

<b>Institution:</b> University of Kent		
<b>Unit of Assessment:</b> 13: Architecture, Built Environment and Planning		
<b>Title of case study:</b> Innovation in Conservation: The Restoration of the Palace of Westminster		
<b>Period when the underpinning research was undertaken:</b> August 2013-July 2020		
<b>Details of staff conducting the underpinning research from the submitting unit:</b>		
<b>Name(s):</b>	<b>Role(s) (e.g. job title):</b>	<b>Period(s) employed by submitting HEI:</b>
Henrik Schoenefeldt	Professor of Sustainability in Architectural Heritage (October 2020-present); Senior Lecturer in Sustainable Architecture (2016-2020); Lecturer in Sustainable Architecture (2011-2016)	2011-present
<b>Period when the claimed impact occurred:</b> January 2013 – February 2020		
<b>Is this case study continued from a case study submitted in 2014?</b> No		
<b>1. Summary of the impact</b> (indicative maximum 100 words)		
<p>Professor Henrik Schoenefeldt's research into the Palace of Westminster's nineteenth-century ventilation system has been fundamental to the most complex heritage renovation project ever undertaken in the UK. His research has influenced the work of the Restoration and Renewal Programme and informed a range of stakeholders, including architects, structural engineers, surveyors, conservators, and Parliamentarians. As a direct result of Schoenefeldt's work, the revitalisation of the historic ventilation system, and its integration into the design of a modern, potentially more sustainable scheme, was made a requirement within the design brief and was enshrined within the Conservation Management Plan. His research has underpinned the design of building surveys; was used in the fire safety improvement scheme; and led to the creation of a digital BIM model of the entire Palace of Westminster system.</p> <p>By connecting different disciplines and bringing academic research to bear on such a large and high-profile project, Schoenefeldt's work has wide-ranging and lasting implications for future restoration and renovation programmes.</p>		
<b>2. Underpinning research</b> (indicative maximum 500 words)		
<p>This impact case study is based on the unique and original research on the Palace of Westminster's nineteenth-century ventilation system undertaken by Professor Henrik Schoenefeldt at the University of Kent between 2013 and 2020.</p> <p>In the first phase of his research (August 2013-May 2016), Schoenefeldt explored the development of the historic ventilation system and its impact on the architecture of the Palace of Westminster (PoW). Following the destruction of the ancient PoW by fire in 1834, temporary chambers were constructed while planning took place for a permanent structure. Schoenefeldt's research included a study of David Boswell Reid's experimental system inside the Temporary Houses of Parliament, published in <i>Architectural History</i> [R4], which showed that the temporary chambers were also used to test and refine new technologies for the permanent structure. This study was followed by research into the processes by which these technologies were integrated into architect Charles Barry's design for the PoW, using original archival records, such as letters, sketches, and drawings. A study published in the book <i>Gothic Revival Worldwide</i> [R5] has shown that Reid's technology had a fundamental impact on the exterior architecture. This was followed by an in-depth analysis of Reid's original ventilation system for the House of Commons, which was only in use from 1852 until 1854. This research, published in the <i>Antiquaries Journal</i> [R3], was the first to provide a detailed reconstruction of the lost system and to examine its actual performance and the difficulties that led to its premature decommissioning. Another study, published in a book chapter (Bloomsbury, 2018) [R6], has revealed how Members of Parliament</p>		

at the time, being directly involved in the evaluation of its performance, influenced the outcome.

During the second phase of the research (June 2016-July 2020), Professor Schoenefeldt was seconded to Parliament to lead three projects [G1-G3] as part of the PoW Restoration and Renewal (R&R) Programme, which acted as the client body responsible for the restoration. His work has yielded deeper understanding of the design, operation, and performance of the historic systems of the PoW, and has revealed the possibility of reutilising the historic infrastructure.

Schoenefeldt research was the first study to systematically examine the system through a methodology combining archival research with digital modelling, onsite investigations, and technical analysis. Detailed examinations of surviving physical features within the building revealed that Reid's system had a much more substantial and lasting impact on the design and construction of the PoW than previously believed. This finding had direct implications for the planned restoration works.

A government grant [G3] enabled the creation of a virtual model using Building Information Modelling (BIM). This has provided a virtual reconstruction of the historic system covering both existing and lost features. In addition to the reconstruction, the research also involved critical investigations into the performance, operation, and adaptation of the system over a period of 170 years. Hitherto the post-occupancy history of architecture has received only marginal attention from architectural historians, yet this research has yielded critical insights into how the system was operated and how effectively it had performed under a variety of conditions. One of these studies, published in *Building Research and Information*, has revealed that the historic system of the original House of Commons was not static, but had been continually adapted to improve its performance until 1941, when the chamber was lost [R2].

