Retrofitting Lundager

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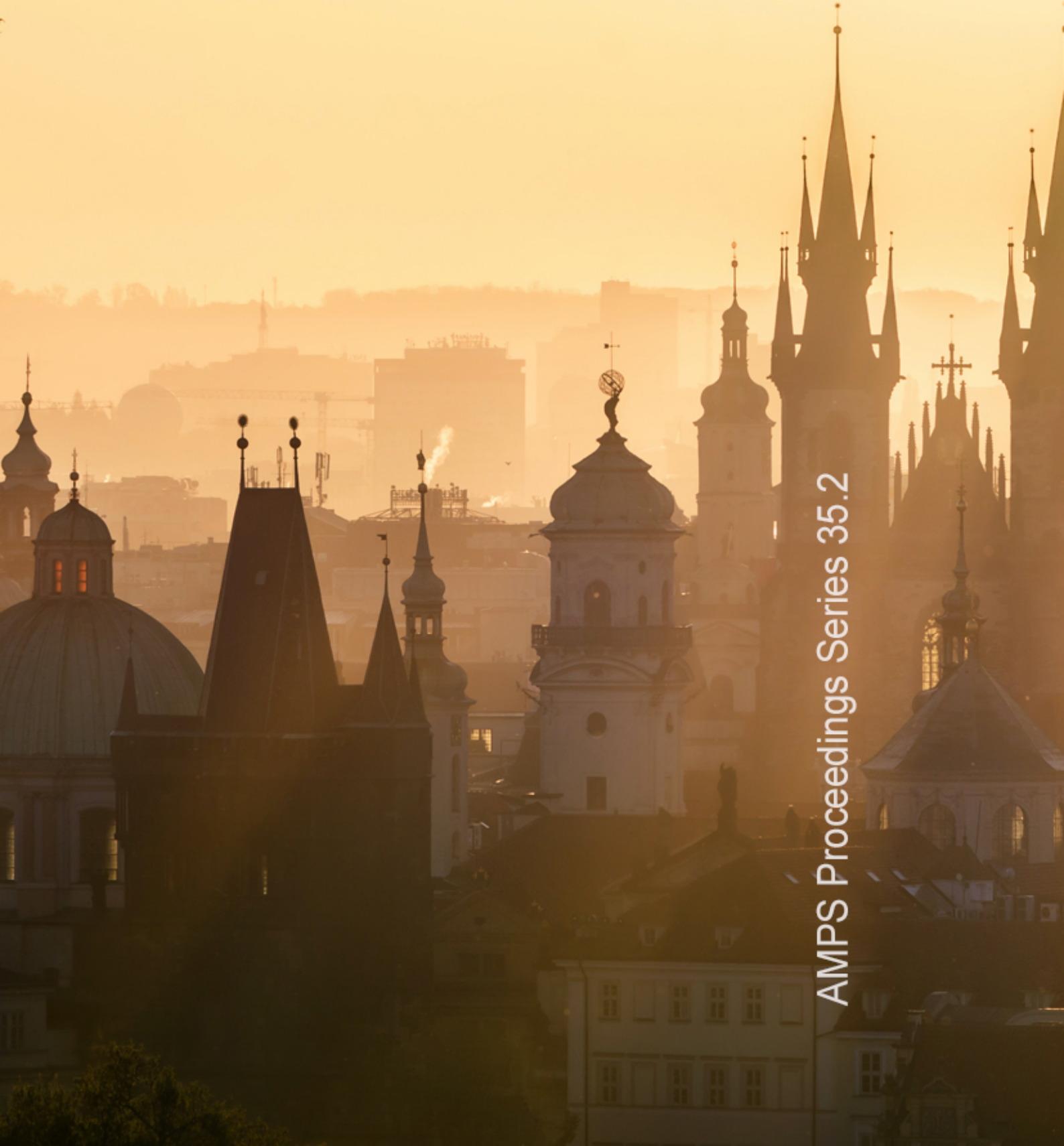

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INTRODUCTION

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Past and Present - Built and Social

2023 marks the twentieth anniversary of the UNESCO Convention on Cultural Heritage. It established culture as a concept to be safeguarded. That event came three decades after the World Heritage Convention. Through that, UNESCO had set up its World Heritage List of protected sites and buildings. The intervening years have seen multiple shifts in how we define heritage – as both material objects and social traditions. Today more than ever before, the distinction is blurred. The streets on which we live, and the monuments we protect are all connected to the traditions and social groupings we celebrate and preserve – whether physically, socially or, increasingly, digitally.

