhD colloquia

Funding Applications

J. Article or book ch.

Conf. paper

R. presentation

JRF? Lectureship?

Job appl.

T&E 3

Env. 2

Des. 2

Tech 4

MSc

HEA

Parliament

PGCHE

Lectureship

Diss

Env. 2

Env. all

Des 2

MSc

4th yr

MSc

Pass

2nd yr

CPD

4th yr

2nd yr