A final study, conducted in 2019 and published in *Building and Cities* [R1], examined the environmental technology of the post-war House of Commons chamber. Schoenefeldt used archival research to reconstruct the historic practices deployed in the 1950s and 1960s, as well as interviews with staff and MPs, to reconstruct current practices and their evolution over the last 25 years. The research described how the performance of the chamber's environmental technology relied on a close relationship between technology, building users, and staff, and how this relationship has been evolving over the last 70 years.

### 3. References to the research (indicative maximum of six references)

[R1] Schoenefeldt, Henrik (2020). 'Delivery of occupant satisfaction in the House of Commons, 1950-2019'. *Buildings and Cities* 1(1): 141-163. E-ISSN 2632-6655. doi:

<https://doi.org/10.5334/bc.57>

[R2] Schoenefeldt, Henrik (2018). 'The House of Commons: a historic precedent for post-occupancy evaluation'. *Building Research and Information* 47(6): 635-665. ISSN 0961-3218. doi:

<https://doi.org/10.1080/09613218.2019.1547547>

[R3] Schoenefeldt, Henrik (2018). 'The Historic Ventilation System of the House of Commons, 1840-52: revisiting David Boswell Reid's environmental legacy', *Antiquaries Journal* 98: 245-295. ISSN 0003-5815. E-ISSN 1758-5309. doi: <https://doi.org/10.1017/S0003581518000549>

[R4] Schoenefeldt, Henrik (2014). 'The Temporary Houses of Parliament and David Boswell Reid's architecture of experimentation'. *Architectural History* 57: 175-215. ISSN 0066-622X. doi:

<https://doi.org/10.1017/S0066622X00001416>

[R5] Schoenefeldt, Henrik (2016). 'Architectural and Scientific Principles in the Design of the Palace of Westminster'. In: Brittain-Catlin, Timothy, and Bressani, Martin, and De maeyer, Jan, eds. *Gothic Revival Worldwide A. W. N. Pugin's Global Influence*. KADOC Art Series. Leuven: Leuven University Press, pp. 175-199. ISBN 9789462700918. <http://kar.kent.ac.uk/59156/>

[R6] Schoenefeldt, Henrik (2018). 'Powers of politics, scientific measurement and perception: evaluating the performance of the Houses of Commons' first environmental system, 1852-54'. In: Gillin, Edward, and Joyce, Horatio, eds. *Experiencing Architecture in the Nineteenth Century: Buildings and Society in the Modern Age*. London: Bloomsbury. ISBN 978-1-350-04594-1.

<https://kar.kent.ac.uk/67053/>

**Grants**

**[G1]** 'Between Heritage and Sustainability', AHRC, 06/27/2016-06/26/2018. Value: £144,464.

**[G2]** 'Research for the Palace of Westminster Conservation Management Plan', House of Commons, 7/2017-10/2018. Value: £15,000 + £8,000.

**[G3]** 'Expert historic ventilation advice for the Palace of Westminster', House of Lords, 01/11/2018-31/12/2019. Value: £127,000 paid to the University for Schoenefeldt's secondment + £219,000 from Parliament to cover the cost of hiring the modeller team that Schoenefeldt supervised to create the model.

**4. Details of the impact** (indicative maximum 750 words)

The Palace of Westminster (PoW), home of the Houses of Parliament, is a UNESCO World Heritage site and its restoration is the biggest and most complex renovation of a heritage building ever undertaken in the UK, with an estimated budget of £4 billion. A major challenge is the renewal of its outdated building services. The original nineteenth-century ventilation system is currently disused, but the restoration offers the opportunity to revitalise and integrate it into the design of a more sustainable approach.

In response to a formal inquiry into the restoration project by the House of Commons Commission in October 2012, Schoenefeldt presented a paper that explained the possibility of reusing the historic infrastructure. He was subsequently asked to provide additional evidence at two advisory sessions in Parliament, and invited by Richard Ware, Director of the Restoration and Renewal Programme, to form a research partnership in 2015. His work has been fundamental to the restoration programme, with wide-ranging and lasting impacts for conservation, architecture, and building services.