What we mean by heritage today then, is an open and diverse question. Our buildings and environments, our cities and neighborhoods, our memorials and our artworks, our cultures and communities are all component parts of what we understand as ‘preservable’ history. The dynamics at play are, however, complex. Conserving architectural heritage can conflict with development models. Community traditions are threatened by globalization. Monuments are often focal points for cultural contestation. Archaeological sites are valued in themselves and simultaneously erased by both the forces of conflict and ‘progress’. Digital models and modes of experience both attract a new audience and can alienate an older one.

However, the past and the present also overlap and mutually support. Placemaking sees built and cultural heritage as key to urban practice. Contextualization is central to planning laws. Museums are sites for communities and display. Digital modelling can be the only way to fully experience an ancient object or archeological site. Galleries present historical art while debating meanings in contemporary terms. Reflecting this scenario, the papers collected in this publication represent diverse perspectives of the complex and shifting concept of heritage.

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RETROFITTING LUNDAGER: TOWARDS CLIMATE CHANGE MITIGATION AND ARCHITECTURAL SENSEMAKING

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INTRODUCTION

This paper presents the results of one part of a research project carried out in collaboration with the National Museum of Denmark and Roskilde University. As a cross-disciplinary research project between the fields of communication, history and critical heritage studies, and architecture, the overall aim is to investigate how the experiential potential of selected vernacular buildings at the Open Air Museum outside Copenhagen may be enhanced by making architectural interventions, and subsequently investigating whether the visitors' experience of these interventions may become embodied aesthetic knowledge and inspire future (more) sustainable actions. The architectural subproject described in this paper is the making of a retrofit insulation of an existing threshing floor [*Lo*] in the *Lundager Farmhouse,* that is a part of the Open Air Museum. The intervention is an investigation of how to reuse and make a retrofit insulation in an existing room using biogenic materials and existing building components, so that the cultural-historical and aesthetic qualities present in the existing building are not weakened, but rather strengthened. The intervention is designed by the authors and built by students and teachers from the Royal Danish Academy in 2023.

BACKGROUND AND RESEARCH QUESTION

Providing a global assessment of climate change mitigation progress and potentials, IPCC points out that "[…] in developed countries the highest mitigation potential is within the retrofit of existing buildings."[1] Similarly, a recent Finnish study proposes a hierarchy for resource efficient construction within the planetary boundaries prioritising the utilisation of vacant and shareable spaces over renovating existing buildings, extending existing buildings and building new.[2]

Even if the reuse and retrofit insulation of existing buildings may hold a large potential to save operational and embodied energy, there may be a latent conflict between a new intervention and the values of the existing building. Consequently, retrofitting strategies often seem to be characterised by either apprehensive restorations or oblivious renovations.

Discussing the environmental significance of reusing existing buildings, a recent Norwegian report points out that not only should upgrading of existing buildings be prioritized over demolition and construction of new buildings, just as complete life cycle analyses constitute important decision making tools, also cultural and historical conservation values should be considered.[3] In a similar perspective, a recent Danish study, aiming to maintain the existing cultural-historical values, indicates that a gentle restoration of a historical timber frame building may in fact be a viable alternative to a more comprehensive renovation regarding environmental impact seen in a life-cycle perspective.[4]

Figure 1. Lundager Farmhouse.

Figure 2. Lundager Farmhouse.

Instead of understanding existing buildings and their cultural-historical, technological, and aesthetic qualities as something that is either in opposition to climate change mitigation actions or not relevant at all, ICOMOS has argued that "[…] cultural heritage is a source of creativity and inspiration for adaptation and mitigation actions that are responses to the findings of climate science."[5] This leads to the research question asking how cultural-historic, technological, and aesthetic qualities may inform adaptive reuse and retrofit insulation? What characterises a retrofit strategy that respects existing cultural-historic, technological, and aesthetic qualities and, in continuation, what are the perspectives of this regarding future sustainable building cultures?

RESEARCH METHOD

The research method in this paper is a *combined strategy*, involving the qualitative analysis of an existing building and the design and construction of an experimental retrofit structure within an existing space of the building.[6] The analysis of the existing building is seen from the perspectives of cultural history, technology, and aesthetics, aiming at developing architectural strategies in response to the findings of climate science and inform discussions on the adaptation and mitigation potential of existing buildings. The design and construction of the experimental structure is situated within the framework of *research by design* as described by EAAE[7] and is methodically developed through the architectural phenomenological method as described by Andersen.[8]

Building on the above framework, the research process is structured as follows. First, characteristic motives from the *Lundager Farmhouse* have been identified and photographed with the aim of developing a better understanding of the specific architectural situation, including cultural-historic, technical, and aesthetic values (Fig. 1–2). Second, selected motives have informed the design of a retrofit insulation in the threshing floor of the existing farmhouse (Fig. 3–4). Given the circumstances of building within a museum object, the aim of the design has been to develop an architectural entity which clearly corresponds with the existing building, while concurrently being autonomous and distinguishable as something new. Third, the experimental retrofit has been built by students and teachers as part of the curriculum. Fourth, the experimental retrofit has been described and documented photographically (Fig. 5–10). Fifth, the documented motifs, the design documents, and the documentation of the retrofit are considered empirical findings, which have been described and analysed through a phenomenological-hermeneutic lens in relation to the theoretical framework. Finally, the significances of the results have been discussed in relation to the research question and recommendations have been made.

THEORETICAL FRAMEWORK

Conservation

Western conservation theory may be considered an ongoing discussion between positions along an axis demarcated by maximalist and minimalist interventions represented by Viollet-le-Duc and John Ruskin, respectively.[9] Having mayor impact on conservation practise in the 20th century, *The Venice Charter* argued that the aim of restoration is *not* the unity of style but rather the harmonious yet distinguishable integration of missing parts with the whole.[10] Today, conservation theory is contested, including not only the conservation object, but also the users. Laurajane Smith has argued that heritage values, meanings, and identities are continuously created and recreated in a cultural and social *process*.[11] Introducing the concept of *sustainability*, Salvador Muñoz Viñas has furthermore argued that conservation does not represent a final truth but is instead rooted in the uses, values, and meanings that an object has to people.[12]

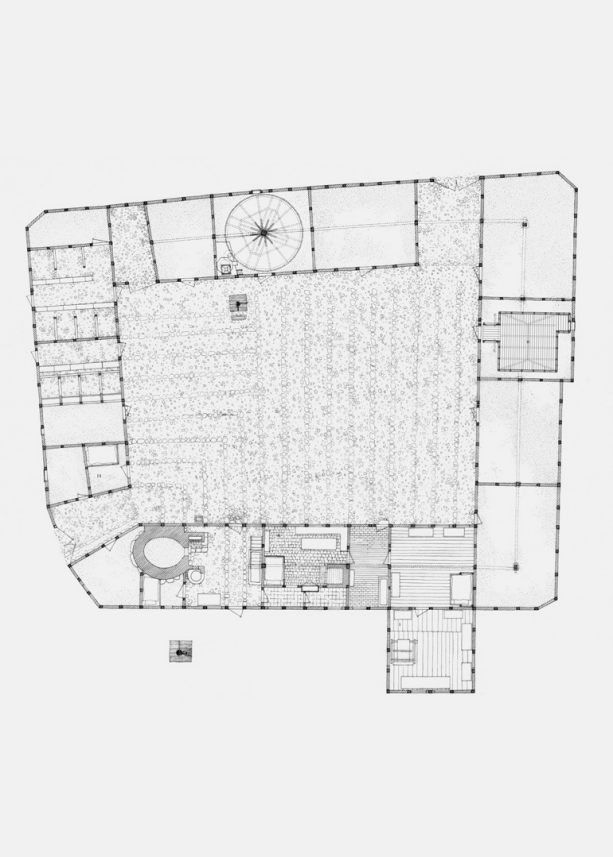

Figure 3. Lundager Retrofit, site plan.