**Directly influencing the Restoration and Renewal (R&R) Programme**

As a result of Schoenefeldt's research, the importance of the historic ventilation system has been formally recognised by the R&R Programme, featured in the restoration programme, and preserved for the future. The Director of the R&R Programme, Richard Ware, confirms: 'I read the outline of [Schoenefeldt's] research with great interest and referred it to our Principal Architect. [...] serious consideration is being given to partial re-use of the Victorian ventilation system in the Palace of Westminster.' **[a]**. In media interviews, Ware has also described the importance of maintaining and incorporating the Victorian systems into the contemporary design: 'the transformation of this iconic site will be in keeping with its history and one that will hopefully set a gold standard for restoration projects of actively used historic buildings across the world' **[b]**. Andrew Piper, Design Director of the R&R programme, noted that Schoenefeldt's research 'will feed into future investigations looking at the potential of a natural or mixed-mode ventilation schemes', adding that it 'will feed into a number of other work streams, adding significant value to these and will help establish the overall services approach for R&R; and feed into investigations looking at the potential of a natural or mixed mode ventilation scheme'. **[a]**.

Schoenefeldt's research directly informed the development of the RIBA Stage 1 Brief for the R&R Programme **[c]**. It also underpinned the preliminary design studies undertaken by the architect BDP in 2019, who wrote: 'To come to an understanding of the historic hidden voids within the Palace of Westminster and the ventilation system they comprise, it is essential to become familiar with the work of Dr Henrik Schoenefeldt.' **[d]**. Schoenefeldt also advised structural engineers Alan Baxter, whose final structural survey reports reference and discuss his research, acknowledging that the structural fabric and historic ventilation are closely intertwined **[e]**.

One important application of Schoenefeldt's work is in the development of a more effective fire safety improvement scheme. His research underpins the current Fire Safety Improvement Works (FSIW) programme by providing new knowledge of the historic network of hidden shafts, which represents a major fire risk. Matt Hodgson, the lead conservation architect of the FSIW programme, wrote that he had 'not appreciated just how complex and extensive the system and its associate voids and ducts are', and that he was 'particularly concerned that those working to create the fire compartments within the building have an understanding of the voids within the building fabric'. **[a]**.

**Informing PoW conservation for the future**

Schoenefeldt received a government grant in 2017 [G2] to research and write chapters for the new Palace of Westminster Conservation Management Plan (CMP), and to collaborate with the conservation architects Donald Insall Associates (DIA), Historic England, and the Conservation Department of the Parliamentary Estate in the development of new policies. The CMP [f] sets out the policy framework for the R&R Programme, and Schoenefeldt's responsibility was to ensure that the significance and vulnerability of the environmental heritage is fully acknowledged and its preservation and potential re-use enshrined within policies. Patrick Duerden, Director of DIA, notes that it was previously not understood 'exactly how it worked, exactly what it was that made it work', and that 'having the level of specialist technical expertise within the field of conservation allows us to develop a much more sophisticated understanding' of the PoW [g].

**Improving knowledge and understanding of the Palace of Westminster**

Schoenefeldt has increased knowledge and understanding of the historic ventilation system of the PoW amongst a broad range of stakeholders, including senior members of the R&R Programme, politicians, Parliament's Strategic Estates team, consulting architects, engineers, and surveyors.

Because it is closely intertwined with the construction and architectural design of the PoW, knowledge of the historic system affects several aspects of the restoration. It has been fundamental to addressing the question of architectural conservation, sustainability, and fire safety, and also to developing new approaches to the design of building services, surveys, and the use of BIM. During his secondment, Schoenefeldt acted as an advisor and led activities that enabled his research to be fully embedded within these workstreams. This involved developing and implementing new working practices that bridged the gap between conservation practice and academic scholarship, which are the subject of an article in the *Journal of the Institute of Building Conservation* [b].

The research also informed two parliamentary inquiries: it was referenced in the report of the Joint Select Committee on Restoration and Renewal (September 2016), and was also debated in January 2019 by the Joint Select Committee on the Parliamentary Buildings Bill [h].

**Managing development of a BIM model of the historic ventilation system**

In 2016, the Palace of Westminster was surveyed and virtually modelled using Building Information Modelling (BIM) without including the historic voids. As a direct result of Schoenefeldt's research, however, the brief was extended in 2018 to include a second phase, which focused on the creation of a specialist BIM model of the ventilation network [i]. Schoenefeldt collaborated with R&R, BDP, and surveyors Plowman Craven in developing a methodological framework, and was awarded Parliamentary funding [G3] for a research project to underpin the production of the model. The House of Lords also provided funding to employ a team of specialist BIM modellers to produce the model under Schoenefeldt's direct supervision. This model, which 'was produced on time and on budget' [i] in February 2020, is significant as it provides the detail required to design the building services that utilise the historic infrastructure and comply with the requirements of fire safety and architectural conservation. It is an important tool for the development of the new system during forthcoming design stages.