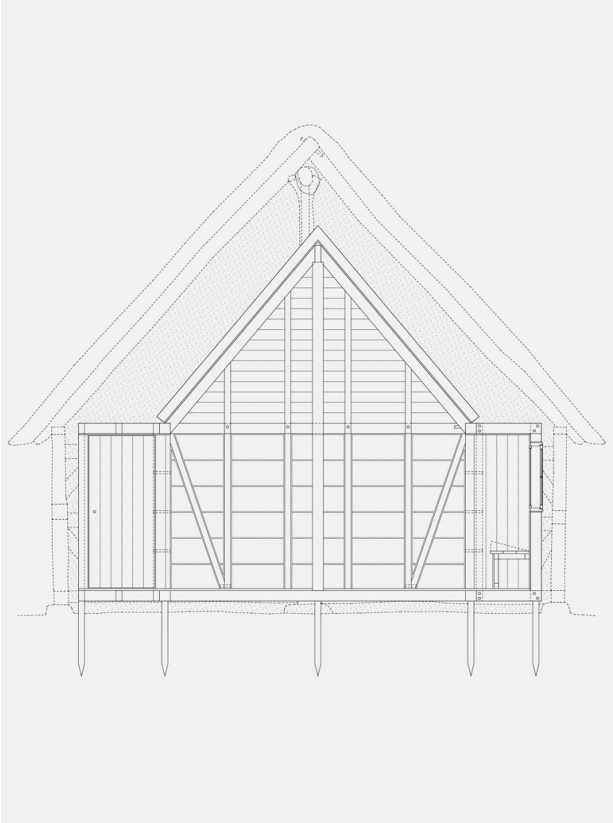

Figure 4. Lundager Retrofit, section.

Sustainability

The term of sustainability – or rather, *sustainable use* – was coined by Hans Carl von Carlowitz in 1713 as the balancing of harvest and growth in a given system.[13] In resonance, the Brundtland Commission Report *Our Common Future* defined sustainability as "[…] development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[14] Following decades of work by the UN and the member states, the 17 Sustainable Development Goals, adopted by all United Nations Member States in 2015, aim at ending poverty, reducing inequality, improving health and education while tackling climate change and preserving oceans and forests.[15] However, failing to deal with the increase in resource use, the SDGs have been criticized as prioritizing economic growth over ecological integrity.[16] Material resources are limited on a bounded planet[17] and the safe operating space of numerous planetary boundaries are long exceeded.[18] Combining an inner *social foundation* with an outer *ecological ceiling* and visualizing them in combination as a doughnut, Kate Raworth has proposed the probably most comprehensive model for a future sustainable development.[19]

Aesthetics

Separating *noeta,* as the object of logic, from *aisthetike,* as the things perceived, Alexander Gottlieb Baumgarten coined the term *aesthetics* in 1735.[20] Somewhat in resonance, Martin Heidegger understands the relation of humans to the world as not just utilitarian or theoretical, but also poetic. Describing a painting by Vincent van Gogh, Heidegger makes clear that a pair of peasant shoes are not only equipment for walking or a circumspect object, but for the artist "[…] a becoming and happening of truth."[21] Central for this becoming and happening of truth is, the ancient Greek concept of *techne*. Deriving from *teks*-, it describes "to weave," "to fabricate" or to "to make wicker or wattle fabric for (mud-covered) house walls."[22] As understood by Heidegger, however, *techne* is neither art nor craft in the present day sense, but rather a mode of presentation where "[t]he rock comes to bear and rest and so first becomes rock; metal comes to glitter and shimmer, colors to glow, tones to sing, the word to say."[23] Focusing on what a building *does* rather than what it *is*, David Leatherbarrow similarly points out that, indeed, "a building is a technical and aesthetic work, but it is known as such through its workings […] through its actions or performances."[24] To Leatherbarrow, architectural elements are understood as passively active through an *interenvironmental system of correspondences*.[25] Rather than focusing on a dualist perspective, attention is directed towards a cultivation of potential between things and rests on the ways things may "exceed themselves."[26]

RESULTS AND ANALYSIS

The three characteristic motives that have informed the retrofit are *post*, *lining* and *lighting*. Each motif has been selected in accordance with the methodical and theoretical framework as based on an analysis of the existing farmhouse. Each motif has furthermore been selected with the intention of demonstrating a degree of commonplace traits, as to be relevant in a larger architectural context.

Post

The *Lundager Retrofit* is a new interpretation of the traditional *Lundager Farmhouse's* post and beam timber structure. Constructed with a series of central columns carrying a longitudinal beam stabilised with diagonal braces, this characteristic ridge-post framing typology can be traced back to the Stone Age. The new intervention similarly comprises a timber structure with a freestanding post, joined by wood-on-wood joints (Fig. 6, 8). The loadbearing structure is made entirely of locally sourced Douglas timber, which may be considered a potential renewable resource because of the relatively short geological time scale. Sequestering CO_2 when growing, wood acts as a carbon sink when

Figure 5. Lundager Retrofit.

Figure 6. Lundager Retrofit.

maintaining its chemical form. The new structure stands on a steel ground screw foundation, that, compared to a conventional 30 cm wide and 90 cm deep concrete foundation along the exterior walls, reduces emissions by 1.66 tonnes of CO_2, corresponding to approximately 85%.[27]

Lining

As an interpretation of the traditional wattle and daub, the retrofit structure is lined with 90x300x600 mm Hempcrete blocks (Fig. 6, 9). The blocks comprise the panels of the half-timbered structure and are joined using clay mortar. The hempcrete panels are plastered with clay level with the timber and subsequently limewashed. Hempcrete is an insulating building block consisting of pressed hemp bound together by lime. Hemp is a fast-growing, hardy plant, sequestering 75 kg of CO_2 per m^3 material. A *Isohemp* hempcrete block has a thermal conductivity (λ-value) of 0.071 W/mK.[28] An existing half-timbered wall retrofitted with 200 mm hempcrete has an overall climate impact of heat loss and materials of 68.6 CO_2 e/year. In comparison, 300 mm mineral wool - due to a greater climate impact during production - has a total climate impact of 71.6 CO_2 e/year.[29] With reference to the traditional thatched roof of the farmhouse, the roof of the retrofit is furthermore insulated with 80x600x1200 mm grass fibre mats (Fig. 10). The material is locally collected, dried, and pressed surplus grass from public squares and parks. With a thermal conductivity (λ-value) of 0.040 W/mK, *Gramitherm* grass insulation is 100% recyclable and sequesters 1.5 kg of CO_2 per kg of material.[30]

Lighting

As part of the intervention, a 19th century window was restored (Fig. 6). Loose paint was scraped off and decayed wood was carefully replaced. It was primed with boiled linseed oil and painted with linseed oil paint in three thin coats. The window was finally fitted with an interior window frame and built into a deep nook, providing seating and reflecting light diffusely. While conserving both aesthetic values and material resources, restoring and retrofitting an existing window reduces the heat loss from around 313 kWh/m^2 per year to 66 kWh/m^2 per year.[31] Fitted with an interior window frame with double energy glazing, the total heat loss would be 25 kWh/m^2 per year.[32] Not taking a full LCA perspective into account, a similar new wood/aluminium window with a double energy pane will have a heat loss of around 72 kWh/m^2 per year while a corresponding new wood/aluminium window with a three-layer energy pane will have a heat loss of around 42 kWh/m^2 per year.[33]

Results

In conclusion of the above, the *Lundager Retrofit* may be understood as being part of a larger system of cultural-historic, technological, and aesthetic correspondences involving landscape, building, and intervention. Manifesting knowledge developed through an in-depth analysis of the existing technological properties, aesthetic qualities, and experiential effects, the *Lundager Retrofit* may be understood as making sense in the specific architectural situation as well as in a larger inter-environmental system. Furthermore, the intervention may be considered sense-making by way of responding to and expressing architectural qualities without compromising existing heritage values. Finally, it may be argued that the adaptation of the existing building is characterised by sense-making and making sense by harmoniously integrating the conservation of cultural-historic and aesthetic values as well as the energy- and material resource saving actions as part of a mitigation strategy.

DISCUSSION

As the findings suggest, not only technological measures, but also cultural-historic and aesthetic aspects should be taken into consideration when retrofitting. In this perspective, the principles of the *Venice Charter* may once again become relevant. Being in principle similar to the existing building,

Figure 7. Lundager Retrofit.