**Wider impacts on professional practice**

By connecting different disciplines and bringing academic research directly to bear in such a high-profile practical application, Schoenefeldt's research will have wide-ranging and lasting implications for restoration and renovation programmes, beyond the PoW project. This is evidenced from the film accompanying this case study. As Patrick Duerden, Conservation Architect and Practice Director at Donald Insall Associates, states: 'The transferability of now recognising that there is conservation of building services as a specific discipline [...] that's really quite exciting and an emerging field, and I feel that there are many other buildings perhaps of other periods where that that can be developed further.' This is echoed by Andrew More, Senior Building Services Engineer at Historic England: 'The principles that Henrik has worked on here, you can apply in broad brush terms to any sort of project.' [g] Rebecca Madgin from the editorial board of the journal of the IHBC, has described Schoenefeldt's project as an example of

academic research that ‘responds to specific practical problems’ and that addresses the important issue of ‘how we manage change’. [b]. Discussing Schoenefeldt’s work, Richard Lorch, Editor in Chief of *Buildings and Cities*, says: ‘one of the things I am fascinated by [...] is how you break through various silos and connect various disciplines that have not been as easily connected before [...], you are connecting many different disciplines with these questions and with this approach, and I think that’s actually quite radical.’ [g].

Schoenefeldt has engaged extensively throughout the project with the media [b], industry, and professional bodies across the architecture, building, and conservation sectors, and this engagement has increased the reach of his work nationally and internationally. He has received over 40 invitations to speak about the research to architectural practices and professional bodies, each with audiences ranging from 30 to 300 people [j]. These include the UK’s leading conservation architects; large international design practices such as Maxfordham, Eric Perry Architects, Allies & Morrison, and Grimshaw; and professional organisations, including the Chartered Institute of Building Services Engineers (CIBSE), Institute of Historic Building Conservations (IHBC), Royal Institute of British Architects (RIBA), International Association of Museum Facilities Administrators (IAMFA), and Ecclesiastical Architects and Surveyors Association (EASA).

His research has featured in the Built Environment journal of the Royal Institution of Chartered Surveyors (RICS) [b], EASA journal [b], and it was the subject of cover feature in the CIBSE journal in November 2017 [b]. In 2017, Schoenefeldt convened a symposium at CIBSE, exploring its implications for professional education of building services engineers [b]. He also gave seminars on the RIBA Advanced Conservation Course, a training programme for qualified architects aiming to specialise in conservation and to be included within RIBA’s conservation register. Janie Price, convenor of this programme, stated that the research represented a ‘really important story in how we approach conservation’, and has recommended that it should be incorporated within the curriculum [a].

#### 5. Sources to corroborate the impact (indicative maximum of 10 references)

[a] Email correspondence and meeting minutes evidencing evidence of impact on Schoenefeldt’s work of consultants and Parliament.

[b] Compiled evidence of key media engagements, 2014-20 demonstrating Schoenefeldt’s impact within the wider industry.

[c] Palace of Westminster Restoration and Renewal, Design Brief RIBA Stage 1, March 2017.

[d] BDP, ‘Hidden Voids Desktop study’, July 2019, evidencing Schoenefeldt’s impact on the preliminary design studies undertaken by BDP. (This evidence is confidential.)

[e] Palace of Westminster Structural Engineer Reports (extracts). These reports were prepared for Restoration and Renewal Programme, September 2016. (This evidence is confidential.)

[f] Duerden, P., Parham H., and Schoenefeldt, H., Palace of Westminster Conservation Management Plan and Policies, vols 1-4 (London: Donald Insall Associates, 2019). Sample pages evidencing that Schoenefeldt drafted sections of this document.

[g] Testimonies from KMTV documentary and screening, evidencing the importance of Schoenefeldt’s work for the historic understanding and restoration of the Palace of Westminster.

[h] Report of the Joint Committee on the Draft Parliamentary Buildings Bill, and minutes of oral evidence, 9 January 2019, evidencing that Schoenefeldt’s work was debated.

[i] Compiled evidence relating collaboration with the R&R Programme and Plowman Craven in the creation of the BIM of the historic ventilation system, which was produced under supervision by Schoenefeldt.

[j] List of external talks (2014-20), evidencing Schoenefeldt’s extensive engagement with the media throughout the project.