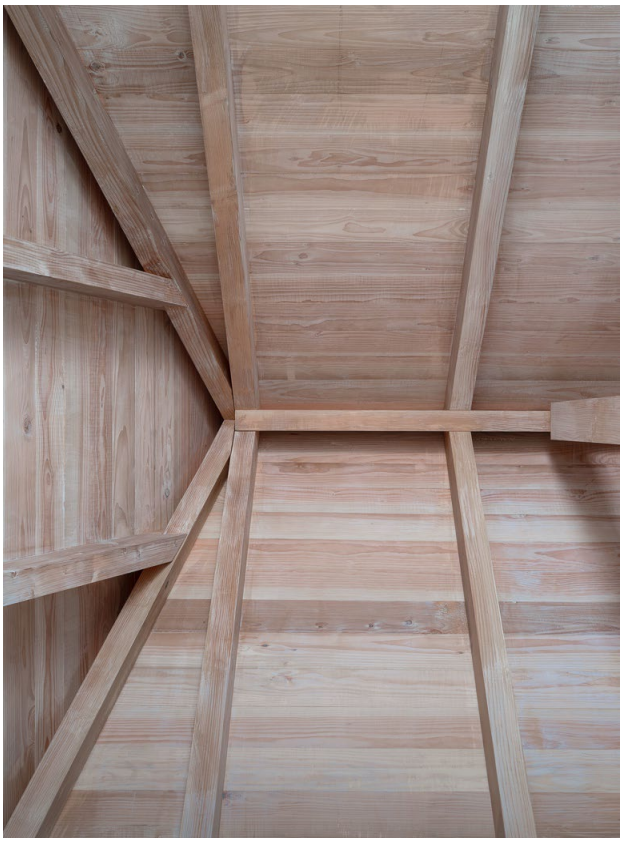

Figure 8. Lundager Retrofit.

but in a contemporary interpretation, the *Lundager Retrofit* may be considered a *harmonious yet distinguishable integration* of new and old. As such, the intervention exemplifies a strategy that neither rejects any change nor transforms the existing building to unrecognizability, but rather respects and enhances the existing qualities within a *system of correspondences* that is guided by sustainable actions. Even if contemporary conservation theory has shifted its focus from the original physical *material* towards cultural and social *processes*, [34] it may be argued that a renewed comprehensive focus on physical material is pivotal as part of a future circular economy.[35]

Even if a retrofit insulation may save energy, improvements in efficiency have, however, historically been cancelled out by growth in floor area.[36] As such, efficiency measures alone are inadequate as also underlined in the SER (Sufficiency, Efficiency, Renewable) framework.[37]

Traditional building culture may be characterised by making use of locally sourced materials, accommodating cyclic renewal, and being designed according to the principles of protection by design, while simultaneously allowing parts of the building to age and be replaced without compromising the whole. Similarly, the retrofit is designed for disassembly, planned with simple maintenance in mind, and built with nontoxic materials from near and traceable supply chains. By e.g., using clay mortar (which is "weaker" than the hempcrete), dry-fit wood-on-wood joints, and a clear structural layering, the design supports maintenance, recycling, reuse of individual elements and allows the materials to be returned to the ecosystem at the end of lifespan in accordance with the principles of a circular economy.[38]

In a renewable's perspective, added building materials in the *Lundager Retrofit,* such as wood and hemp, may be considered renewable resources and potentially abundant, carbon neutral, and recyclable. Even if clay is not a renewable material as such, it may be considered both abundant and recyclable. In this perspective, the *Lundager Retrofit* exemplifies a resource saving-, carbon uptake-, and storage-strategy using regenerative bio-based materials.

In a sufficiency perspective, fair consumption of space and resources is required. According to the IPCC, sufficiency requires optimising the use of buildings, repurposing unused existing ones, prioritising multi-family homes over single-family buildings, and downsizing dwellings[39] As pointed out by Stewart Brand, what allows adaptation to changing requirements over time is dependent on the separation of the differently paced systems of the *Site*, *Structure*, *Skin*, *Services*, *Space plan* and *Stuff*.[40] In this perspective, the regular space plan as well as the clear tectonic articulation of the *Lundager Retrofit* may easily allow future optimization and repurposing. More importantly, as pointed out by the IPCC, people do not demand primary energy and physical resources as such, they demand services.[41] As seen from an architectural perspective, it may furthermore be argued that what is important is not bricks or electricity as such, but rather quality homes.

CONCLUSION AND RECOMMENDATIONS

As described above, the existing *Lundager Farmhouse* has inspired adaptation and mitigation actions in response to the findings of climate science as called upon by ICOMOS.

Generally applicable, but with different results depending on the architectural situation, the proposed strategy requires that a careful building analysis be done in advance of any intervention. In this, it is recommended that not only technological, but also cultural-historic and aesthetic qualities be taken into consideration. Furthermore, it is recommended that sufficiency measures should supplement adaptive reuse and retrofit insulation using renewable resources strategies to mitigate climate change. When designing, these general recommendations should be complemented by taking design for disassembly, protection by design, maintenance, and supply chains into consideration.

In addition to the strategy and recommendations, the results of the *Lundager Retrofit* have prompted a re-evaluation of several theories and practises, that are normally taken for granted.

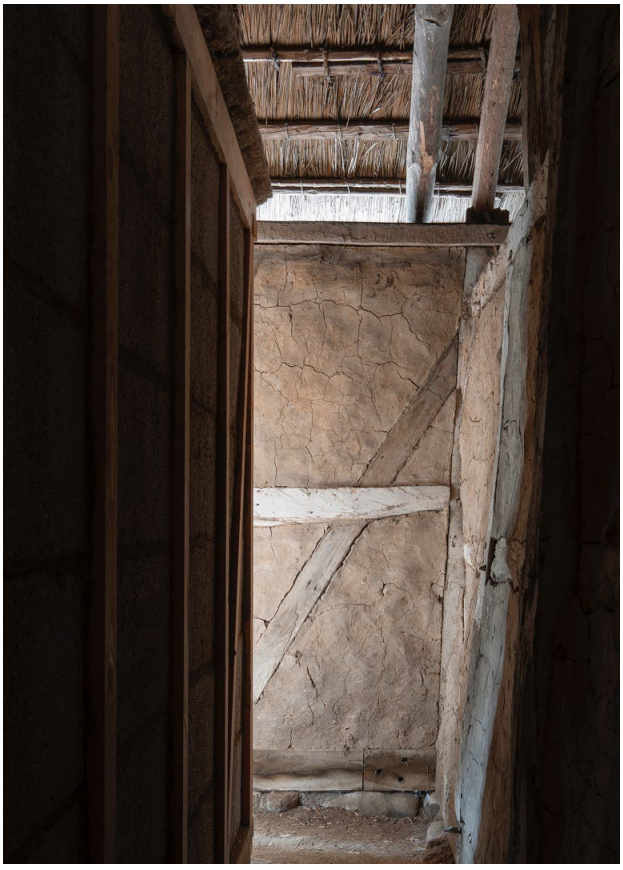

Figure 9. Lundager Retrofit.

Figure 10. Lundager Retrofit.

As not only efficiency, but also renewables and sufficiency strategies should be taken into consideration when working with existing buildings, a discussion of maximalist and minimalist interventions has, again, become pertinent. In the case of the *Lundager Retrofit*, this becomes a question not of reducing, but rather enhancing existing cultural-historic and aesthetic qualities that have low climate impact – limiting interventions to what is sufficient.

Balancing the intervention with the existing building, the *Lundager Retrofit* adds a new perspective to the discussion of the relation between new and old. Being neither an apprehensive restoration nor an oblivious renovation, the intervention is characterised by a harmonious, yet distinguishable integration – a redefinition of the strategy as originally called for in the *Venice Charter*. Similarly, acknowledging the urgency of the accelerating climate, resource- and biodiversity crisis, both the importance of the material substance as well as cultural and social processes are recognised.

The qualities of the intervention are, in this respect, not only related to the building as an individual object, isolated in time and space, nor do they represent a visualisation of the so-called *spirit of the place*. [42] Rather, they are characterised by being part of a larger system of cultural-historic, technological, and aesthetic *correspondences* involving landscape, building, and intervention.

In conclusion, the *Lundager Retrofit* embodies architectural adaptation and mitigation actions in response to the findings of climate science, characterised by both sense-making and making sense.

NOTES

[1] IPCC Intergovernmental Panel on Climate Change, *Climate Change 2022 – Mitigation of Climate Change – Working Group III – Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (2022), 31.
[2] Matti Kuittinen, "Building within planetary boundaries: moving construction to stewardship."
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[3] Selamawit Mamo Fufa, Cecilie Flyen and Christoffer Venås, *Grønt er ikke bare en farge: Bærekraftige bygninger eksisterer allerede* (Oslo: SINTEF akademisk forlag, 2020).
[4] Thomas Hacksen Kampmann, Teddy Serrano and Morten W. Ryberg, "Comparative Life-Cycle Assessment of restoration and renovation of a traditional Danish farmer house." Building and Environment 219 (2022). August 20, 2023, DOI: https://doi.org/10.1016/j.buildenv.2022.109174.
[5] ICOMOS Climate Change and Cultural Heritage Working Group (2019), *The Future of Our Pasts: Engaging Cultural Heritage in Climate Action* (Paris: ICOMOS, 2019), 14.
[6] Linda Groat and David Wang, *Architectural Research Methods* (Hoboken: Wiley, 2013).
[7] "EAAE Charter on Architectural Research," EAAE, accessed August 24, 2023,
https://www.eaae.be/about/statutes-and-policypapers/eaae-charter-architectural-research/.
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[11] Laurajane Smith, *Uses of Heritage* (London: Routledge, 2006).
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[13] Finn Arler, "Bæredygtighed og bæredygtig udvikling", in Finn Arler, Mette Alberg Mosgaard and Henrik Riisgaard, *Bæredygtighed – værdier, regler og metoder* (Aarhus: Aarhus Universitetsforlag, 2015).
[14] World Commission on Environment and Development, *Our Common Future [Brundtland Report]* (Oxford: Oxford University Press, 1987).
[15] "The 17 Sustainable Development Goals," United Nations, accessed August 24, 2023, https://sdgs.un.org/goals.
[16] Nina Eisenmenger et al., "The Sustainable Development Goals prioritize economic growth over sustainable resource use." Sustainability Science 15, 1101–1110 (2020). August 20, 2023, DOI: https://doi.org/10.1007/s11625-020-00813-x.
[17] Herman Daly, *Ecological Economics and Sustainable Development, Selected Essays of Herman Daly* (Cheltenham: Edward Elgar Publishing Limited, 2007).
[18] Johan Rockström, Will Steffen W, Kevin Noone et al., "A safe operating space for humanity." Nature 461, 472–475 (2009). August 20, 2023, DOI: https://doi.org/10.1038/461472a.
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[19] Kate Raworth, *Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist* (New Orleans: Cornerstone, 2018).
[20] Alexander Gottlieb Baumgarten, *Reflections on Poetry* (Los Angeles: University of California Press, 1954).
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[22] "*teks-," Etymology Dictionary, accessed August 20, 2023, https://www.etymonline.com/word/*teks-#etymonline_v_52573.
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[24] David Leatherbarrow, *Architecture Oriented Otherwise* (New York: Princeton Architectural Press, 2009), 49.
[25] David Leatherbarrow, *Architecture Oriented Otherwise* (New York: Princeton Architectural Press, 2009), 38.
[26] David Leatherbarrow, *Architecture Oriented Otherwise* (New York: Princeton Architectural Press, 2009), 91.
[27] This according to the supplier.
[28] This according to the supplier.
[29] Thomas Hacksen Kampmann, Teddy Serrano and Morten W. Ryberg, "Comparative Life-Cycle Assessment of restoration and renovation of a traditional Danish farmer house." Building and Environment 219 (2022). August 20, 2023, DOI: https://doi.org/10.1016/j.buildenv.2022.109174.

In a more nuanced LCA perspective, it may also be argued that using a thinner hempcrete block (i.e. 75mm) only produces a slightly higher environmental impact than a 200mm block while being resource efficient and, in some cases, more suitable for the architectural task at hand.

[30] This according to the supplier.

[31] Thomas Hacksen Kampmann, "Gamle vinduer modarbejdes." Arkitekten 04 (2022), 32.

[32] Thomas Hacksen Kampmann, "Gamle vinduer modarbejdes." Arkitekten 04 (2022), 32.

[33] Thomas Hacksen Kampmann, "Gamle vinduer modarbejdes." Arkitekten 04 (2022), 32.

[34] Laurajane Smith, *Uses of Heritage* (London: Routledge, 2006).

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[36] IPCC Intergovernmental Panel on Climate Change, *Climate Change 2022 – Mitigation of Climate Change – Working Group III – Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (2022), 100, 102, 955.

[37] IPCC Intergovernmental Panel on Climate Change, *Climate Change 2022 – Mitigation of Climate Change – Working Group III – Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (2022), 957–959.

[38] "Let's build a circular economy," Ellen MacArthur Foundation, accessed August 20, 2023, https://ellenmacarthurfoundation.org.

[39] IPCC Intergovernmental Panel on Climate Change, *Climate Change 2022 – Mitigation of Climate Change – Working Group III – Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (2022), 955, 958, 959.

[40] Stewart Brand, *How Buildings Learn: What Happens After They're Built* (New York: Penguin Books, 1994).

[41] IPCC Intergovernmental Panel on Climate Change, *Climate Change 2022 – Mitigation of Climate Change – Working Group III – Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (2022), 505.

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